Recent advances in refutations and validations using Meth8 modal logic model checker

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In applied and theoretical mathematics, assertions are categorized in alphabetical order as: axiom; conjecture; definition, entry; equation; expression; formula; functor; hypothesis; inequality; metatheorem; paradox; problem; proof; schema; system; theorem; and thesis. We evaluate 175 items for 721 assertions to validate 208 as tautology and 513 as not (71%). We use Meth8 that is a modal logic checker in five models.

The semantic content or predicate basis of some expressions on their face does not disqualify them from evaluation by Meth8 in classical modal logic. However, the rules of classical logic, as based on the corrected Square of Opposition by Meth8, apply to virtually any logic system. Consequently some numerical equations are mapped to classical logic as Meth8 scripts.

The rationale for mapping quantifiers as modal operators is in the Appendix based on satisfiability and reproducability of validation of syllogisms.

A table lists what was tested with separated results. The names are numbered in alphabetical order. Test results are Invalidated as Not Validated Tautology (nvt), *not* tautologous, or Validated as Tautology (vt), tautologous. For a paradox, *not* tautologous means it is not a paradox or contradiction.

The experimental tests used variables for 4 propositions, 4 theorems, and 11 propositions. The size of truth tables are respectively for 16-, 256-, and 2048- truth values. One formula of Popper in 250-characters processed in 125-steps instantly due to recent advances in look up table indexing.

The Meth8 modal theorem prover implements the logic system variant VŁ4 which corrects the quaternary Ł4 of Łukasiewicz. There are two sets of truth values on the 2-tuple {00, 10, 01, 11} as respectively {False proof for contradiction; Contingent for falsity; Non contingent for truthity; Tautology for proof} and {Unevaluated; Improper; Proper; Evaluated}.   The designated proof value is T for tautology and E for evaluated. The model checker contains recent advances in parsing technology and is U.S. Patent Pending.

The mapping of formulas into Meth8 script was performed by hand, checked, and tested for accuracy of intent. (A semi-automation of that process is underway.) The Meth8 script uses literals and connectives in one-character. Propositions are p-z, and theorems are A-B. The connectives for {and, or, imply, equivalent} are {&, +, >, =}. The negated connectives for {nand; nor; not imply; exclusive-or} are {\, -, <, @}. The operators for {not; possibility ◇∃; necessity □ ∀} are {~, %, #}. Some expressions are adopted for clarity such as: (p=p) for tautologous; (p@p) for contradiction; and (x<y) for x∈y. The expression x≤y as "x less than or equal to y" is rendered in the negative as ~(y<x) or as (~x>~y).

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Binary ordinal
1	p=p	T	tautology	proof	11	3
2	p@p	F	contradiction	absurdum	00	0
3	%p>#p	N	non-contingency	truthity	01	1
4	%p<#p	C	contingency	falsity	10	2

Note the meaning of (%p>#p): a possibility of p implies the necessity of p; and some p implies all p. In other words, if a possibility of p then the necessity of p; and if some p then all p. This shows equivalence of respective modal operators and quantified operators, as proved in Appendix.

For Meth8 an immediate further application to "validate as tautologous" is mapping sentences of natural language into logical formulas. The approach identifies parts of speech as nouns, verbs, and modifiers. These translate into logical symbols for literals, connectives, and operators. For example: the conjunction "and" becomes the connective "&"; and the modifier articles "the" and "a" become the modal box # and lozenge %. Expressions for consecutive sentences are linked by the imply connective to build paragraphs to form requirements documents.

No.	**Name of object**	**Type of object**	**Results with instances**
1	ABC	Conjecture	Invalidated
2	Alcoholics Anonymous BB: We agnostics, p 53	Traditions	Invalidated
3	Alexandroff correspondence	Conditional	Invalidated (3)
4	Anderson division by zero as nullity	Theorem	Invalidated
5	Axiomatizing category theory in free logic	Axioms	Invalidated
6	Banach-Tarski	Paradox	Invalidated
7	Barcan	Formula	Validated
8	Bayes rule	Rule	Invalidated (11) Validated(11)
9	Bell / CHSH / Spekken toy model	Inequalities	Invalidated
10	Berkeley	Paradox	Invalidated
11	Bernstein-Vazirani	Algorithm	Invalidated (4) Validated (1)
12	Bertrand-Chebyshev theorem / postulate	Theorem	Invalidated (2)
13	Biscuit conditionals	System	Invalidated (13)
14	Bogdanov map, 2D conjugate of Hénon map	Formula	Invalidated
15	Borsuk-Ulam	Theorem	Validated
16	Borsuk-Ulam extensible, non-invertive	Theorem	Validated (2)
17	Branching quantifier (Hintikka)	System	Invalidated
18	Buridan's Ass	Paradox	Invalidated
19	Cantor's continuum conjecture	Hypothesis	Invalidated (2)
20	Cantor's diagonal argument	Proof	Invalidated (3)
21	Cantor pairing	Functor	Invalidated (2)
22	Category composition of morphisms	Definition	Invalidated (1)
23	Chaitin incompleteness and L constant	Theorem	Invalidated (3) Validated (1)
24	Chinese room argument: Brain Simulator Reply	Conjecture	Validated (3)
25	Church	Thesis	Invalidated
26	Clifford tori 2D / Kanban cell neuron	Definition	Validated
27	(Lothar) Collatz	Conjecture	Validated
87	Complex (ℂ), imaginary number rendering	Method	Invalidated (4) Validated (4)

29	Constructivistic logic	System	Invalidated (14) Validated (2)
30	Creative theories in degrees of unsolvability	Theorem	Invalidated
31	D Ultrafilter contra continuum problem	Equation	Invalidated (1)
32	Dedekind lattice identity	Axiom	Validated
33	Density of all Turing and truth table degrees	Formula	Invalidated (2)
34	Description logic	System	Invalidated (2)
35	Dialetheism	System	Invalidated (4)
36	Dialetheism: inconsistent	System	Invalidated (2)
37	Dichotomy of selection	System	Invalidated
38	Diverse double compiling	Schema	Invalidated
39	Doxastic logic	System	Invalidated (8) Validated (13)
40	E=mc^2	Theorem	Invalidated (3) Validated (1)
41	EF-axiom: topology and near sets	Axiom	Invalidated
42	Ehrenfeucht-Mostowski indiscernables	Theorem	Invalidated (1)
43	Energy-mass equation, E=mc^2	Theorem	Invalidated (3) Validated (1)
44	Epistemic coalition	Perfect recall	Invalidated (4) Validated (3)
45	Epistemic dynamic reasoning	System	Invalidated (2)
46	Epistemic Hilbert substructure	System	Invalidated (5)
47	Epistemic navigation	System	Invalidated (8)
48	Epistemic quantifiers over agents	Conjecture	Invalidated (8) Validated (12)
49	Erdös-Strauss	Conjecture	Invalidated
50	Euathlus paradox	Paradox	Invalidated (9)
51	FOL disjunctive normal forms (DNF): minimize	FOL Optimizer	Invalidated (2) Validated (1)
52	Frequency dependence of mass	Theorem	Invalidated (3) Validated (1)
53	Functions as injective, surjective, bijective	Theorems	Validated (4)
54	Gentzen proof of sequent System G-M	System	Invalidated (6) Validated (2)
55	Gettier (Justified tautologous belief)	Conjecture	Validated
56	Gödel compactness	Theorem	Invalidated (6) Validated (2)
57	Gödel completeness	Theorem	Invalidated
58	Gödel first incompleteness	Theorem	Invalidated (4)
59	Gödel incompleteness	Equations	Invalidated (14) Validated (1)
60	Gödel incompleteness FOL	Contradictions	Invalidated (14) Validated (1)
61	Gödel incompleteness theorem	Assistant tools	Invalidated (2) Validated (2)
62	Gödel incompleteness theorem	Refutation	Invalidated (7)
63	Gödel-Löb	Axiom	Invalidated

64	Gödel pairing function	Axiom	Invalidated (3)	Validated (1)
65	Gödel recursion	Theorem		Validated
66	Gödel-Scott on God	Theorem schema	Invalidated	
67	Goldbach's conjectures	Conjectures	Invalidated	
68	Grassmannian (*recently discovered*)	Paradox	Invalidated	
69	Heisenberg uncertainty principle	Axiom	Invalidated (2)	
70	Henkin cyclic algebra and first order logic	System	Invalidated (9)	Validated(6)
71	Applications to logic	Axioms	Invalidated (8)	Validated(6)
72	Permutation model nonrepresentable	Assertion	Invalidated (1)	
73	Herbrand semantics	System	Invalidated (6)	
74	Heyting-Brouwer intuitionistic logic	Systems	Invalidated (9)	Validated (1)
75	Higher order logic	Systems	Invalidated (2)	Validated (1)
76	Hilbert #10 Diophantine universal solution	Formulas	Invalidated	
77	Hilbert generalization	System	Invalidated	
78	Huhn 2-distributive lattice identity	Formula	Invalidated	
79	Imperative logic	System	Invalidated (3)	Validated (4)
80	Ignorance of first choice	System	Invalidated	
81	Inconsistent theory	Theorem	Invalidated	
82	Extending the monad to a triad	Formulas	Invalidated	
83	Kunen inconsistency	Theorem	Invalidated	
84	Independence-friendly logic (Kreiselization)	System	Invalidated (2)	
85	Indicative conditionals	Encyclopedia entry	Invalidated	
86	Induction: Black raven (swan); Kripkenstein	System	Invalidated (3)	
87	Inequality: 'arbitrarily' vs 'sufficiently large	Conjecture	Invalidated (2)	Validated (1)
88	Infinite set theory	Theorem	Invalidated	
89	Join-prime in lattice theory	Definition		Validated
90	Jonsson positive logic: retromorphism	System	Invalidated (3)	
91	Immanuel Kant: falsity of syllogistic figures	Theorems	Invalidated (8)	Validated (2)
92	Karpenko, S.A.	System K-Ł4	Invalidated	
93	Kuratowski–Zorn lemma (Zorn's lemma)	Lemma	Invalidated	
94	Lachlan problem solution	Problem	Invalidated (4)	
95	Leibniz' ontological proof	Proof	Invalidated (1)	Validated (1)
96	Briefest known ontological proof of God	Proof		Validated (2)
97	Lemmon D	Axiom	Invalidated	
98	Liar	Paradox	Invalidated	

99	Prior rendition	Paradox	Invalidated
100	Kripke rendition	Paradox	Invalidated
101	Löb original, corrected	Theorem	Invalidated (1) Validated (1)
102	Löwenheim–Skolem, Hilbert style	Metatheorem	Invalidated
103	Luce model (general)	Definitions/Axioms	Validated (5)
104	Majorana's 'root'	Equations	Invalidated (5)
105	Meth8 versus Prover9 via Lifshitz	Problem	Validated
106	Minkowski plane, classical set of points/cycles	Theorems	Invalidated (2) Validated (1)
107	Modified divine command	Theory	Invalidated
108	Necessitation: **K**,**T**,**4**,**B**,**D**,**5**; *D*,*M*,*S4*,*B*,*S5*	Axiom	Invalidated (10) Validated (7)
107	Leonard Nelson's criticism of epistemology	System	Invalidated
108	von Neuman-Bernays-Gödel [NBG]	Theory	Invalidated (2) Validated (3)
109	Neutrosophic logic	Theorems	Invalidated (5)
110	Generalized intuitionistic, fuzzy logic	System	Invalidated (2)
111	Neutrosophic sets	Properties	Invalidated (3)
112	Soft lattice theory	Theorem	Invalidated (2)
113	Unification of other logics	Axioms / Rules	Invalidated (2)
114	P=NP; 3-SAT	Conjectures	Invalidated (5)
115	Paraconsistency, machine-assisted view	Axioms	Invalidated
116	Paraconsistent contradiction	Conext	Invalidated
117	Peano arithmetic 9, 1-8	Axioms	Invalidated (1) Validated (8)
118	Poincaré recurrence theorem	Theorem	Invalidated (2)
119	Prenex normal format	Rules	Invalidated (11) Validated (3)
120	Karl Popper on God	Proof	Validated
121	PowerEpsilon mathematical induction	Axiom	Validated (1)
122	Prover9 vs Meth8 differences	System	Invalidated
123	Quantum control by observation	System	Invalidated
124	Quantum gates correspond to logical operators	Theorems	Invalidated (4) Validated (1)
125	Quantum simulation of Hamiltonian spectra	Operator	Invalidated (1)
126	Ramsey's theorem for the 2-color case	Theorem	Validated (2)
127	Ranjan, A.	Problem	Validated
128	Realizability semantics for QML	Theorems	Invalidated (3)
129	Reichenbach common cause / event-splitting	Principle	Invalidated
130	Riemann: only zeroes at 0, 1/2	Hypothesis	Invalidated
131	Zeta function, Caceres 6	Proposition	Invalidated (4)

132	Roman Catholic Church (RCC)	(Dogma)	Invalidated (7)
133	Erasmus contra Luther	Controversy	Validated
134	Infallibility and the Historic Church	Pius IX	Invalidated (2)
135	Magisterium	Paul VI	Invalidated (1)
136	Tradition above scripture	Pius IX	Invalidated (4)
137	Rota lattice theory, distributive	Axiom	Invalidated
138	Russell	Paradox	Invalidated
139	S5Π+ propositional quantification	System	Invalidated
140	Schrödinger's cat	Paradox	Invalidated
141	Self-equilibrium	Law / Paradox	Invalidated
142	Sorites	Paradox	Invalidated
143	Square of Opposition Meth8 Corrected	System	Validated
144	Square of Opposition Modern Revised	System	Invalidated
145	Square of Opposition	Proportions	Invalidated (3)
146	Stone space type lattice logic model	Theory	Invalidated (2)
147	Stone-Wales rotation transform reversibility	Theorem	Invalidated (2) Validated (1)
148	Superposition of states	Principle	Invalidated (6)
149	Tarski's undefinability of truth	Theorem	Invalidated (2)
150	Time as God	Conjecture	Validated
151	Topological manifold transition	Function	Invalidated (1)
152	Turing halting problem	Problem	Invalidated (2) Validated (1)
153	Twin paradox	Paradox	Invalidated (2)
154	Universal finite set	Theorem	Invalidated (2)
155	Veblen (corrected)	Axiom	Invalidated (1) Validated (1)
156	Veronoï regions (with "nonempty sets")	Definition	Invalidated
157	W (K4W)	Theorem	Invalidated
158	Well ordering property	Axiom	Invalidated
159	Wittgenstein's ab-notation	System	Invalidated (3)
160	Yalcin logic	Axioms	Invalidated (2)
161	Zadeh first operators on fuzzy logic	System	Invalidated (5)
162	Zermello-Fraenkel (ZFC):	(Axioms)	Invalidated (13) Validated (2)
163	ZFC Choice	Axiom	Invalidated
164	ZFC Empty set	Axiom	Invalidated
165	ZFC Extensionality	Axiom	Invalidated (1) Validated (1)
166	ZFC Infinity	Axiom	Invalidated (2)

167	ZF INF	Axiom	Invalidated
168	ZFC Pairing	Axiom	Invalidated
169	ZFC Power set	Axiom	Invalidated
170	ZFC Regularity or foundation	Axiom	Invalidated
171	ZFC Schema of replacement	Axiom	Invalidated
172	ZFC Specification	Axiom	Validated
173	ZFC Union	Axiom	Invalidated
174	ZFC Well ordering	Axiom	Invalidated (2)
175	ZF Law of excluded middle: infinite set	Axiom	Invalidated (2)
176	Zero and one in fractions	Axioms	Invalidated (3) Validated (8)
176	Zero knowledge proof	Theorem	Invalidated

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Refutation of the **ABC conjecture**

The ABC conjecture is described at wiki. Basically it says for the relatively prime numbers of p,q,s the expression p+q=s is tautologous. If the conjecture is refuted, then it cannot be used as the proof for a multitude of other unrefuted conjectures.

Using propositional logic in Meth8, LET

p,q,s	integers
r	relatively prime
&	And;
+	Or;
>	Imply;
=	Equivalent to.

In less words: "If p+q=s and that p,q,s are relatively prime, then p+q is tautologous."

This effectively defines s and asserts p,q,s are relatively prime to prove p+q is tautologous.

(((p+q)=s)&(((p&q)&s)=r))>(p+q) ; not tautologous; this deviates by only one value from tautologous, in bold.

In more words: "If p or q is equivalent to s and p,q,s are relatively prime, then p or q is tautologous."

Truth tables are row major for all four rows; the designated truth values are Tautologous and Evaluated.

	Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
p	FTFT FTFT FTFT FTFT	UEUE UEUE UEUE UEUE	UEUE UEUE UEUE UEUE	UEUE UEUE UEUE UEUE	UEUE UEUE UEUE UEUE
q	FFTT FFTT FFTT FFTT	UUEE UUEE UUEE UUEE	UUEE UUEE UUEE UUEE	UUEE UUEE UUEE UUEE	UUEE UUEE UUEE UUEE
(p+q)	FTTT FTTT FTTT FTTT	UEEE UEEE UEEE UEEE	UEEE UEEE UEEE UEEE	UEEE UEEE UEEE UEEE	UEEE UEEE UEEE UEEE
(p&q)	FFFT FFFT FFFT FFFT	UUUE UUUE UUUE UUUE	UUUE UUUE UUUE UUUE	UUUE UUUE UUUE UUUE	UUUE UUUE UUUE UUUE
s	FFFF FFFF TTTT TTTT	UUUU UUUU EEEE EEEE	UUUU UUUU EEEE EEEE	UUUU UUUU EEEE EEEE	UUUU UUUU EEEE EEEE
((p&q)&s)	FFFF FFFF FFFT FFFT	UUUU UUUU UUUE UUUE	UUUU UUUU UUUE UUUE	UUUU UUUU UUUE UUUE	UUUU UUUU UUUE UUUE
r	FFFF TTTT FFFF TTTT	UUUU EEEE UUUU EEEE	UUUU EEEE UUUU EEEE	UUUU EEEE UUUU EEEE	UUUU EEEE UUUU EEEE
((p+q)=s)	TFFF TFFF FTTT FTTT	EUUU EUUU UEEE UEEE	EUUU EUUU UEEE UEEE	EUUU EUUU UEEE UEEE	EUUU EUUU UEEE UEEE
(((p&q)&s)=r)	TTTT FFFF TTTF FFFT	EEEE UUUU EEEU UUUE	EEEE UUUU EEEU UUUE	EEEE UUUU EEEU UUUE	EEEE UUUU EEEU UUUE
(((p+q)=s)&(((p&q)&s)=r))	TFFF FFFF FTTF FFFT	EUUU UUUU UEEU UUUE	EUUU UUUU UEEU UUUE	EUUU UUUU UEEU UUUE	EUUU UUUU UEEU UUUE
(((p+q)=s)&(((p&q)&s)=r))>(p+q)	**F**TTT TTTT TTTT TTTT	**U**EEE EEEE EEEE EEEE	**U**EEE EEEE EEEE EEEE	**U**EEE EEEE EEEE EEEE	**U**EEE EEEE EEEE EEEE
	Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

This proof is an example of using the simplicity of propositional logic to map numerical expressions in arithmetic. It is the fine grained detail of the VŁ4 logic system of Meth8 that makes this view possible.

Recent advances in AA: factual mistake in We agnostics, p 53, invalidates the traditions

> *... the proposition that either God is everything or else He is nothing.*

The unattributed source of this quotation is Emmet Fox, whose personal secretary was associated with Bill Wilson, meaning Bill was promoting his family religion. Fox, despite claims, was not a Christian but a dishonest Gnostic. The problem with the quotation on its face is the use of the existential quantifier (every, as in everything) and the negation of the universal quantifier (not all, as in nothing).

The Meth8 modal logic checker maps the quotation as follows.

LET: p God; q thing(s); ~ not; + Or; = equivalence;
% possibility (for at least one instance); # necessarily (for all instances)

"God is everything" (antecedent)

This is rewritten from	"God is possibly a thing"	p = %q	(1)
to	"God is all possible things"	p = #%q	(2)

"God is nothing" (consequent)

This is rewritten from	"God is all things"	p = #q	(3)
to its negation as	"God is not all things"	p = ~#q	(4)

The assertion is that antecedent Or consequent is tautologous. Hence the logical connective is Or, and the expression used for Tautologous is "God is God" p = p (5)

We rewrite the quotation as:

Either "God is all possible things" or "God is not all things" is equivalent to Tautologous.
Such truth is supposed to be a self-evident truth, an axiom.
By substitution of Eq. 2, 4, 5: ((p = #%q) + (p = ~#q)) = (p = p) (6)

Meth8 evaluates Eq 6 as not tautologous with these truth table fragments from the five models:

NTNT EEEE UEUE IEIE PEPE, where designated truth values are T and E and mean by first letter Non-contingent, Tautologous, Evaluated, Unevaluated, Improper, Proper.

This means the quotation is factually mistaken as proved by mathematical logic.

What follows is that the quotation is seriously misleading in this way. Many AA's invoke a description of God as "God is everything or God is nothing" to mean God can be both good and evil at the same time because both good and evil are ostensibly things. This is dangerous because to assert God is evil means God can tell a lie. However that is contradictory from the counter example that God is capable to do anything except for one thing: God cannot tell a lie. (The quality of God of absolute truthfulness was proved by Karl Popper, *Conjecture and Refutation*, 1972 ed, over 45 years ago.)

What follows is Tradition 2 (*one ultimate authority ... God ... in our group conscience)* is mistaken by assuming it is necessarily God's will, and thus the traditions themselves do not self-validate as claimed.

Topological semantics for conditionals and the Alexandroff correspondence

Marti, Johannes; Pinosio, Riccardo. Topological Semantics for Conditionals. Logica. January, 2013.

From: researchgate.net/publication/29945557

We evaluate three theorems using the Meth8 apparatus.

LET: > -v->; @ Not equivalent to; # necessity, universal quantifier ; % possibility, existential quantifier;
p lc_phi; q lc_psi; (p=p) uc_Tau (for tautology); (p@p) inverted uc_Tau (for contradiction)

The designated proof value is T (tautology) as opposed to F (contradiction). N means non-contingent (truth value) as opposed to C contingent (falsity value).

Repeating fragments are from the 16-value truth table.

On page 11, Theorem 9 has three equivalences to hold in coherent neighborhood spaces. These equations are transcribed due not non-rendering as such:

#p=(~p>(p@p))	; TNTN ;	(9.1)
#p = ((p=p)>p)	; TNTN ;	(9.2)
(p>q) = ((%p>#(p>q)) & (~%p>#(p>%(p&#(p>q)))))	; NTNN ;	(9.3)

This tells us that topological conditionals are not bivalent. By extension the Alexandroff correspondence is also not bivalent. Previously, that fact was independently implied by Meth8 showing the Gödel-Löb theorem was not a tautology, and hence the axiom of choice was also not a tautology. Therefore the Alexandroff correspondence which relies on the axiom of choice is also not a tautology.

Anderson division by zero

From James A.D.W. Anderson et al (2006), "Perspex Machine VIII: Axioms of Transreal Arithmetic".

The transreal number system based on 1/0 = Nullity (*not* undefined) claims this axiom for Lattice Completeness:

> The set, X, of all transreal numbers, excluding Φ (Nullity), is lattice complete because
>
> $\forall Y\!: Y \subseteq X \Rightarrow (\exists u \in X\!: (\forall y \in Y\!: y \leq u) \wedge (\forall v \in X\!: (\forall y \in Y\!: y \leq v) \Rightarrow u \leq v))$ [A32]

We map and test axiom A32 in Meth8 script.

> LET: pqrsuv xyXYuv; nvt not tautologous;
> \# ∀; % ∃; ~ Not; & ∧; + ∨; > Imply; < ∈, Not Imply; ~(m > n) (m ≤ n), (m ⊆n);
>
> (#s&~(s>r)) > (((%u<r)&((#q<s)&~(q>u)))&((#q<s)&(~(q>v)>~(v>u)))); nvt (1)

Eq 1 is not tautologous. Here is the repeating fragment of the 128-truth tables:

```
Model 1          .Model 2.1       .Model 2.2       .Model 2.3.1     .Model 2.3.2
TTTTTTTTCCCCTTTT.EEEEEEEEUUUUEEEE.EEEEEEEEEEEEEEEE.EEEEEEEEPPPPEEEE.EEEEEEEEIIIIEEEE
(#s&~(s>r))>(((%u<r)&((#q<s)&~(q>u)))&((#q<s)&(~(q>v)>~(v>u))))   Step: 29
```

Eq 1 with the main connective < Not Imply is also not tautologous.

> (#s&~(s>r)) < (((%u<r)&((#q<s)&~(q>u)))&((#q<s)&(~(q>v)>~(v>u)))); nvt (2)

We jump forward in the paper to evaluate the first general algebraic property theorem:

> $(a+b)=\Phi \equiv (a=\Phi)\vee(b=\Phi)\vee((a=\infty)\wedge(b=-\infty))\vee((a=-\infty)\wedge(b=\infty))$ [T52]
>
> LET: pqrs *a b* Φ∞ [*We note the infinity symbol is used as a positive or negative number.*]
>
> ((p+q)=r) = (((p=r)+(q=r))+ (((p=r)&(q=~r))+((p=~r)&(q=r)))) ; nvt (3)

Here is the entire truth table:

```
Model 1          .Model 2.1       .Model 2.2       .Model 2.3.1     .Model 2.3.2
TFFTTTTTTTFFTTTTT.EUUEEEEEEEUUEEEEE.EUUEEEEEEEUUEEEEE.EUUEEEEEEEUUEEEEE.EUUEEEEEEEUUEEEEE
((p+q)=r)=(((p=r)+(q=r))+(((p=r)&(q=~r))+((p=~r)&(q=r))))   Step: 29
```

We resuscitate Eq 3 by replacing the main connective = Equivalent with the > Imply connective.

> ((p+q)=r) > (((p=r)+(q=r))+ (((p=r)&(q=~r))+((p=~r)&(q=r)))) ; vt (4)

However, this is not what the authors stated in theorem T52, so we stop here.

Validation of **"Axiomatizing category theory in free logic"**

Introduction

The authors Christoph Benzmüller and Dana S Scott (2016) use a proof assistant named Isabelle/HOL to formalize axiom sets for category theory using the system "free logic" which is supposed to abide by the rules of classical logic.

Our motivation of this experiment is to validate those logical expressions of free logic in terms of classical logic. We ask, "Is system free logic compliant with classical logic?"

The approach is to use the modal logic theorem checker named Meth8 for five models from James (2016). Meth8 is based on the variant system **VŁ4** from Goodwin, James (2015) that corrects and rehabilitates the Łukasiewicz quaternary logic system of **Ł4**, where:

> % Existential Quantifier, Modal Possibility; # Universal Quantifier, Modal Necessity; ~ Not;
>
> & And; \ Not And; = Equivalent; @ Not Equivalent; > Imply; < Not Imply; + Or; - Not Or;
>
> vt Validated as Tautologous; nvt Not Validated as Tautologous; nvt F Not Validated as Tautologous, all models contradiction
>
> The logical values are, with designated truth values in italics:
>
> FCNT for F contradiction, Contingent (falsity), Non Contingent (truth), *Tautologous*;
> UIPE for Unevaluated, Improper, Proper, *Evaluated.*

We proceed to test the logical expressions in that paper.

Validation

The validation is presented as a table of the 8 expressions evaluated from that paper with: ID; section name or Meth8 script as tested; test validation result; name of the expression, section number; and notes. For expressions not validated as tautologous, the test results are shaded lighter gray, and of those returning all F values (contradictory) are further shaded darker gray.

ID	Section name / Meth8 script	Test	Name	Sec no	Notes
	1. Introduction				
1	(%p&~(s&p))>(p@p) [(p@p) is F contradiction]	nvt	[f_exist_proved]	1	"We can prove"
	2. Embedding of free logic in HOL				
2	#p=((q&(r&q))>(p&q))	nvt	f_for_all	2	
3	(#p&(q&p))>#q	vt	f_for_all_binder	2	
4	(p+q)=(~p>q)	vt	f_or	2	
5	(p&q)=~(~p+~q)	vt	f_and	2	
6	(p=q)=((p>q)&(q>p))	nvt	f_implied	2	
7	(p=q)=((p>q)&(q>p))	vt	f_equiv	2	

ID	Section name / Meth8 script	Test	Name	Sec no	Notes
8	%p=~(#(r&q)&~(p&q))	nvt	f_exists	2	
9	(%p&(q&p))=%q	nvt	f_exists_binder	2	

Truth table fragments for nvt tests above are keyed to the ID for models and step (stp) below.

ID	Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2	Stp
1.	NFNF NFNF NTNT NTNT	EUEU EUEU EEEE EEEE	UUUU UUUU UEUE UEUE	IUIU IUIU IEIE IEIE	PUPU PUPU PEPE PEPE	9
2.	FNFN FNTN FNFN FNTN	UEUE UEEE UEUE UEEE	UUUU UUEU UUUU UUEU	UIUI UIEI UIUI UIEI	UPUP UPEP UPUP UPEP	11
6.	FTTF FTTF FTTF FTTF	UEEU UEEU UEEU UEEU	UEEU UEEU UEEU UEEU	UEEU UEEU UEEU UEEU	UEEU UEEU UEEU UEEU	7
7.	CTCT CTTT CTCT CTTT	UEUE UEEE UEUE UEEE	EEEE EEEE EEEE EEEE	PEPE PEEE PEPE PEEE	IEIE IEEE IEIE IEEE	9
8.	NNFT NNFT NNFT NNFT	EEUE EEUE EEUE EEUE	UUUE UUUE UUUE UUUE	IIUE IIUE IIUE IIUE	PPUE PPUE PPUE PPUE	7

Discussion

Of the 9 expressions tested by Meth8, 4 are validated as tautologous (vt) and 5 are not validated as tautologous (nvt).

1. Introduction

The paper authors write: [0.] "We can prove (∃x.~(*E*x))→contradictory, where *E* is the existence predicate"; and "Read this as: "If there are undefined objects, then we have falsity."

We write this as 1. (%p&~(s&p))>(p@p) to mean "Both possibly p and the non-existence of r imply falsity." Substituting from above 7. f_exists for *E*x as %p=~(#(r&q)&~(p&q)), writes

10	(%p&~(~(#(r&q)&~(p&q))))>(p@p)	vt	f_exists_*E*x	1	

Hence we confirm [0].

2. Embedding of free logic in HOL

We validate as tautologous the non-assistant expressions of 4, 5, and 7 as the connectives Or, And, and Equivalent.

We validate as not tautologous the non-assistant expressions of 1, 6, and 8 as the universal quantifier, Implication connective, and existential quantifier.

Conclusion

Because we do not validate as tautologous expressions 1, 6, and 8, free logic is not validated as compliant with classical logic. Consequently we do not proceed to subsequent sections 3 and 4-10 for Preliminaries and Axiom sets 1-8. We conclude that the assistant tool Isabelle/HOL is not compliant with classical logic.

References

Goodwin, Garry, James III, Colin. 2015. Meth8 model prover for multivalued logic: Truth is as a white light. [*in submission*].

James III, Colin. 2016. Meth8 modal logic model checker. [US Patent Pending]
(Production software for real time performance on 11-propositions and 4-theorems).

Benzmüller, Christoph, Scott Dana S. 2016. Axiomatizing category theory in free logic.
arXiv:1609:01493v3 32

Resolution to the Banach-Tarski Paradox

This experiment logically tests the Banach-Tarski Paradox as an equivalence and an implication.

At en.wikipedia.org/wiki/Banach%E2%80%93Tarski_paradox , we find after "[s]ome details fleshed out", Step 3:

$$S^2 = ... = (E - D) \cup (S^2 - E) = S^2 - D \quad (1.1)$$

We assume the Meth8 apparatus using VŁ4, where the designated proof value is T tautology and F contradiction. The 16-value truth table is presented row major and horizontally.

LET: s S^2; q E; p D; = Equivalent to; ∪ + Or; ⊃ > Imply; - Not Or; & And

s = (((q-p)+(s-q)) = (s-p)) ; `FTTF FTTF FTTT FTTT` (1.2)

Because Eq. 1.2 is not tautologous, we weaken the argument for the equivalent to connective =, with replacement by the connective > Imply.

s > (((q-p)+(s-q)) > (s-p)) ; `TTTT TTTT FTTT FTTT` (1.3)

Eq. 1.3 is the equivalent to writing Eq 1.1 in the text symbols as:

$$S^2 \supset (E - D) \cup (S^2 - E) \supset S^2 - D. \quad (1.4)$$

While Eq. 1.3 is relatively less contradictory than Eq.1.2, it remains that both Eq. 1.1 and Eq. 1.4 in the text symbols remain as not tautologous.

This means the Banach-Tarski Paradox, as rendered, is not a paradox, not a theorem, and non-tautologous.

What follows is that the Von Neumann Paradox on the Euclidean plane is also suspicious as a paradox and possibly not a paradox.

Barcan formula in Validation of "Can modalities save naive set theory?"

Introduction

As a memorial to Grigori Mints, the captioned draft paper was authored by Peter Fritz, Harvey Lederman, Tiannkai Liu, and Dana Scott (2015). That paper contains many modal comprehension principles and relies on the Converse Barcan Formula and logic system **T**. The intent of that paper is to: affirm that naive set theory is inconsistent; affirm that the Russell paradox is consequently inconsistent; and answer the question as "no".

Our motivation is to validate the logical expressions of that paper. The approach is to use the modal logic theorem checker named Meth8 for five models from James (2016). Meth8 is based on the variant system **VŁ4** from Goodwin, James (2015) that corrects and rehabilitates the Łukasiewicz quaternary logic system of **Ł4**, where:

% Existential Quantifier, Modal Possibility; # Universal Quantifier, Modal Necessity; ~ Not;

& And; \ Not And; = Equivalent; @ Not Equivalent; > Imply; < Not Imply; + Or; - Not Or;

vt Validated as Tautologous; nvt Not Validated as Tautologous; nvt F Not Validated as Tautologous, all models contradiction

FCNT for F contraction, Contingent, Non Contingent, *Tautologous*;
UIPE for Unevaluated, Improper, Proper, *Evaluated.*

We evaluate the schemata of the Barcan Formula and its converse before proceeding to test the logical expressions in that paper.

The Barcan Formula

The Barcan Formula is defined in Meth8 script as either:

(#x&#(p&x)) > #(#x&(p&x)) ; vt ; (BF0.1) > (BF0.2): (BF.0)
%(%x&(p&x)) > (%x&%(p&x)) ; vt ; (BF1.1) > (BF1.2): (BF.1)

The truth tables for each literal group in (BF.0) and (BF.1) are in non repeating rows after 5 or 6 steps:

```
FFFN FFFN   UUUE UUUE   UUUU UUUU   UUUI UUUI   UUUP UUUP
CCCT CCCT   UUUE UUUE   EEEE EEEE   PPPE PPPE   IIIE IIIE
```
(BF0.1); (BF0.2)
(BF1.1); (BF1.2)

In Meth8 for (BF.0) and (BF.1), the respective antecedents and consequents are equivalent, so:

((#x&#(p&x)) = #(#x&(p&x))) = (%(%x&(p&x)) = (%x&%(p&x))) ; vt ; (BF.2)

The converse Barcan Formula to (BF.2) is defined in Meth8 script as:

#(#x&(p&x))) = ((#x&#(p&x)) = (%x&%(p&x))) = (%(%x&(p&x)) ; vt ; (BF.5)

Because (BF.2) and (BF.5) are equivalent, we do not take the converse Barcan formula to be more plausible than the Barcan formula. In that paper, the expression (p&x) is substituted for p below.

Validation

The validation is presented as a table of the 64 expressions evaluated from that paper with: ID; section name or Meth8 script as tested; test validation result; name of the expression, section number; and notes. For expressions not validated as tautologous, the test results are shaded lighter gray, and of those returning all F values (contradiction) are further shaded darker gray.

ID	Section name / Meth8 script	Test	Name	Sec no	Notes
	1. Background				
1	(%y&#x)&((x<y)=#p)	nvt	(Comp#)	1	
2	(%y&#x)&#((x<y)=#p)	nvt	(#Comp#)	1	
3	#(#x&p)>(#x&#p)	vt	(CBF)	1	converse Barcan
4	%y&#(#x&((x<y)=#p))	nvt	Principle	1	imply (#Comp#)
5	(#x&#p)>#(#x&p)	vt	(BF)	1	Barcan formula
6	%y& #(#x&((x<y)=((x<u)&p)))	nvt	(MZF Comp)	1	per Kajíček et al
7	(%y&#x) & (((#x<y)=#p) & ((#~x<y)=#~p))	nvt F	(MCA)	1	
	2. The Consistency of (Comp#)				
8	Substitution of predicate logic theorem		(LPC)	2	not tested
9	(#(p>q)>(#p>#q)) > (t=t)	vt	(K)	2	"⊦" as "> (t=t)"
10	(#p>p)>(t=t)	vt	(T)	2	
11	((p>(t=t))&((p>q)>(t=t)))>(p>(t=t))	vt	(MP)	2	
12	((p>q)>(t=t))>(((p>(#x&q))>(t=t))&(~%x& p))	nvt	(∀2) x ~free p	2	~%x&p
13	(p>(t=t))>(#p>(t=t))	vt	(RN)	2	
14	((p>q)>(t=t)) > (((#p>#q)>(t=t))&((%p> %q)>(t=t)))	vt	(RM)	2	
15	(#x&#p)>#(#x&p)	vt	(BF)	2	Barcan formula
16	#(#x&p)>(#x&#p)	vt	(CBF)	2	converse Barcan
17	#p>##p	vt	(L4)	2	
18	~#p>#~#p	vt	(L5)	2	
19	p>#%p	vt	(B)	2	
	2.1 Consistency				
20	#(#x&(p&x))=(#x&#(p&x))	vt	(Bar)	2.1.6.1	
21	(#y&#p)&((#x&((x<y)=(x<p)))>(y=p))	nvt	(Ext)	2.16.2	
22	((#p&%y)&#x)&((x<y)=~(x<p))	nvt	(Neg)	2.1.6.3	
23	((#p&#q)&(%y&#x))&((x<y)=((x<p)&(x<q)))	nvt	(Con)	2.1.6.4	
24	(%y&#x)&((x<y)=(%p&x))	nvt	(Comp%)	2.1.6.5	
25	(#x&#y)&((%x=y)>(#x=y))	nvt	(Equ)	2.1.6.6	

ID	Section name / Meth8 script	Test	Name	Sec no	Notes
26	(#x&#y)&%(x<y)	nvt F	(Mem)	2.1.6.7	
27	(#x&#y)&%(~x<y)	nvt F	(Non)	2.1.6.8	
	2.2 Undecidability				
28	(%y&#x)&(~x<y)	nvt F	(Empty)	2.2	
29	((#y&#z)&(%w&#x)) & ((x<w)=((x<y)+(x=z)))	nvt F	(Add) (x=z)	2.2	
30	((x@x)&((#y&#z)&(%w&#x))) & ((x<w)=((x<y)+(x=z)))	nvt F	(Add) (x@x)	2.2	
31	((x@x)&((%y&#x)&((x<y)=#p))) = ((%y&#x)&(~x<y))	vt	(Comp#) > (Empty)[x@x]	2.2	
	2.3 Concluding discussion				
32	(x<y)>(#x<y)	nvt	Axiom	2.3	membership is #
33	p=(x>x)	nvt	Instance	2.3	inconsistent **KD**
	3. Inconsistency (#Comp#)				
34	(%y&#x)&#((x<y)>(#~x<x))	nvt	(#Russell#)	3.1	
35	(p>(q=#~q))>~#p	vt	Proposition	3.2	
36	(#y&~#x)&#((x<y)=#(~x<x))	nvt F	Generalization	3.2.13	on 3.2.12
37	(~%y&#x)&#((x<y)=#(~x<x))	nvt F	Df∀	3.2.14	on 3.2.13
38	((#p>(q=#~q))>~#p	vt	Proposition	3.3	
39	(#p>q)>(#p>#q)	vt	(RM)	3.3	
40	((p>q)>(t=t)) > (((#p>#q)>(t=t))&((%p> %q)>(t=t)))	vt	(RM)	3.3	
41	#p>(q=#~q)	nvt	Assumption	3.3	
	4. Inconsistency of (#Comp#%)				
42	(%y&#x)&#((x<y)=#%#p)	nvt	(#Comp#%)	4	
43	(%y&#x)&#((x<y)>(#%~x<x))	nvt	(#Russell#%)	4	
44	(#p>(q=#%~q)) > ~#p	vt	Proposition	4.2	
45	#p>(q=#%~q)	nvt	(Assumption)	4.2.1	antecedent
46	~#p [tested as ~#p+~#p]	nvt	Proposition	4.2.12	consequent
	5. Inconsistency of (#Comp#%#)				
47	(%y&#x)&#((x<y)>#%p)	nvt	(#Comp#%#)	5	
48	(%y&#x)&#((x<y)>(#%~x<x))	nvt	(#Russell#%#)	5	
49	#%p=#%#%p	vt	(Red#%)	5	Reduction law
50	(#p>(p=#%#~p))>~#p	vt	Proposition	5.2	
	6. Duality between modalities				
	7. Conclusion				

ID	Section name / Meth8 script	Test	Name	Sec no	Notes
	7.1 Converse Barcan formula				
51	(#x&p) > p	vt	predicate logic	7.1.1	
52	#(#x&p) > #p	vt	(RN), (K)	7.1.2	
53	#(#x&p)>(#x&#p)	vt	(∀2)	7.1.3	
54	%y&#(#x &((x<y)=#p))	nvt	(#∀Comp#)	7.1	"the principle"
55	(#x&p)>((%x&(x=y))>(p&(x+y)))	vt	(Rest Gen)	7.1	for [x/y] as x+y
56	(#x&p)>((%x&(x=y))>(p&(x@y)))	nvt	(Rest Gen)	7.1	for [x/y] as x@y
57	#x&(%y&(x=y))	nvt	(UE)	7.1	
58	(#x&(p>q)) > ((#x&p) > (#x&q))	vt	(∀>)	7.1	
59	(p>(t=t))>((#x&p)>(t=t))	vt	(UG)	7.1	also (U=G)
60	(%y&##x)&((x<r)=#((%y&(y=x))>(x>x)))	nvt	(#∀Russell#)	7.1	
	7.2 Replacing (T) with (D)				
61	#p>%p	vt	(D)	7.2	Replace (T), (D)
62	%p>#p	nvt	(Dc)	7.2	in **KDDc**, (Dc)
	7.3 Gödel-McKinsey-Tarski naive comp.				
63	#%%y&##x)&#((#x<y)=#p)	nvt	(CompGMT)	7.3	
64	(#%%y&##x)&#((#x<y)=#~#p)	nvt	(RussellGMT)	7.3	
65	(###y&~##x)&#((#x<y)=#(~#x<x))	nvt F	Proposition	7.3.6	last line in proof

Discussion

Of the 64 expressions tested by Meth8, 1 is not tested, 28 are validated as tautologous (vt), 36 are not validated as tautologous (nvt), and 10 of those not validated as tautologous are nvt *and* F contradiction. The logical expressions of interest are those which Meth8 refuted as nvt, and in particular of those nvt *and* F contradiction. Rather than relisting those nvt we step through that paper by section.

1. Background

All of the comprehension principles are validated as not tautologous: (Comp#); (#Comp#); principle implying (#Comp#); (MZF Comp); and (MCA) as nvt *and* F contradiction. We note that 4. Principle to imply 2. (#Comp#) is vt although not listed. These results confirm the results in that section.

2. The Consistency of (Comp#)

We test 12. (∀2) with x not free in p as nvt. However the expression is vt if the constraint is removed.

2.1 Consistency

For (Comp#) as valid in the model M,. the principles of **S5** apply as do a series of 8 axioms. Axiom (Bar) is vt, but axioms 2-8 are nvt. In particular axioms 7 and 8 are nvt *and* F contradiction. This raises our suspicions that (Comp#) is not valid in model M, and hence is not consistent.

2.2 Undecidability

Axiom (Empty) is nvt *and* F contradiction. This causes us to doubt if the axiom of the empty set is also nvt by virtue of the two interpretations of Robinson Arithmetic given there. We tested two variations of (Add): with x=z and x@z, both as nvt *and* F contradiction. If (Empty) and (Add) are F contradiction, then the interpretation of that section does not support (Comp#)+**S5** as undecidable.

3. Inconsistency (#Comp#)

We tested (#Russell#) as nvt, confirming it it inconsistent. We tested Proposition 3.2.13 and 3.2.14 as nvt *and* F contradiction, confirming that (#Comp#) is inconsistent.

4. Inconsistency of (#Comp#%)

We tested (#Comp#%) and (#Russell#%) as nvt, confirming inconsistency.

5. Inconsistency of (#Comp#%#)

We tested (#Comp#%#) and (#Russell#%#) as nvt, confirming inconsistency.

7.1 Converse Barcan formula

We test (#∀Comp#) and (#∀Russell#) as nvt, confirming inconsistency. We test (RestGen) for [y/x] to mean x+y or x@y as vt or nvt. We note that (UG) also holds for (U=G), and should be rewritten as such with the equivalence connective.

7.2 Replacing (**T**) with (**D**)

We test the axiom schema %p>#p as nvt. rendering Dc in **KDDc** as suspicious.

7.3 Gödel-McKinsey-Tarski naive comprehension

We test (CompGMT), (RussellGMT), and Step 7.3.6 as nvt, confirming inconsistency.

Conclusion

While we confirm inconsistency in many expressions of that paper and the answer "no", we are left with some egregious expressions as nvt *and* F contradiction. For example, %p>#p as Dc is untenable, as is also (Comp#)+**S5** as undecidable, and particularly the Russell paradox as inconsistent (due to what follows).

From our previous refutations we may cut to the chase regarding ZFC and the Russell paradox: axiom of the empty set is nvt; and Russell's paradox is *not* inconsistent, and hence resolved as *not* a paradox.

Axiom of the empty set

The ZFC axioms we find nvt are: extensionality; regularity (foundation); empty set; pairing; union; and power set.

For example the axiom of the empty set is:

(#p&#q) & ((#r&((r<p)=(r<q)))>(p=q)) ; consequent tautologous; [&] makes nvt (ES.1)

Russell's paradox (See en.wikipedia.org/wiki/Russell%27s_paradox)

R = { x | x ∉x }, then R ∈R <=> R ∉R. (R.1)
(r = (x>x)) > ((r<r) = (r>r)) ; nvt (R.2)

Russell's paradox as stated is nvt, but it is not a paradox or a contradiction.

In the formal presentation of Russell's "Naive Set Theory (NST), as the theory of predicate logic with a binary predicate ∈and the following axiom schema of unrestricted comprehension:

∃y ∀x (x ∈y <=> P (x)) (R.5)

for any formula *P* with only the variable *x* free. Substitute x ∉x for P (x).
Then by existential instantiation (reusing the symbol *y*) and universal instantiation
y ∈y <=> y ∉y is a contradiction. Therefore, NST is inconsistent.": [∉ is >]

(%y&#x)&((x<y)=(p&x)) ; nvt (R.6)
for (p&x) substitute (x>x)
(%y&#x)&((x<y)=(x>x)) ; nvt *and* F contradiction (R.7)

However there is a problem with the substitution of (p&x)=(x>x) if (p&x) is removed from the expression as in (7); the correct expression is (p&x)=(x>x), not (x>x) with truth table fragment:

(%y&#x)&((x<y)=((p&x)=(x>x))) ; nvt [but not *and* F contradiction] (R.8)

```
Model 1    Model 2.1  Model 2.2  Model 2.3.1Model 2.3.2
FFFF FFNF  UUUU UUEU  UUUU UUUU  UUUU UUIU  UUUU UUPU    Step: 15
```

Therefore Russell's NST is nvt, but it is *not* inconsistent as a contradiction.

References

Fritz, Peter, Lederman, Harvey, Liu, Tiankai, Scott, Dana. 2015. Can modalities save naive set theory? *Memorial to Grigori Mints (1939-2014)*.

Goodwin, Garry, James III, Colin. 2015. Meth8 model prover for multivalued logic: Truth is as a white light.

James III, Colin. 2016. Meth8 modal logic model checker. [US Patent Pending] (Production software for real time performance on 11-propositions and 4-theorems).

Meth8 validation of Bayes rule

Bayes rule from cs.cornell.edu/home/kleinber/networks-book/networks-book-ch16.pdf, information cascades

Section 1. We ask:

"Can we validate Bayes rule as defined in the captioned textbook link?"

We assume the notation of Meth8 and Pr[...] from the text as Probability of [...], which is ignored for our purposes here because Pr[...] precedes each term of the formulas of the text.

We assume the apparatus of Meth8 modal logic model checker, implementing our resuscitation of the Łukasiewicz four-valued logic as system variant VŁ4. The 16-valued truth tables are horizontal.

LET: p q [A B, from the text], (q>p) [A|B], (p>q) [B|A]
vt Validated tautology, nvt Not validated tautology,
Designated truth value: T Tautology (F Contradiction)

The text defines A given B, that is, if B then A:

(q>p)=((p&q)\q) ; nvt ; TTFF TTFF TTFF TTFF (1)

Because Eq 1 is not vt, as expected from the text, we test the main connective for > Imply instead of = Equivalent.

(q>p)>((p&q)\q) ; nvt ; TTTF TTTF TTTF TTTF (1.1)

The text defines B given A, that is, if A then B:

(p>q)=((q&p)\p) ; nvt ; TFTF TFTF TFTF TFTF (2)

Because Eq 2 is not vt, as expected from the textbook, we test the main connective for > Imply instead of = Equivalent.

(p>q)>((q&p)\p) ; nvt ; TTTF TTTF TTTF TTTF (2.1)

Eq 1 and Eq 2 are supposed to be vt but are not. We note that Eq 1.1 is equivalent to Eq 2.1 where the respective main connectives are > Imply, not = Equivalent.

((q>p)>((p&q)\q)) = ((p>q)>((q&p)\p)) ; vt ; TTTT TTTT TTTT TTTT (3)

Because Eqs 1 and 2 are nvt, we could terminate validation at this point.

Section 2. We ask:

"Can the argument from the text be resuscitated in the process of continuing to evaluate it?"

The text rewrites Eqs 1 and 2 by multiplying both sides of the formula by the denominator in the respective consequent. In Eqs 1 and 2 the respective multiplier terms are q and p. The idea is to clear the denominator in the respective consequents.

((q>p)&q) = (((p&q)\q)&q) ; nvt ; TTFF TTFF TTFF TTFF (4)
((p>q)&p) = (((q&p)\p)&p) ; nvt ; TFTF TFTF TFTF TFTF (5)

We test the main connective in Eqs 4 and 5 for > Imply instead of = Equivalent, with the same result as in Eqs 1.1,2.1, and 3.

Because (p&q) = (q&p), the text rewrites Eq 5 but Eq 4 is carried over as unchanged.

((q>p)&q) = (((p&q)\q)&q) ; nvt ; TTFF TTFF TTFF TTFF (6)
((p>q)&p) = (((p&q)\p)&p) ; nvt ; TFTF TFTF TFTF TFTF (7)

The text rewrites Eqs 6 and 7 by simplifying the consequents.

((q>p)&q) = (p&q) ; vt ; TTTT TTTT TTTT TTTT (8)
((p>q)&p) = (p&q) ; vt ; TTTT TTTT TTTT TTTT (9)

The text sets Eq 8 equal to Eq 9.

((q>p)&q) = ((p>q)&p) ; vt ; TTTT TTTT TTTT TTTT (10)

For Eq 10 the text divides both antecedent and consequent by the term q to reduce the antecedent then rewrites.

(q>p) = (((p>q)&p)\q) ; nvt ; TTFF TTFF TTFF TTFF (11)

This produces the intended definition of the text for the expression Pr[(A|B] (16.4) as Bayes rule.

Bayes rule as Eq 11 is nvt. We note the text begins with Eqs 1 and 2, both nvt.

This leads us to consider Eq 3 vt as the basis from which to obtain Bayes rule.

((q>p)>((p&q)\q)) = ((p>q)>((q&p)\p)) ; vt ; TTTT TTTT TTTT TTTT (3)

From Eq 3, we seek to find the definition of (q>p), or as an alternative approach of (p>q).

In the case of the term (q>p) we seek to remove from the antecedent in Eq 3 the term ((p&q)\q). The procedure is to apply the expression <((p&q)\q) to the antecedent and consequent.

(((q>p)>((p&q)\q))<((p&q)\q)) = (((p>q)>((q&p)\p))<((p&q)\q)) ; vt ;
TTTT TTTT TTTT TTTT (12)

We simplify and rewrite Eq 12.

(q>p) = (((p>q)>((q&p)\p))<((p&q)\q)) ; nvt ; FFTF FFTF FFTF FFTF (13)

In the case of the term (p>q) we seek to remove from the consequent in Eq 3 the term ((q&p)\p)). The procedure is to apply the expression <((q&p)\p) to the consequent and antecedent.

(((q>p)>((p&q)\q))<((q&p)\p)) = (((p>q)>((q&p)\p))<((q&p)\p)) ; vt ;
TTTT TTTT TTTT TTTT (14)

We simplify and rewrite Eq 14.

(p>q) = (((q>p)>((p&q)\q))<((q&p)\p)) ; nvt ; FTFF FTFF FTFF FTFF (15)

The textbook definitions of Bayes rule are not validated as tautologous and cannot be resuscitated from the textbook.

Section 3. As an experiment, we ask:

> "Are the definitions of Bayes rule derivable from Eq 3, the only expression tautologous, from Section 1; in other words, can Meth8 produce a correct Bayes rule because Section 1 failed to do so?"

We reiterate Eq 3 from above and rename it for this section as Eq 3'.

((q>p)>((p&q)\q)) = ((p>q)>((q&p)\p)) ; vt (3')

LET r=((p&q)\q), s=((q&p)\p) and rewrite Eq 3' with those definitions by substitution.

((r=((p&q)\q))&(s=((q&p)\p)))> ((((q>p)>r)-s) = (((p>q)>s)-r)) ; vt (4')

Our approach is to manipulate the term ((q>p)>r)-s) so that (q>p) is the antecedent of an equality.

This means finding the correct method to represent (q>p) as a separate term in ((q>p)>r)-s), or as an alternative approach to represent (p>q) as a separate term in ((p>q)>s)-r), or both.

We use the template A>B = ~A+B where A is (q>p) and B is r, so ((q>p)>r)-s becomes (~(q>p)+r)-s.

((r=((p&q)\q))&(s=((q&p)\p)))> (((~(q>p)+r)-s) = (((p>q)>s)-r)) ; vt (5')

This successfully removed from the antecedent term of interest the second > Imply connective to leave connectives + Or and - Not Or.

We use the same template as C>D = ~C+D where C is (p>q) and D is s, so that ((p>q)>s)-r becomes (~(p>q) +s)-r.

((r=((p&q)\q))&(s=((q&p)\p)))> (((~(q>p)+r)-s) = ((~(p>q)+s)-r)) ; vt (6')

This successfully removed from the consequent term of interest the second > Imply connective to leave connectives + Or and - Not Or.

We cannot extract either (q>p) or (p>q) as separate terms from Eq. 6'. Therefore we abandon seeking these terms as those claimed for Pr[A|B] or Pr[B|A] in the text for Bayes rule.

The Bell /CHSH inequalities and Spekken toy model

From: en.wikipedia.org/wiki/Spekkens_Toy_Model (edited)

> The *knowledge balance principle* of the Spekken toy model ensures that any measurement of a system from within itself yields incomplete knowledge of itself. This implies that observable states of a system are epistemic, that is, only relate to the study of knowledge.
>
> The Spekken toy model implicitly assumes that there is an ontic state of a system at any instant, but which is unobserved.
>
> The model can not derive quantum mechanics due to a disparity of model and quantum theory.
>
> The model contains local and noncontextual variables, so based on Bell's theorem [*] the model can not replicate predictions made by quantum mechanics.
>
> The toy model produces strange quantum effects, interpreted in support the epistemic view.

For an elementary system, the four ontic states are p,q,r,s.

LET { 1, 2, 3, 4, |0>, |1>, |+>, |->, |i>, |-i>, *I*/2 }, where *I* is not defined at the link (1)
= { p, q, r, s, t, u, v, w, x, y, , z }

For an elementary system, the four ontic states are p, q, r, s.

These map into 6 qubit states, with + And, = Equivalent, @ Not Equivalent, > Imply, < Not Imply:

LET p+q = t; r+s = u; p+r = v; q+s = w; p+s = x; q+r = y; p+q+r+s = z; (2a)
Derived for: r = (((u-s)+(v-p))+(y-q)); s = (((u-r)+(w-q))+(x-p)); (2b)
All states: (((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w))& (2c)
((((p+s)=x)&((q+r)=y))&(((p+q)+(r+s))=z))) ;

The knowledge balance principle [**] is satisfied by transformations on the ontic state of the system in permutations of the four ontic states. For example:

(((p&q)&(r&s))&(p+q)) > (p+q) ; (3)
(((p&q)&(r&s))&(p+r)) > (q+s) ; (4)
(((p&q)&((((u-s)+(v-p))+(y-q))&(((u-r)+(w-q))+(x-p))))&(p+r)) > (q+r) ; (5)

The example given of an antiunitary map on Hilbert space is the antecedent of Eq 5:

(((p&q)&((((u-s)+(v-p))+(y-q))&(((u-r)+(w-q))+(x-p))))&(p+r)) ; (6)

For the permutations of the six states below, no single transformation as the antecedent serves as a universal state inverter to imply the properties of these consequents:

(p+q)<(r+s) ; (p+r)<(q+s) ; (p+s)<(q+r) ; (7a)
(r+s)<(p+q) ; (q+s)<(p+r) ; (q+r)<(p+s) ;

We rewrite Eqs 7a by substitution of Eqs 2a as:

(t<u) ; (v<w) ; (x<y) ; (7b)
(u<t) ; (w<v) ; (y<x) ;

We ask if any or all of Eqs 7b are validated as Tautologous, that is, are *not* allowed as implied transformations.
This means we test Eqs 7b for each equation as separate and also for all of the equations as combined.

To test Eqs 7b for any equation, we use the Or connective (+) as sum of equations below in Eq 7c:

((((t<u)+(v<w))+((x<y)+(u<t)))+((w<v)+(y<x))) ; (7c)

To test Eqs 7b for all equations, we use the And connective (&) as product of equations below in Eq 7d.

((((t<u)&(v<w))&((x<y)&(u<t)))&((w<v)&(y<x))) ; (7d)

We also note that for Eq 7c, 7d to be complete, we must account for the definitions of variables in Eq 2c. We therefore rewrite Eq 7c, 7d in Eq 7e, 7f below:

((((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w)))&((((p+s)=x)&((q+r)=y))&(((p+q)+(r+s))=z))) &
((((t<u)+(v<w))+((x<y)+(u<t)))+((w<v)+(y<x)))) ; (7e)
((((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w)))&((((p+s)=x)&((q+r)=y))&(((p+q)+(r+s))=z))) &
((((t<u)&(v<w))&((x<y)&(u<t)))&((w<v)&(y<x)))) ; (7f)

Our experiment tests Eqs 7e, 7f for the Truth value of (z=z) in Eqs 8.1,8.2 and Eqs 9.1,9.2.

(z=z) = ((((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w)))&((((p+s)=x)&((q+r)=y))
&(((p+q)+(r+s))=z))) & ((((t<u)+(v<w))+((x<y)+(u<t)))+((w<v)+(y<x)))) ; (8.1)
not validated as tautologous, and contradictory ;

(z=z) > ((((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w)))&((((p+s)=x)&((q+r)=y))
&(((p+q)+(r+s))=z))) & ((((t<u)+(v<w))+((x<y)+(u<t)))+((w<v)+(y<x)))) ; (8.2)
not validated as tautologous, and contradictory ;

(z=z) = ((((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w)))&((((p+s)=x)&((q+r)=y))
&(((p+q)+(r+s))=z))) & ((((t<u)&(v<w))&((x<y)&(u<t)))&((w<v)&(y<x)))) ; (9.1)
not validated as tautologous, and contradictory ;

(z=z) > ((((((p+q)=t)&((r+s)=u))&(((p+r)=v)&((q+s)=w)))&((((p+s)=x)&((q+r)=y))
&(((p+q)+(r+s))=z))) & ((((t<u)&(v<w))&((x<y)&(u<t)))&((w<v)&(y<x)))) ; (9.2)
not validated as tautologous, and contradictory ;

To our question if any or all of Eqs 7b are validated as Tautologous, our answer is no, meaning some or all of Eqs 7b are allowed as transformations. This means that the knowledge based principle, as applied to elementary ontic values and transformations therefrom, is not validated as tautologous.

What follows is that according to the VŁ4 modal propositional logic of Meth8, the Spekken toy model as an epistemic foundation of the quantum model is suspicious.
[*] The CHSH inequality and Bell inequality

1. The CHSI inequality is an acronym for John Clauser, Michael Horne, Abner Shimony, and Richard Holt, and is described at en.wikipedia.org/wiki/CHSH_inequality :

|S| ≤ 2 [= (|S|-1) ≤ 1] where (10)
E = (w-x-y+z)\(w+x+y+z) (11)
S = E(p,q) - E(p,s) +E(r, q) + E(r,s), (12)

LET (|s|-1)≤1) :: (((s-(s\s))=(s\s))+((s-(s\s))<(s\s))) ; (13)
LET E :: u = (((w-x)-(y+z))\((w+x)+(y+z))) ; (14)
LET S :: s = u&(((p&q)-(p&s))+((r&q)+(r&s))) ; (15)

((u=(((w-x)-(y+z))\((w+x)+(y+z))))&(s=(u&(((p&q)-(p&s))+((r&q)+(r&s)))))) >
(((s-(s\s))=(s\s))+((s-(s\s))<(s\s))) ; validated as tautologous (16)

The CHSH inequality is validated as tautologous.

2. The original Bell inequality named after John Stewart Bell is described at en.wikipedia.org/wiki/Bell %27s_theorem :

Ch(a,b) = E(A(a,z),B(b,z)), where z is lower case lambda (17)
[Ch(a,c) - Ch(b,a) - Ch(b,c)] ≤ 1 (18)

LET Ch(a,b) :: (y&(p&z)) = (u&((w&(p&z))&(x&(q&z)))) ; (19)
LET Ch(a,c) :: (y&(p&r)) = (u&((w&(p&z))&(x&(r&z)))) ; (20)
LET Ch(b,c) :: (y&(q&r)) = (u&((w&(q&z))&(x&(r&z)))) ; ` (1)
LET [Ch(a,c) - Ch(b,a) - Ch(b,c)] :: (2)

(((y&(p&z))=(u&((w&(p&z))&(x&(q&z))))) - (((y&(p&r))=(u&((w&(p&z))&(x&(r&z))))) -
((y&(q&r))=(u&((w&(q&z))&(x&(r&z))))))) ; `(23a)

We assign this as its own named definition in Eq 23b, preparing for assignment of inequality in Eq 24:

s = (((y&(p&z))=(u&((w&(p&z))&(x&(q&z))))) - (((y&(p&r))=(u&((w&(p&z))&
(x&(r&z))))) - ((y&(q&r))=(u&((w&(q&z))&(x&(r&z))))))) ; `(23a)

LET s ≤ 1 = ~(s > 1) :: ((s<(s\s))+(s=(s\s))) = ~(s>(s\s)) ; (24)

(((y&(p&z))=(u&((w&(p&z))&(x&(q&z))))) - (((y&(p&r))=(u&((w&(p&z))&(x&(r&z))))) -
((y&(q&r))=(u&((w&(q&z))&(x&(r&z))))))) = ~(s>(s\s))) ; *not* tautologous (25)

Bell's inequality (25) is not validated as tautologous, but it should be validated as tautologous because the CHSH inequality (16) is validated as tautologous as an abstraction of (25).

3. We then test the truth relationship between the CHSH inequality and Bell's inequality.

We ask if the more general CHSH inequality implies the more specific Bell's inequality.

(((u=(((w-x)-(y+z))\((w+x)+(y+z))))&(s=(u&(((p&q)-(p&s))+((r&q)+(r&s)))))) >
((s<((s\s)-(s\s)))>((s&((s\s)-((s\s)-(s\s))))<((s\s)+((s\s)+(s\s)))))) >
((((y&(p&z))=(u&((w&(p&z))&(x&(q&z))))) - (((y&(p&r))=(u&((w&(p&z))&(x&(r&z))))) -

((y&(q&r))=(u&((w&(q&z))&(x&(r&z))))))) = ~(s>(s\s))) ; *not* tautologous ; (26)

The CHSH inequality does not imply Bell's inequality, or vice versa. What follows is that the CHSH inequality and Bell's inequality are not logically related.

This means both inequalities are now suspicious as proofs of Bell's theorem.

This also raises a further, more general doubt that the foundation of quantum mechanics is questionable from the standpoint of system VŁ4.

[**] We note that the term "knowledge balance principle", as defined above at the instant wiki site, was no where else found in the extant quantum literature.

Berkeley's paradox

From: http://lesswrong.com/lw/nr/the_argument_from_common_usage/

"Berkeley's paradox. Tautologically, nobody has ever heard a tree fall that nobody heard. (Planting a tape recorder or radio transmitter and listening to that counts as hearing it.)" (1)

This is rewritten in a simpler format, excluding falling trees, but folding in the caveat of tape recorder:

"No one heard the sound that no one heard: a tape recorder counts as hearing sound." (2)

LET: p hearing person; ~p no hearing person; s sound
~ Not; > Imply (hearing); < Not Imply (not hearing);
vt tautologous; nvt not tautologous

"No person heard the sound of either what no person heard (no tape recorder sound) or what no person did not hear (tape recorder sound)." (3.1)

~p>(s=((~p>s)+(~p<s))) ; nvt (3.2)

```
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
FTFT FTFT TTTT TTTT   UEUE UEUE EEEE EEEE   UEUE UEUE EEEE EEEE   UEUE UEUE EEEE EEEE   UEUE UEUE EEEE EEEE
```

Berkeley's paradox is not tautologous, so it is not a paradox.

The difficulty is in understanding exactly the meaning of the original paradox statements because there are two, and they are linked.

For example, these two logical expressions seem to be equivalent, but Meth8 based on VŁ4 shows they are in fact not:

"No person heard either the sound no person heard or the sound no person did not hear." (4.1)

~p>((~p>s)+(~p<s)) ; vt (4.2)

"No person heard the sound of either the sound no person heard or
he sound no person did not hear." (5.1)

~p>(s=((~p>s)+(~p<s))) ; nvt [Eq 3.2 is the same.] (5.2)

In Eq 4.1 for "heard either the sound" reads in Eq 5.1 "heard the sound of either the sound". Hence Eq 5.1 further clarifies the sound as either that sound heard by no one or that sound not heard by no one.

Refutation of tensor product and Bernstein-Vazirani algorithm

We assume the apparatus and method of Meth8/VŁ4. The designated *proof* value is `T`. Result tables are in row-major and presented horizontally.

1. We initially evaluate the tensor product operation.

From en.wikipedia.org/wiki/Kronecker_product (relation to the abstract tensor product),

> v, w, x, y are vector spaces; linear transformations are s=(v>x) and t=(w>y); and
> the tensor product symbol ⊗ is taken as @, to mean Not Equivalent, the XOR operator.

The abstract tensor product of linear maps is:

((s=(v>x))&(t=(w>y)))>((s@t)=((v@w)>(x@y))) ;
repeating tables as: `TTTT TTTT TTTT TTTT`, ... , `TTTT TTTT FFFF FFFF` (1.2)

By substitution for s and t, we rewrite Eq. 1.2.

(((v>x)@(w>y))>(((v@w)>(x@y)) ; (2.2)

We cast Eq. 2.2 into the four variable version of Meth8/VL4 for the brevity of 16-valued result tables.

LET p q r s: v, w, x, y
((p>r)&(q>s))=((p@q)>(r@s)) ; `TTTF TTFF TFTF TFFT` (3.2)

From Eq. 3.2 as rendered, the tensor product operation is *not* tautologous. This was expected because vector spaces are not bivalent but probabilistic.

2. We next evaluate the Bernstein-Vazirani algorithm in two variables.

From: Krishna, R.; Makwanay, V.; Suresh, A. (2016). "A generalization of Bernstein-Vazirani algorithm to qudit systems". arxiv.org/pdf/1609.03185.pdf

"in a tensor product of two quantum states we are free to associate the sign with whichever state we choose to. $|u\rangle \otimes (-|v\rangle) = -(|u\rangle \otimes |v\rangle) = (-|u\rangle) \otimes |v\rangle$ (4.1)

LET p q: |u⟩ ; |v⟩ ; = Equivalent; @ Not Equivalent; ~ Not

(p@~q) = (~(p@q) = (~p@q)) ; `TFFT TFFT TFFT TFFT` (4.2)

Eq. 4.2 as rendered is *not* tautologous, hence Bernstein-Vazirani is refuted.

Remark: Eq. 4.2 coerces a tautology with the Imply connective: (p@~q)>(~(p@q)=(~p@q)). However, that violates the strength of the Bernstein-Vazirani algorithm as based on the Equivalent connective. The other replacement of the Imply connective does *not* coerce a tautology: ((p@~q)=~(p@q))>(~p@q), with the result table of Eq. 4.2.

Refutation of the Bertrand postulate and Bertrand-Chebyshev theorem

We assume the apparatus and method of Meth8/VŁ4, with the designated proof value of T and truth tables as row-major, horizontally.

From: en.wikipedia.org/wiki/Bertrand%27s_postulate, the Bertrand postulate:

[F]for every n > 1, there is always at least one prime p such that n < p < 2 n. (1.1)

LET: pq pn; (%p>#q) 1; (%p<#q) 2

#(q>(%q>#q)) > %((q<p)&~ (p>((%q<#q)&q))) ; CCCC CCCC CCCC CCCC (1.2)

From: proofwiki.org/wiki/Bertrand-Chebyshev_Theorem, Bertrand-Chebyshev theorem:

For all $n \in N>0$, there exists a prime *number p* with $n<p\leq 2n$. (2.1)

LET: r N; ~(q<p) p≤q

(q<r)>%((q<p)&~(p>((%q<#q)&q))) ; TTCC TTTT TTCC TTTT ; (2.2)

Eqs. 1.2 and 2.2 as rendered are *not* tautologous, meaning both Bertrand expressions are suspicious.

Biscuit conditionals

An example of the biscuit conditional is: There is a biscuit, if you want it. (1)
This can be rephrased as: If you want a biscuit, there is one. (2)

We assume the Meth8 script and apparatus.

LET: p something; % possibly; # necessarily; > Imply; (n)vt (Not) validated as a tautology

We rewrite Eq 2 in an abstract form in modal logic as:

If possibly something, then not necessarily something. (3.1)
%p > ~#p ; nvt ; TCTC TCTC ; (3.2)
[Tautology is a proof value, and Contingency is a not truth value.]

The above is equivalent logically to:

If possibly something, then not possibly necessarily something. (4.1)
%p > ~%#p ; nvt ; TCTC TCTC ; (4.2)

If something, then not necessarily something. (5.1)
p > ~#p ; nvt ; TCTC TCTC ; (5.2)

If all things, then not possibly all things. (6.1)
#p > ~%#p ; nvt ; TCTC TCTC ; (6.2)

If all things, then not necessarily possibly all things. (7.1)
#p > ~#%p ; nvt ; TCTC TCTC ; (7.2)

If all things, then not possibly a thing. (9.1)
#p > ~%p ; nvt ; TCTC TCTC (9.2)

If possibly something, then not necessarily possibly something. (10.1)
%p > ~#%p ; nvt ; NFNF NFNF ; (10.2)
[Non contingent is a truth value, and F is a contradiction value.]

If something, then not possibly something. (11.1)
p > ~%p ; nvt ; TFTF TFTF ; (11.2)

From this exposition, Meth8 does not validate as a tautology the biscuit conditionals.

We also examine some definitions of biscuit conditionals from the literature.

From: Katshuhiko Sano, Yurie Hara. "Conditional independence and biscuit conditional questions in dynamic semantics". 2014. Proceedings of SALT 24: 84-101. at journals.linguisticsociety.org/proceedings/index.php/SALT/article/download/2473/2221

a. The speaker knows the proposition P ([]P, in short) in r if $r \subseteq P$. (8)
b. P is consistent (<>P, in short) in r if $r \cap P \neq 0$.
c. 'if P then Q' holds in r if $r \cap P \subseteq Q$.

LET: p P; q Q; r lower-case omega

~(r>p)>#p ; TTTT FTFT ; (8.1)

((r&p)=~(p-p))>%p ; CTCT CTCT ; (8.2)

~((r&p)>q)>(p>q) ; TTTT TFTT ; (8.3)

(~(r>p)>#p) & ((((r&p)=~(p-p))>%p)&(~((r&p)>q)>(p>q))) ; CTCT FFFT ; (8.4)

[T]he consequent entailment []Q follows from a strict implication 'if P then Q', together with the following independence assumption. (12)

(p>q)>#q ; FTNN FTN ; (12.1)

Meth8 evaluates Eqs 8.1-8.4, and 12.1 to not validated as tautologies.

Bogdanov map as a 2D conjugate to the Hénon map

From mathworld.wolfram.com/BogdanovMap.html :

x' = x + y'; also rewritable as y' = x' - x (21)
y' = y + ey +kx(x-1) + mxy (22)

LET:
x = x; y = y; w = x'; p = e; q = k; r = m; = Equivalent; + Or; (x\x) = 1

(w-x) = ((y+(p&y))+(((q&x)&(x-(x\x)))+((r&x)&y))) ; nvt (23)

Result: the Bogdanov map as a 2D conjugate to the Hénon map is not tautologous.

Proof of the Borsuk-Ulam theorem

The pair of points in antipodal points does not identify the individual point, so this introduces the new terms of podal and contrapodal point as the respective opposing points in a pair of antipodal points.

Using propositional logic in Meth8,

LET:
p point or region on a 2D plane
q podal non-entangled point or region on a 3D sphere;
r contrapodal entangled point or region on a 3D sphere;
& And;
+ Or;
> Imply;
= Equivalent to.

In less words: "A point mapping to both antipodal points implies that point implies either of the antipodal points."

This effectively defines a point as mapping to both antipodal points which implies that point in turn implies mapping to either antipodal point.

(p=(q&r)) > (p>(q+r)) ; tautologous.

In more words: "If a point on a 2D plane is equivalent on a 3D sphere to both a podal point and a contrapodal point, then a point on a 2D plane implies either a podal point or a contrapodal point on a 3D sphere."

Truth tables are rows 1 and 2 of 4, as repeated:

	Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
q	FFTT FFTT	UUEE UUEE	UUEE UUEE	UUEE UUEE	UUEE UUEE
r	FFFF TTTT	UUUU EEEE	UUUU EEEE	UUUU EEEE	UUUU EEEE
p	FTFT FTFT	UEUE UEUE	UEUE UEUE	UEUE UEUE	UEUE UEUE
(q&r)	FFFF FFTT	UUUU UUEE	UUUU UUEE	UUUU UUEE	UUUU UUEE
(q+r)	FFTT TTTT	UUEE EEEE	UUEE EEEE	UUEE EEEE	UUEE EEEE
(p=(q&r))	TFTF TFFT	EUEU EUUE	EUEU EUUE	EUEU EUUE	EUEU EUUE
(p>(q+r))	TFTT TTTT	EUEE EEEE	EUEE EEEE	EUEE EEEE	EUEE EEEE
(p=(q&r))>(p>(q+r))	TTTT TTTT	EEEE EEEE	EEEE EEEE	EEEE EEEE	EEEE EEEE
	Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

Borsuk-Ulam theorem: extensible, non-invertive general case

LET: D dimension; T tautology; F contradiction;

We assume the Meth8 apparatus, and previously:

p point or region on a 2D plane
q podal non-entangled point or region on a 3D sphere;
r contrapodal entangled point or region on a 3D sphere;
& And;
+ Or;
> Imply;
= Equivalent to.

In less words: "A point mapping to both antipodal points implies that point implies either of the antipodal points."

1. We ask, Do the n D points in the antecedent cascade into the next dimension as n+1 D points. In other words, Is the Borsuk-Ulam theorem (BUT) extensible in the general case?

(p=(q&r)) > (p>(q+r)) ; TTTT (1)

We answer, Yes. Eq 1 is BUT from our previous paper and extensible from n=2 to 3 D.

2. We ask, Do the n+1 D points in the consequent cascade as well as points into the next n+2 D. In other words, Is BUT subsequently extensible in a general case?

((p=(q&r))>(p>(q+r))) > (((q=(s&t))>(q>(s+t))) & ((r=(u&v)>(r>(u+v)))) ; TTTT (2)

We answer, Yes.

3. We ask, Do the four points of q,r,s,t,u,v in the n+2 D logically point backward to any points in the n or n+1 Ds of p,q,r? In other words, is BUT reversible in the general case?

(((p=(q&r))>(p>(q+r)))>(((q=(s&t))>(q>(s+t)))&((r=(u&v))>(r>(u+v)))))
> ((((u&v)&(s&t)) & (q&r))>p) ; TTFT (3)

We answer, No. In other words, BUT is non-invertive in the general case.

3.1. However, for the *specific* cases of r=~q, t=~s, and v=~u [taken from the bijection of f(+x)=f(-x) for f as a homeomorphism],we can force BUT to be reversible, that is, coerce BUT to be invertive.

(((p=(q&~q))>(p>(q+~q)))>(((q=(s&~s))>(q>(s+~s)))&((~q=(u&~u))>(~q>(u+~u)))))
> ((((u&~u)&(s&~s)) & (q&~q))>p) ; TTTT (3.1)

It is incumbent upon the practitioner to acknowledge this distinction clearly when implementing BUT.

4. Implications

Because BUT is non-invertive in the general case, these questions follow.

4.1. We ask, If a working model of consciousness follows BUT, then is consciousness state reversible exactly to a previous state?

We propose this answer, No because of the proof of Eq 3. For example, can the glow of the first glass of wine ever consumed be replicated exactly, and we think not.

4.2. We ask, If a previous consciousness state cannot be replicated exactly, then is the previous conscious state effectively lost as a result of the one way trip planned by BUT?

We propose this answer, Yes the previous state is not exactly retrievable and hence abandoned.

4.3. We ask, If BUT means no state is reproducible, does this mean the flow of time cannot be reversed.

We answer, Yes, and hence BUT is the only plausible explanation of conscious states in the flow of time, implying consciousness is a one way trip without an exact turning back.

4.4. We ask, If BUT is non-invertive, what does this mean in terms of mathematical logic?

We answer, It means only bi-valent logic is capable of the proof of Eq 3, and further that conscious states are provably bi-valent.

4.5. We ask, If BUT means conscious states are bi-valent, can metaphysical assertions be conscious states and hence reduced to physicalistic conjectures subject to refutation by verification and falsification?

We answer, Yes, and further that the moral imperative of "I ought to …", invoking conscience, is a physicalistic conjecture and hence BUT in Eq 1 is a potential proof of God, who cannot tell a lie.

Branching quantifier

From en.wikipedia.org/wiki/Branching_quantifier, the FOL capture of Hintikka's natural language sentence to demonstrate branching is:

$[\forall x1 \; \exists y1 \; \forall x2 \; \exists y2 \; \phi (x1 , x2 , y1 , y2)] \wedge [\forall x2 \; \exists y2 \; \forall x1 \; \exists y1 \; \phi (x1 , x2 , y1 , 2)]$ (1.1)
where
$\phi (x1 , x2 , y1 , y2)$ (2.1)
denotes
$(V (x1) \wedge T (x2)) \rightarrow (R (x1 , y1) \wedge R (x2 , y2) \wedge H (y1 , y2) \wedge H (y2 , y1))$ (3.1)

LET: p ϕ; q ; r R; s ; t T; u H ; v V; w x2; x x1; y y1; z y2; # $\forall$; $\exists$ %; nvt not tautologous;

Designated truth value is T Tautology (proof), with C Contingent (falsity),
N Non contingent (truth), and F for contradiction (absurdum).

(#x&(%y&(#w&(%z&(p&(x&(w&(y&z)))))))) & (#w&(%z&(#x&(p&(x&(w&(y&z))))))) ; (1.2)

(p&(x&(w&(y&z)))) ; (2.2)

((v&x)&(t&w)) > (((r&(x&y))&(r&(w&z)))&((u&(y&z))&(u&(z&y)))) ; (3.2)

For the conjecture as If Eq 2.1 is equivalent to Eq 3.1, then Eq 1.1 as: (4.1)

((p&(x&(w&(y&z))))=(((v&x)&(t&w))>(((r&(x&y))&(r&(w&z)))&((u&(y&z))&(u&(z&y)))))) > ((#x&(%y&(#w&(%z&(p&(x&(w&(y&z))))))))&(#w&(%z&(#x&(p&(x&(w&(y&z)))))))) ; nvt (4.2)

In Model 1, fragments of repeating truth tables are:

```
FFFF FFFF FFFF FFFF
TTTT TTTT TTTT TTTT
TNTN TNTN TNTN TNTN
FTFT FTFT FTFT FTFT
FTFT TNTN FTFT TNTN
```

Meth8 finds Eq 4.2 nvt, hence invalidating the conjecture of Eq 4.1 (composed of Eqs 1.1, 2.1, and 3.1).

Weakening the conjecture with "denotes" to mean "implies" also results with nvt and these truth table fragments:

```
FFFF FFFF FFFF FFFF
FTFT FTFT FTFT FTFT
FNFN FNFN FNFN FNFN
FTFT FNFN FTFT FNFN
```

Buridan's Ass paradox

Donkey's are known to eat only the food stuff nearest to them. Buridan's paradox states that a donkey with two food sources at equal distances chooses neither and starves. (1)

(1)

LET: p Left hay; q Donkey; r Right hay

(p < q) < r)	Positions from left to right of left hay, the donkey, and right hay
(q-p), (r-q)	Distance to hay on either side of the donkey
(u = (q&p))	Donkey eats right hay
(v = (q&r))	Donkey eats left hay

If the position of the left hay is less than the position of the donkey is less than the position of the right hay and the hay distance from the donkey is the same on the left and right sides, then the donkey eating hay left hay and right hay implies the donkey does "not eat either the left or right hay". (2)

$$(((p<q)<r)\&((q-p)=(r-q)))>(((u=(q\&p))\&(v=(q\&r)))>\ \sim(u+v)) \ ;\ vt \qquad (3)$$

Now we write Assertion 2 with the ending connective and consequent as implies the donkey does not "not eat either the left or right hay". (4)

$$(((p<q)<r)\&((q-p)=(r-q)))>(((u=(q\&p))\&(v=(q\&r)))>\sim\sim(u+v)) \ ;\ vt \qquad (5)$$

At first appearance, Eq 3 tautologous is contradicted by Eq 4 also tautologous.

We test this by including both the ending consequent expressions to rewrite as And or Or, for: implies the donkey "does eat and/or does not eat either the left or right hay". (6), (7)

$$(((p<q)<r)\&((q-p)=(r-q)))>(((u=(q\&p))\&(v=(q\&r)))>((u+v)\&\sim(u+v))) \ ;\ vt \qquad (8)$$

$$(((p<q)<r)\&((q-p)=(r-q)))>(((u=(q\&p))\&(v=(q\&r)))>((u+v)+\sim(u+v))) \ ;\ vt \qquad (9)$$

Therefore the donkey eating and not eating reduces as a choice to tautologous, and the donkey eating or not eating reduces as a choice to tautologous. In other words, the donkey can logically choose to eat and not eat as a tautologous choice. This means the paradox of Buridan's donkey is not a paradox of the donkey unable to eat, but is a theorem of the donkey able to eat or not to eat *if it wants to eat*.

Refutation of Cantor's original continuum hypothesis via injection and binary trees

From: Pindsle, C. (2018). "The continuum hypothesis". vixra.org/pdf/1803.0088v1.pdf

Note: Because of no email contact disclosed at that venue, that author's name is likely a pseudonym.

> "[With representation using binary trees: the intention was] to prove the hypothesis in its original form as proposed by Georg Cantor in 1878: Any uncountable set of real numbers is equinumerous with ℝ. Since there is a bijection between the open interval (0,1) and the set of all the real numbers, there is a bijection between any subset of (0,1) and a subset of ℝ. Therefore it is sufficient to prove: Any uncountable subset of (0,1) is equinumerous with ℝ."

$\phi : RJ \longmapsto RJT$ *is bijective:* It is injective because:
$\phi(r1) = \phi(r2) \Rightarrow (\phi(r1) \succ \phi(r2) \text{ and } \phi(r2) \succ \phi(r1)) \Rightarrow (r1 \succ r2 \text{ and } r2 \succ r1) \Rightarrow r1 = r2$ (3.5.1.)

Because the intention of the proof is to show $\phi(r1) = \phi(r2) \Rightarrow \ldots\ldots \Rightarrow r1 = r2$, we rewrite Eq. 3.5.1.

$\phi(r1) = \phi(r2) \Rightarrow r1 = r2$ (3.5.1.1)

We assume the apparatus and method of Meth8/VŁ4 with designated *proof* value `T`, and contradiction value `F`. The 16-valued result table is row-major and presented horizontally.

LET p q r: *ϕ,* lc_phi; r1; r2; & And; > Imply, ≻, ⇒; = Equivalent to.

((p&q)=(p&r))>(q=r) ; `TTFT FTTT TTFT FTTT` (3.5.1.2)

Eq. 3.5.1.2 as rendered is *not* tautologous. Hence, the hypothesis as Eq. 3.5.1.1 fails.

This is the briefest known such refutation of Cantor's continuum conjecture.

Remark: To coerce Eq. 3.5.1.2 into tautology, we weaken the argument by replacing the Equivalent connective with the Imply connective.

((p&q)>(p&r))>(q>r) ; `TTFT TTTT TTFT TTTT` (3.5.1.3)

Eq. 3.5.1.3 does come closer to tautology with two less contradiction `F` values, but to no avail.

Refutation of Cantor's diagonal argument

From: en.wikipedia.org/wiki/Cantor%27s_diagonal_argument

"A generalized form of the diagonal argument was used by Cantor to prove Cantor's theorem: for every set *S*, the power set of *S*—that is, the set of all subsets of *S* (here written as ***P***(*S*))—has a larger cardinality than *S* itself. This proof proceeds as follows: Let *f* be any function from *S* to ***P***(*S*). It suffices to prove *f* cannot be surjective. That means that some member *T* of ***P***(*S*), i.e. some subset of *S*, is not in the image of *f*. As a candidate consider the set:

$T = \{ s \in S : s \notin f(s) \}$. [0.1]

For every *s* in *S*, either *s* is in *T* or not. If *s* is in *T*, then by definition of *T*, *s* is not in *f*(*s*), so *T* is not equal to *f*(*s*). [1.1]

On the other hand, if *s* is not in *T*, then by definition of *T*, *s* is in *f*(*s*), so again *T* is not equal to *f*(*s*) ..." [2.1]

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply, ∈; = Equivalent to; @ Not equivalent to; # all, every; % some, each; pqrs fTSs; *s*∉*f*(*s*) ~(*s*>*f*(*s*))

Results are the repeating proof table(s) of 16-values in row major horizontally.

q=((s<r)>~(s<(p&s))) ; `FFTT FFTT TFFT FFTT` (0.2)

(q=((s<r)>~(s<(p&s))))>(((#s<r)>((s<q)>~(s>(p&s))))>(q@(p&s))) ;
`TTTT TTTT FTTF TTTF` (1.2)

(q=((s<r)>~(s<(p&s))))>((~(#s<r)>((s<q)> (s>(p&s))))>(q@(p&s))) ;
`TTTT TTTT CTTF TTTF` (2.2)

Because Eqs. 1.2 and 2.2 result in the same consequent, they are rewritten to remove respective common terms and set as an equivalence according to Eqs. [1.1] and [2.1].

((#s<r)>((s<q)>~(s>(p&s)))) = (~(#s<r)>((s<q)> (s>(p&s)))) ;
`TTTT TTTT NCTT FTTT` (3.2)

Eqs. 1.2 and 2.2 as rendered are *not* tautologous. Hence Cantor's diagonal argument is not supported.

Refutation of Cantor's pairing function:

Recall Cantor's pairing function as a functor designation of

$$c(x,y) \;=\; (\,(1\,/2)*\,(x+y)*(\,x+y+1))+y. \qquad (1)$$

This is rewritten with spaces so as to map to Meth8 script for propositions (LET p=c, q=x, r=y) and for theorems (LET A=c, B=x, C=y) with 01 as (%p>%#p):

```
(c (x,y)  = ( (   1    /         2          ) *  (x+y)*(  x+y +   1   )) + y.
                                                                          (2a)
(p&(q&r)) = ( ((%p>%#p)\((%p>%#p)+(%p>%#p))) & ((q+r)&(((q+r)+(%q>%#q)) + r))) ;
                                               TTNN NNNC TTNN NNNC        (2b)
```

Should we replace the main connective in 2b from equivalent to "=" with imply ">"

```
(p&(q&r)) > ( ((p\p)\((p\p)+(p\p))) & ((p+q)&(((p+q)+(p\p)) + q))) ;
                                               TTTT TTTC TTTT TTTC        (3b)
```

then Eq. 2b fares slightly better toward tautology, but still not tautologous.

This leads us to consider that Cantor's pairing function is not an equivalency and hence suspicious.

Category composition of morphisms

From en.wikipedia.org/wiki/Category_theory, en.wikipedia.org/wiki/Glossary_of_category_theory:

The binary operation, named composition of morphisms, is defined :

If f: a → b, g: b → c are functors, then the composition g ∘ f is the functor defined by:

for an object x and a morphism y in a as

$$(g \circ f)(x) = g(f(x)) \text{ and } (g \circ f)(y) = g(f(y)) \qquad (1.1)$$

Meth8 maps Eq 1 as

LET: p a; q b; r c; u f; v g; s x; t y;
> Imply →; ∘ And &; = Equivalent to =; nvt not tautologous.

We rewrite Eq 1 components as If u: p > q and v: q > r, then v & u is equivalent to ... :

((u=(p>q)) & (v=(q>r))) > ((u&v) = ((((v&u)&s)=(v&(u&s))) & (((v&u)&t)=(v&(u&t))))) ; nvt; (1.2)

The repeating truth table fragment for Model 1 is TFTT TTTT, where T is the designated truth value.

Eq 1.2 is not tautologous, thereby rendering category theory as not tautologous.

Refutation of Chaitin's theorem of incompleteness

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to;
@ Not equivalent to; # all; % some; (p@p) 00, zero; (p=p) 11, one;
pqrs KLns

Results are the proof table of 16-values in row major horizontally.

We evaluate Chaitin's incompleteness theorem of 1974 from

wikipedia.org/wiki/Kolmogorov_complexity#Chaitin.27s_incompleteness_theorem .

Martin Davis described it as "*a dramatic extension of Gödel's incompleteness theorem*" (Davis, 1978).

"Theorem: There exists a constant L ... such that there does not exist a string s for which the statement

(K(s) ≥ L) (as formalized in S) [This is equivalent to ~(K(s) < L).] (0.1)

can be proven within the axiomatic system S. Note that, by the abundance of nearly incompressible strings, the vast majority of those statements must be true. (1.1)

The proof is by contradiction. It the theorem were false [not a proof] then the following is a proof [tautology]:

Assumption (X): For any integer n there exists a string s for which there is a proof in [logic system] S of the expression "(K(s)≥ L)". (S is assumed to enumerate all formals proofs of S.) (2.1)

We render Eq. 0.1 as:

~((p&s)<q) ; `TTTT TTTT TFTT TFTT` (0.2)

Eq. 0.2 means that "~(K(s)<L) (as formalized in S)" is already not a proof (not a tautology) but is also is not a contradiction because the F value of contradiction is mixed twice into the resulting proof table.

Remark: Eq. 0.2 implies that Chaitin's constant L is suspicious.

We render Eq. 1.1 as:

%q>((~((p&s)<q)=(s=s))>~%s) ; NNNN NNNN NTFF NTFF (1.2)

Eq. 1.2 means the theorem is not a tautology, and *not* a contradiction, with the proof table of a mixture of values for F, N, and T.

The refutation of the theorem could end here, however for to be comprehensive we continue the approach of the argument and render Eq. 2.1 as:

#r&(%s>(~((p&s)<r)>(s=s))) ; FFFF NNNN FFFF NNNN (2.2)

Eq. 1.2 means that Assumption (X) is not a contradiction because of the N value of truth mixed into the resulting proof table.

In an attempt to resuscitate Eq. 1.2, we rewrite it by distributing the universal quantifier over the antecedent and consequent as:

(#r&%s) > (#r&(~((p&s)<r)>(s=s))) ; TTTT TTTT TTTT TTTT (2.3)

In this case, Eq. 2.3 shows Assumption(X) is a proof, and therefore Eq. 1.1 should be a contradiction. However, we already showed Eq. 1.2 is *not* a contradiction, but rather contains some T value of tautology mixed with some F value of contradiction.

In either case of Eq. 0.2 with Eq. 2.2 or with Eq. 2.3, the approach of the conjecture is moot, and Chaitin's theorem of incompleteness is refuted.

Reference:

Davis, M. (1978). “What is a computation?”. Steen, L.A. (ed.) Mathematics Today, Twelve informal essays. Springer. 1978. pp. 241/267. DOI: 10.1007/978-1-4613-9435-8_10.

The Brain Simulator Reply (BSR) of the Chinese Room Argument (CRA) is confirmed.

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to;
@ Not equivalent to; # all; % some; (p@p) 00, zero; (p=p) 11, one

Results are the repeating proof table(s) of 16-values in row major horizontally.

From: plato.stanford.edu/entries/chinese-room by dcole@d.umn.edu (2014)

"Brain Simulator Reply. ... Searle correctly notes that one cannot infer from *X* simulates *Y*, and *Y* has property *P*, to the conclusion that therefore *X* has *Y*'s property *P* for arbitrary *P*. [1.1]

But ... Searle ... commits the simulation fallacy in extending the CR argument from traditional AI to apply against computationalism. The contrapositive of the inference is logically equivalent—*X* simulates *Y*, *X* does not have *P* therefore *Y* does not [have P]" [2.1]

We map Eqs. 1.2 and 2.1 as follows.

LET: p q r P X Y

((q>r)&(r>p))>(q>(r>p)) ; TTTT TTTT TTTT TTTT (1.2.1)
((q>r)&(r>p))>(q>(r&p)) ; TTTT TTTT TTTT TTTT (1.2.2)

Eqs. 1.2.1 and variant 1.2.2 are tautologous, contradicting the conjecture of [1.1].

((q>r)&(q>~p))>(r>~p) ; TTTT TFTT TTTT TFTT (2.1)

Eq. 2.1 is not tautologous, contradicting [2.1] as logically equivalent to [1.1].

The Brain Simulator Reply of the Chinese room argument is hence confirmed and validated.

Church's thesis (constructive mathematics)

From: en.wikipedia.org/wiki/Church%27s_thesis_(constructive_mathematics)

Formal statement:

(∀x ∃y ϕ (x , y)) → (∃e ∀x ∃y , u T (e , x , y , u) ∧ϕ (x , y)) . (1)

LET: # ∀, % ∃, r y, s ϕ, p x, q ψ , e r, t f, u u, v T

((#p&%q)&(s&(p&q)))>((%r&(#p&%q))&((u&(v&(r&(p&(q&u)))))&(s&(p&q)))); nvt (2)

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTC TTTC  EEEE EEEE EEEU EEEU  EEEE EEEE EEEE EEEE  EEEE EEEE EEEP EEEP  EEEE EEEE EEEI EEEI
TTTT TTTT TTTC TTTC  EEEE EEEE EEEU EEEU  EEEE EEEE EEEE EEEE  EEEE EEEE EEEP EEEP  EEEE EEEE EEEI EEEI
TTTT TTTT TTTC TTTC  EEEE EEEE EEEU EEEU  EEEE EEEE EEEE EEEE  EEEE EEEE EEEP EEEP  EEEE EEEE EEEI EEEI
TTTT TTTT TTTC TTTT  EEEE EEEE EEEU EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEP EEEE  EEEE EEEE EEEI EEEE
```

Result: Church Thesis (1) is not tautologous .

Extended Church thesis (ECT):

(∀x ψ (x) → ∃y ϕ (x , y)) → ∃f (∀x ψ (x) → ∃y , u T (f , x , y , u) ∧ϕ (x , y)) . (3)

((#p&(q&p))>(%r&(s&(p&r))))>(%t&((#p&(q&p))>(%r&((u&(v&(t&(p&(r&u)))))
&(s&(p&r)))))) ; nvt (4)

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
CCCT CCCT CCCT CCCC  UUUE UUUE UUUE UUUU  EEEE EEEE EEEE EEEE  PPPE PPPE PPPE PPPP  IIIE IIIE IIIE IIII
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
```

Result: Extended Church Thesis (2) is not tautologous.

The definition for generalized Clifford tori in even-dimensional Euclidean space with complex coordinates for unit spheres is tautologous.

From: en.wikipedia.org/wiki/Clifford_torus

> Any unit sphere S^{2n-1} in an even-dimensional euclidean space $\mathbf{R}^{2n} = \mathbb{C}^n$ may be expressed in terms of the complex coordinates as follows:
>
> $$S^{2n-1} = \{ (z_1 , \ldots , z_n) \in C^n : |z_1|^2+ \ldots +|z_n|^2 = 1 \} . \quad (1)$$

1.1 We ask: "Is the set denoted in Eq 1 compatible as a subset of the formula defined?"

We assume the Meth8 apparatus and method, and designated truth values as `T`autologous, `E`valuated.

LET: p q r s (z_1 , … , z_4), ∈ <
(%p>#p) 1, ((%p>#p)-(%p>#p)) 0

If Eq 1 is followed in order, where the C^n term can be ignored for our purposes, then the z-element series term is a subset of the the z-power series term:

((p&q)&(r&s))<(((p+q)+(r+s))=(%p>#p)) ; `FFFF FFFF FFFF FFFC` (2)

Because the truth table for Eq. 2 diverges slightly from contradictory, we rewrite Eq 1 to juxtapose the terms so that the z-power series is now the superset of the z-element series:

(((p+q)+(r+s))=(%p>#p))>((p&q)&(r&s)) ; `NCCC CCC CCC CCCT` (3)

1.2 We answer 1.1: "No, both Eqs. 1 and 2 are not tautologous."

2.1 We then ask: "Is the definition in Eq 2 tautologous when the degenerate case of the radius of 0 is included?"

(((p+q)+(r+s))&(((%p>#p)-(%p>#p))=(%p>#p)))>((p&q)&(r&s)) ;
`TTTTT TTTT TTTT TTTT` (4)

2.2 We then answer: "The definition as modified in Eq 4 is tautologous." This confirms the definition with a degenerate radius of 0 in Eq 4.

We are reminded this is for even-dimensional Euclidean space. In other words the validated dimensions are [D0], D2, D4 but not D1, D3, D5. This means for the Clifford tori to be a model for the brain requires 2D or 4D, but not 3D or 5D. Because 4D can be explained as the assumption of 3D with the addition of time as a dimension to make 3D into 4D, we believe that assumption is mistaken.

What follows is a 2D Clifford torus becomes flattened to a plane, and hence effectively a network of linear spaces. Therefore a series of such flat tori with intersections may constitute the brain model.

By extension from the standpoint of the Kanban cell neuron model network, this means the linear formula ((p'&q')+r')=s' then feeds a subsequent linear formula as ((s'&q")+r")=s" in a network of linear formulas.

3.1 We now ask: "Is the Kanban cell neuron model based on the AND-OR gate correct, as rendered with 14 self-filtering and self-timing values not equal to zero in Table 1 (from US Patent No. 9,501,737 and No. 9,202,16)?"

<table>
<tr><th>Connective No.</th><th>((ii</th><th>& pp)</th><th>| qq)</th><th>= kk</th></tr>
<tr><td>091</td><td>01</td><td>01</td><td>10</td><td>11</td></tr>
<tr><td>095</td><td>01</td><td>01</td><td>11</td><td>11</td></tr>
<tr><td>106</td><td>01</td><td>10</td><td>10</td><td>10</td></tr>
<tr><td>111</td><td>01</td><td>10</td><td>11</td><td>11</td></tr>
<tr><td>123</td><td>01</td><td>11</td><td>10</td><td>11</td></tr>
<tr><td>127</td><td>01</td><td>11</td><td>11</td><td>11</td></tr>
<tr><td>149</td><td>10</td><td>01</td><td>01</td><td>01</td></tr>
<tr><td>159</td><td>10</td><td>01</td><td>11</td><td>11</td></tr>
<tr><td>167</td><td>10</td><td>10</td><td>01</td><td>11</td></tr>
<tr><td>175</td><td>10</td><td>10</td><td>11</td><td>11</td></tr>
<tr><td>183</td><td>10</td><td>11</td><td>01</td><td>11</td></tr>
<tr><td>191</td><td>10</td><td>11</td><td>11</td><td>11</td></tr>
<tr><td>213</td><td>11</td><td>01</td><td>01</td><td>01</td></tr>
<tr><td>234</td><td>11</td><td>10</td><td>10</td><td>10</td></tr>
</table>

Table 1

In Table 1, the "Connective No." is the decimal representation of the bits as concatenated and indexes a canonical table of 256 connectives based on 8-bits in our literature.

The expression we test is "If ii, pp, qq, or kk are not 00, then (ii * pp) + qq = kk." (5)

LET: p q r s ii pp qq kk, + |, p=(p@p) p=00, q=(q@q) q=00, r=(r@r) r=00, s=(s@s) s=00

Eq. 5 may be written equivalently in two ways with the same truth tables:

~(((s=(s@s))+(r=(r@r)))+((p=(p@p))+(q=(q@q))))>(((p&q)+r)=s) ;
TTTTT TTTT TTTT TTTT (6)

~(((s&r)&(p&q))=(((s@s)&(r@r))&((p@p)&(q@q))))>(((p&q)+r)=s) ;
TTTTT TTTT TTTT TTTT (7)

3.2 We now answer 3.1: "The Kanban model is correct as stated above."

This means the Kanban model in Eq 6, 7 is consistent with the 2D Clifford torus in Eq 4.

(Lothar) Collatz conjecture in one variable confirmed as tautologous

From: blogs.ams.org/matheducation/2015/05/01/famous-unsolved-math-problems-as-homework/

> Given a positive integer n, if it is even, calculate n/2, otherwise if
> it is odd then calculate 3n+1; repeat this process with the resulting value. (1.1)

We assume the apparatus and method of Meth8/VŁ4 modal logic model checker. Meth8 allows to mix four logical values with four analytical values. The designated *proof* value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truthity	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or, addition; - Not Or, subtraction; & And, multiplication;
\ Not And, division; > Imply greater than; < Not Imply, less than;
= Equivalent; @ Not Equivalent; # necessity, for all; % possibility, for one or some.

The proof table in 16-values in row-major and presented horizontally.

(p>(p@p))>(((p=(%p<#p))>(p\(%p<#p)))+((p=(%p>#p))>((p&(p=p))+(%p>#p)))) ;
TTTT TTTT TTTT TTTT (1.2)

A more elaborate alternative proof uses two ordinal values as {0,1} to derive the four {3,0,1,2} and explicitly tests arity results based on 0 for even or 1 for odd, with iteration specified by the universal operator as applied to the single variable p in the antecedent.

p > zero, as tautologous: (p>((%p>#p)-(%p>#p))) = (r=r); TCTC TCTC TCTC TCTC (1.3.1)

p = even, as tautologous: ((((p-(p\(%p<#p)))&(%p<#p))=((%p>#p)-(%p>#p)))
>(p=(p\(%p<#p)))) = (r=r); CTCT CTCT CTCT CTCT (1.3.2)

p = odd, as tautologous: (~(((p-(p\(%p<#p)))&(%p<#p))=((%p>#p)-(%p>#p)))
>(p=((%p>#p)+(p&((%p>#p)+(%p<#p)))))) = (r=r) ; TTTT TTTT TTTT TTTT (1.3.3)

all instances of p > zero: #(p>((%p>#p)-(%p>#p))) > (((((p-(p\(%p<#p)))&(%p<#p))
=((%p>#p)-(%p>#p)))>(p=(p\(%p<#p)))) + (~(((p-(p\(%p<#p)))&(%p<#p))=((%p>#p)-
(%p>#p)))>(p=((%p>#p)+(p&((%p>#p)+(%p<#p))))))) ; TTTT TTTT TTTT TTTT (1.3.4)

Eq. 1.2 or 1.3.5 as rendered show the conjecture is confirmed as tautologous.

Meth8/VŁ4 on complex numbers (ℂ)

Complex numbers (ℂ) are generally defined by a component of the imaginary number as *i*^2 = (-*i**-*i*) = (*i***i*) = -1, where *i* = ± (-1)^0.5 .

We assume the apparatus and method of Meth8/VŁ4, where the designated proof value is `T`.

LET p = + (-1)^0.5; ~p = - (-1)^0.5; & And; + Or; = Equivalent to; > Imply.

(p&~p)= p ;	`TFTF TFTF TFTF TFTF`	(0.1)
(p&~p)=~p ;	`FTFT FTFT FTFT FTFT`	(0.2)
((p&~p)= p)+ ((p&~p)=~p) ;	`TTTT TTTT TTTT TTTT`	(0.1+0.2)

The complex number work-around is to abandon the connective Equivalent to as above and to use the Imply connective as below, where the consequent in the antecedent is the consequent of the literal as in Eqs. 2 and 3.

(p>~p)> p ;	`FTFT FTFT FTFT FTFT`	(1)
(p>~p)>~p ;	`TTTT TTTT TTTT TTTT`	(2)
(~p> p)> p ;	`TTTT TTTT TTTT TTTT`	(3)
(~p> p)>~p ;	`TFTF TFTF TFTF TFTF`	(4)
((p>~p)> p)+ ((~p> p)>~p) ;	`TTTT TTTT TTTT TTTT`	(1+4)
((p>~p)>~p)+ ((~p> p)> p) ;	`TTTT TTTT TTTT TTTT`	(2+3)
((p>~p)>~p)& ((~p> p)> p) ;	`TTTT TTTT TTTT TTTT`	(2&3)

Eqs. (1+4)=(2+3)=(2&3).

This means Meth8/VŁ4 maps complex numbers (ℂ) using implication and not equivalence which serves to reason since complex numbers are imaginary and not real.

Constructivistic logic

Badie, F. A theoretical model for meaning construction through constructivist concept learning . 2017. From: researchgate.net/publication/318430404 .

We evaluate constructivistic logic using two papers at the page numbers of the dissertation text.

We assume the apparatus of M8-VL4.

LET: p ai, m; q A,lc_L; r R, mentor(l); s aj, learner(m); t MentorOf(m,l); u LearnerOf(l,m);
x constant; y function; z R; # universal quantifier; % existential quantifier

Fragments are the repeating truth tables of 16-values, of 128 tables.

In *A conceptual mirror: towards a reflectional symmetrical relation between mentor and learner*:

"Formally:"
(#p<q)>((p&r)&p) ; TCTT TTTT TCTT TTTT pg 95
((#p<q)>((p&r)&s)) > ((%s<q)>((s&r)&p)) ; NNTT NNTT FNTT FTTT pg 96

In *Towards semantic analysis of mentoring-learning relationships within constructivist interactions*.

t ; FFFF FFFF FFFF FFFF, TTTT TTTT TTTT TTTT (i), pg 188
r ; FFFF TTTT FFFF TTTT, FFFF TTTT FFFF TTTT (ii)
t>r ; TTTT TTTT TTTT TTTT, FFFF TTTT FFFF TTTT (i) > (ii)
r=p ; TFTF FTFT TFTF FTFT, TFTF FTFT TFTF FTFT (iii)
p=r ; TFTF FTFT TFTF FTFT, TFTF FTFT TFTF FTFT (iv)
(r=p)>((r>p)&(p>r)) ; TTTT TTTT TTTT TTTT, TTTT TTTT TTTT TTTT (v), pg 189
(x>y)&(y>x) ; TTTT TTTT TTTT TTTT, TTTT TTTT TTTT TTTT (vi)
t=((r>p)&(p>r)) ; FTFT TFTF FTFT TFTF, TFTF FTFT TFTF FTFT (vii)
(t>((r>p)&(p>r)))&(((r>p)&(p>r))>t) ;
FTFT TFTF FTFT TFTF, TFTF FTFT TFTF FTFT (viii)
(z>((y>x)&(x>y)))&(((x>y)&(y>x))>z) ;
FFFF FFFF FFFF FFFF, TTTT TTTT TTTT TTTT
16*F, 32*T, 16*F, 16*T, 32*F, 16*T = 128 tables ; (ix)
[(viii) is not structurally equivalent to (ix)]
t>((r>p)&(p>r)) ; TTTT TTTT TTTT TTTT, TFTF FTFT TFTF FTFT (x), pg 190
u>((s>q)&(q>s)) ; TTTT TTTT TTTT TTTT, TTFF TTFF FFTT FFTT (xi)
((r>p)&(p>r))>t ; FTFT TFTF FTFT TFTT, TTTT TTTT TTTT TTTT (xii)
((s>q)&(q>s))>u ; FFTT FFTT TTFF TTFF, TTTT TTTT TTTT TTTT (xiii)

As rendered, 14-expressions are *not* tautologous, therefore constructivistic logic is suspicious.

Creative theories in degrees of unsolvability

Solomon Feferman. "Degrees of unsolvability associated with classes of formalized theories." Journal of symbolic logic. v 22, n 2, June 1957. pg 169

[The unnumbered equation at top of the page cannot be rendered due to image adulteration enforced by jstor.org and aslonline.org.]

LET: # inverted upper case V; y y; x upper case Phi; v V-sub upper case Tau; & And;
w upper case Delta sub p; % upper case V; z z; < lower case epsilon, Not imply; > Imply

(#y&(((x&v)&(w&y)) > ((v&z)&(~(z>y)&((x&y)&(w&z)))))) < v ;
FFFF FFFF FFFF FFFF; NNNN NNNN NNNN NNNN ; (1)

Eq 1 is not validated as tautology by Meth8, meaning the degrees of unsolvability are not finitely axiomizable.

Analysis of ultrafilter D equations by Meth8 logic model checker

From:

Aleksandar Jovanovic, Aleksandar Perović (2007.01), "Contrapunctus of the continuum problem and the measure problem", *Publications de l Institut Mathematique* 01/2007(82(96)):83 - 91.

An ultrafilter D over infinite cardinal κ is:

weakly normal, if each function f:κ−→κ such that [we read *κ−→κ* as *κ→κ*] (1.1)

(f&(k>k)) (1.2)

{α∈κ|f(α)< α}∈D (2.1)

(((a<k)+((f&a)<a))<D) (2.2)

is bounded by some constant in ∏D 〈κ, <〉 , i.e. there is β∈κ (3.1)

(b<k) (3.2)

such that

{α∈κ|f(α)< β}∈D (4.1)

(((a<k)+((f&a)<b))<D) (4.2)

We build:

(((a<k)+(((f&a)<a)<D)) >(f&(k>k))) < ((b<k)>(((a<k)+((f&a)<b))<D)). (5.1)

To map to Meth8:

LET pqrst = abfDk; vt tautologous, nvt not tautologous

(((p<t)+(((r&p)<p)<s))>(r&(t>t))) < ((q<t)>(((p<t)+((r&p)<q))<s)) ; nvt; (5.2)

```
FFTF FFTF FFTF FFTT   UUEU UUEU UUEU UUEE   UUEU UUEU UUEU UUEE   UUEU UUEU UUEU UUEE   UUEU UUEU UUEU UUEE
FFFF FFFF FFFF FFFF   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
```

For Eq 5.1 to be tautologous, the truth table fragment above for Eq 5.2 should be T Tautologous for Model 1 and E Evaluated for Models 2.n.

Dedekind lattice identity

From: Gian-Carlo **Rota**. "The Many Lives of Lattice Theory". Notices of the AMS. 44:11. 1440-1445. December, 1997.

p. 1441, identity discovered by Dedekind:

((r&(p+q))+q) = ((r+q)&(p+q)) ; tautologous

Density of a final segment of the truth-table degrees

From: Mohrherr, Jean-Leah (1984). "Density of a final segment of the truth table degrees". Pacific Journal of Mathematics. 1984.115.2: 409-420. [msp.org/pjm/1984/115-2/pjm-v115-n2-p12-s.pdf]

"D_T is the structure of all Turing (T) degrees with the induced partial ordering; D_{tt}, [is] the structure of all truth-table (tt) degrees with the induced partial ordering."

"Still, we do not know whether there is a $\mathbf{d} \in D_{tt}$ such that

$(\forall \mathbf{a} \in D_{tt})(\mathbf{a} > \mathbf{d} \rightarrow (\exists \mathbf{b} \in D_{tt})(\mathbf{b} < \mathbf{a} \text{ and } \mathbf{a} = \mathbf{b} \cup \mathbf{d}))$." (410.1)

LET p a, s D_{tt}, q d, r b, and assume the Meth8 script:

```
((#p<s)&(((p>q)>(%r<s))&((r<p)&(p=(r+q))))) > (q<s) ; vt          (410.1.1)
```

In Eq 410.1.1 we show there is such a $\mathbf{d} \in D_{tt}$.

"Therefore the sentence

$(\forall \mathbf{a})(\exists \mathbf{b})(\mathbf{b} > \mathbf{a} \text{ and } (\forall \mathbf{c})(\mathbf{b} \geq \mathbf{c} \geq \mathbf{a} \rightarrow \mathbf{c} = \mathbf{b} \text{ or } \mathbf{c} = \text{a}))$ (410.2)

is tautologous for D_T but contradictory for D_{tt}."

LET t c, u D_T.

```
(s\u)>((#p&%r)&((r>p)&(~(~(r<t)<p)>((t=r)+(t=p))))) ; nvt          (410.2.1)
```

FFFF FFFF FFFF FFFF . FFFF FNFN FFFF FNFN . FFFF FFFF TTTT TTTT . FFFF FNFN TTTT TTTT

In Eq2 410.2.1 we show that the sentence and conclusion of Eq 410.2 is not tautologous.

What follows is that Eqs 410.1.1 and 410.2.1 do not validate tautologous what Mohrer (1984) claims to prove. This means that Turing degrees and truth-table degrees are not related, and a connection is therefore suspicious. That conclusion is consistent with our previous work showing set theory is also suspicious.

Description logic

Badie, F. A formal semantics for concept understanding relying on description logics. Proceedings of the 9th International Conference on Agents and Artificial Intelligence (ICAART 2017). 2:42-52. DOI:10.5220/0006113800420052.

We evaluate the prototypical description logic from Table 1.

We assume the apparatus of M8-VŁ4.

LET: p a; q b; r R; s C; # necessity, universal quantifier; % possibly, existential quantifier

The designated proof value is T tautology, with C contingent (falsity value), N non-contingent (truth value); and F contradiction (not a proof). The fragments are the truth table as horizontal rows major.

$\exists R.\ C$ [is] $\{ a \mid \exists b.(a,b) \in RI \wedge b \in CI \}$ (1.1.1)
(%r&s)= ((((%q&(p&q))<r)&(q<s))>p) ; FFFF FFFF CCCC TTTT (1.1.2)

$\forall R.\ C$ [is] $\{ a \mid \forall b.(a,b) \in RI \supset b \in CI \}$ (1.2.1)
(#r&s)= ((((#q&(p&q))<r)&(q<s))>p) ; FFFF FFFF FFFF NNNN (1.2.2)

We remark that the definition for existential "restriction" fares closer to a tautology than does the universal quantification.

We conclude description logic is suspicious.

Dialetheism

Arenhart, J.R.B.; Melo, E.S. (2017). Classical negation strikes back: Why Priest's attack on classical negation can't succeed. *Logica Universalis*. October.

From: researchgate.net/publication/320506867

We assume the Meth8 apparatus, implementing the variant system VŁ4.

LET: p a; q I; ~ ⌙,¬ ; # any, universal quantifier;
> Imply; = Equivalent to, equal; @ Not equivalent to, not equal;
(p@p) contradictory; (p=p) tautologous;

Result fragments are repeating rows in the truth table, with T as the designated proof value.

While we choose the second negation symbol of ⌙, an upside down ¬, both such negation symbols are evaluated the same in VŁ4 as the tilde ~ not symbol.

We map the four equations on page 7 in Section 3, which are the crux of Graham Priest's thesis:

... selecting two different signs, one ¬ for De Morgan negation, and another, ⌙, for Boolean negation ... the model theoretic truth conditions for these negations in an interpretation are as follows: given any interpretation *I*,

De Morgan:

¬*a* is tautologous in *I* iff *a* is contradictory in *I*. (1.1.1)

(#q>(p= (p@p)))>(#q>(~p=(p=p))); TTTT (1.1.2)

¬*a* is contradictory in *I* iff *a* is tautologous in *I*. (1.2.1)

(#q>(p=(p=p))) >(#q>(~p=(p@p))); TTTT (1.2.2)

Boole:

⌙*a* is tautologous in *I* iff *a* is **not** tautologous in *I*. (2.1.1)

(#q>(p=~(p=p)))>(#q>(~p=(p=p))); TTTT (2.1.2)

⌙*a* is contradictory in *I* iff *a* is tautologous in *I*. (2.2.1)

(#q>(p=(p=p)))>(#q>(~p=(p@p))); TTTT (2.2.2)

Meth8 evaluates the renditions of Eqs. as tautologous. Hence there is no difference in negation between Boole and De Morgan. Due to this experiment, we conclude that dialetheism is suspicious.

Where dialetheism is mistaken

https://plato.stanford.edu/entries/dialetheism/, Section "2. Dialetheism in the history of philosophy".

> "This technique is called *parameterisation* and is adopted quite generally: when one is confronted with a seemingly tautologous contradiction, A & ¬A, it is a common strategy to treat the suspected dialetheia A, or some of its parts, as having different meanings, and hence as ambiguous (maybe just *contextually* ambiguous). For instance, if one claims that $P(a)$ & ¬$P(a)$, parameterisation holds that one is in effect claiming that a is P and is not P under different parameters or in different respects — say, *r1* and *r2*. To the extent that one's claim shows no sign of such parameters, it is tempting to ascribe inconsistency to the claim. But this can be resolved by clarifying that $P_{r1}(a)$ & ¬$P_{r2}(a)$ "
> Copyright © 2013 by Graham Priest. (Francesco Berto <*F.Berto@uva.nl*>)

We assume the Meth8-VŁ4 apparatus, including equivalency of modal and quantified operators, and map the expressions.

LET: p P( ); q a; r r-sub-1; s r-sub-2; # necessity mode, universal quantity

Result fragments are the entire 16-value truth table in rows major horizontally.
The designated proof value is T tautology, and **F** contradiction;
also C contingent (falsity), and N non-contingent (truth) .

if $P(a)$ & ¬$P(a)$, then a is P and is not P (2.1.1)
((p&q)&~(p&q))>((p=q)&(p=~q)) ; TTTT TTTT TTTT TTTT (2.1.2)

We test Eq. 2.1.1 for if the equivalency of the antecedent and consequent clauses.

$P(a)$ & ¬$P(a)$ is equivalent to a is P and is not P (2.1.1.1)
((p&q)&~(p&q))=((p=q)&(p=~q)) ; TTTT TTTT TTTT TTTT (2.1.1.2)

Next we evaluate the fix.

this can be resolved by clarifying that $P_{r1}(a)$ & ¬$P_{r2}(a)$ (2.2.1)
(((p&r)&q)&((p&s)&q))>((q=(p&r))&(q=(p=s))); TTTT TTTT TTTT TTTT (2.2.1)

We test Eq. 2.2.1 for the equivalency of the antecedent and consequent clauses.

$P_{r1}(a)$ & ¬$P_{r2}(a)$ is equivalent to a is P and is not P (2.2.1.1)
(((p&r)&q)&((p&s)&q))=((q=(p&r))&(q=(p=s))) ; **FF**TT **F**TTT **F**TTT **F**TTT (2.2.1.2)

We reintroduce the universal quantifier "for any A, it is necessary" as a prophylactic test:

For any A, $P_{r1}(a)$ & ¬$P_{r2}(a)$ is equivalent to a is P and is not P (2.2.2.1)
(((#p&r)&q)&((#p&s)&q))=((q=(#p&r))&(#q=(p=s))) ;
FFTT **F**NTT **F**TTT **F**TTT (2.2.2.2)

Eq. 2.2.2.2 results in marginally greater truth value than Eq. 2.2.1.2.

Eq. 2.1.1 is an equivalency, but the description for dialetheism in Eq. 2.2.1 is an inference, not an equivalency. This tells us that *parameterisation* introduces an inconsistency to demonstrate dialetheism. What follows is that dialetheism is suspicious.

In passing, as found later we evaluated the contra assertion against the objection of the argument from explosion, Section 4.1, with edited labels:

> "Aristotelian syllogistic — the first formally articulated logic in Western philosophy — is not explosive. Aristotle held that some syllogisms with inconsistent premises are valid, whereas others are not (An. Pr. 64a 15). Just consider the inference:
>
> (P1.1) Some logicians are intuitionists; [*]
> (P2.1) No intuitionist is a logician;
> (C3.1) Therefore, all logicians are logicians. [*]
> [(R4.1) (P1.1) & (P2.1) > (C3.1).; we also use the = connective to test theoremhood.]
>
> This is not a valid syllogism, despite the fact that its premises are inconsistent."

We evaluate as follows:

LET: p logicians; q intuitionists; % possibility, existential; # necessity, universal

(P1.2) %(p=q) ;	TCCT TCCT TCCT TCCT
(P2.2) (~q=p) ;	**F**TT**F** **F**TT**F** **F**TT**F** **F**TT**F**
(C3.2) #(p=p) ;	NNNN NNNN NNNN NNNN
[(R4.2)(%(p=q)&(~q=p))>#(p=p) ;	TTNT TTNT TTNT TTNT
(R4.3)(%(p=q)&(~q=p))=#(p=p) ;	CC**F**C CC**F**C CC**F**C CC**F**C

Eq. R4.1 as rendered in R4.2 is a valid syllogism, and the premises are consistent, but the result is not tautologous. This means Eq. R4.1 cannot be discredited as an argument from explosion against dialetheism. (What follows is the Aristotelian logic *is* in fact explosive according to system VŁ4.)

* If P1.1 is rendered as "some (possibly one) logician is an intuitionist" (%p=q), instead of "some (the possibility of) logicians are intuitionists" %(p=q), then R4.1 can be coerced to tautology. We believe Aristotle intended P1.2, as in our text, because of the plural of "intuitionists".

Using this same reason of plural words for C3.1, we interrupt the universal operator as outside the equation of logicians are logicians, #(p=p).

The dichotomy of selection argument as a contradiction

Manuel Morales proposed a philosophy of science based on a system of logic named the dichotomy of selection argument for two variables of coin, cup as p,q here. There are two possible states of affairs: for the coin in the cup; and for the coin in the cup or outside the cup. These states are not "hidden variables" and are named "one potential" and "more than one potential", mapped as:

$$(p\&q) \tag{1}$$
$$(p\&(q+\sim q)) \tag{2}$$

Eq 1 means "coin and cup".
Eq 2 means "coin, and cup or no cup".

The argument requires that two conditions are applied to Eq 1-2 as "direct selection" and "indirect selection". We take these conditions to be the logical connective of Imply as "p>", to mean "If coin, then ... " or "Coin implies ... ." The conditions are not a "hidden variable".

$$p>(p\&q) \tag{3}$$
$$p>(p\&(q+\sim q)) \tag{4}$$

Eq 3 means "If coin, then coin and cup are selected."
In other words, "Coin implies direct selection of coin and of cup."

Eq 4 means "If coin, then both coin and cup or no cup are selected."
In other words, "Coin implies indirect selection of both coin and of cup or of no cup."

The argument also requires that an action be taken (executed) or not be taken (not executed), where: if not taken or not executed, then "no physical effects exist." The action is not a "hidden variable". The action taken is mapped above in Eq 3-4, and the action not taken is mapped below in Eq 5-6:

$$(\sim p>\sim(p\&q)) \tag{5}$$
$$(\sim p>\sim(p\&(q+\sim q))) \tag{6}$$

Eq 5 means "If no coin, then no physical effect on coin and on cup."
In other words, "No coin implies no action on coin and on cup."
Eq 5 does *not* mean the negation of Eq 3 as "Coin does not imply direct selection ... .")

Eq 6 means "If no coin, then no physical effect on coin, and on cup or on no cup."
In other words, "No coin implies no action on both coin and on cup or on no cup."
Eq 6 does *not* mean the negation of Eq 4 as "Coin does not imply indirect selection ... .")

We test if both Eq 3-4 are equivalent to the negation of the opposite as both Eq 5-6:

$$((p>(p\&q))\&(p>(p\&(q+\sim q)))) = \sim((\sim p>\sim(p\&q))\&(\sim p>\sim(p\&(q+\sim q)))) \tag{7}$$

Eq 7 is not validated as tautologous. (The main connective as imply > also is not validated as tautologous). Therefore the dichotomy of selection argument is a contradiction and hence not a viable philosophy of science.

Diverse double-compiling (DDC)

We evaluate a security scheme using the Meth8 modal model checker implementing variant system VŁ4, a resuscitation of the Łukasiewicz quaternary logic based on the 2-tuple {11,10,01,00}, in five models..

From Wheeler, David. "Fully countering trusting trust through diverse double-compiling". 2009. arxiv.org/ftp/arxiv/papers/1004/1004.5534.pdf, on pg 47, 5.1.2 DDC components:

LET: nvt not tautologous; and

	cT:	p
	sP:	q
	sA:	r
(1)	e1:	((p&q)>s)
(2)	e2:	((s&r)>t)
(3)	eA_run:	u
(4)	1sP:	v & q [not used in Eq 9]
(5)	1sA:	v & r [not used in Eq 9]
(6)	e1_effects:	e1 > w; (s>w)
(7)	e2_effects:	e2 > x; (t>x)
(8)	stage_1:	(q & p & e1_effects & e2 & eA_run) > y; ((q&(p&(w&(t&u)))))>y)
(9)	stage_2:	(r & stage_1 & e2_effects & e2 & eA_run) [> z]; (r&(y&(x&(t&u))))

The conjecture to test in words is: If Eqs 1,2,3,6,7,8, then Eq 9. By substitution:

(((p&q)>s)&(((s&r)>t)&((s>w)&((t>x)&((q&(p&(w&(t&u))))>y)))))>(r&(y&(x&(t&u))));nvt; (10)

A fragment in Model 1 is below of the 7 repeating truth tables (of 128). The designated truth value is T tautology with other 2-tuple values as C contingent (falsity value), N non contingent (truth value), and F contradiction.

```
TTTT TTTT TTTT TTTT
FFFT FFFT TTTT TTTT
FFFT TTTT TTTT TTTT
FFFT FFFT FFFF TTTT
FFFT FFFT FFFF FFFF
FFFT FFFT FFFF TTTT
FFFT TTTT FFFF TTTT
```

Eq 10 is nvt by Meth8. The reason this differs from the paper using Prover9 (P9) is that P9 implements standard FOL which is not bivalent, as we showed elsewhere. FOL is based on the modern, revised Square of Opposition without equations for all edges and from which two of the 24 usable syllogisms needed fix-ups (Modus Camestros and Modus Cesare).

If Eq 10 is modified to use the universal quantifier or modal necessity on the antecedent or consequent, then it is nvt and only on values T, C. Similarly for the existential quantifier or modal possibility, it is nvt on values T, F, N. (We proved elsewhere the equivalence of the respective quantifiers to modal operators.)

Doxastic logic

We assume the script of Meth8 where nvt not tautologous. The designated truth value in the proof tables of horizontal rows is T Tautologous. Other values are F contradictory, C Contingent, and N Non contingent.

From en.wikipedia.org/wiki/Doxastic_logic (a difficult read with gendered pronouns):

			`Model 1 of 5
Accurate reasoner:	#p>((r&p)>p) ;	vt ;	TTTT TTTT TTTT TTTT
Inaccurate reasoner:	(%p&~p)&(%p&(r&p)) ;	nvt ;	**FFFF FFFF FFFF FFFF**
Conceited reasoner.1:	r&(~%p&(~p&(r&p))) ;	nvt ;	**FFFF FFFF FFFF FFFF**
Conceited reasoner.2:	r&(#p&((r&p)>p)) ;	nvt ;	**FFFF FNFN FFFF FNFN**
Consistent reasoner.1:	(~%p&(r&p)) & (~%p&(r&~p)) ;	nvt ;	**FFFF FFFF FFFF FFFF**
Consistent reasoner.2:	(#p&(r&p)) > (#p&(~r&~p)) ;	nvt ;	**TTTT TCTC TTTT TCTC**
Normal reasoner;	(#p&(r&p)) > (#p&(r&(r&p))) ;	vt;	
Peculiar reasoner:	(%p&(r&p)) & (%p&(r&~(r&p))) ;	nvt ;	**FFFF FFFF FFFF FFFF**
Regular reasoner:	(#(p&q)&(r&(p>q))) > (#(p&q)&(r&((r&p)>(r&q)))) ;	vt	
Reflexive reasoner;	((#p&(%q&r))&q) = ((#p&(%q&r))&((r&q)>p));	vt	
Unstable reasoner:	(%p&(r&(r&p))) & (%p&~(r&p)) ;	nvt ;	**FFFF FFFF FFFF FFFF**
Stable reasoner:	(#p&(r&(r&p))) > (#p&(r&p)) ;	vt	
Modest reasoner:	(#p&(r&((r&p)>p))) > (#p&(r&p)) ;	vt	
Queer reasoner:	Not explicitly stated, so not evaluated here.		Type G
Timid reasoner:	Not explicitly stated, so not evaluated here.		
Type 1.1 reasoner:	(#(p&q)&((r&p)&(r&(p>q)))) > (#(p&q)&(r&p)) ;	vt	
Type 1.2 reasoner:	(#(p&q)&(r&(p>q))) > (#(p&q)&((r&p)>(r&q))) ;	vt	
Type 1* reasoner:	(#(p&q)&(r&(p>q))) > (#(p&q)&(r&((r&p)>(r&q)))) ;	vt	
Type 2 reasoner:	((#(p&q)&r)&((r&p)&(r&(p>q)))) > ((#(p&q)&r)&(r&q)) ;	vt	
Type 3 reasoner:	(#p&(r&p)) > (#p&(r&(r&p))) ;	vt	
Type 4 reasoner:	((r&#p)&(r&p)) > ((r&#p)&(r&(r&p))) ;	vt	
Type G reasoner:	((r&#p)&(r&((r&p)>p))) > ((r&#p)&(r&p)) ;	vt	

Doxastic logic relies on the Löb theorem, also known as the

Gödel-Löb theorem:	#(#p>p)>#p ;	nvt ;	**CTCT CTCT CTCT CTCT**

We observe doxastic logic contains axioms not tautologous such as the Reasoners named: Inaccurate; Conceited; Consistent; Peculiar; and Unstable. Five types of Reasoners however are tautologous.

We conclude that doxastic logic as a whole is a logic system not tautologous by Meth8.

Anomaly in the equation of E=mc^2

We assume the Meth8/VŁ4 apparatus with T as designated *proof* value and tables row-major, horizontal:

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: pqrs Emcs where c is a constant r equivalent to s the speed of light, and E=mc^2.

The equation for mass-energy equivalence is E=mc^2. (1.0)

If necessarily c is equivalent s, and c is not greater than or less than s, then:

(#(r=s)&~((r<s)+(r>s)))> #(p=(q&(r&s))) ; TTTT TTTT TTTT TTTT (1.1)

If possibly c is not equivalent to s, and c is less than or greater than s, then:

(%(r@s)& ((r<s)+(r>s)))> #(p=(q&(r&s))) ; TTTT TCTC TCTC TTTT (1.2)

If possibly c is not equivalent to s, and possibly c is less than or greater than s, then:

(%(r@s)&%((r<s)+(r>s)))> #(p=(q&(r&s))) ; NNNN NFNF NFNF NNNN (1.3)

If possibly c is equivalent to s, or possibly c is less than or greater than s, then:

(%(r=s)+%((r<s)+(r>s)))> #(p=(q&(r&s))) ; NFNF NFNF NFNF NFFN (1.4)

Eqs. 1.2-1.4 show the assumption for the logic of Eq. 1.0 to hold as Eq. 1.1 is that the speed of light is constant. Stephen J. Crothers questioned and showed this is not the case, that the speed of light varies. Hence Eqs. 1.2-1.4 serve as counter examples to Eq. 1.1, making E=mc^2 *not* tautologous after all.

Refutation of the EF-axiom

The EF-axiom describes the Efremovifč proximity δ by V.A. Efremovič from 1934 and published in Russian in 1951.

From: en.wikipedia.org/wiki/Near_sets#Visualization_of_EF-axiom

> "Let the set X be represented by the points inside [a] rectangular region ... . Also, let A, B be any two non-intersection subsets (i.e. subsets spatially far from each other) in X ... . Let C^c = X\C (complement of the set C). Then from the EF-axiom ... :
>
> A $\underline{\delta}$ B, B ⊂C, D = C^c, X = D ∪C, A ⊂D, hence, we can write
> A $\underline{\delta}$ B ⇒A $\underline{\delta}$ C and B $\underline{\delta}$ D, for some C, D in X so that C ∪D = X." (1.1.1)

We interpret the operator $\underline{\delta}$ to mean "nearby" or "in proximity", but could just as easily mean "distant" or "far apart". The size of an antecedent or consequent is not stated for the operator, so we determine that the operator applies to unrelated literals. Therefore, we evaluate A $\underline{\delta}$ B as ((A∈B) Nor (B∈A)).

We assume the apparatus and method of Meth8/VŁ4 with the designated *proof* value of `T` for tautology, `F` contradiction, `C` falsity, and `N` truth. The proof result is for 16-tables of 16-values as row-major and horizontally. There are 256-values because four theorems are evaluated as the capitalized variables.

~ Not; + Or; - Not Or; & And; \ Not And; = Equivalent to; @ Not Equivalent to;
> Imply, greater than; < Not Imply, less than, ∈;
necessity, for all; % possibility, for one or some.

LET: A B C D A B C D; A $\underline{\delta}$ B = ((A<B)-(B<A)); D = ((D+C)\C); X = D+C.

```
(((((A<B)-(B<A))&(((B<C)&(D=((D+C)\C)))&((D+C)&(A<D))))>
((%C<(D+C))&(%D<(D+C)))) > ((C+D)=(D+C))) >
(((A<B)-(B<A))>(((A<C)-(C<A))&((B<D)-(D<B)))) ;                (1.2.1)
```

```
TTTT TNTN TTCC TNCF . NTNT TNTN NTFC TNCF . CCTT CFTN TTCC TNCF . FCNT CFTN NTFC TNCF
NTNT TNTN NTFC TNCF . NTNT TTTT NTFC TTCC . FCNT CFTN NTFC TNCF . FCNT CCTT NTFC TTCC
CCTT CFTN TTCC TNCF . FCNT CFTN NTFC TNCF . CCTT CFTN TTTT TNTN . FCNT CFTN NTNT TNTN
FCNT CFTN NTFC TNCF . FCNT CCTT NTFC TTCC . FCNT CFTN NTNT TNTN . FCNT CCTT NTNT TTTT
```

Eq. 1.2.1 as rendered is *not* tautologous.

We conclude the EF-axiom is suspicious as the theoretical basis for proximity space and for topology in fuzzy, near, and rough sets.

Ehrenfeucht–Mostowski theorem of discernables

From en.wikipedia.org/wiki/Ehrenfeucht%E2%80%93Mostowski_theorem

This theorem is based on ZFC set theory. However, ZFC is not validated as tautologous by Meth8 (except for the axiom of specification, unrelated to this argument). Therefore a model for indiscernables does not exist.

Anomaly in the equation of E=mc^2

We assume the Meth8/VŁ4 apparatus with T as designated *proof* value and tables row-major, horizontal:

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: pqrs Emcs where c is a constant r equivalent to s the speed of light, and E=mc^2.

The equation for mass-energy equivalence is E=mc^2. (1.0)

If necessarily c is equivalent s, and c is not greater than or less than s, then:

(#(r=s)&~((r<s)+(r>s)))> #(p=(q&(r&s))) ; TTTT TTTT TTTT TTTT (1.1)

If possibly c is not equivalent to s, and c is less than or greater than s, then:

(%(r@s)& ((r<s)+(r>s)))> #(p=(q&(r&s))) ; TTTT TCTC TCTC TTTT (1.2)

If possibly c is not equivalent to s, and possibly c is less than or greater than s, then:

(%(r@s)&%((r<s)+(r>s)))> #(p=(q&(r&s))) ; NNNN NFNF NFNF NNNN (1.3)

If possibly c is equivalent to s, or possibly c is less than or greater than s, then:

(%(r=s)+%((r<s)+(r>s)))> #(p=(q&(r&s))) ; NFNF NFNF NFNF NFFN (1.4)

Eqs. 1.2-1.4 show the assumption for the logic of Eq. 1.0 to hold as Eq. 1.1 is that the speed of light is constant. Stephen J. Crothers questioned and showed this is not the case, that the speed of light varies. Hence Eqs. 1.2-1.4 serve as counter examples to Eq. 1.1, making E=mc^2 *not* tautologous after all.

Epistemic coalition with perfect recall

Naumov, Pavel; Tao, Jia. "Strategic coalitions with perfect recall". Technical report. July 2017. researchgate.net/publication/318460936.

We apply the Meth8 modal logic model checker* apparatus to the epistemic transition system T_2 for these universal principles, keyed to equations:

1. Strategic positive introspection; (1.0)
2. Strategic negative introspection; (2.0)
3. Perfect recall; and (3.0)
4. Cooperation principle. (4.0)

(The agent is assumed to have perfect recall with two states: *one knows what a strategy is*; or *one does not know what a strategy is*.)

LET: lc lower_case; p lc_phi; q lc_psi; r s t u C D H K;
z null value; (z@z) contradiction; (z-z) zero;
~ Not; & And; - Not Or; = Equivalent to; @ Not Equivalent to; > Imply

Designated truth value is T (tautology), with negation F (contradiction).
The results are repeating truth fragments from 128-tables, each of 16-values.

(t&(r&p)) > (u& ((r&t)&(r&p))) ; `TTTT TFTF TTTT TFTF` ; (1.2)
~(t&(r&p)) > (u&~((r&t)&(r&p))) ; `FFFF FTFT FFFF FTFT` ; (2.2)

Perfect recall principle with null as contradiction:
(~(s>r)@(z@z)) > ((t&(s&p)) > (t&((s&u)&(r&p)))) ; `TTTT TTTT TFTF TTTT` ; (3.2.1)

Perfect recall principle with null as zero:
(~(s>r)@(z-z)) > ((t&(s&p)) > (t&((s&u)&(r&p)))) ; `TTTT TTTT TFTF TTTT` ; (3.2.2)

Cooperation principle with null as contradiction:
((r&s)=(z@z)) > (((t&r)&(p>q)) > ((t&(s&p))>((t&r)+(s&q)))) ;
`TTTT TTTT TTTT TTTT` ; (4.2.1)

Cooperation principle with null as zero:
((r&s)=(z-z)) > (((t&r)&(p>q)) > ((t&(s&p))>((t&r)+(s&q)))) ;
`TTTT TTTT TTTT TTTT` ; (4.2.1)

Lemma: contradiction, as null, implies zero:
(z@z) > (z-z) ; `TTTT TTTT TTTT TTTT` ; (L.0)

We find this knowledge system is very important because of those evaluated so far by Meth8 using VŁ4, this system has the highest proof potential. For example, the cooperation principle is tautology in Eq 4.2.1. While the perfect recall principle and positive strategic introspection are not tautologous, they are subject to subsequent manipulation using our modal operators as interchangeable quantifiers.

* Meth8 implements system Łukasiewicz$_4$ in our resuscitated variant VŁ4 (see ersatz-systems.com).

Dynamic epistemic reasoning

Wang, Yanjing; Li, Yanjun. Not All Those Who Wander Are Lost: Dynamic Epistemic Reasoning in Navigation. 2014.

From:
researchgate.net/publication/267668798_Not_all_those_who_wander_are_lost_Dynamic_epistemic_reasoning_in_navigation

We assume the Meth8 apparatus using system variant VŁ4 to evaluate two expressions.

LET: lc lower_case; p lc_phi; q lc_phi-prime; r lc_psi; s lc_psi-prime; t K; u <a>;
~ Not; & And; = Equivalent to; > Imply; T tautology; F contradiction.

Results are in horizontal fragments are repeating truth tables of 128, as 16-values row major.

From 3.1 Finite axiomatization System S_sub_EAL_A_P, page 565:

¬Kp→K¬Kp (3.1.5.1)
(~t&p)>(t&(~t&p)) ; TFTF TFTF TFTF TFTF, TTTT TTTT TTTT TTTT ; (3.1.5.2)

From Proposition 3.5, page 566:

((p=q)&(r=s)) > (((~p=~q)&((p&q)=(~p&~q)))&(((u&p)=(u&q))&((t&p)=(t&q)))) ;
FTTF TTTT TTTT FTTF (3.5.2)

We conclude that dynamic epistemic reasoning in navigation is not tautologous by Meth8, and hence suspicious.

Epistemic logics: Hilbert substructure

Sedlár, Igor. "Substructural epistemic logics". J*ournal of applied non-classical logics* .25(3) January 2016. d.o.i: 10.1080/11663081.2015.1094313.

From: researchgate.net/profile/Igor_Sedlar

We use the Meth8 apparatus to evaluate the equations with these not found to be tautology as claimed:

(p@q)=(p&q) ;	TFFF ;	Prop 26.2
#(p>q)>(#p>#q) ;	TCTC ;	Prop 26.4
p\#p ;	TCTC ;	Prop 26.5
#((#q&p)>#(p>(q&p))) ;	NNNN ;	Fig. 7
(p&q)= ~(p=q) ;	TFFF ;	page 28, under Rules.

We conclude that substructural epistemic logics are not bivalent and further, when based on Hilbert-style rules, cannot be coerced into bivalency.

Navigation in epistemic logic

Deuser, Kaya; Naumov, Pavel. Navigability with Imperfect Information. Armstrong's Axioms and Navigation Strategies. 2017.

From respectively: researchgate.net/publication/318720612; arxiv.org/pdf/1707.08255.pdf

We evaluate three expressions, an Axiom (1) in both papers and a Lemma (19) and Claim (5) in the first paper. We assume the Meth8 modal logic model apparatus implementing system variant VŁ$_4$.

LET: p A; q B; r C, F; s D, G ; ~ Not; > Imply, ⊳ direction of travel; + Or, ∪;
\ Nand; = Equivalent to; T tautology; F contradiction.

Truth tables in 16-values are horizontal as row-major.

The axiom of reflexivity is the same from respectively 1. Reflexivity, page 6, and 1. Axiom, page 7:

A⊳B, where A⊆B (A.1.1.4.1.1)
~(p>q)>(p>q) ; TFTT TFTT TFTT TFTT ; (A.1.1.4.1.2)

Lemma 19, page 19:

(A∪B)\C=(A\C)∪(B\(A∪C)). (L.19.1.1)
((p+q)\r)=((p\r)+(q\(p+r))) ; TTTT TFFT TTTT TFFT ; (L.19.1.2)

Proof [with decomposed expressions].
(A∪B)\C=(A∪(B\A))\C=(A\C)∪((B\A)\C) (L.19.2.1)
((p+q)\r)=(((p+(q\p))\r)=((p\r)+((q\p)\r))) ; TTTT FFTT TTTT FFTT ; (L.19.2.2)

(A∪B)\C=(A∪(B\A))\C=(A\C)∪((B\A)\C)=(A\C)∪(B\(A∪C)) (L.19.3.1)
(((p+q)\r)=(((p+(q\p))\r)=((p\r)+((q\p)\r))))=((p\r)+((q\p)\r)) ;
TTTT FTTT TTTT TTTT ; (L.19.3.2)

(A∪B)\C (L.19.4.1)
(p+q)\r ; TTTT TFFF TTTT TFFF ; (L.19.4.2)

(A∪(B\A))\C=(A\C)∪((B\A)\C) (L.19.5.1)
((p+(q\p))\r)=((p\r)+((q\p)\r)) ; TTTT FTFF TTTT FTFF ; (L.19.5.2)

(A\C)∪(B\(A∪C)) (L.19.6.1)
(p\r)+((q\p)\r) ; TTTT TFTT TTTT TFTT ; (L.19.6.2)

Claim 5, page 27:

A∪B⊆F∪G (C.5.1)
~(p+q)>(r+s) ; FTTT TTTT TTTT TTTT ; (C.5.2)

Meth8 validates all script renditions above as *not* tautology; hence the subject area is suspicious.

Quantifiers over epistemic agents

Naumov, Pavel; Tao, Jia. "Everyone knows that someone knows: quantifiers over epistemic agents". *The review of symbolic logic*. January 2018.

From:researchgate.net/publication/315775241_Everyone_Knows_That_Someone_Knows_Quantifiers_over_Epistemic_Agents

We note that these conjectures assume the validity of set theory, as does S5 and Kripke worlds.

Using the Meth8 apparatus, we evaluate equations numbered in order by page and appearance. The logic values by 2-tuple are { 11, 10, 01, 00 } for < Tautology (T proof), Contingent (C falsity value), Non contingent (N truth value), Contradiction (F, Not T) >.

LET: r s t a b c; p q lc_phi lc_psi; u A;
~ Not; # necessity, universal quantifier; % possibility, existential quantifier;
> Imply, element of as (x>A) for (x is not an element of A).

(#r&#p) > #(#r&p) ; TTTT ; (page 1.1)
(#r&#p) > (##r&p) ; TTTT ; (page 1.1) ; moving the #
(r& p) > (r&p) ; TTTT ; (page 1.1) ; without the #

(((#r&s)&p)&((#s&r)&q)) > ((#r&(s&r))&(p&q)) ; TTTT ; (page 1.2) ; with #
(((r&s)&p)&((s&r)&q)) > ((r&(s&r))&(p&q)) ; TTTT ; (page 1.2) ; without #

#r&((#r&p)>(#r&q)) ; FFFF NFNN ; (page 2.1)
r&((#r&p)>(#r&q)) ; FFFF TCTT ; (page 2.1) ; no antec #
#r&((r&p)>(r&q)) ; FFFF NFNN ; (page 2.1) ; no consq#
r&((r&p)>(r&q)) ; FFFF TFTT ; (page 2.1) ; no #

(#r&(#r&p)) > (#r&(#r&q)) ; TTTT TCTT ; (page 2.2) ; different than (page 2.1)

(#r&#s) & (((#r&#s)&p)>((#r&p)+(#s&p)));
FFFF FFFF FFFF NNNN ; (page 2.3)

#r & (((#r&%s)&(#s&p))>(#r&p)) ; FFFF NNNN FFFF NNNN ; (page 2.4)

LET: q A

(r>q) > (((#r&#q)&p)>((#q&#r)&p)); TTTT TTTT TTTT TTTT ; (page 2.5)
Barcan antecedent, Imply
(r>q) & (((#r&#q)&p)>((#q&#r)&p)) ; TTTT FFTT TTTT FFTT ; (page 2.5)
Barcan antecedent, And
((#r&#q)&p)>((#q&#r)&p) ; TTTT TTTT TTTT TTTT ; (page 2.5)
Barcan without antecedent restriction
((#r&#q)&p)>((#q&#r)&p) ; TTTT TTTT TTTT TTTT ; (page 2.5)
Barcan without antecedent restriction, no #

On the page 3 definitions, we ignore "separate quantifiers for epistemic worlds and agents".

LET: uc upper_case; lc lower_case; p lc_psi; q uc_Phi; r C; s lc_phi;
~ Not; > Imply, not element of, as (~(s>q)) for (s is an element of q); v V; x x

~(s>(q&r)) > ~(~s>(q&r)) ; TTTT TTTT FFFF FFTT ; Def.3.2
~((s&p)>(q&r)) > (s>~(p>(q&r))) ; TTTT TTTT TTTT TTTT ; Def.3.3
(~(x>v)&~(s>(q&r))) > ~((#x&s)>(q&r)) ; TTTT TTTT TTTT TTTT ; Def.3.5
(~(x>v)&~(s>(q&r))) > ~((x&s)>(q&r)) ; TTTT TTTT TTTT TTTT ; Def.3.5, no #

Meth8 validates as tautology the Barcan formula as stated (both with and without the restriction and both with and without the existential quantifier and modal necessity) and also Defs 3.3 and 3.5. Meth8 does not validate as tautology Def 3.2. For the moment, we end our evaluation here.

What follows is that for system variant VŁ4, "separate quantifiers for epistemic worlds and agents" are not needed as a distinction.

Erdös-Strauss Conjecture:

From: blogs.ams.org/matheducation/2015/05/01/famous-unsolved-math-problems-as-homework/

This uses the Meth8 model checker where ~ Not, + Or, - Not Or, @ Not equivalent, = Equivalent to, & And, \ Not And, > Imply.

((((p+q)+r)@((p@p) + ((r@r)-(%r>%#r)))) & (s@(((s>%#s)+(s@s)) + ((s@s)-(%s>%#s)))))
>
(((((s>%#s)+(s>%#s))+(s>%#s))\s) = ((((s>%#s)\p)+((s>%#s)\q))+((s>%#s)\r))) ;

TTTT TTCT TTTT TTTT ; *not* tautologous

Refutation of the Euathlus paradox: neither pay

We evaluate this paper:

> Lisanyuk, Elena. (2017). "Why Protagoras gets paid anyway: a practical solution of the Paradox of Court". philarchive.org/archive/ELEWPG

We assume the apparatus and method of Meth8/VL4, with the designated *proo*f value of `T`. We use four variables.

LET	p,	q,	r,	s :
	pupil Euathlus;	instructor Protagoras;	court judgment;	tuition payment

"The famous sophist Protagoras took on a pupil, Euathlus, on the understanding that the student will pay Protagoras for his instruction after he wins his first court case." (1.1)

(q&p) > ((p&r)>(p>(q&s))) ; `TTTT TTTF TTTT TTTT` (1.2)

Eq. 1.2 as rendered is *not* tautologous, but nearly so with one value `F` of 16 diverging from the tautology of all `T` .

Remark 1. The instructor's assumption is that the pupil will win the necessity of his first court case, but no contingency is made for the event that the pupil possibly does not continue onto perform in any court. For example, there is no contingency for if the pupil became a lawyer but acted as a solicitor and not a barrister, then the litigious status of the pupil could never be tested before a court.

Remark 2. The rule of law in the West is that when an experienced lawyer as contractor, Protagoras, frames an agreement with a lesser experienced non-lawyer as contractee, Euathlus, then the contractor is held to a higher level of performance and closer reading of the agreement than is the contractee.

Remark 3. On the basis of no contingency arrangement for the contractee not to perform, the court would hold for a defective contract and disallow any claim by Protagoras. Should Euathlus counter-claim for lawyer's fees, the court would probably grant that motion on the basis of a frivolous lawsuit claim by Protagoras in the first place. In other words, Protagoras would would lose in either scenario, that is, not obtain relief for instructing the pupil, and liable for the pupil's legal expenses in that event.

"After instruction, Euathlus decided not to enter the profession of law, (2.1.1) and
[then] Protagoras decided to sue Euathlus for the amount owed." (2.2.1)

((q&p)>((p&r)>(p>(q&s)))) > (~(p&r)>~(p>(q&s))) ; `FTFT FTFT FTFF FTFT` (2.1.2)
(((q&p)>((p&r)>(p>(q&s))))>(~(p&r)>~(p>(q&s)))) > (q&(r+~r)) ;
`TFTT TFTT TFTT TFTT` (2.2.2)

Eqs. 2.2.1 and 2.2.2 are *not* tautologous, therefore that chain of events is suspicious.

Remark 4. The metaphysical question of "Was Euathlus morally wrong in not paying Protagoras for services rendered, regardless of outcome" can now be cast onto a physicalistic basis in this way. The proof tables for performance by Protagoras in Eq. 1.2 and for non-performance by Euathlus in Eq. 2.1.2
are compared:

(q&p) > ((p&r)>(p>(q&s))) ; TTTT TTTF TTTT TTTT (1.2)
((q&p)>((p&r)>(p>(q&s)))) > (~(p&r)>~(p>(q&s))) ; FTFT FTFT FTFF FTFT (2.1.2)

Clearly Eq. 2.1.2 diverges more from tautology than does Eq. 1.2. This means a physcialistic basis if mapped for moral theology as a recent advance. In other words, Euathlus failed to do the right thing by withholding payment in any event, so as not to violate the intended spirit of the albeit defective contract.

"Protagoras argued that if he won the case he would be paid his money." (3.1.1)
((((q&p)>((p&r)>(p>(q&s))))>(~(p&r)>~(p>(q&s))))>(q&(r+~r))) >
((q&r)>(p>(q&s))) ; TTTT TTTF TTTT TTTT (3.1.2)

"If Euathlus won the case, Protagoras would still be paid according to the original contract, because Euathlus would have won his first first case." [from (1.1)] (3.2.1)

((((q&p)>((p&r)>(p>(q&s))))>(~(p&r)>~(p>(q&s))))>(q&(r+~r))) >
((p&r)>(p>(q&s))) ; TTTT TTTF TTTT TTTT (3.2.2)

Eqs. 3.1.2 and 3.2.2 are *not* tautologous, but nearly so with one value F of 16 diverging from the tautology of all T .

"Euathlus, however, claimed that if he won, then by the court's decision he would not have to pay Protagoras." (4.1.1)
((((q&p)>((p&r)>(p>(q&s))))>(~(p&r)>~(p>(q&s))))>(q&(r+~r))) >
((p&r)>(p>(q&~s))) ; TTTT TTTT TTTT TTTF (4.1.2)

"If, on the other hand, Protagoras won, then Euathlus would still not have won a case and would therefore not be obliged to pay." (4.2.1)
((((q&p)>((p&r)>(p>(q&s))))>(~(p&r)>~(p>(q&s))))>(q&(r+~r))) >
((q&r)>(p>(q&~s))) ; TTTT TTTT TTTT TTTF (4.2.2)

Eqs. 4.1.2 and 4.2.2 are *not* tautologous. This means regardless of who wins the lawsuit of Portagoras, Euathlus does not pay. Hence the Euathlus paradox is refuted and resolved by default in favor of Euathlus.

Disjunctive normal form (DNF) in first order logic, minimized by FOL Optimizer

Lampert, Timm."Minimizing disjunctive normal forms of pure first-order logic". Logic Journal of IGPL.

From:
researchgate.net/publication/319304582_Minimizing_disjunctive_normal_forms_of_pure_first-order_logic

We use the apparatus of Meth8 modal logic model checker (system Ł4 as resuscitated in variant VŁ4).

The designated proof value is T (tautology); other logic values are: Contingent (falsity); Non-contingent (truth); and F (contradiction). The 2-tuple is respectively { 11, 10, 01, 00 }.

Truth tables are presented as repeating fragments of four 16-values out of 128 tables, as four row major horizontally.

We replicate three examples of equations in FOLDNFs.

LET: s t u x y F G H x y; ~ Not; & And, ^; + Or, V; = Equivalent to
universal quantifier; % existential quantifier

17. This problem of complexity is given as "a conjunction/disjunction of primary formulas may be equivalent to a conjunction / disjunction of minimized primary formulas (context sensitivity of minimization)." The example in the footnote is supposed to be a tautology, and rendered in pseudo script as:

%y(Fy^#x(Gx V Hxy))^#xGx == %yFy^#xGx (17.1)

In Meth8, Eq. 17.1 is mapped as:

((%y&((s&y)&(#x&((t&x)+((u&x)&y)))))&(#x&(t&x))) = ((%y&(s&y))&(#x&(t&x))) ;
TTTT TTTT TTTT TTTT ; Steps 35 ; (17.2)

Eq. 17.2 is replicated as an expected tautology. This demonstrates the problem of complexity in minimization is overcome seamlessly by the automated tool Meth8.

18. This problem is given as reliance on derivation trees for minimization. The example is rendered in pseudo script as:

LET: u v F G; p q r s t x1 x2 y1 y2 y3

%y1(¬Fy1&%y2(Fy2&%y3(¬Gy1y3&¬Gy3y2))) & #x1(Fx1+#x2(¬Fx2+Gx1x2)); (18.1)

In Meth8, Eq. 18.1 is mapped as:

(%r&(~(u&r)&(%s&((u&s)&(%t&((~v&(r&t))&(~v&(t&s)))))))) &
(#p&((u&p)+(#q&(~(u&q)+(v&(p&q)))))) ; FFFF FFFF FFFF FFFF ; Steps 43 ; (18.2)

Eq. 18.2 is replicated as an expected contradiction. This demonstrates the problem of complexity in minimization is overcome seamlessly without reliance on special rules or derivation trees.

Test. We replicate the test problem for "FOL Optimizer". The test equation is rendered in pseudo script as:

LET: p q r s t u v w x z, x1 x2 y1 y2 y3 y4 y5 y6 y7 F

~#y6~~#y3~%y2%y4#x1~(~Fy3y3 + ~(#x2(%y1Fy2y1 & (~Fy2y4 > Fy3x1) &
%y5%y7((Fy5y7 & Fy5x2) + Fy6x2)))) ; (Test.1)

In Meth8, Eq. Test.1 is mapped as:

(~#w&(~~#t&(~%s&(%u&#p)))) & (~(~z&(t&t)) + ~(#q&(((%r&(z&(s&r))) &
((~z&(s&u))>(z&(t&p)))) & ((%v&%x)&(((z&(v&x))&(z&(v&q))) + (z&(w&q))))))) ; (Test.2)
Steps 59 ;

In the repeating fragment below of 32 truth tables (out of 128), Eq. Test.2 has this result.

FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,**FNFN FNFN** FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,**FNFN FNFN** FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,**FNFN FNFN** FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,**FNFN FNFN** FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,
FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,FFFF FFFF FFFF FFFF,

Result. We replicate the test result for FOL Optimizer. The result equation is rendered in pseudo script as:

#x1%y1Fx1y1 (Result.1)

In Meth8, Eq. Result.1 is mapped as:

(#p&%r)&(z&(p&r)) ; ; Steps 9 ; (Result.2)

In the two repeating fragments below, the truth table result of Eq. Result.2 does not match that of Result.1.

FFFF FFFF FFFF FFFF, (For tables 1- 63)
FFFF **FNFN** FFFF **FNFN**. (For tables 64-128)

We conclude that FOL Optimizer is not bivalent.

Refutation of the frequency dependence of mass

Taken from:

Rajna, G. (2014). "The secret of quantum entanglement." vixra.org/pdf/1406.0008v2.pdf; and
Rajna, G. (2018). "Mathematical models of inventions". vixra.org/pdf/1801.0366v1.pdf
Note: We attempted to contact George Rajna, the chess master and physicist, without address.

"The frequency dependence of mass: Since E = hν and E = mc^2, m = hν /c^2 that is the m depends only on the ν frequency." where m = mass, h = Planck's constant, c = speed of light.
Remark: Planck's constant is arguably not exact, but rather a probabilistic estimation.

m = hν /c^2 (1.1)
Remark:m is undefined if either hν or c^2 is zero. (Elsewhere we show 0/n is not 0.)

LET: pqrs cmhv; ~ Not; - Not Or; & And; \ Not And; > Imply; = Equivalence; (p-p) Numeric zero

T is tautology as the designated *proof* value, with F as contradiction
The 16-valued truth tables are presented row-major and horizontally.

Using the Meth8/VŁ4 apparatus and method, we render Eq. 1.1 as

q=((r&s)\(p&p)) ; FFTT FFTT FFTT FFTT (1.2)

Eq. 1.2 is *not* tautologous which means the fractional equation cannot be a theorem.

We attempt to resuscitate Eq. 1.2 by changing the connective of the literal to > Imply.

q>((r&s)\(p&p)) ; TTTT TTTT TTTT TTTF (1.2.1)

Eq. 1.2.1 is *not* tautologous, meaning that Eq. 1.2.1 is not an implication, although nearly so.

We attempt to resuscitate Eq. 1.2 by defining p as not numeric zero ~(p-p):

(p=~(p-p))>(q=((r&s)\(p&p))) ; FFTT FFTT FFTT FFTT (1.3)

Eq. 1.3 is *not* tautologous and results in the same truth table as Eq. 1.2.

We attempt to resuscitate Eq. 1.2 by defining p as numeric zero (p-p):

(p= (p-p))>(q=((r&s)\(p&p))) ; TTTT TTTT TTTT TTTT (1.4)

Eq. 1.4 is tautologous, meaning that in the case of p as numeric zero then Eq. 1.2 is a theorem.

What follows is:

The frequency dependence of mass is *untenable*: Since E = hν and E = mc^2, m = hν /c^2 that is the m depends only on the ν frequency is *not* tautologous.
Hence, the frequency of mass is a suspicious statistic.

Injection, surjection, and bijection functions as bivalent mappings

From: /en.wikipedia.org/wiki/Bijection,_injection_and_surjection

The terminology of injection, surjection, and bijection was due to the Bourbaki group which attempted to recast mathematics onto set theory since 1934. (We prove elsewhere that the axiom of specification as-is is the *only* ZFC axiom that is tautologous.)

We evaluate arguments and images as input and output between domain and codomain for functions defined as injective, surjective, and bijective.

We assume the apparatus and method of Meth8/VŁ4. The designated *proof* value is T; F contradiction; C falsity; N truth. The 16-valued truth tables are row-major and horizontally.

LET: p q r s f x; x', y; X; Y; (X>Y) as (r>s);
~ Not; & And; > Imply, greater than, ⇒; < Not Imply, less than, ∈; = Equivalent to;
# necessity, for all, ∀; % possibility, for one or some, ∃.

We distribute quantified expressions for intended clarity.

Given a function $f : X \rightarrow Y$,

Injective, notationally: $\forall x, x' \in X$, $f(x) = f(x') \Rightarrow x = x'$. (1.1.1)
((#(p&q)<s)&(((r>s)&p)=((r>s)&q))) > ((#(p&q)<s)&(p=q)) ;
TTTT TTTT TTTT TTTT (1.1.2)

Surjective, notationally: $\forall y \in Y$, $\exists x \in X$ such that $y = f(x)$. (2.1.1)
(#(q<s)&(((r>s)&p)=q)) > (#(q<s)&%(p<r)) ; TTTT TTTT TTTT TTTT (2.1.2)

Bijective, notationally: iff for all $y \in Y$, there is a unique $x \in X$ such that $f(x) = y$. (3.1.1)
(#(q<s)&(((r>s)&p)=q))>(#(q<s)&%(p<r)) ; TTTT TTTT TTTT TTTT (3.1.2)

Or the function is *both* injective and surjective: (Eq. 1.1.1) & (Eq. 2.1.1) (3.2.1)
(((#(p&q)<s)&(((r>s)&p)=((r>s)&q))) > ((#(p&q)<s)&(p=q))) &
((#(q<s)&(((r>s)&p)=q)) > (#(q<s)&%(p<r))) ; TTTT TTTT TTTT TTTT (3.2.2)

The equations above as rendered are tautologous.

From the category of sets, injection, surjection, and bijection correspond precisely to monomorphism, epimprophism, and isomorphism; hence the latter are respectively also tautologous.

Gentzen proof of sequent System G-M

Steward, Charles; Stouppa, Phiniki. (2004). A systematic proof theory for several modal logics; also at textproof.com/supervision/phiniki04sbm.pdf

We assume the Meth8 apparatus implementing system variant VŁ4 in five models.

LET: p A; q B; r C; > Imply; + Or; & And; # [] modal necessity; % <> modal possibility.

The designated proof value is T tautology with F contradiction, C contingency (truth), and N non-contingency (falsity). Fragments are repeating rows one and two (of four) in the truth table.

We begin evaluation on pages 313/4, 323 of the text to derive the systems of interest.

K: [](p ⊃q) ⊃([]p ⊃[]q)		(3.1.1)
#(p>q)>(#p>#q) ;	TTTT TTTT	(3.1.2)
Axiom **T**: []p ⊃p		(3.2.1)
#p>q ;	TTTT TTTT	(3.2.2)
M, obtained by extending system **K** with rule **T** [not Gödel's system T]		(3.3.1)
(#(p>q)>(#p>#q))>(#p>q) ;	TCTT TCTT	(3.3.2)

"The strongest system from these modal logics that is perfectly straightforward to formulate in a sequent system and to prove cut-free is system **G-M** (for Gentzen system **M**)".

[We remark that the subsequent derivations of **S4**, **B**, and **S5** are tautologous, as are **K** and **T**.]

"The following lemma is a straightforward exercise in theoremhood over **K**:

LEMMA 6	If A ⊃B is a theorem of **M**, then so are:	(L.6.0.1)
	1. A ∧C ⊃B ∧C;	(L.6.1.1)
	2. A ∨C ⊃B ∨C;	(L.6.2.1)
	3. []A ⊃[]B;	(L.6.3.1)
	4. <>A ⊃<>B."	(L.6.4.1)

To map Eq. L.6.0.1 we use Eq. 3.3.2.

((#(p>q)>(#p>#q))>(#p>q)) > (p>q) ;	TNTT TNTT	(L.6.0.2)

We then reuse Eq. L.6.0.2 to map L.6.1.2 - 6.4.2.

(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > ((p&r)>(q&r)) ;	TTTT TCTT	(L.6.1)
(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > ((p+r)>(q+r)) ;	TCTT TTTT	(L.6.2)
(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > (#p>#q) ;	TCTT TCTT	(L.6.3)
(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > (%p>%q) ;	TCTT TCTT	(L.6.4)

On page 321, "we recommend the reader works through ... for example (A ⊃B ⊃C) ⊃(A ⊃C) ⊃B ⊃C". That equation is also *not* tautologous: ((((p>q)>r)>(p>r))>q)>r ; TFFF TFFF.

We conclude system **G-M** as rendered is not tautologous, and Gentzen-sequent systems are suspicious.

Gettier Problem (Justified tautologous belief)

From: all-that-is-interesting.com/fascinating-unsolved-problems/2

A subject S knows that a proposition P is tautologous if and only if:

P is tautologous, and
S believes that P is tautologous, and
S is justified in believing that P is tautologous.

1. Without modal modifiers:

LET:

s = subject; p = proposition; (p=p) is Tautologous;

(p>(p=p)) for p implies that p is tautologous.

(s>((p=p)) for s believes p is tautologous;

(s&(s>(p=p)) for s is justified in believing p is tautologous;

(s&(p=p)) for s knows p is tautologous.

((p>(p=p))&((s>(p=p))>(s&(s>(p=p))))) > (s&(p=p)) ; tautologous

2. With modal modifiers:

LET also:
\# mean necessity; % possibility

(#p) for necessarily p, that is, for all p

(%s) for possibly s, that is for at least one s

This rewrites (1) as:

(#p&((p>(p=p))&((s>(p=p))>(%s&(s>(p=p)))))) > (#p&(s&(p=p))) ; tautologous

Gödel compactness theorem

From ocw.mit.edu/courses/linguistics-and-philosophy/24-241-logic-i-fall-2005/readings/chp09.pdf

> **Definition.** A set of sentences Ω is a complete story just in case it satisfies
> the following five conditions, for any φ and ψ:
>
> a) (φ ∧ψ) ∈Ω iff φ ∈Ω and ψ ∈Ω.
> b) (φ ∨ψ) ∈Ω iff φ ∈Ω or ψ ∈Ω (or both).
> c) (φ → ψ) ∈Ω iff φ ∉Ω or ψ ∈Ω (or both).
> d) (φ ↔ ψ) ∈Ω iff φ and ψ are both in Ω or neither of them is.
> e) ¬Φ ∈Ω iff φ ∉Ω.

Meth8 mapping is as follows.

LET: p = lc-phi; q = psi; r = uc-omega; s = uc-phi; ¬ ~; ∈ <; ∉ >; ∧&; ∨+; → =; ↔ =.

```
(((p&q)=(p=p))& (  (p<r)&(q<r))                        ) > ((p&q)<r)   ; a.      validated
(((p&q)=(p=p))&((  (p<r)+(q<r)) +(  (p<r)&(q<r)))) > ((p&q)<r)   ; b.      validated
(((p&q)=(p=p))&((  (p>r)+(q<r)) +(  (p>r)&(q<r)))) > ((p >q)<r)   ; c. not validated ; no ~
(((p&q)=(p=p))&((~(p<r)+(q<r)) +(~(p>r)&(q<r)))) > ((p >q)<r)   ; c. not validated
(((p&q)=(p=p))&((  (p<r)&(q<r))+  ((p<r) \ (q<r)))) > ((p =q)<r)   ; d. not validated ; no ~
(((p&q)=(p=p))&((  (p<r)&(q<r))+~((p<r)&(q<r)))) > ((p =q)<r)   ; d. not validated

(       (p=p) &   (p>r)                  )                          > (~s <r)       ; e. not validated ; uc-Phi
(       (p=p) & ~(p<r)                   )                          > (~p <r)       ; e. not validated ; lc-phi
```

Two conditions (a,b) are satisfied (tautologous), and three conditions are not satisfied (not tautologous). This means the five conditions of the compactness theorem are not all satisfied, and hence the Gödel compactness theorem is not tautologous.

Gödel completeness theorem

From en.wikipedia.org/wiki/G%C3%B6del%27s_completeness_theorem#/media/File:Completude%CC%A0_logique_premier_ordre.png

"The formula (∀x. R(x,x)) → (∀x∃y. R(x,y)) holds in all structures. By Gödel's completeness result, it must hence have a natural deduction proof."

(∀x. R(x,x)) → (∀x∃y. R(x,y))

(#x&(r&(x&x))) > ((#x&%y)&(r&(x&y))) ; TTTT CCCC ; *not* tautologous

Godel's completeness theorem is *not* tautologous.

Gödel's first incompleteness theorem

Gödel reduced the liar paradox to a self-referential sentence with an initially unknown truth value:

"This sentence is contradictory." (1.1.1)

We assume the Meth8 apparatus. The designated proof value is T tautology. Other values are: F contradiction; C contingency (a value of falsity); N non-contingency (a value of truth). The results are 16-value truth tables, presented as row major horizontally.

LET: p sentence; = Equivalent to; @ Not equivalent to, XOR; > Imply;
% "This" as meaning a possible instance, the existential quantifier.
(p@p), (p&~p) contradictory; (p=p) tautologous ;

"This sentence is contradictory." (1.1.1)
%(p=(p@p))=(p@p) ; `FNFN FNFN FNFN FNFN` (1.1.2)

If we attempt to weaken the conjecture in Eq. 1.1.1 by using the connective imply >, then the sentence reads:

"This sentence implies falsity." (1.2.1)
%(p>(p@p))>(p@p) ; `FNFN FNFN FNFN FNFN` (1.2.2)

Eqs. 1.1.2 and 1.2.2 are the same truth table, and not tautologous.

The instance of the sentence changing the value of "contradictory" to "tautologous" is:

"This sentence is tautologous." (2.1.1)
%(p=(p=p))=(p=p) ; `CTCT CTCT CTCT CTCT` (2.1.2)

If we attempt to weaken the conjecture in Eq. 2.1.1 by using the connective imply >, then the sentence reads:

"This sentence implies truth": (2.2.1)
%(p>(p>p))>(p>p) ; `TTTT TTTT TTTT TTTT` (2.2.2)

Eqs. 2.1.2 and 2.2.2 are not the same truth table, with 2.2.2 tautologous.

For a conjecture to test both sentences in Eqs. 1.1.1 and 2.1.1, we write the sentence to read:

"This sentence is contradictory", or "This sentence is tautologous".
(3.1.1)

(%(p=(p@p))=(p@p)) + (%(p=(p=p))=(p=p)) ; `CTCT CTCT CTCT CTCT` (3.1.2)

If we attempt to weaken the conjecture in Eq. 3.1.1 by using the connective imply >, then the instance reads:

"This sentence implies falsity", or "This sentence implies truth". (3.2.1)

(%(p>(p@p))>(p@p)) + (%(p>(p>p))>(p>p)) ; `TTTT TTTT TTTT TTTT` (3.2.2)

Limiting an evaluation to the mapping of "is" to mean equivalence, then Eqs. 1.1.1, 2.1.1, and 3.1.1 are not tautologous. This does not confirm the liar's paradox as rendered, and hence shows Gödel's first incompleteness theorem as not tautologous.

On the other hand, if the mapping of "is" relaxes to "implies", then Eqs. 2.2.2 and 3.2.2 are tautologous.

However we are left with the fact that the liar's sentence as written is an equivalency and not an implication.

If Gödel's first incompleteness theorem is not tautologous, then there is no reason to pursue his second incompleteness theorem.

Gödel incompleteness theorems

Zhu, M-Y. (2013). Gödel's incompleteness theorem verified by PowerEpsilon. Technical report. DOI: 10.13140/RG.2.2.31985.6896

This paper relies heavily on the first order logic (FOL) expressions in the text which is a perfect implementation of Gödel's axioms, rules, and theorems in the programming language of PowerEpsilon. With that exposition, Meth8 was capable to validate as tautologous the theorems of Gödel.

LET: p x; q y; s s; # for all; % for some; & And; \ Not And /; > Imply; < Not Imply

The designated proof value is T tautology. Other values are: F contradiction; C contingency (a falsity value); and N non-contingency (a truth value).

Truth tables are presented as the 16-values in row major, horizontally.

When rendering quantified operators from the text to the script of Meth8, we explicitly distribute quantified operators for clarity and portability. For example ∀p . (p ∨¬p) is equivalent to ∀p . (p) ∨ ∀p . (¬p).

We examine FOL expressions to replicate results in the text:

[Section 4.4. FOL axioms replicated and confirmed tautologous.
Section 4.5. FOL inference rules; we stopped at 4.5.2.13 with functions;
then commenced again at 4.5.2.14.1.]

At 4.5.2.15 for universal quantifier:

LET: p X; q Y; r v; s upper_case_Gamma; # for all; % for some

$$\frac{\forall Y . \Gamma \vdash X[Y/v]}{\Gamma \vdash \forall v . X} \qquad (4.5.2.15.1)$$

((#q&s)>(p&(q\r)))>(s>(#r&p)) ; TTTT TTTT TTCT TTTT (4.5.2.15.1.1)

$$\frac{\Gamma \vdash \forall v . X}{\forall Y . \Gamma \vdash X[Y/v]} \qquad (4.5.2.15.2)$$

((s>(#r&p))>(#q&s))>((#q&s)>(p&(q\r))) ; TTTT TTTT TTCT TTCC (4.5.2.15.2.1)

$$\frac{\Gamma \vdash Y \ \Gamma \vdash \forall v . X}{\Gamma \vdash X[Y/v]} \qquad (4.5.2.15.3)$$

((s>q)&(s>(#r&p)))>(s>(p&(q\r))) ; TTTT TTTT TTTT TTTC (4.5.2.15.3.1)

At 4.5.2.16 for existential quantifier:

$$\frac{\exists Y . \Gamma \vdash X[Y/v]}{\Gamma \vdash \exists v . X} \qquad (4.5.2.16.1)$$

((%q&s)>(%q&(p&(q\r))))>(s>(%r&p)) ; `TTTT TTTT CCTC CTTT` (4.5.2.16.1.1)

$$\frac{\Gamma \vdash \exists v \,.\, X}{\exists Y \,.\, \Gamma \vdash X[Y/v]} \tag{4.5.2.16.2}$$

(s>(%r&p))>((%q&s)>(%q&(p&(q\r)))) ; `TTTT TTTT TTTT TTTC` (4.5.2.16.2.1)

$$\frac{\Gamma \vdash Y \quad \Gamma \vdash X[Y\backslash v]}{\Gamma \vdash \exists v \,.\, X} \tag{4.5.2.16.3}$$

((s>q)&(s>(p&(q\r))))>(s>(%r&p)) ; `TTTT TTTT TTTC TTTT` (4.5.2.16.3.1)

At 4.5.2.21 for universal and existential quantifiers:

$$\frac{\Gamma \vdash \neg\forall v \,.\, X}{\Gamma \vdash \exists v \,.\, \neg X} \tag{4.5.2.21.3}$$

(s>(~#r&p))>(s>(%r&~p)) ; `TTTT TTTT TFTF TNTN` (4.5.2.21.3.1)

$$\frac{\Gamma \vdash \neg\exists v \,.\, X}{\Gamma \vdash \forall v \,.\, \neg X} \tag{4.5.2.21.4}$$

(s>(~%r&p))>(s>(#r&~p)) ; `TTTT TTTT TCTC TTTT` (4.5.2.21.4.1)

Meth8 does not replicate those quantified expressions in Sections 4.5.2.15, 4.5.2.16, or 4.5.2.21. Some of the truth tables come close to tautology by pattern.

At 8.2.4 for completeness and incompleteness theorems:

Completeness of logic system:

$$\forall p \,.\, (\exists\Gamma \,.\, \Gamma \vdash p \lor \exists\Gamma \,.\, \Gamma \vdash \neg p) \tag{8.2.3.1}$$

(#p&(%s&(s>p)))+(#p&(%s&(s>~p))) ; `FFFF FFFF FNFN FNFN` (8.2.3.1.1)

Incompleteness of logic system:

$$\exists p \,.\, (\neg\exists\Gamma \,.\, \Gamma \vdash p \land \neg\exists\Gamma \,.\, \Gamma \vdash \neg p) \tag{8.2.3.2}$$

(#p&(~%s&(s>p)))&(#p&(~%s&(s>~p))) ; `FNFN FNFN FFFF FFFF` (8.2.3.2.1)

Completeness of formula set:

$$\forall p \,.\, (\Gamma \vdash p \lor \Gamma \vdash \neg p) \tag{8.2.4.1}$$

(#p&(s>p))+(#p&(s>~p)) ; `FNFN FNFN FNFN FNFN` (8.2.4.1.1)

Incompleteness of formula set:

$\exists p . (\Gamma \not\vdash p \wedge \Gamma \not\vdash \neg p)$ (8.2.4.2

(%p&(s<p))&(%p&(s<~p)) ; `FFFF FFFF FFFF FFFF` (8.2.4.2.1)

Meth8 does not replicate those quantified theorems in Sections 8.2.3 or 8.2.4. Eq. 8.2.4.1 is validated as contradictory.

At Example 6.1, page 105:

"Let p be the string in the formal language S defined by p ≡ ∀y∃x(x = sy)." (1.0)

We ignore the "p = = ", to test the consequent clauses in the 4-variable and 11-variable Meth8 versions.

Meth8-4 for 4-variables (p, q, r, s) produces one 16-value truth table.

p ≡ ∀y∃x(x = sy). (1.0)
(#q&%p)&(p=(s&q)) ; `FFFF FFFF FFFF FFFN` (1.1)

If Eq. 1.1 is weakened by replacing the equivalent connective = with the imply connective, we have:

(#q&%p)&(p>(s&q)) ; `FFFF FFFF FFFN FFFN` (1.1.1)

In the truth table for Eq. 1.1, `FFFF FFFF FFFF FFFN` , we notice the result is nearly a contradiction except for the one truth value of `N` non-contingency.

While Meth8 validates Peano arithmetic as tautologous elsewhere here, the particular Eq. 1.1 is *not* tautologous.

Gödel incompleteness theorem: contradictions in FOL

The Gödel incompleteness theorem (Meyer, 2014) contains examples of two contradictions in first order logic (FOL), as an axiom in system P and a proposition for generic schema.

> We assume the Meth8 apparatus implementing variant system VŁ4 for:
> T tautology (designated proof value); F contradiction; C contingency (falsity); N non-contingency (truth). Truth table results in 16-values are row-major and horizontally.

1. "This axiom represents the axiom of reducibility (the axiom of comprehension of set theory)" in formal system P, Section 2, Proposition IV.1:

$(\exists u)(v \ \forall(u(v) \equiv a))$ (2.4.1.0)

LET: p r s a u v ; % existential quantifier, # universal quantifier, as undistributed

%r&(s&#((r&s)=p)) ; `FFFF FFFF FFFF FNFN` (2.4.1.1)

LET: p r s a u v ; % existential quantifier, # universal quantifier, as distributed

(%r&s)&(%r&((#r&#s)=#p)) ; `FFFF FFFF CCCC CTCT` (2.4.1.2)

Eqs. 2.4.1.1 and 2.4.1.2 are not tautologous.

2. "Relation (class) is called arithmetical" in Section 3, Proposition 6:

$x > y \equiv \sim(\exists z)[y = x+z]$; (3.6.0)

LET: p q r x y z ; % existential quantifier, as undistributed

(p>q)=(~%r&(q=(p+r))) ; `NTFN FTFF NTFN FTFF` (3.6.1)

LET: p q r x y z ; % existential quantifier, as distributed

(p>q)=((~%r&q)=(~%r&(p+r))) ; `TNCT TFTT TNCT TFTT` (3.6.2)

Eqs. 3.6.1 and 3.6.2 are not tautologous.

Using Meth8-VŁ4 we can not find tautology in these examples. We conclude that the use of quantified operators by Gödel was mistaken as inconsistent, or not bivalent, or both.

References

Meyer, J.R. 2014. Meltzer's English translation of "Über formal unentscheidbare Sätze der Principia Mathematica und verwandter Systeme I". jamesrmeyer.com/pdfs/godel-original-english.pdf.

Gödel incompleteness theorems: Evaluation of computer assisted proofs

To better evaluate computer assisted proofs of Gödel incompleteness theorem(s), we ask two questions.

Q1. Are there refutations of Gödel incompleteness theorems using proof assistants?; and

Q2. In the PowerEpsilon proof language (Zhu, 2013), what is the first mistake found, and does it color the results?

We answer:

A1.1 The website jamesrmeyer.com/ffgit/representability.html shows that first order logic (FOL) can be represented mistakenly in numeric symbols. Used as examples are objections to Gödel theorems at:

jamesrmeyer.com/pdfs/ff_harrison.pdf
jamesrmeyer.com/pdfs/ff_oconnor.pdf
jamesrmeyer.com/pdfs/ff_shankar.pdf

Each assessment is negative for the computer assisted tool in evaluation of the theorems. The reasons rely on set theory to show a mixing of number domains as the cause of misrepresentation, with the effective admonition against the proof assistants of garbage-in, garbage-out.

The website proffers no assisted proof tool, alternative or original, to those abandoned. The website publishes logical verbiage as contra arguments to the incompleteness theorems. Unfortunately there are no clear FOL expressions proffered for mapping into renditions suitable to test, as in those very proof assistants so abandoned. In other words, the negated proof tools are not allowed to evaluate the arguments proposed by the website.

Unfortunately none of the website papers is peer reviewed which we could recognize or presented elsewhere on academic forums for comments.

A1.2 The website does not evaluate PowerEpsilon, so we supplied a copy of (Zhu, 2013) with the question of: "What is mistaken in this monograph". Due to no timely response, a complaint invoked by the website on others, we concluded that the website found no logical mistakes in (Zhu, 2013). This led us to ask Q2.

A2. The first equation we evaluated in (Zhu, 2013) was for induction that we validated as tautologous using Meth8-VŁ4 (James III, 2017).

The next expression in the text is the FOL axiom of the law of excluded middle (LEM):

$$\forall P \,.\, P \vee \neg P \qquad (2.1)$$

We assume the Meth8 apparatus, where the designated proof value is T tautology. Truth tables are in 16-values as presented row major and horizontally.

LET: # ∀; p P; + Or; ~ Not; = Equivalent to; (p=p) Tautology.

$$\forall P \,.\, P \vee \neg P \qquad (2.1)$$

(#p&(p+~p)) = (p=p) ; FNFN FNFN FNFN FNFN (2.1.1)

Eq. 2.1.1 is not tautologous.

We distribute the universal quantifier directly to the variable in the antecedent at Eq. 2.1.1:

(#p+#~p) = (p=p) ; `FNFN FNFN FNFN FNFN` (2.1.2)

The result of Eq. 2.1.2 and 2.1.1 is the same, as not tautologous.

We are reminded that the LEM without the universal quantifier is:

(p+~p) = (p=p) ; `TTTT TTTT TTTT TTTT` (2.1.3)

Eq. 2.1.3 is tautologous.

We attempt to coerce the universal quantifier onto the LEM to make it tautologous as follows:

(#(p+~p)=#(p=p))) = (p=p) ; `TTTT TTTT TTTT TTTT` (2.1.4)

Eqs. 2.1.4 is tautologous.

We conclude that Eq. 2.1 is mistaken.

For the second part of Q2, does Eq. 2.1, now as not tautologous, affect the resulting conclusion in PowerEpsilon to prove the theorem(s) of incompleteness? We conclude Eq. 2.1 has no affect. Our reasoning is that the Gödel formulas are mistaken, due to non-uniform representation of quantification, but mapped with fidelity by PowerEpsilon. In other words, the source of error is fully with Gödel.

References

James III, C. 2017. PowerEpsilon mathematical induction. Technical report.)

Zhu, M-Y. 2013. Gödel's incompleteness theorem verified by PowerEpsilon. Technical report. DOI: 10.13140/RG.2.2.31985.6896

The shortest refutation of Gödel's theorem of incompleteness

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to;
@ Not equivalent to; # all; % some; (p@p) 00, zero; (p=p) 11, one

Results are the proof table of 16-values in row major, horizontally.

We define:

"a sentence" as p (0.0)
p ; `FTFT FTFT FTFT FTFT` (0.1)

We assert for clarity an expression cast in the positive using *a*s for a fragment of implication, instead of *is* for a sentence of equivalency, and inserting the modal operator of necessity:

"The necessity of 'This sentence as a proof'." (1.1)
#(p > (p=p)) ; `NNNN NNNN NNNN NNNN` (1.2)

Systems of two- or three-valued logic are insufficient to capture the complete informational content of Eq. 1.1 for subsequent discourse. We also avoid testing the more complicated instance forced by assignment of Eq. 1.1 to another variable by inserting the modal operator of possibility:

"Possibly a sentence implies the necessity of 'This sentence as a proof'." (2.1)
%p > #(p > (p=p)) ; `NNNN NNNN NNNN NNNN` (2.2)

This means Eq. 2.1 is an axiom with a truth value of N for non-contingency (as opposed to a falsity value of C for contingency), but not a theorem with truth value of T for tautology. This contradicts Gödel's theorem of incompleteness, where Eq. 2.2 should a refutation with truth value of F for contradiction.

We test the common contra-example for 'This sentence as not a proof'. We rewrite Eqs. 1.1-2.2:

"The necessity of 'This sentence as not a proof'." (3.1)
#(p > ~(p=p)) ; `NFNF NFNF NFNF NFNF` (3.2)

"Possibly a sentence implies the necessity of 'This sentence as not a proof'." (4.1)
%p > #(p > ~(p=p)) ; `NFNF NFNF NFNF NFNF` (4.2)

This means Eq. 4.2 is not an axiom or a theorem. This contradicts Gödel's theorem of incompleteness, where

Eq. 4.2 should be a theorem with truth value of T for tautology.

Remark: In quantified terms, Eqs. 2.1 and 4.1 with the same results alternatively read:

"Some sentence implies all instances of 'This sentence as a proof'." (5.1)
"Some sentence implies all instances of 'This sentence as not a proof'." (6.1)

Our examples show the shortest refutation for Gödel's incompleteness theorem.

Gödel-Löb Axiom

This example replicates the proof for provability logic of the Gödel-Löb axiom GL as $\Box(\Box p \rightarrow p) \rightarrow \Box p$. If p is "*choice*", this transcribes in words to: "The necessity of *choice*, as always implying *a choice*, implies always *a choice*."

The axiom transcribes to #(#p>p)>#p for test input to Meth8 with output in Tab. 6. Model 2.2 is validated as one of five models. Hence by VŁ4 the Gödel-Löb axiom is suspect.

For the GL axiom to be validated in five of five models, the expression is rewritten as $\Box(\Box p \rightarrow p) \leftrightarrow (p \vee \neg p)$, in words: "The necessity of *choice*, as always implying *a choice*, is equivalent to always *a choice* or *no choice*."

A simpler rendition of a validated GL-type axiom is either $\Box(\Box\neg p \rightarrow p) \leftrightarrow \Box p$ or $\Box(\Box p \rightarrow \neg p) \leftrightarrow \Box\neg p$ as respectively in words: "The necessity of *no choice*, as always implying *a choice*, is equivalent to always *a choice*."; or "The necessity of *choice*, as always implying *no choice*, is equivalent to always *no choice*."

If GL fails, then so also does Zermelo-Fraenkel set theory and axiom of choice (ZFC) as the basis of modern mathematics.

Table 6

Test input as processed is: #(#p>p)>#p				
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
#p				
FNFN	UEUE	UUUU	UIUI	UPUP
p				
FTFT	UEUE	UEUE	UEUE	UEUE
#(#p>p)				
NNNN	EEEE	UUUU	IIII	PPPP
#p				
FNFN	UEUE	UUUU	UIUI	UPUP
#(#p>p)>#p ; not validated tautologous				
CTCT	UEUE	EEEE	PEPE	IEIE
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

Gödel pairing function (pairing axiom)

From: math.uni-bonn.de/people/koepke/Preprints/Computing_a_model_of_set_theory.pdf

$\forall\alpha, \beta, \gamma(g(\beta, \gamma) \leq \alpha \leftrightarrow \forall\delta, ((\delta,) <\ast(\beta, \gamma) \rightarrow g(\delta,) < \alpha)).$ (1.1)

LET: p q r s t u v $\alpha\ \beta\ \gamma\ \delta\ \theta\ \eta$ g

#p,q,r(v(q,r)≤p = #s, ((s,) < * (q,r) > v(s,) < p)). (1.2)
#((p&q)&r) & (~((v&(q&r))>p)=(#s&((s< *(q,r))>((v&s)<p)))) ;
#((p&q)&r) & (~((v&(q&r))>p)=(#s&((s<(q&r))>((v&s)<p)))) ; `FFFF FFFN FFFF FFFF` (1.3)

#((p&q)&r) & (~((v&(q&r))>p)=(#s&((s<(q&r))>((v&s)<p)))) ;
(#((p&q)&r) &~((v&(q&r))>p))=(#((p&q)&r) &(#s&((s<(q&r))>((v&s)<p)))) ; (#((p&q)&r) distributed; `TTTT TTTT TTTT TTTC` (1.4)

(#((p&q)&r) &~((v&(q&r))>p))=(#((p&q)&r) &(#s&((s<(q&r))>((v&s)<p)))) ; (#((p&q)&r) distributed, (s<(q&r)) replaced by Eq 2.2, a tautology, from farther below

((%u&t)&(((p>q)&(u=p)+(~(p>q)&(u=q)))&(((r>s)&(t=r))+(~(r>s)&(t=s)))&((u<t)+ (((u=t)&(p<r)))+(((u=t)&(p =r))&(q<s))))) as: (2.2)

(#((p&q)&r) &~((v&(q&r))>p))=(#((p&q)&r) &(#s&((%u&t)&(((p>q)&(u=p)+ (~(p>q)&(u=q)))&(((r>s)&(t=r))+(~(r>s)&(t=s)))&((u<t)+(((u=t)&(p<r)))+(((u=t)&(p =r))&(q<s)))))>((v&s)<p)))) ; `TTTT TTTT TTTT TTTC` (1.5)

Eq. 1.5 is nearly barely *not* tautologous with the contingency C value of falsity.

Here $(\alpha, \beta) <\ast(\gamma, \delta)$ stands for (p,q) < * (r, s) (2.1)

$\exists\eta, \theta(\eta = \max(\alpha, \beta) \wedge\theta = \max(\gamma, \delta) \wedge(\eta < \theta \vee(\eta = \theta \wedge\alpha < \gamma) \vee(\eta = \theta \wedge\alpha = \gamma \wedge\beta < \delta))),$
$\exists\eta, \theta(((\alpha > \beta) \wedge(\eta = \alpha)) \vee((\alpha \leq \beta) \wedge(\eta = \beta))) \wedge(((\gamma > \delta) \wedge(\theta = \gamma)) \vee((\gamma \leq \delta) \wedge(\theta = \delta))) \wedge((\eta < \theta) \vee (((\eta = \theta) \wedge(\alpha < \gamma))) \vee((\eta = \theta) \wedge(\alpha = \gamma) \wedge(\beta < \delta)))),$

where $\gamma = \max(\alpha, \beta)$ abbreviates $(\alpha > \beta \wedge\gamma = \alpha) \vee(\alpha \leq \beta \wedge\gamma = \beta)$;
where $\eta = \max(\alpha, \beta)$ abbreviates $(\alpha > \beta \wedge\eta = \alpha) \vee(\alpha \leq \beta \wedge\eta = \beta)$;
where $\theta = \max(\gamma, \delta)$ abbreviates $(\gamma > \delta \wedge\theta = \gamma) \vee(\gamma \leq \delta \wedge\theta = \delta)$;

(%u&t)&(((p>q)&(u=p)+(~(p>q)&(u=q)))&(((r>s)&(t=r))+(~(r>s)&(t=s)))&((u<t)+ (((u=t)&(p<r)))+(((u=t)&(p =r))&(q<s)))) ; `TTTT TTTT TTTT TTTT` (2.2)

Eq. 3.2 is tautologous.

Gödel Recursion

From Xaver Y. Newberry (2016), "The Recursion Theorem from a Different Angle" we map into Meth8 script the formula for the diagonal lemma following Table 2 of the text as below.

~(Ex)(Prf(x,<#~(Ex)(Ey)((Prf(x,y)&This(y) #>) <==> ~(Ex)(Ey)((Prf(x,y)&This(y)) (0)

LET: % E, p Prf, t This, This(y) = (t&y) = (~(%x&%y)&((p&(x&y))&(t&y))),
vt tautologous, nvt not tautologous;
T Tautologous, E Evaluated, F Contradictory,
U Unevaluated [values are FCNT, UIPE as 00, 10, 01, 11]

(((t&y) = (~(%x&%y)&((p&(x&y))&(t&y)))) & (~%x&(p&(x&(t&y))))) =
(((t&y) = (~(%x&%y)&((p&(x&y))&(t&y))))&(t&y)) ; vt (1)

The truth table for Eq 1 in the five models of Meth8 is below:

```
TTTT TTTT TTTT TTTT   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE
(((t&y)=(~(%x&%y)&((p&(x&y))&(t&y))))&(#~x&(p&(x&(t&y)))))=(((t&y)=(~(%x&%y)&((p&(x&y))&(t&y))))&(t&y))
Step: 49
```

We include the definition of (t&y) for both the antecedent and consequent groups to ensure the repeated (t&y) is present; without that the expression is nvt.

This confirms that Eq 0 is tautologous.

Gödel-Scott on God

From:

Christoph Benzmüller, Bruno Woltzenlogel Paleo. (2003). "Formalization, Mechanization and Automation of Gödel's Proof of God's Existence". DOI: 10.3233/978-1-61499-419-0-93. arxiv.org/abs/1308.4526.

These assertions are attributed to the rendering of Gödel's expressions by Dana S. Scott (unpublished, 2004), where A axiom, T theorem, and D definition:

A1.1 Either a property or its negation is positive, but not both:
$\forall\varphi[P(\neg\varphi) \leftrightarrow \neg P(\varphi)]$

A2.1 A property necessarily implied by a positive property is positive:
$\forall\varphi\forall\psi[(P(\varphi) \wedge \forall x[\varphi(x) \rightarrow \psi(x)]) \rightarrow P(\psi)]$

T1.1 Positive properties are possibly exemplified:
$\forall\phi[P(\phi) \rightarrow \blacklozenge\exists x\phi(x)]$

D1.1 A God-like being possesses all positive properties:
$G(x) \leftrightarrow \forall\varphi[P(\varphi) \rightarrow \varphi(x)]$

A4.1 Positive properties are necessarily positive:
$\forall\varphi[P(\varphi) \rightarrow P(\varphi)]$

The Meth8 mapping is below with repeating fragments of truth tables.

LET:
¬ ~, # ∀, % ∃, % ♦, ∧ &, → >, ↔ =, p P, t G, x x, φ q, ψ r, nvt not tautologous, vt ~nvt.

A1.2 (#q&(p&~q))=(#q&(~p@q)) ; nvt

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTC TTTC TTTC TTTC  EEEU EEEU EEEU EEEU  EEEE EEEE EEEE EEEE  EEEP EEEP EEEP EEEP  EEEI EEEI EEEI EEEI
```

A2.2 ((#q&#r)&((p&q)&#(#x&((q&x)>(r&x))))) >((#q&#r)&(p&r)) ; vt

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
```

T1.2 (#q&(p&q))=(#q&%(%x&(q&x))) ; nvt;

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTC TTTC TTTC TTTC  EEEU EEEU EEEU EEEU  EEEE EEEE EEEE EEEE  EEEP EEEP EEEP EEEP  EEEI EEEI EEEI EEEI
TTCT TTCT TTCT TTCT  EEUE EEUE EEUE EEUE  EEEE EEEE EEEE EEEE  EEPE EEPE EEPE EEPE  EEIE EEIE EEIE EEIE
```

D1.2 (t&x)=(#q&((p&q)>(q&x))) ; nvt

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTCC TTCC TTCC TTCC  EEUU EEUU EEUU EEUU  EEEE EEEE EEEE EEEE  EEPP EEPP EEPP EEPP  EEII EEII EEII EEII
FFNN FFNN FFNN FFNN  UUEE UUEE UUEE UUEE  UUUU UUUU UUUU UUUU  UUII UUII UUII UUII  UUPP UUPP UUPP UUPP
TTCT TTCT TTCT TTCT  EEUE EEUE EEUE EEUE  EEEE EEEE EEEE EEEE  EEPE EEPE EEPE EEPE  EEIE EEIE EEIE EEIE
```

A4.2 (#q&(p&q))=(#q&#(p&q)); vt

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
```

We ask if (A1.1 & A2.1) > T1.1, that is: (A1.2 & A2.2) > T1.2.

(((#q&(p&~q))=(#q&(~p@q))) &
(((#q&#r)&((p&q)&#(#x&((q&x)>(r&x)))))>((#q&#r)&(p&r))) >
((#q&(p&q))=(#q&%(%x&(q&x)))) ; nvt

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTCT TTCT TTCT TTCT  EEUE EEUE EEUE EEUE  EEEE EEEE EEEE EEEE  EEPE EEPE EEPE EEPE  EEIE EEIE EEIE EEIE
```

We ask if (A1.1 > A2.1) > T1.1, that is: (A1.2 > A2.2) > T1.2.

(((#q&(p&~q))=(#q&(~p@q))) >
(((#q&#r)&((p&q)&#(#x&((q&x)>(r&x)))))>((#q&#r)&(p&r))) >
((#q&(p&q))=(#q&%(%x&(q&x)))) ; nvt

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTC TTTC TTTC TTTC  EEEU EEEU EEEU EEEU  EEEE EEEE EEEE EEEE  EEEP EEEP EEEP EEEP  EEEI EEEI EEEI EEEI
TTCT TTCT TTCT TTCT  EEUE EEUE EEUE EEUE  EEEE EEEE EEEE EEEE  EEPE EEPE EEPE EEPE  EEIE EEIE EEIE EEIE
```

Our results are summarized as:

R1 A1, T1, and D1 are not tautologous.
R2 A2 and A4 are tautologous.
R3 A1 and A2 does not imply T1.
R4 A1 implying A2 does not then imply T1.

We conclude that the Gödel-Scott proof of God is not tautologous, as advertised in the popular press.

Our attempts to collaborate with Benzüller, Paleo, and Scott, so as to replicate their tool results, failed.

Goldbach's conjectures

Noheda, Pedro; Tabarés, Nuria. 2017. "A primordial, mathematical, logical and computable, demonstration (proof) of the family of conjectures known as Goldbach´s"
From: researchgate.net/publication/315793002_A_primordial_mathematical_logical_and_computable_demonstration_proof_of_the_family_of_conjectures_known_as_Goldbachs

We evaluated the beginning of this conference paper using Meth8 modal logic model checker, based on Łukasiewicz variant system VŁ4 of our resuscitation, with negative results, so we stopped.

Troubling was early on page 8 with the equation following this text :

"Thus, we were able to state about natural numbers (0) and one (1) the following:
(((0∈N[0⊂PA] **∧ 0**∈ N[0⊄PA]**) ∧(1**∈N[0⊂PA] **∧** N[0⊄PA]**)** [1]
∨ (((0∈N[0⊂PA] ∩ N[0⊄PA]**) ∧(1**∈N[0⊂PA] ∩ N[0⊄PA]**)** [2]
→ **(**N[0⊄PA] ⊂N[0⊂PA]**))**" [3]

We label the unnumbered equation parts as follows. Eq 1 Or Eq 2 Implies Eq 3. Eq 1 has antecedent 1.1 And consequent 1.2. Eq 2 has antecedent 2.1 And consequent 2.2.

Meth8 makes no distinction between set operators and Boolean operators. Therefore Eq 1.2 is equivalent to Eq 2.2. Because both Eq 1.2 and 2.2 are antecedents connected by Or between Eq 1 and Eq 2, we can remove Eq 1.2 and Eq 2.2. This reduces to Eqs: (1.1 Or 2.1) Implies 3. This means explicit reference to natural number (1) is removed logically, and the equation describes only natural number (0).

LET: ~ Not; q = 0<PA; ~q = ~(0<PA); > Imply, greater than; < member of, less than, Not Imply; = Equivalent; @ Not Equivalent; & And; + Or; 0 ((%p>#p)-(%p>#p)); ~(q<q) = (q>q)+(q=q).

The designated truth value is T for tautology, and opposite F for contradiction. Result fragments are a repeating row from a 16-value truth table.

p ; FTFT
q ; FFTT
~q ; TTFF *
((%p>#p)-(%p>#p)) ; CCCC
~(((%p>#p)-(%p>#p))<~q) ; TTNN
(~q<q) ; TTFF *
Eq 1: (((%p>#p)-(%p>#p))<q)&~(((%p>#p)-(%p>#p))<~q) ; CCFF
Eq 2: (((%p>#p)-(%p>#p))<~q)&~q ; FFFF
Eq 3: ~q ; TTTT
Eq 4: Eq 1 + Eq 2 = Eq 3: (((((%p>#p)-(%p>#p))<q)&~(((%p>#p)-(%p>#p))<~q))+((((%p>#p)-(%p>#p))<~q)&~q)) > ~q ; TTTT

We conclude that while Eq 4 is proved in the weakest form of implication where two contradictory expressions imply a tautologous one, Eq 4 relates only to natural number (0), and hence excludes proof also of natural number (1).

What follows is that the text statement in italics "We are able to define both, the union and the intersection of both [~q] and [q]" is not mistaken. What follows correctly is that contradictory antecedent Eq 1 Or contradictory consequent Eq 2 Implies a tautologous result Eq 3 for natural number (0), only.

The Grassmannian paradox

A paradox arises for the Grassmannian **Gr**(r,V) in the short exact sequence and the dual, from en.wikipedia.org/wiki/Grassmannian:

> Every r-dimensional subspace W of V determines an $(n - r)$-dimensional quotient space V/W of V. This gives the natural *short exact sequence*:
>
> $0 \rightarrow W \rightarrow V \rightarrow V/W \rightarrow 0.$ (1)
>
> Taking the *dual* to each of these three spaces and linear transformations yields an inclusion of $(V/W)^*$ in V^* with quotient W^*:
>
> $0 \rightarrow (V/W)^* \rightarrow V^* \rightarrow W^* \rightarrow 0.$ (2)
>
> Using the natural isomorphism of a finite-dimensional vector space with its double dual shows that taking the dual again recovers the original short exact sequence.

We map Eq 1 and 2 into Meth8 script. The keyed truth table fragments follow on the next page and are informative.

LET: v=V=V*; w=W=W*; → Imply (>); \ Not And; = Equivalent;
0 zero ((u\u)-(u\u)) ; nvt not tautologous

(((((u\u)-(u\u))>(v\w))>v)>w) > ((u\u)-(u\u)) ; nvt (1.1)
(((((u\u)-(u\u))>w)>v)>(v\w)) > ((u\u)-(u\u)) ; nvt (2.1)

We test if Eq 1.1 and 2.1 are equivalent:

((((((u\u)-(u\u))>w)>v)>(v\w))>((u\u)-(u\u))) =
((((((u\u)-(u\u))>(v\w))>v)>w)>((u\u)-(u\u))) ; nvt (3)

Eq 1.1 and 2.1 are not equivalent.

We then test if Eq 1.1 implies 2.1:

((((((u\u)-(u\u))>w)>v)>(v\w))>((u\u)-(u\u))) >
((((((u\u)-(u\u))>(v\w))>v)>w)>((u\u)-(u\u))) ; nvt (4)

Eq 1.1 does not imply 2.1 (and because of 3, 2.1 also does not imply 1.1). Therefore from Eq 3 and 4, the *short exact sequence* and the *dual* of the Grassmannian **Gr**(r,V) are a paradox. This renders such a theory of vector analysis in physics as suspicious.

Truth table fragments are keyed to the above Eq 1.1, 2.1, 3, 4. We note that Eq 4, meaning the short exact sequence implies the dual, approaches a proof, but fails with 2 of the 16 table lines as F contradictory and Unevaluated.

(1.1) `(((((u\u)-(u\u))>w)>v)>(v\w))>((u\u)-(u\u))` Step: 23

Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE

(2.1) `(((((u\u)-(u\u))>(v\w))>v)>w)>((u\u)-(u\u))` Step: 23

FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE

(3) `((((((u\u)-(u\u))>w)>v)>(v\w))>((u\u)-(u\u)))=((((((u\u)-(u\u))>(v\w))>v)>w)>((u\u)-(u\u)))` Step: 47

TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE

(4) `((((((u\u)-(u\u))>w)>v)>(v\w))>((u\u)-(u\u)))>((((((u\u)-(u\u))>(v\w))>v)>w)>((u\u)-(u\u)))` Step: 47

TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
FFFF FFFF FFFF FFFF	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**	**UUUU UUUU UUUU UUUU**
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

Refutation of the Heisenberg principle of uncertainty by mathematical logic

The Heisenberg principle of uncertainty is written with h for an approximation of Planck's constant as

$$\sigma(X) * \sigma(p) \geq (h/(4*\pi)) \qquad (1)$$

From Eq. 1 we rewrite it as

$$(h/(4*\pi)) * \sigma(X) * \sigma(p) \geq 1 \qquad (2)$$

Eq. 2 may be stated in the negative as Not < 1 as

$$\text{Not } [(h/(4*\pi)) * \sigma(X) * \sigma(p) < 1] \qquad (3.1)$$

Assuming the apparatus and method of Meth8/VŁ4, we map Eq. 3.1 below.

LET: p q r s p, X, (h/(4*π)), σ;
~ Not; & And, *; \ Not And; > Imply; < Not Imply, less than; = Equivalent to;
# Necessity, for all; % Possibility, for some (one);

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

(%p>#p) 1; (p=p) T tautology, as the designated *proof* value.

The 16-valued truth table is presented row-major and horizontally.

~((r&((s&q)&(s&p))) < (%p>#p)) = (p=p) ; `TTTT TTTT TTTN TTTN` (3.2)

It is permissible to remove the r term because it is a scalar constant.

~(((s&q)&(s&p)) < (%p>#p)) = (p=p) ; `TTTT TTTT TTTN TTTN` (3.3)

Eqs. 3.2 and 3.3 result in the same truth table, rendering Eq. 2 as *not* tautologous.

This means the Heisenberg uncertainty principle is untenable.

Henkin applications to logic

From: J Donald Monk, [ca 1986], "Leon Henkin and cylindric algebras" at euclid.colorado.edu/~monkd/monk85.pdf.

"Cylindric algebras are abstract algebras which stand in the same relationship to first-order logic as Boolean algebras do to sentential logic."

From pages 6-7, with Meth8 scripts and results inserted as N.n equation numbers.

LET # $\forall$, % $\exists$, p ϕ, q ψ, r r, u F, v G, x x, y y, ~ $\neg$, + $\vee$, & $\wedge$, > $\rightarrow$, = =, = $\leftrightarrow$,
vt tautologous, nvt not tautologous

"In [67] Henkin considers first-order logic with only finitely many variables. In the case of just two variables x and y, he proves that the formula

$\exists x(x = y \wedge \exists yGxy) \rightarrow \forall x(x = y \rightarrow \exists yGxy)$ (2.1)
(%x&((x=y)&((%y&v)&(x&y)))) > (#x&((x=y)>((%y&v)&(x&y)))) ; nvt (2.2)

is universally valid but not derivable from the natural axioms (restricted to two variables). Here G is a binary relation symbol.

The non-derivablity is proved using a modified cylindric set algebra. This example suggests adding all formulas of the following forms to the axioms for two-variable logic:

(1) $\exists x(x = y \wedge \phi) \rightarrow \forall x(x = y \rightarrow \phi)$ (3.1)
(%x&((x=y)&p)) > (#x&((x=y)>p)) ; nvt (3.2)

$\exists y(x = y \wedge \phi) \rightarrow \forall y(x = y \rightarrow \phi)$ (4.1)
(%y&((x=y)&p)) > (#y&((x=y)>p)) ; nvt (4.2)

Henkin shows, again using a modified cylindric set algebra, that this axiom system is also incomplete; the following universally valid formula is not provable in the expanded axiom system:

$\exists xFx \wedge \forall x\forall y[Fx \wedge Fy \rightarrow x = y] \rightarrow [\exists x(Fx \wedge Gxy) \leftrightarrow \forall x(Fx \leftrightarrow Gxy)]$ (5.1)
((%x&(u&x))&((#x&#y)&(((u&x)&(u&y))>(x=y)))) >
((%x&((u&x)&(v&(x&y))))=(#x&((u&x)=(v&(x&y))))) ; vt (5.2)

An analysis of this situation leads to adding the following formulas to the axioms:

(2) $\exists x\forall y(\phi \leftrightarrow y = x) \rightarrow [\exists y(\phi \wedge \psi) \leftrightarrow \forall y(\phi \rightarrow \psi)]$ with x not free in ϕ
[x not free in ϕ is ~%x&ϕ] (6.1)
((~%x&p)&((%x&#y)&(p=(y=x)))) > ((~%x&p)&((%y&(p&q))=(#y&(p>q)))) ; vt (6.2)
$\exists y\forall x(\phi \leftrightarrow x = y) \rightarrow [\exists x(\phi \wedge \psi) \leftrightarrow \forall y(\phi \rightarrow \psi)]$ with y not free in ϕ
[y not free in ϕ is ~%y&ϕ] (7.1)
((~%y&p)&((%y&#x)&(p=(x=y)))) > ((~%y&p)&((%x&(p&q))=(#y&(p>q)))) ; vt (7.2)

But again the resulting axiom system is not complete. By another modified cylindric set algebra Henkin shows that the following formula is universally valid but not derivable in this axiom system:

$\exists xGxy \leftrightarrow \exists x(x = y \wedge \exists yGyx).$ (8.1)
(%x&(v&(x&y))) = (%x&((x=y)&((%y&v)&(y&x)))) ; vt (8.2)

Finally, adding the following axioms results in a complete axiom system:

$\exists x\phi \leftrightarrow \exists x(x = y \wedge \exists y\phi r)$ (9.1)
(%x&p) = (%x&((x=y)&(%y&(p&r)))) ; nvt (9.2)

$\exists y\phi \leftrightarrow \exists y(y = x \wedge \exists y\phi r)$ [probably should read ... $\exists x\phi r$] (10.1)
(%y&p) = (%y&((y=x)&(%y&(p&r)))) ; nvt [... *(%x&(p&r))* ; nvt] (10.2)

where ϕr is recursively defined by interchanging x and y if ϕ is atomic, with

$(\neg\phi)r = \neg\phi r,$ (11.1)
(~p&r) = ~(p&r) ; nvt [but (~p&r) = (~p&r) ; vt] (11.2)

$(\phi \vee \psi)r = \phi r \vee \psi r,$ (12.1)
((p+q)&r) = ((p&r)+(q&r)) ; vt (12.2)

$(\exists x\phi)r = \exists y(x = y \wedge \exists x\phi)$, and (13.1)
((%x&p)&r) = (%y&((x=y)&(%x&p))) ; nvt (13.2)

$(\exists y\phi)r = \exists x(x = y \wedge \exists y\phi)$; [probably should read ... $\wedge \exists x\phi$] (14.1)
((%y&p)&r) = (%x&((y=x)&(%y&p))) ; nvt [... *&(%x&p)* ; nvt] (14.2)

The proof of completeness of the resulting axiom system is rather involved, but is completely carried out.

It is shown that the above axioms do not suffice for logic with three variables."

Results from Meth8 conclude that out of the 14 axioms above, 8 are not tautologous (1-4,9-10, 12-14).

Consequently, Henkin's proof of Eq 2 is not tautologous for two variables and is not universally valid.

This means the application to logic of cylindric algebras to first order logic is suspicious.

Henkin: Validation of permutation model in non-representable cylindric algebra

From: J Donald Monk, [ca 1986], "Leon Henkin and cylindric algebras" at euclid.colorado.edu/~monkd/monk85.pdf.

The problem is taken from an unnumbered equation on page 5 where with Meth8 scripts and results inserted as N.2 equation numbers.

> "the following inequality (which can be written as an equation) holds in every representable CAα with $\alpha \geq 3$ but fails in a permutation model:"
>
> $c_0x \cdot c_1y \cdot c_2z \leq c_0c_1c_2[c_2(c_1x \cdot c_0y) \cdot c_1(c_2x \cdot c_0z) \cdot c_0(c_2y \cdot c_1z)]$. (1.1)
>
> LET p c0, q c1, r c2, x x, y y, z z
>
> (((p&x)&(q&y))&(r&x)) =
> (((p&w)&r) & (((r&((q&x)&(p&y))) & (q&((r&x)&(q&x)))) & (p&((r&y)&(q&z)))));
> vt (1.2)

Eq 1.2 as an equivalency is tautologous, and hence also holds for < Imply and > Not Imply.

Hence Eq 1.2 is not an inequality but also holds in a permutation model.

This means the assertion that the inequality fails is not validated.

Herbrand semantics

From Genesereth, M; Kao, E. "The Herbrand manifesto: thinking inside the box". 2015. ;

logic.stanford.edu/herbrand/manifesto.htmllogic.stanford.edu/herbrand/manifesto.html

"4. Curiouser and Curiouser ...

"The typical approach in relational logic would be to write the definition shown here.

∀x.∀z.(q(x,z) ⇔p(x,z) ∨∃y.(p(x,y) ∧q(y,z))) (1.1)

The Meth8 script maps Eq 1.1 as:

LET: u qh (the helper relation); n v;
necessity, universal quantifier∀; % possibility, existential quantifier ∃;
= Equivalent to ⇔; & And ∧; + Or ∨; ~ Not;
nvt Not validated as tautologous; vt Validated as tautologous
Model 1 logic values by first letter: F contradictory; Contingent; Non contingent; Tautologous

(#x&#z) & ((q&(x&z))=((p&(x&z))+(%y&((p&(x&y))+(q&(y&z)))))) ;
nvt; (1.2)

The repeating truth table fragment is NFFN FFFF FNNN;
the designated truth value as T is not present.

"Suppose we have the object constant 0, an arbitrary unary relation constant s (2.1, 3.1)

Meth8 maps Eq 2.1 and 3.1 as

~(s=s), (s=s) (2.2, 3.2)

"We ... can easily define *q* in terms of *qh*. *q* is tautologous of two elements
if and only if there is a level at which *qh* becomes tautologous of those elements. (4)

qh(*x*,*z*,0) ⇔*p*(*x*,*z*) ∨*p*(*x*,0) ∧*p*(0,*z*) (5.1)

qh(*x*,*z*,*s*(*n*)) ⇔*qh*(*x*,*z*,*n*) ∨(*qh*(*x*,*s*(*n*),*n*) ∧*qh*(*s*(*n*),*z*,*n*)) (6.1)

Meth8 maps Eq 5.1 and 6.1 as

(u&(x&(z&~(s=s)))) = ((p&(x&z)) + ((p&(x&~(s=s)))&(p&(~(s=s)&z)))) ;
nvt; TTTT TFTF (5.2)

(u&((x&z)&((s=s)&v))) = ((u&(x&(z&v))) + ((((u&x)&((s=s)&(v&v))) &
((u&(s=s))&(v&(z&v))))); vt; TTTT (6.2)

Meth8 maps Eq 5.1, 6.1, and 4 as

(((u&(x&(z&~(s=s)))) = ((p&(x&z)) + ((p&(x&~(s=s)))&(p&(~(s=s)&z))))) &
((u&((x&z)&((s=s)&v))) = ((u&(x&(z&v))) + (((u&x)&((s=s)&(v&v))) &
((u&(s=s))&(v&(z&v))))))) > (q = u) ; nvt ; TTFF FFTT TTFT FTTT (7)

"The only disadvantage of this axiomatization is that we need the helper relation *qh*. But that causes no significant problems.

$$\forall x.\forall z.(q(x,z) \Leftrightarrow \exists n.qh(x,z,n)) \tag{8.1}$$

Meth8 maps Eq 8.1 as

((#x&#z)&(q&(x&z))) = ((%v&u)&(x&(z&v))) ; nvt;
TTTT TTCC FFNN (8.2)

Meth8 finds Eq 6.2 to be validated as tautologous, and all others not so, notably the main conjecture of Eq 7. The conclusion is that Herbrand semantics are logically suspicious.

Meth8 on Heyting-Brouwer logic

Kamide, Norihiro; Shramko, Yaroslav; Wansing, Heinrich. "Kripke completeness of bi-intuitionistic multilattice logic and its connexive variant". *Studia Logic*. September 2017. doi:10.1007/s11225-017-9752-x.

From: researchgate.net/publication/319645851_Kripke_Completeness_of_Bi-intuitionistic_Multilattice_Logic_and_its_Connexive_Variant

Using the Meth8 apparatus we evaluate the Heyting-Brouwer logic via its variants of:

1.	bi-intuitionistic multilattice (*n*-lattice) logic [BML*n*];
4.4.-4.5	bi-intuitionistic connexive *n*-lattice logic [CMLn]; and
4.3	bi-intuitionistic logic [BL] with a Kripke completeness extension.

LET: ~ Not; p lc_alpha; q lc_beta; r j; s k

The designated truth value is T (tautology), where ~T is F (contradiction). Repeating fragments of rows in truth tables are listed horizontally. For four variables, there is one table of 16-values. For five variables, there are 128-tables.

1. The following expressions are provable in BML*n*:

(a) ~j(α→jβ) ⇔~jβ←j~jα, (1.7.a.1)
(~r&(p>(r&q))) = ((~r&q)<(r&(~r&p))) ; FTTF TTTT ; (1.7.a.2)

(b) ~j(α←jβ) ⇔~jβ→j~jα, [same as (a) above]

(c) ~k(α→jβ) ⇔~kα→j~kβ, (1.7.c.1)

(~s&(p>(r&q))) = ((~s&q)>(r&(~s&p))) ; TFFT TFFT ; (1.7.c.2)
(d) ~k(α←jβ) ⇔~kα←j~kβ, [same as (d) above]

4.4. The following expressions are provable in CMLn:

(a) ~j(α→jβ) ⇔α→j~jβ, (4.4.a.1)
(~r&(p>(r&q))) = (p>(r&(~r&q))) ; TTTT FTFT ; (4.4.a.2)

(b) ~j(α←jβ) ⇔~jα←jβ, (4.4.b.1)
(~r&(p<(r&q))) = ((~r&p)<(r&q)) ; TTTT TTTT ; (4.4.b.2)

4.5. Kripke connexive extension

(a) ~(α→β) ⇔α→~β, (4.5.a.1)
~(p>q) = (p>~q) ; FTFT FTFT ; (4.5.a.2)

(b) ~(α←β) ⇔~α←β (4.5.b.1)
~(p<q) = (~p<q) ; TTFF TTFF ; (4.5.b.2)

4.3. Kripke completeness extension

LET u f; v h

1. f(~j(α→jβ)) := f(~jβ)←f(~jα), (def.4.3.1.1)
(u&(~r&(p>(r&q)))) = ((u&(~r&q))<(u&(~r&p))) ; TTTT TTTT TTTT TTTT,
FTTT TTTT FTTT TTTT ; (def.4.3.1.2)

2. f(~j(α←jβ)) := f(~jβ)→f(~jα), (def.4.3.2.1)
(u&(~r&(p<(r&q)))) = ((u&(~r&q))>(u&(~r&p))) ; FFFF FFFF FFFF FFFF,
TFFF FFFF TFFF FFFF ; (def.4.3.2.2)

with the following conditions:

1. h(~j(α→jβ)) := h(α)→h(~jβ), (def.4.3.1.1.replace)
(v&(~r&(p>(r&q)))) = ((v&p)>(v&(~r&q))) ; FFFF FFFF FFFF FFFF,
TTTF FTFT TTTF FTFT ; (def.4.3.1.2.replace)

2. h(~j(α←jβ)) := h(~jα)←h(β) (def.4.3.2.1.replace)
(v&(~r&(p<(r&q)))) = ((v&p)<(v&(~r&q))) ; TTTT TTTT TTTT TTTT,
TTTF TFTF TTTF TFTF ; (def.4.3.2.2.replace)

In our previous work we showed the standard four-valued lattice logic was not bi-valent, but a probabilistic vector space. With the intention of re-evaluating that conclusion, we evaluated the Heyting-Brouwer logic based on lattice logic with the extensions proposed for BML_n, CMLn, and BL above.

We evaluated 10 expressions. Meth8 validated as tautology one, Eq. 4.4.b.2. We confirm our initial conclusion regarding lattice logic as not bi-valent. What follows is that intuitionistic logic is also not bivalent.

Refutation of higher-order logic as bivalent

From: en.wikipedia.org/wiki/Higher-order_logic

"First-order logic quantifies only variables that range over individuals; second-order logic, in addition, also quantifies over sets; third-order logic also quantifies over sets of sets, and so on. For example, the second-order sentence

$$\forall P\,(\,(\,0 \in P \land \forall i\,(\,i \in P \rightarrow i + 1 \in P\,)\,) \rightarrow \forall n\,(\,n \in P\,)\,) \qquad (1.1)$$

expresses the principle of mathematical induction. Higher-order logic is the union of first-, second-, third-, … , *n*th-order logic; i.e., higher-order logic admits quantification over sets that are nested arbitrarily deeply."

We evaluate higher-order logic based on the principle of mathematical induction.

We assume the Meth8/VŁ4 apparatus and method.

LET: p q r P i n; # necessity, all, ∀; % possibility, one or some; + Or; - Not Or; & And; > Imply, →; < Not Imply, less than, ∈; 1 (%p>#p); 0 ((%p>#p)-(%p>#p)) .

The designated proof value is T; F contradiction; C falsity; N truth. The 16-valued truth tables are row-major, horizontally.

Eq. 1.1 is a higher-order logic expression where the entire formula is universally quantified on one set (P) over universally quantified variables (i, n).

Meth8/VŁ4 treats sets and variables as variables. Therefore Eq. 1.1 is rendered as:

(#p & (((((%p>#p)-(%p>#p))<p) & (#q&((q<p)>((q+(%q>#q))<p))))>(#r&(r<p))))
= (p=p) ; FNFN FNFN FNFN FNFN (1.2)

Because Eq. 1.2 as rendered is *not* tautologous, the quantification over quantification is not bivalent.

We alleviate this constraining condition by distributing the quantified expression over nested expressions. At each nested level, the quantification is explicitly distributed for clarity.

(((#p&((%p>#p)-(%p>#p)))<(#p&p))&(#p&((#q&(q<p))>(#q&((q+(%q>#q))<p))))) >
(#p&(#r&(r>p))) ; TTTT TTTT TTTT TTTT (2.2)

Eq. 2.2 as rendered is tautologous. The truth tables of the main antecedent, consequent, and result are:

(((#p&((%p>#p)-(%p>#p)))<(#p&p))&(#p&((#q&(q<p))>(#q&((q+(%q>#q))<p))))) ;
FFFF FFFF FFFF FFFF (2.2.1)
(#p&(#r&(r>p))) ; FFFF FNFN FFFF FNFN (2.2.2)
> TTTT TTTT TTTT TTTT (2.2)

As an experiment we may simplify the quantification further so as to avoid any artifacts by expressing quantified variables directly:

((((%p>#p)-(%p>#p))<#p)&((#q<#p)>((#q+(%q>#q))<#p))) > (#r<#p) ;
NNNN NNNN NNNN NNNN (3.2)

Eq. 3.2 as rendered is *not* tautologous, although true with a value of N. Hence with absolute quantification, the induction principle as stated is *not* tautologous.

We conclude that higher-order logic is not bivalent and that nested quantification is better expressed as explicitly distributed.

Hilbert's Problem Ten is undecidable

Acknowledgment: Thanks are due for comments from Mihai Prunescu, Institute of Mathematics of the Romanian Academy.

1. Coefficients a and b are integers (mapped in Meth8 script as propositions t and u); and

2. We look for solutions x and y which are natural numbers N or integers I.

For both N and I, the relation is Diophantine, and a general decision method is not validated as tautologous.

2.1 In N: $a > 0$ is equivalent with $\exists(b).(a= b+1)$ (2.1)

(t>((t\t)-(t\t))) = (#u&(t=(u+(u\u)))) ; not validated as tautologous for =, >, <

Eq 2.1 is equivalent with:

$ax + by = z + 1$ (2.1.1) and

$1 - ax - by = v + 1$ (2.1.2)

((t&x)+(u&y)) = (z+(z\z)) ; not validated as tautologous for =, but tautologous for >, and contradictory for <; and ((t\t)-((t&x)-(u&y)))=(v+(v\v)) ; not validated as tautologous for =, but tautologous for >, and contradictory for <

Both Eq 2.1.1-.2 must be rewritten such that both right side and left side have only positive coefficients (always possible) or negative coefficients are allowed in Eq 2.1.3.

$(ax + by - z - 1)^2 + (v + ax + by)^2 = 0$ (2.1.3)

((((((t&x)+(u&y))-z)-(z\z))&((((t&x)+(u&y))-z)-(z\z)))+((v+((t&x)+(u&y)))&(v+((t&x)+(u&y)))))=((z\z)-(z\z)) ; not validated as tautologous for =, >, <

This has no natural solutions in x, y, z, v.

2.2 In Z: $a > 0$ is equivalent with $\exists(b,c,d,e).(a = 1 + b^2 + c^2 + d^2 + e^2)$ (2.2)

(t>((t\t)-(t\t))) = (#(u&(p&(q&r))) & (t=((t\t)+((p&p)+((q&q)+((r&r)+(s&s))))))); not validated as tautologous for =, >, <

So your relation is equivalent with:

$ax + by = 1 + v^2 + w^2 + z^2 + u^2$ (2.2.1) and

$1 - ax - by = 1 + r^2 + r^2 + p^2 + q^2$ (2.2.2)

We write this as one Diophantine equation which will have no solution in the displayed variables p,q,r,s,t,u,v,w,x,y,z. Hence, Eq 2.2.1 + Eq 2.2.2 = Eq 2.2.3.

$0 = 1 + v^2 + w^2 + z^2 + u^2 + m^2 + n^2 + p^2 + q^2$ (2.2.3)

((v\v)-(v\v)) = ((v\v)+((v&v)+((w&w)+((z&z)+((u&u)+((r&r)+((s&s)+((p&p)+(q&q))))))))) ; not validated as tautologous for =, but tautologous for >, and contradictory for <

Eq 2.2.3 may be rewritten as Eq 2.2.4, with the same result as in Eq 2.2.3.

$\sim(v^2 + w^2 + z^2 + u^2 + m^2 + n^2 + p^2 + q^2) = 1,$ (2.2.4)

3. We extend results from N and I to the open question of application to rational numbers as field Q of real numbers as structure R. We do this because modal propositional logic logic is sufficient to apply. This means that no solutions exist for the Q field in the R structure. Hence a general decision method for solving Diophantine equations does not exist, and Hilbert's Tenth Problem is rendered undecidable.

Hilbert system generalization

Hilbert system expression in question: "∀y(∀xPxy→Pty)".

In Meth8 script this is (#q&(#p&(p&q)))>(#q&(r&q)), where the universal quantifier ∀ is replaced by the modal necessity operator #.

The expression is not validated,:

```
(#q&(#p&(p&q))):  FFFN FFFN;  UUUE UUUE;  UUUU UUUU;  UUUI UUUI;  UUUP UUUP
(#q&(r&q)):       FFFF FFNN;  UUUU UUEE;  UUUU UUUU;  UUUU UUII;  UUUU UUPP
(#q&(#p&(p&q)))>(#q&(r&q)):
                  TTTC TTTT;  EEEU EEEE;  EEEE EEEE;  EEEP EEEE;  EEEI EEEE
                  ___^        ___^                    ___^        ___^
```

Huhn 2-distributive lattice identity

From: Gian-Carlo **Rota**. "The Many Lives of Lattice Theory". Notices of the AMS. 44:11. 1440-1445. December, 1997.

p. 1441, 2-distributive lattice identity by **Huhn**:

(p+((q&r)&s))=(((p&(q+r))+(p&(q+r)))+(p+(r&s))) ; not tautologous

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTT FTTT  EEEE EEEE EEEE UEEE  EEEE EEEE EEEE UEEE  EEEE EEEE EEEE UEEE  EEEE EEEE EEEE UEEE
. . . . . . . . .^   . . . . . . . . .^
```

Imperative logic: potential mistakes in footnote 47

Vranas, P.B.M. (2011). New foundations for imperative logic II: pure imperative inference.
cdn.getforge.com/petervranas.getforge.io/1484861684/papers/implogicII.pdf

We replicate results from equations in footnote 47 using our resuscitation of Ł4, named variant VŁ4, as implemented in our Meth8 modal logic model checker.

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; > Imply, is; (p=p) true; (p@p) false
p q r F M R (We rewrite upper case theorems into lower case propositions.)

Results are the repeating proof table(s) of 16-values in row major horizontally.

"[47] The fact that the conjunction of 'if the volcano erupts, flee' with 'smile or do not smile' is 'let it not be the case that the volcano erupts and you do not flee' follows from Definition 6 but can also be seen intuitively as follows (letting R, P, and Q be respectively the propositions that the volcano erupts, that you flee, and that you smile):

LET: (r>(r=r)) "R is true";
(p>(p=p)) "P be true";
((q+~q)>(q=q)) "(Q+~Q) is true;
((r>(r@r)) "R is false";
((p&(q+~q))=(q=q)) "P&(Q+~Q) be true";
((r&~p)>(r@r)) "R&~P be true"

'if R is true, let P be true' & 'let Q+~Q be true' = (1.1)

(((r>(r=r))>(p>(p=p))) & ((q+~q)>(q=q))) ; TTTT TTTT TTTT TTTT (1.2)

'if R is true, let P be true' & ('if R is true, let Q+~Q be true' & 'if R is false, let Q+~Q be true') = (2.1)

((r>(r=r))>(p>(p=p)))&(((r>(r=r))>((q+~q)>(q=q)))&((r>(r@r))>((q+~q)>(q=q)))) ;
TTTT TTTT TTTT TTTT (2.2)

('if R is true, let P be true' & 'if R is true, let Q+~Q be true') & 'if R is false, let Q+~Q be true' = (3.1)

((((r>(r=r))>(p>(p=p)))&((r>(r=r))>((q+~q)>(q=q))))& ((r>(r@r))>((q+~q)>(q=q)))) ;
TTTT TTTT TTTT TTTT (3.2)

'if R is true, let P&(Q+~Q) be true' & 'if R is false, let Q+~Q be true' = (4.1)

(((r>(r=r))> ((p&(q+~q))=(q=q)))&((r>(r@r))>((q+~q)>(q=q)))) ;
FTFT FTFT FTFT FTFT (4.2)

'if R is true, let P be true' & 'if R is false, let Q+~Q be true' = (5.1)

(((r>(r=r))>(p>(p=p)))&((r>(r@r))>((q+~q)>(q=q)))) ;
TTTT TTTT TTTT TTTT (5.2)

'if R is true, let R&~P be false' & 'if R is false, let R&~P be false' = (6.1)

((r>(r=r))>((r&~p)>(p@p)))& [TTTT FTFT TTTT FTFT]
((r>(r@r))>((r&~p)>(p@p))) [TTTT TTTT TTTT TTTT];
TTTT FTFT TTTT FTFT (6.2)

'let R&~P be false'. (7.1)

(r&~p)>(p@p) ; TTTT FTFT TTTT FTFT (7.2)

(The prescriptions expressed by 'if R is false, let Q+~Q be true' (8.1)

((r>(r@r))>((q+~q)>(q=q)) ; TTTT TTTT TTTT TTTT (8.2)

and by 'if R is false, let R&~P be false' (9.1)

((r>(r@r))>((r&~p)>(p@p))) ; TTTT TTTT TTTT TTTT (9.2)

are the same because their violation propositions, namely ~R&~(Q+~Q) (10.1)

(~r&~(q+~q)) ; FFFF FFFF FFFF FFFF (10.2)

and ~R&(R&~P) respectively, (11.1)

(~r&(r&~p)) ; FFFF FFFF FFFF FFFF (11.2)

are both impossible, and their contexts are the same, namely ~R.) (12.1)

~r ; TTTT FFFF TTTT FFFF (12.2)

Eqs. 4.2, 6.2, and 7.2 as rendered are *not* tautologous as claimed.

We conclude that imperative logic is a probabilistic vector space, not bivalent, and hence suspicious.

Ignorance of first choice

In the Morales system for ignorance of first choice, the basketball version assigns valenced variables to make the argument clearer to student readers.

LET x = action; ~x = no action;
LET y = potential; ~y = no potential
where + is Or, > is Imply, = is Equivalent, @ is Not Equivalent (mutually exclusive), & is And

0. The question named ignorance of first cause is "which of the two mutually exclusive selection variables (x,y) or (-x,y) caused the effect of [(x,y)]".

0.1 (x&y)@(~x&y) ; the selection variable pairs are mutually exclusive; not validated as tautologous

This means that the selection variables are not mutually exclusive as stated.

0.2 ((x&y)+(~x&y)) > (x&y) ; "If one or the other selection variables, then the effect as the first selection variables."; not tautologous

This means the term "ignorance of first cause" is mis-applied.

Here is the mapping of the other argument parts as pictured in the system.

1.1 (x&y) ; selection dichotomy of act and no potential, which flavors
1.2 (x>y) ; cause, to produce
1.3 (x>y) ; effect, for
1.4 ((x&y)&(x>y))>(x>y) ; argument for act and no potential; not tautologous
- -
2.1 (~x&y) ; selection dichotomy of no act and potential, which flavors
2.2 (~x>y) ; cause, to produce
2.3 (~x>~y) ; effect, for
2.4 ((~x&y)&(~x>y))>(~x>~y) ; argument for no act and potential; not tautologous

Ignorance of first choice should be defined as both 1.4 and 2.4 implying the consequent in 0.2 as 1.1:

3. ((((x&y)&(x>y))>(x>y)) & (((~x&y)&(~x>y))>(~x>~y))) > (x&y) ; not tautologous

This means the arguments do not prove: "mechanics of the two acts of selection", anything about Albert Einstein, or "a flawed scientific method".

What follows is that the above arguments cannot be re-asserted or used again to bar or invalidate acts of selection because their probability according to Rudolf Carnap is not 1.

Inconsistent theory

From en.wikipedia.org/wiki/List_of_first-order_theories#

"One special case of this is the **inconsistent theory** defined by the axiom ∃*x* ¬*x* = *x*. It is a perfectly good theory with many good properties: it is complete, decidable, finitely axiomatizable, and so on. The only problem is that it has no models at all. By Gödel's completeness theorem, *it is the only theory (for any given language) with no models.*"

(%p&~p) > (%p&p) ; not tautologous
%p&(~p=p) ; not tautologous ; validated as F contradictory

(%p&#~%p) > p ; validated as tautologous
(#p&#~p) > p ; validated as tautologous ; * replace % with # and = with >
(#p&~%p) > p ; validated as tautologous ; * replace % with # and = with >

(#p&~p) > p ; validated as tautologous ; * replace % with # and = with >
(#p&~p) = p ; not validated as tautologous

(%p&~p) > p ; not validated as tautologous
(%p&~p) = p ; not validated as tautologous

Inconsistent theory: Extending the monad ∃*p ~p* = *p* to a triad

Introduction

Inconsistency theory begins with a unique model for the monad of ∃*p~p=p*.

The requirement here is to write and test a proof expression extending the monad into a triad (and higher forms), and without knowing if the respective variable *p*, or *q*, *r*, *s*, are Tautologous or contradictory at antecedent input. (0)

Experiment

We use the Meth8 logic model checker (U.S. Patent Pending), based on the logic system VŁ4.

LET: % the Existential quantifier; = Equivalent; > Imply; ~ Not; nvt not tautologous; vt ~nvt.

1. Monad

∃p~p=p maps to: (1)

(%p&~p) = p ; nvt; equivalent monad (1.1)
(%p&~p) > p ; nvt; implied monad (1.2)

2. Dyad

(∃p~p)(∃q~q)=p&q maps to: (2)

((%p&~p)&(%q&~q)) = (p&q) ; nvt; equivalent dyad (2.1)
((%p&~p)&(%q&~q)) > (p&q) ; nvt; implied dyad (2.2)

3. Triad

(∃p~p)(∃q~q)(∃r~r)=p&q&r maps to: (3)

((%p&~p)&((%q&~q)&(%r&~r))) = (p&(q&r)) ; nvt; equivalent triad (3.1)
((%p&~p)&((%q&~q)&(%r&~r))) > (p&(q&r)) ; nvt; implied triad (3.2)

We rewrite the antecedent in Eq 3.1 as an equivalent in Eq 3.3 and present repeating rows of truth tables for the five models, where the designated truth values are *T*autologous and *E*valuated:

((%p&(%q&%r))&(~p&(~q&~r))) = (p&(q&r)) ; not validated; equivalent triad; (3.3)

```
NTTT TTTF; EEEE EEEU; UEEE EEEU; IEEE EEEU; PEEE EEEU
```

((%p&(%q&%r))&(~p&(~q&~r))) > (p&(q&r)) ; not validated; implied triad; (3.4)

```
NTTT TTTT; EEEE EEEE; UEEE EEEE; IEEE EEEE; PEEE EEEE
```

We note how to inject a truth value in the consequent as for example (p+~p) which always evaluates to Tautologous. This is consistent as an attempt to force explicitly the second phrase in the word expression of Eq 0. The phrase then reads in part as "equivalent to p or not p and q or not q and r or not r" and appears in Eq 3.5.

((%p&(%q&%r))&(~p&(~q&~r))) > ((p+~p)&((q+~q)&(r+~r))) ; vt; implied triad

```
TTTT TTTT; EEEE EEEE; EEEE EEEE; EEEE EEEE; EEEE EEEE
```
(3.5)

While Eq 3.5 is validated as tautologous, the truth insertion is an artifice because the original "equivalent to p and q and r" captures all values as input from the antecedent without *knowing* the truth value, which was the original intent of the second phrase in Eq 0.

A further rendition of Eq 3.5 accommodates the mapping as "x OR y OR z" in Eq 3.6.

((%p&(%q&%r))&(~p&(~q&~r))) > ((p+(q+r)) ; vt; implied triad (3.6)

```
NTTT TTTT; EEEE EEEE; UEEE EEEE; IEEE EEEE; PEEE EEEE
```

4. Tetrad

(∃p~p)(∃q~q)(∃r~r)(∃s~s)=p&q&r&s maps to: (4)

(((%p&~p)&((%q&~q)&(%r&~r)))&(%s&~s)) = ((p&(q&r))&s) ; nvt; equivalent triad (4.1)

(((%p&~p)&((%q&~q)&(%r&~r)))&(%s&~s)) > ((p&(q&r))&s) ; nvt; implied triad; (4.2)

Conclusion

None of the forms for monad or extensions for dyad, triad, or tetrad are validated as tautologous by the Meth8 modal logic model checker.

Hence the inconsistency theory, as based on Eq 0 et seq, is suspicious.

Inconsistent theory: Kunen's inconsistency theorem

From en.wikipedia.org/wiki/Kunen%27s_inconsistency_theorem

"[T]here is no formula *J* in the language of set theory such that for some parameter $p \in V$ for all sets $x \in V$ and $y \in V$: j (x) = y ↔ J (x , y , p) ." (1)

(((p<v)&#((x<v)&(y<v)))&((q&x)=y)) = (((p<v)&#((x<v)&(y<v)))& (r&((x&y)&p))) ; (2)
tautologous

This is a proof by contradiction that (1) is contradictory.

To better see this, consider changing the main connective in (1) from equivalent (=) to Not equivalent (@) as in (3) below:

(((p<v)&#((x<v)&(y<v)))&((q&x)=y)) @ (((p<v)&#((x<v)&(y<v)))& (r&((x&y)&p))) ; (3)
not tautologous, and contradiction

Independence-friendly logic (Kreiselization)

From en.wikipedia.org/wiki/Independence-friendly_logic, we present only Kreiselization due to invalidation by other work:

2. Kr U (ψ ∧ χ) = Kr U (ψ) ∨ Kr U (χ) (1.1)
3. Kr U (ψ ∨ χ) = Kr U (ψ) ∧ Kr U (χ) (2.1)

LET: p Kr U; q ψ ; r χ; nvt not tautologous;

Designated truth value is T Tautology (proof), with C Contingent (falsity value), N Non contingent (truth value), and F for contradiction (absurdum).

Results include the 16-value truth tables as row major horizontally.

(p&(q+r)) = ((p&q)&(p&r)) ; nvt ; TTTF TFTT TTTF TFTT (1.2)
(p&(q&r)) = ((p&q)+(p&r)) ; nvt ; TTTF TFTT TTTF TFTT (2.2)

Meth8 finds Kreiselization suspicious due to Eqs 1.2 and 2.2 nvt.

From the article on **Indicative Conditionals** at plato.stanford.edu/entries/conditionals/:

In Section 3.2,

> But, as we saw, “~(*A*&*B*); so *A* ⇒~*B*” is invalid. (1)

We think (1) is always valid as a theorem due to the truth table fragments below for ~(p&q)=(p>~q), where the logical equivalence "=" is stronger than the "hook, line, or sinker" (Hook, Arrow, Supp).

	Model 1	Models 2.1; 2.2; 2.3.1; 2.3.1
p:	FTFT FTFT	UEUE UEUE
q:	FFTT FFTT	UUEE UUEE
~q:	TTFF TTFF	EEUU EEUU
~(p&q):	TTTF TTTF	EEEU EEEU
(p>~q):	TTTF TTTF	EEEU EEEU
~(p&q)=(p>~q):	**TTTT TTTT**	**EEEE EEEE**

FCNT is: F contradiction, Contingent (falsity), Non contingent (truth), Tautology. UIPE is: Unevaluated, Improper, Permissible, Evaluated. [Designated proof values are T, E; > is Imply; = is Equivalent to; and fragments here are the first two rows of four rows.]

Our attempts to correspond with the article's author of record were unsuccessful.

Logical induction is not tautologous via the Black raven paradox and Kripkenstein

Black raven paradox from wiki

Induction was described as the Black raven paradox, from en.wikipedia.org/wiki/Raven_paradox :

> "(1) All ravens are black. (1)
> In strict logical terms, via contraposition, this statement is equivalent to:
> (2) Everything that is not black is not a raven." (2)
> and Eq 1 and Eq 2 via contraposition are to be equivalents. (3)

The universal quantifier is in Eq 1 for the antecedent as "All ravens". The existential quantifier is invoked in Eq 1 for the consequent as "*a* black *thing*", in Eq 2 for the antecedent as "every [*each and every*]*thing* not black", and in Eq 2 for the consequent as "not *a raven*". The contraposition statement is also mistaken because the antecedent in Eq 2 does not read "All that is not black."

We assume the Meth8 script; the truth table is four rows major horizontally, with designated truth value as T; nvt not tautologous.

LET: p black; r raven; > is; = equivalent; # for All; % for One

(#r>%p) = (%~p>~%r) ; nvt ; `NNNN NNNN NNNN NNNN` (3.1)

"It should be clear that in all circumstances where (2) is tautologous, (1) is also tautologous; and likewise, in all circumstances where (2) is contradictory (i.e. if a world is imagined in which something that was not black, yet was a raven, existed), (1) is also contradictory. This establishes logical equivalence." (4)

We write Eq 4 as:

#(%~p>~%r) > #(#r>%p) ; vt (4.1)
#(~(%~p>~%r)) > #(~(#r>%p)) ; nvt ; `NNNN NNNN NNNN NNNN` (4.2)

The example of "(2) contradictory" as "if a world is imagined in which something that was not black, yet was a raven, existed" is not equivalent below:

~(%~p>~%r) = (%~p>%r) ; nvt ; `TCTC TCTC TCTC TCTC` (4.3)

From Eq 3, the Black raven paradox is not tautologous by Meth8.

Black raven paradox from plato

From John M. Vickers plato.stanford.edu/entries/induction-problem/, the Black raven paradox is recast.

The Nicod principle states: "Universal generalizations are supported or confirmed by their positive instances and falsified by their negative instances." This is applied as a paradoxical conclusion for:

"a is not black and not a raven" confirms "all non-black things are non-ravens." (5)
with the paradoxical juxtaposition that
"If all non-black things are non-ravens", then "a [*thing*] is not black and not a raven". (6)

LET: p black, r raven, q a [*thing*]

(#r>p)>((q>~p)&(q>~r)) ; nvt ; TTTF TTNF TTTF TTNF (5.1)
((q>~p)&(q>~r))> (#r>p) ; nvt ; TTTT CTTT TTTT CTTT (6.1)

The juxtaposition of Eq 5 into Eq 6 as a paradox is tautologous by Meth8.

C.G. Hempel (1945) with Nelson Goodman look at truth conditions of the premise and supported hypothesis, where:

the antecedent conditions are "this is neither a raven nor black"
and the consequent hypothesis is "all ravens are black" (7)
with the restated hypothesis "Everything is either a black raven or is not a raven" (8)
and also Eq 7 to be the equivalent of Eq 8. (9)

LET: p black, r raven, q this [*thing*]

(q>~(r+p))>(#r>p) ; nvt ; TTTT CTTT TTTT CTTT (7.1)
#q>((p&r)+~r) ; nvt ; TTTT TTCT TTTT TTCT (8.1)
((q>~(r+p))>(#r>p)) = (#q>((p&r)+~r)) ; nvt ; TTTT CTCT TTTT CTCT (9.1)

The Hempel-Goodman proposed resolution rewords the equivalent of the Nicod principle and therefore is not a resolution tautologous by Meth8.

Kripkenstein

Induction was subsequently recast from en.wikipedia.org/wiki/New_riddle_of_induction :

Regarding the private language argument of Wittgenstein, "Saul Kripke proposed a related argument that leads to skepticism about meaning rather than skepticism about induction, as part of his personal interpretation of the private language argument. ... Kripke then argues for an interpretation of Wittgenstein as holding that the meanings of words are not individually contained mental entities."
This was later nick-named "Kripkenstein" to describe a form of addition (+) named quus where:

x quus y = { (x+y for x,y <57) = (5 for ~(x<57) or ~(y<57)) }. (10)

LET: p,q x,y; r 57; s 5

(((p&q)<r)>(p+q)) = ((~(p<r)+~(q<r))>s) ; FFFT FFFF TTTT TTTT (10.1)

From Eq 10.1, Kripkenstein is not a "new riddle of induction" and not tautologous by Meth8.

What follows is that the Black swan theory of Nassim Nicholas Taleb is also not tautologous.

Inequality of "arbitrarily large" versus "sufficiently large"

From wiki:

The statement "f(x) is non-negative for arbitrarily large x." could be rewritten as:

$\forall n \in R$, $\exists x \in R$ such that $x > n \wedge f(x) \geq 0$ (1)

LET: # ∀All, % ∃Exists, < ∈member of, pqrs fnRx, ~(A<B) (A≥B), > Imply, > ⇒, & ∧And, vt tautologous, nvt not tautologous

((#q<r)&(%s<r)) & ((s>q)&~((p&s)< (p-p))) ; nvt (2)

Using "sufficiently large" instead yields:

$\exists n \in R$ such that $\forall x \in R$, $x > n \Rightarrow f(x) \geq 0$ (3)
(%q<r)&((#s<r)&((s>q)>~((p&s)<(p-p)))) ; nvt (4)

We ask: "What is the difference between "sufficiently large" and "arbitrarily large"?

((%q<r)&((#s<r) & ((s>q)>~((p&s)<(p-p))))) =
(((#q<r)&(%s<r)) & ((s>q)&~((p&s)< (p-p)))) ; vt (5)

We show there is no difference, so the mathematical jargon "arbitrarily large" is equivalent to "sufficiently large".

Infinite set theory

One of the few interesting properties that can be stated in the language of pure identity theory is that of being infinite. This is given by an infinite set of axioms stating there are at least 2 elements, there are at least 3 elements, and so on:

$\exists x_1 \exists x_2 \neg x_1 = x_2$, $\exists x_1 \exists x_2 \exists x_3 \neg x_1 = x_2 \wedge \neg x_1 = x_3 \wedge \neg x_2 = x_3$,... (1), (2)

These axioms define the **theory of an infinite set**.

LET: p x_1, q x_2, r x_3, % $\exists$.

((%p&%q)&~p) = r ; nvt (3)

((%p&%q)&(%r&~p)) = ((q&~p)=(r&~q)) ; nvt (4)

Infinite sets are not validated as tautologous.

Validation of join-prime in lattice theory

From en.wikipedia.org/wiki/Birkhoff%27s_representation_theorem

"An element x is join-prime if, whenever $x \leq y \vee z$, either $x \leq y$ or $x \leq z$."

Assuming the Meth8/VL4 apparatus and method,

LET: p q r x y z

((p<(q+r))+(p=(q+r)))>(((p<q)+(p=q))+((p<r)+(p=r))) ; TTTT TTTT TTTT TTTT (1.0)

The join-prime definition is tautologous (all T).

Retromorphisms of Jonsson theory in positive logic

From: Poizat, B.; Yeshkeyev, A. "Jonsson Theories in Positive Logic". 2015. ;
logique.jussieu.fr/modnet/Publications/Preprint%20server/papers/873/873.pdf

On page 36/7 of Section 3.5 Retromorphisms,

The designated truth value is Tautologous "11"; C means Contingent "10".

23(i): We ask if this equation is tautologous: ((#p&%q)&(r&p)) > (s&(p&q)) ; nvt;

The truth table for Model 1 is: TTTT TTTC TTTT TTTT

23(ii): We ask if this equation is contradictory: (#p&(r&p)) > (s&p) ; nvt;

The truth table for Model 1 is: TTTT TCTC TTTT TTTT

23(iii): We cannot evaluate this, but it is moot if 23(i) is not tautologous.

For any positive integer, the equation r > (r - r) holds, meaning "r IMPLIES (r NOR r)" or in arithmetic "r IS GREATER THAN (r MINUS r)".

Immanuel Kant's contradictory subtlety of four syllogistic figures

This paper adopts and keys to the translated arguments (following) by the anonymous author of:

en.wikipedia.org/wiki/The_contradictory_Subtlety_of_the_Four_Syllogistic_Figures

for Immanuel Kant (1762), "The contradictory subtlety of the four syllogistic figures proved", (Die falsche spitzfindigkeit der vier syllogistischen figuren erwiese).

The Meth8 modal logic prover checks five models using system VŁ4, a variant of Łukasiewicz' quaternary logic. Symbols are:

~ Not, & And, > Imply, = Equivalent, + Or, # necessity (all), % possibility (some),
vt tautologous, nvt not tautologous, T Tautologous, E Evaluated (designated truth values)

Section III Of pure and mixed ratiocination

III: LET: p thing, q immortal, r man, s Socrates

(((~p=r)>(~r=q))&(s=r))>(~s=q) ; nvt (III.1)

FTTT TTTT TTTT TTTF	UEEE EEEE EEEE EEEU	UEEE EEEE EEEE EEEU	UEEE EEEE EEEE EEEU	UEEE EEEE EEEE EEEU
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

(((~p&q)=r)&(s=r))>(s=q) ; nvt (III.2.1)

TTTF TTTT TTTT TTTT	EEEU EEEE EEEE EEEE	EEEU EEEE EEEE EEEE	EEEU EEEE EEEE EEEE	EEEU EEEE EEEE EEEE
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

((((~p&q)=r)>(~r=q))&(s=r))>(s=q) ; nvt (III.2.2)

TTFF TTTT TTTT FFTT	EEUU EEEE EEEE UUEE	EEUU EEEE EEEE UUEE	EEUU EEEE EEEE UUEE	EEUU EEEE EEEE UUEE
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

Section IV In the so-called first figure only pure ratiocinations are possible, in the remaining figures only mixed ratiocinations are possible.

IV.1: LET: p A, q B, r C

((r=q)&(p=r))>(p=q) ; vt (IV.1)

IV.2: LET p A, q B, r C

((~q=r)&(p=r))>(p=~q) ; vt (IV.2)

IV.3: LET: p mammals, q air breathers, r animals

((#p=q)&(#p=r)) > (%p=q) ; nvt (IV.3.1)

NNTT TTTT NNTT TTTT	EEEE EEEE EEEE EEEE	UUEE EEEE UUEE EEEE	IIEE EEEE IIEE EEEE	PPEE EEEE PPEE EEEE
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2

(((#p=q)&(#p=r)) > (%r=p)) > (%r=q); nvt (IV.3.2)

```
TNCC FFTT TNCC FFTT   EEUU UUEE EEUU UUEE   EUEE UUEE EUEE UUEE   EIPP UUEE EIPP UUEE   EPII UUEE EPII UUEE
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
```

IV.4: LET: p man, p+p persons, q learned, r stupid, s pious

(((~r&p)=q) & ((%q&(p+p))=s)) > ((%s&(p+p))=~r) ; nvt (IV.4.1)

```
FTTT TTTT TTTT TNTT   UEEE EEEE EEEE EEEE   UEEE EEEE EEEE EUEE   UEEE EEEE EEEE EIEE   UEEE EEEE EEEE EPEE
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
```

((((~r&p)=q)>((~q&(p+p))=r)) & (((%q&(p+p))=s)>
((%s&(p+p))=q))) >((%s&(p+p))=~r) ; nvt (IV.4.2)

```
FCTC TNTN FTFT TCTF   UUEU EEEE UEUE EUEU   UEEE EUEU UEUE EEEU   UPEP EIEI UEUE EPEU   UIEI EPEP UEUE EIEU
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
```

((((~r&p)=q)>((~q&(p+p))=r)) & (((%q&(p+p))=s)>
((%s&(p+p))=q))) >((%s&(p+p))=~r) ; nvt (IV.4.2)

FCTC TNTN FTFT TCTF   UUEU EEEE UEUE EUEU   UEEE EUEU UEUE EEEU   UPEP EIEI UEUE EPEU   UIEI EPEP UEUE EIEU
Model 1   Model 2.1   Model 2.2   Model 2.3.1   Model 2.3.2

Eq IV.1 and IV.2 are tautologous; all others are not tautologous.

This shows that the comments in the article as to how to fix up the syllogisms are mistaken, but nevertheless renders Kant's essay as a historical record to bear the logic of the time.

Karpenko System K-Ł4

Replication of A.S. Карпенко (2015). Решетки четырехзначных модальных логик. УДК 164.3 + 510.643. [A.S. Karpenko (2015). *Lattices of Four-valued Modal Logics.* English abstract / references.]

We named the instant logic system as Karpenko-Ł4 with the acronym **K-Ł4**. We evaluated each logical expression found using the Meth8 logic model checker based on the bivalent variant VŁ4.

The presentation format is: expression; validation result; comment, if any; and paper section number with location. The expressions are grouped by section number below.

From the lattice arrangement we asked if K-Ł4 is bivalent or a vector space after the three valued logic system of Dunn-Belnap. We invalidate many many of the expressions. This and the assignments of various logical values confirmed that K-Ł4 is for a vector space and is not a bivalent logical system.

#(p>q)>(#p>#q) ;	not validated; Model 2.1 tautologous; 3.K
#p+(#(r>q)+#(p>~q)) ;	not validated; Model 2.1 tautologous; 4. unnumbered with S5
#p>#(#%p>%#p);	validated; after "S4.4"
#p>#(%#p>#p) ;	validated; after "S4 +"
#(p>q)>(#p>#q) ;	validated; 4.2
#p>p ;	validated 4.3
#p>(q>#q) ;	validated 4.4

Substitution formulas, where:

LET r=e1(p);	s=e2(p);	t=e1(q);	u=e2(q);
LET J1(p)=(r&s);	J1(q)=(t&u);	Ja(p)=(~r&s);	Ja(q)=(~t&u) [Ja(p,q) not used];
LET Jb(p)=(r&~s);	Jb(q)=(t&~u);	J0(p)=(~r&~s);	J0(q)=(~t&~u);

for:

(p+q)=((p&q)+(((~r&~s)&q)+((p&(~t&~u))+(((r&~s)&q)+((p&(t&~u))+((r&s)+(t&u)))))) ;
not validated; 4. xVy .... with substitutions.

Shown is one repeating truth table of 24 for 12-propositions.

```
(p+q)=((p&q)+(((~r&~s)&q)+((p&(~t&~u))+(((r&~s)&q)+((p&(t&~u))+((r&s)+(t&u))))))
Model: 1              Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
TTTT TTTT TTFT FTTT   EEEE EEEE EEUE UEEE   EEEE EEEE EEUE UEEE   EEEE EEEE EEUE UEEE   EEEE EEEE EEUE UEEE
TTTT TTTT TTFT FTTT   EEEE EEEE EEUE UEEE   EEEE EEEE EEUE UEEE   EEEE EEEE EEUE UEEE   EEEE EEEE EEUE UEEE
TFTT TFTT TFFT FTTT   EUEE EUEE EUUE UEEE   EUEE EUEE EUUE UEEE   EUEE EUEE EUUE UEEE   EUEE EUEE EUUE UEEE
FTTT FTTT FTTT FTTT   UEEE UEEE UEEE UEEE   UEEE UEEE UEEE UEEE   UEEE UEEE UEEE UEEE   UEEE UEEE UEEE UEEE
```

(p&q)=~(~p+~q) ;	validated; 4. x&y=~(~x V ~y);
(#p&~p)= (p@p) ;	validated; 7.TM1
(~#p&p)=(~p&p);	not validated; Model 2.1 tautologous; 7.TM2
(q>p)+(((p>q)>p)>p) ;	validated; 9.unnumbered
#(p>q)=(#p>#q) ;	not validated; Model 2.2 tautologous; 10.2
~#p=#~p ;	not validated; Model 2.1 tautologous; 10.3
##p=p ;	not validated 10.4

The Kuratowski–Zorn lemma (Zorn's lemma)

From en.wikipedia.org/wiki/Zorn%27s_lemma:

"To prove that I is an ideal, note that if a and b are elements of I, then there exist two ideals J, K ∈ T such that a is an element of J and b is an element of K."

```
LET pqrstu abIJKT
((p&q)<r) > (((s&t)<u) & ((p<s)&(q<t))) ; nvt ; TTTF TTTT TTTF TTTT
```

If the Kuratowski–Zorn lemma is suspicious, so also is the Ultrafilter lemma and the Prime Ideal theorem as a replacement for ZFC.

Lachlan problem solution

From: Sudoplatov, S.V. *The Lachlan Problem*. 2008.; math.nsc.ru/~sudoplatov/lachlan_eng_03_09_2008.pdf

We evaluate two equations from the text as a pilot survey of experimental results.

1.1. Syntactic characterization of the class of complete theories with finitely many countable models

DEFINITION [56] Lemma 1.1.1., page 18

$$\vDash \forall y \, ((x < y) \rightarrow \exists z \, ((x < z) \wedge (z < y) \wedge P_i(z))) \qquad (18.1)$$

Meth8 script maps this as

LET: > Imply →; & And ^; (p=p) P_i;
necessity, universal quantifier ∀; % possibility, existential quantifier ∃;

```
(#x&#y) & ( (x<y) > ( %z & ( ((x<z) + (z<y)) + ( (p=p)&z)))) ; nvt        (18.2)
```

The 128-line truth table for five models has these repeating fragments:

Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
FFFF FFFF FFFF FFFF	UUUU UUUU UUUU UUUU	UUUU UUUU UUUU UUUU	UUUU UUUU UUUU UUUU	UUUU UUUU UUUU UUUU
NNNN NNNN NNNN NNNN	EEEE EEEE EEEE EEEE	UUUU UUUU UUUU UUUU	IIII IIII IIII IIII	PPPP PPPP PPPP PPPP

where the designated truth values are Tautologous and Evaluated. The other logic values mean Contingent, Non contingent, F contradictory, Improper, Proper, and Unevaluated.

§ 2.5. The uniform *t*-amalgamation property and saturated generic models, page 67

$$\forall X \, ((\text{chi bar-Phi}(X) \wedge \text{phi}(X)) \rightarrow \exists Y \, (\text{chi bar-Psi}(X, Y) \wedge \text{psi}(X, Y))) \qquad (67.1)$$

Meth8 script maps this as

LET: p chi; q bar-Phi; r phi; s bar-Psi; t psi

```
(#x&((p&(q&x))&(r&x))) > (%y&(((p&s)&(x&y))&(t&(x&y)))) ; nvt        (67.2)
```

The 128-line truth table for five models has these repeating fragments:

Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
TTTT TTTT TTTT TTTT	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEE EEEE EEEE
TTTT TTTC TTTT TTTC	EEEE EEEU EEEE EEEU	EEEE EEEE EEEE EEEE	EEEE EEEP EEEE EEEP	EEEE EEEI EEEE EEEI
TTTT TTTC TTTT TTTT	EEEE EEEU EEEE EEEE	EEEE EEEE EEEE EEEE	EEEE EEEP EEEE EEEE	EEEE EEEI EEEE EEEE

§ 3.1. Generic [Ehrenfeucht] theory with a non-symmetric semi-isolation relation, page 82

By the construction of $M \vDash \forall X \, (\text{phi-sub-n}(X) \rightarrow \exists Y \, \text{psi-sub-n}(X; Y))$ (82.1)

Meth8 script maps this as

LET: p phi-sub-n; q psi-sub-n

#x&((p&x)>(%y&(q&(x&y)))) ; nvt ; NFNF FFFF NFNN ; (82.2)

The 128-line truth table for Model 1 has these repeating fragments: NFNF FFFF NFNN.

2. From the type to the formula strict order property", page 177

$\vDash \forall y\,(phi(a_1,y) \rightarrow phi(a_2,y))$ ^ $\exists y\,(\neg phi(a_1\,,y)$ ^ $phi(a_2,y))$ (4.11) (177.1)

Meth8 script maps this as

(#y&((p&(q&y)) > (p&(r&y)))) & (%y&((~p&(q&y))&(p&(r&y)))) ;
nvt ; FFFF UUUU (177.2)

We conclude that sample Eqs 18.2 and 67.2 do not confirm a solution to the Lachlan problem.

Note on Wolfgang Lenzen's "Leibniz's Ontological Proof of the Existence of God and the Problem of »Impossible Objects«"

(Lenzen, W. Log. Univers. (2017) 11: 85. https://doi.org/10.1007/s11787-017-0159-2) ; and page.mi.fu-berlin.de/cbenzmueller/papers/Lenzen2016_Leibniz_Ontological_Proof.pdf , /link.springer.com/article/10.1007/s11787-017-0159-2

In reproducing some of the conjectures above, we found what may be a mistake on pg. 12, section 5:

> Notwithstanding the question how the uniqueness of a necessary being, i.e. ∀x∀y(*E(x)* ∧ *E(y)* → *x* = *y*), might ever be proved, it seems clear that the requirement of the *existence* of a necessary being, (xii) ∃*x(E(x)*), again renders Leibniz's proof *circular.* (1.1)

We evaluate Eq 1 using the apparatus of Meth8 modal logic model checker of four valued logic system variant VŁ4.

> LET: % ◇, possibility, ∃, existential quantifier; # □, necessity, ∀, universal quantifier;
> ~ Not; & ∧, And; > →, Imply;
> p E, concept of existence; q x; r y;
> vt validated as tautologous; nvt not validated as tautologous

> We map Eq 1 in the affirmative with the "(xii)" expression as the antecedent implying the "i.e." expression as the consequent, as follows:

> (%q&#(p&q))> ((#q&#r)& (((#p&q)& (#p&r))> (q= r))) ; nvt ; TTTC TTTT (1.2)

> The repeating truth table fragment has T as designated tautology value and C as falsity contingent value; other values not shown are F as contradiction value and N as truth non contingent value.

Meth8 renders Eq 1.2 as not validated as tautologous, that is, Eq 1.1 is mistaken.

However, we do confirm that *6.1 The Algebra of Concepts* is not validated as tautologous by Meth8.

Briefest known ontological proof of God

The problem with Leibniz' ontological proof of the existence of God was in not defining "most perfect" from "perfect", and then repeating that definition throughout the arguments.

Using the Meth8 apparatus for system variant VŁ4, and the fact that respective existential quantifiers are inter-changeable with modal operators (elsewhere from our rendition of the corrected Square of Opposition):

LET: p God; % possibility, existential quantifier; # necessity, universal quantifier; > Imply;
= Equivalent to; (p=p) Tautologous, perfect; #(p=p) most perfect; T Tautology.

The equivalence of the respective quantifiers and modal operators was established in our updated Square of Opposition and corrections to syllogisms Modus Camestros and Modus Cesare elsewhere.

The result fragment is the repeating row of four values from the truth table of 16 values.

We test these sentences as antecedent (1), consequent (2), and proposition (3, 4).

T*he possibility exists of God as most perfect.* (1.1)

%(p>#(p=p)) ; TTTT ; (1.2)

Necessarily God exists as most perfect. (2.1)

(#p> #(p=p)) ; TTTT ; (2.2)

It the possibility exists of God as most perfect, then necessarily God exists as most perfect. (3.1)

%(p>#(p=p)) > (#p> #(p=p)) ; TTTT ; (3.2)

Eq 1.1 can be diluted by using "perfect" instead of "most perfect" in antecedent and consequent. The reason is that perfect is its own superlative, meaning "most perfect" is redundant as something "most perfectly perfect"

It the possibility exists of God as perfect, then necessarily God exists as perfect. (4.1)

%(p> (p=p)) > (#p> (p=p)) ; TTTT ; (4.2)

The advantage of this proof over that of Karl Popper is that the quality of perfection includes truthfulness and morality. This means that invoking the moral imperative (the existentialist uttering "I ought to ...") to show conscience is not needed to demonstrate that God is a moral being.

Lemmon D in Lemmon (1957)

#(#p>#q)+#(#q>#p) ; not validated; Model 2.1 tautologous

The liar's paradox is resolved as not a paradox

From en.wikipedia.org/wiki/Liar_paradox, paraphrased into clear English as:

"the statement of a liar which states that what the liar states is a lie"

LET:

p = a thing, "this" ; q = the assertion ; vt tautologous ; nvt not tautologous
> Imply ; < Not Imply ; = Equivalent ; @ Not Equivalent
(p@p) contradictory ; (p=p) Tautologous ; q = (p = (p@p))

(q = (p = (p@p))) > ((p = (p@p)) > (p= p)) ; vt (1)
(q = (p = (p@p))) > (q) > (p= p)) ; vt (2)
(p = (p@p)) > ((p = (p@p)) > (p= p)) ; vt (3)
q > ((q = (p = (p@p))) > (p=p)) ; vt (4)

We test if Eq 1-4 are co-equivalents.

((q>((q=(p=(p@p)))>(p=p))) = ((q=(p=(p@p)))>(q>(p=p)))) =
(((q=(p=(p@p)))>((p=(p@p))>(p=p))) = ((p=(p@p))>((p=(p@p))>(p=p)))) ; vt (5)

We test Eq 1-4 for < Not Imply with result of nvt, and not all F as a contradiction.

Result: the liar paradox is resolved as tautologous, hence it not a paradox, and not a contradiction.

The problem with previous attempts is not evaluating the truth value of an assertion, regardless of the truth value of what the assertion states. The problem is overcome by using a separate propositional variable for the assertion as q, and another propositional variable p to build the expression of the assertion.

Liar paradox Arthur Prior

Arthur Prior asserts that these two statements are equivalent:

For "This statement (A) is contradictory.";

(p&q)=(q@q) ; nvt (6.1)

For "This statement (A) is tautologous, and this statement (B) is contradictory.";

((p&q)=(q=q))&((p&r)=(r@r)) ; nvt (6.2)

Hence for "This statement (A) is contradictory is equivalent to this statement (A) is tautologous, and this statement (B) is contradictory.":

((p&q)=(q@q)) = (((p&q)=(q=q))&((p&r)=(r@r))) ; nvt (6.3)

However, making the statement name the same in Eq 6.1 and 6.2, that is "A", then

((p&q)=(q@q)) = (((p&q)=(q=q))&((p&q)=(q@q))) ; nvt (6.4)

is the same result nvt as Eq 6.3.

Hence Meth8 shows Prior et al are mistaken, and their version of the Liar paradox is not a paradox.

Liar paradox Saul Kripke

Saul Kripke introduces contingency, on which Meth8 is based.

LET: (p=p) Tautologous; (p@p) contradictory; p paradoxical; s Smith; t Jones;

only, singly %; majority #; x big spender; y soft on crime.

If the only thing Smith says about ones is a majority of what Jones says about me is contradictory,

((s>%(at>#(p@p))) (7.1)

and Jones says only these three things about Smith: Smith is a big spender, Smith is soft on crime, and everything Smith says about me is tautologous then

& (t>(%s&(((s>x)$(s?y))&#(s>(t&(p=p))))))) > (7.2)

If Smith really is a big spender but is *not* soft on crime, then

(((s=x)&(s=~y)) > (7.3)

both Smith's remarks about Jones and Jones's last remark about Smith are paradoxical.

(((%(t>#p@p)))&#(s>(t&(p=p)))) = p)) ; (7.4)

So:

((s>%(t>#(p@p))) & (t>(%s&(((s>x)&(s>y))&#(s>(t&(p=p))))))) >

(((s=x)&(s=~y)) > (((%(t>#(p@p)))&#(s>(t&(p=p)))) = p)) ; not tautologous (7.5)

Hence Meth8 shows Kripke is mistaken, and the Liar paradox is not a paradox.

Meth8 validation of **Löb's Theorem**

The definition of Löb's Theorem is taken from www.cs.cornell.edu/courses/cs4860/2009sp/lec-23.pdf .

A fourth issue involves the *undefinability of provability*: it is not possible to describe a predicate Prov that represents provability in a theory T such that ~Prov(contradictory) is a theorem in T . We call a predicate Prov a *provability predicate for* T if it satisfies the following conditions for all formulas X and Y.

If |=T X then |=T Prov(X)
|=T Prov(X⊃Y) ⊃(Prov(X) ⊃Prov(Y))
|=T Prov(X) ⊃Prov(Prov(X))

The first condition states that every theorem should be provable, the second that the modus ponens holds for provability, and the third that provability is provable. Note that the second and third conditions are stronger than the first in the sense that the implication itself must be a theorem in T .
Note that a condition like |=T Prov(X) ⊃X is not included in the definition, since this requirement cannot be satisfied unless T is inconsistent. In fact, Löb' s Theorem shows that this condition implies |=T X.

Theorem: [Löb's Theorem] If Prov is a provability predicate for a theory T that can represent the computable functions then |=T Prov(X) ⊃X implies |=T X for any X.

1. for any X: #p
2. such that ~Prov(contradictory) is a theorem in T: ((s=(~r&(p@p))
3. If X then Prov(X): (p>(r&p))
4. Prov(X⊃Y) ⊃(Prov(X) ⊃Prov(Y)): ((r&(p<q))>((r&p)>(r&q)))
5. Prov(X) ⊃Prov(Prov(X)): ((r&p)>(r&(r&p)))
6. Prov(X) ⊃X implies T X, for any X: (#p&(((r&p)>p)>p))

7. For (1 & (2 & (3 > ((4 & (5)) & 6))) > 6:

(<u>#p</u>&((s=(~r&(p@p))) & ((p>(r&p)) & (((r&(p<q))>((r&p)>(r&q)))&((r&p)>(r&(r&p))))))) > (<u>#p</u>&(((r&p)>p)>p)) ; **validated**; 49 steps

Note that validation of 7 is only made by including "for any X" (<u>#p</u>) for both main literals.

8. For (2 & (3 > ((4 & (5)) & 6)) > 6:

((s=(~r&(p@p))) & ((p>(r&p)) & (((r&(p<q))>((r&p)>(r&q)))&((r&p)>(r&(r&p)))))) > (<u>#p</u>&(((r&p)>p)>p)) ; not validated; 47 steps. Note that <u>#p</u> is included only in the consequent.

Model 1: FTFT FTFN TTTT TTTT
Model 2.1: UEUE UEUE EEEE EEEE
Model 2.2: UEUE UEUU EEEE EEEE
Model 2.3.1: UEUE UEUI EEEE EEEE
Model 2.3.2: UEUE UEUP EEEE EEEE

We derive and test a Hilbert style metatheorem for **Löwenheim–Skolem** [LS] as described at en.wikipedia.org/wiki/L%C3%B6wenheim%E2%80%93Skolem_theorem:

Assumption: A metatheorem is *a state machine.*

LET: p = K; q = M; r = N;
~ Not; < Not Imply; > Imply; & And; + Or; = Equivalent; @ Not Equivalent;
vt tautologous; nvt Not Validate tautologous; designated truth values Tautologous, Evaluated

If K<M, then M>N as ((p<q)>(q>r)) ; (1)
If K>M or K=M, then N>M as (((p>q)+(p=q))>(r>q)) ; (2)

To capture the parts of the metatheorem *as a state machine*, we evaluate combinations of Eq 1 and 2 in truth table fragments with the non designated values in bold as **contradictory**, Unevaluated::

(1)&(2): ((p<q)>(q>r)) & (((p>q)+(p=q))>(r>q)); nvt; TTTT **F**TTT; EEEE **U**EEE (3)
(1)>(2): ((p<q)>(q>r)) > (((p>q)+(p=q))>(r>q)) ; nvt; TTTT **F**TTT; EEEE **U**EEE (4)
(1)+(2): ((p<q)>(q>r)) + (((p>q)+(p=q))>(r>q)) ; vt; TTTT TTTT; EEEE EEEE (5)
(1)<(2): ((p<q)>(q>r)) < (((p>q)+(p=q))>(r>q)) ; not needed (6)

From Eq 5, the argument of [(1) Or (2)] seems to capture the essence of the metatheorem states, as a proof tautologous; however there is a state which is missing and unaccounted for as M=N.

We inject an accommodation for M=N as (q=r), or more properly rejection of that state as

M≠N as (q@r) ; (7)

Eq 5 is rewritten to avoid that unaccounted for state as:

(7)&[(1)+(2)]:

(q@r) & (((p<q)>(q>r)) + (((p>q)+(p=q))>(r>q))); nvt;

FFTT TT**FF**; **UU**EE EE**UU** (8)

The problem with the Löwenheim–Skolem Hilbert style metatheorem is that it does not hold for all machine states, and hence is not tautologous.

From Echenique, Saito (2015), "General Luce model"

LET: vt tautologous, nvt not tautologous; # All;
& And; \ Not And; > Imply; < Not Imply; ~ Not;
(%p>%#p) equal to 1

We begin later in the paper with simpler formula:

LET: pqrs, pxyX; vt Validated tautologous, nvt Not Validated tautologous

((#(q&r)<s)&(p&(q&r)))>(p>q) ;	vt;	Definition 7
(#(p&(q&r)) & ((p>q)&(q>r))) > (p>r) ;	vt;	Axiom 8
((#(p&(q&r))<s)& ((p<q)&(q<r))) > (p<r) ;	vt ;	Axiom 9

We then proceed to the beginning of the paper with more complex formula:

LET: pxyz, pxyX

((#(x&y)<z)&((p&(x&y))=(%p>%#p))) > (x>y) ;	vt ;	Definition 2.i
((#(x&y)<z)&((p&(x&y))<(%p>%#p))) > ~(x>y) ;	vt ;	Definition 2.ii

To this point, the General Luce model is tautologous.

Refutation of Majorana's 'root'

From: en.wikipedia.org/wiki/Relativistic_wave_equations.

Using the Meth8 apparatus we evaluate four equations in quantum physics from the above as labeled (3A) and (3B).

> LET: p ψ [(spinor) lc_psi]; q (E/c); r α·p; s βmc [lc_beta * mc];
> T tautology, designated truth value; F contradiction
>
> Truth tables are four rows shown row-major horizontally.

"[Paul] Dirac ... furthered the application of equation (E^2)−(pc)^2 = (mc^2)^2 to the electron ... by various manipulations he factorized the equation into the form:

$(E/c - \alpha\cdot p - \beta mc)\,(E/c + \alpha\cdot p + \beta mc)\psi = 0$ (3.0.1)
(((q-(r-s))&(q+(r+s)))&p) = (p@p) ; `TTTT TFTT TFTT TFTT` ; (3.0.2)

From Eq 3.0.1 the four "'roots'", "by a deviated approach to Dirac" from [Ettore] Majorana, are in Eq 3.1.1.

$(E/c - \alpha\cdot p + \beta mc)\psi = 0$; of interest to Majorana ; (3.1.1)
((q-(r+s))&p) = (p@p) ; `TFTT TTTT TTTT TTTT` ; (3.1.2)

$(E/c + \alpha\cdot p - \beta mc)\psi = 0$; reversing the order of arithmetic in Eq 3.4.1 from -,+ to +,- (3.2.1)
(q+(r-s))&p) = (p@p) ; `TFTF TTTF TTTF TTTF` ; (3.2.2)

$(E/c - \alpha\cdot p - \beta mc)\psi = 0$; an analogous root directly from Eq 3.0.1 (3.3.1)
((q-(r-s))&p) = (p@p) ; `TTTT TFTT TFTT TFTT` ; (3.3.2)

$(E/c + \alpha\cdot p + \beta mc)\psi = 0$; an analogous root directly from Eq 3.0.1 (3.4.1)
((q+(r+s))&p) = (p@p) ; `TTTF TFTT TFTT TFTT` ; (3.4.2)

The results for Eq 3.0.2 and 3.3.2 are equivalent.

In Eq 3.1.1, 3.2.1, 3.3.1, and 3.4.1, the removal of the literal element ψ alters the truth table rows, of Eq 3.1.2, 3.2.2. 3.3.2, and 3.4.2, for "TTTT" to read "FFFF", meaning that the results deviate further from tautology.

Eq 3.1.1 of Majorana was the basis for the angel particle named a chiral Majorana fermion. From Eq 3.1.2 Meth8 refutes that as a tautology because of the one value F in the truth table `TFTT TTTT TTTT TTTT`.

These results from mathematical logic make the experimental discovery of such a particle suspicious.

Meth8 versus Prover9

A problem from Vladimir Lifshitz (2007):

In Prover9, "Prover9 exit: exhausted"

```
exists x exists x1 all y exists z exists z1
(  ( -p(y,y) | p(x,x)   | -s(z,x)  ) &
   ( s(x,y)  | -s(y,z)  | q(z1,z1) ) &
   ( q(x1,y) | -q(y,z1) | s(x1,x1) )   ) .
```

In Meth8, nvt, with this truth table fragment:

```
(%p&(%q&(#r&(%t&%u)))) &
      ((((~v&(r&r))+((v&(p&p))+(~w&(t&q)))) & (w&(p&r))+((~w&(r&t))+
(x&(u&u))))) &
        (((x&(q&r))+(~q&(r&t)))+(w&(q&q)))) ; nvt
```

```
TTTT TTTT TTTT TTTT   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE   EEEE EEEE EEEE EEEE
TTTT TTTC TTTT TTTC   EEEE EEEU EEEE EEEU   EEEE EEEE EEEE EEEE   EEEE EEEP EEEE EEEP   EEEE EEEI EEEE EEEI
. . . . ^ . . . . ^   . . . . ^ . . . . ^   . . . . . . . . . .   . . . . ^ . . . . ^   . . . . ^ . . . . ^
```

Refutation of set of cycles in classical real Minkowski plane

From: en.wikipedia.org/wiki/Minkowski_plane

$P := (R\cup\{\infty\})^2 = R^2\cup(\{\infty\}\times R)\cup(R\times\{\infty\})\cup\{(\infty,\infty)\}, \infty\notin R$, **the set of points**, (1.1)

$Z := \{\{(x,y)\in R^2|y=ax+b\}\cup\{(\infty,\infty)\}|a,b\in R,a\neq 0\}\cup\{\{(x,y)\in R^2|y=ax-b+c,x\neq b\}\cup\{(b,\infty),(\infty,c)\}|$
$a,b,c\in R,a\neq 0\}$, **the set of cycles**. (2.1)

We assume the apparatus and method of Meth8/VŁ4. The designated *proof* value is T tautologous. Repeating fragments of the truth table results are 16-values as row-major, and presented horizontally.

LET r s t u v x y : R a b ∞ c x y;
~ Not; & And, ×, ∪, ","; > Imply, |, greater than; < Not Imply, lesser than, ∈; = Equivalent to; @ Not Equivalent to, ≠; + Or; - Not Or; ~(p>q) (p≤q); ~(p<q) p∉q;
% possibility, existential for one or some; # necessity, universal for all; (s@s) logical 00; (%s>#s)-(%s>#s) numeric zero as one minus one.

P, the set of points:

~(u<r) > (((r&u)&(r&u))=(((r&r)&(u&r))&((r&u)&(u&u))));
TTTT TTTT TTTT TTTT (1.2)

Eq.1.2 as rendered is tautologous. This means the set of points in the classical real Minkowski plane are confirmed.

Z, the set of cycles, using logical 00:

((((x&y)<(r&r))>(y=((s&x)+t)))&((((s&t)<r)&~(s=(s@s)))>(u&u))) & ((((x&y)<(r&r)) & ((y=((s\(x-t))+v))&~(x=t)))&(((((s&t)&v)<r)&~(s=(s@s)))>((t&u)&(u&v))));
FFFF FFFF FFFF FFFF (2.2.1)

Z, the set of cycles, using numeric zero as one minus one:

((((x&y)<(r&r))>(y=((s&x)+t)))&((((s&t)<r)&~(s=((%s>#s)-(%s>#s))))>(u&u))) & ((((x&y)<(r&r))&((y=((s\(x-t))+v))&~(x=t)))&(((((s&t)&v)<r)&~(s=((%s>#s)-(%s>#s))))>((t&u)&(u&v)))); FFFF FFFF FFFF FFFF; FFFF FFFF TTTT FFFF (2.2.2)

Eqs. 2.2.1 and 2.2.2 are *not* tautologous. This means the set of cycles in the classical real Minkowski plane are refuted.

Remark: Eq. 2.2.2 as rendered numerically provides a finer level of detail in proof results than Eq. 2.2.1 logically. Hence Eq. 2.2.2 shows *not* contradictory, but obviously also *not* tautologous.

What follows is that basing quantum theory on the set of cycles in the classical real Minkowski plane is suspicious.

Counter example to "modified divine command theory"

Per Robert Merrihew Adams (a Presbyterian minister for a short stint, whose late spouse was an Episcopalian priestess) originated the modified divine command theory [bracket text is my insertion]:

Eq 1 It is wrong to do X.
Eq 2. It is contrary to God's commands to do X.
[Eq 3.1 To do X implies wrong.]
[Eq 3.2 Wrong implies to do X.]
[Eq 4. If Eq 1 and Eq 2, then Eq 3.1.]
[Eq 5. If Eq 1 and Eq 2, then Eq 3.2.]

LET: p X, q wrong, r God's command,
~ Not, & And, > Imply, nvt not tautologous, vt tautologous

Note: Truth tables are for four propositions and presented left to right as the four rows top-down. Designated truth values are Tautologous and contradictory here.

q > p ;	nvt ;	TTFT TTFT TTFT TTFT	(1)
~r > p ;	nvt ;	FTFT TTTT FTFT TTTT	(2)
p > q ;	nvt ;	TFTT TFTT TFTT TFTT	(3)
((q>p)&(~r>p)) > (p>q) ;	nvt ;	TFTT TFTT TFTT TFTT	(4)
((q>p)&(~r>p)) > (q>p) ;	vt ;	TTTT TTTT TTTT TTTT	(5)

Eq 4 is of concern as a counter example to Eq 5: If both wrong implies doing X and not God's command implies doing X, then doing X implies wrong. This scans as tautologous, but logically it is not.

Eq 5 is tautologous: If both wrong implies doing X and not God's command implies doing X, then wrong implies doing X.

This caused Professor Adams to modify Eq 5 to read something as "If *and only if* Eq 1 and Eq 2, then Eq 3.2" which ultimately begs the question.

My conclusion is that the modified divine command theory is a hypothesis, at best.

Rule of necessitation: tautologous, but not tautologous

1. The axiom or rule of necessitation **N** states that if p is a theorem, then necessarily p is a theorem:

If ⊢p then ⊢□p.

We show this is non-contingent (a truth), but not tautologous (a proof). We evaluate axioms (in bold) of **N**, **K**, **T**, **4, B**, **D**, **5** to derive systems (in italics) of *K*, *M*, *T*, *S4*, *S5*, *D*.

We assume the Meth8 apparatus implementing system variant VŁ4, where:

necessity, universal quantifier; % possibility, existential quantifier;
> Imply; = Equivalent to; (p=p) Tautology

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

The designated proof value is T tautology. Note the meaning of (%p>#p): a possibility of p implies the necessity of p; and some p implies all p. In other words, if a possibility of p then the necessity of p; and if some p then all p. This shows equivalence and interchangeability of respective modal operators and quantified operators, as proved in Appendix.
(That correspondence is proved by VŁ4 corrections to the vertices of the Square of Opposition and subsequent corrections to the syllogisms of Modus Cesare and Modus Camestros.)

Results are the 16-value truth table as row-major and horizontal; tautology is all "TTTT".

N: If ⊢p then ⊢□p. (**N**.1.1)
p>#p ; `TNTN TNTN TNTN TNTN` (**N**.1.2)

Eq. 1.2 is minimally tautologous at a level of non-contingency (`NNNN NNNN NNNN NNNN`), but not a proof at a level of tautology (`TTTT TTTT TTTT TTTT`).

The definitions of the other axioms are as follows (Steward, Stoupa, 2004):

K: $\Box(p \rightarrow q) \rightarrow (\Box p \rightarrow \Box q)$; no conditions (**K**.1.1)
#(p>q)>(#p>#q) ; `TTTT TTTT TTTT TTTT` (**K**.1.2)

T: $\Box p \rightarrow p$; reflexive (**T**.1.1)
#p>p ; `TTTT TTTT TTTT TTTT` (**T**.1.2)

4: □ p → □ □ p (**4**.1.1)
#p>##p ; `TTTT TTTT TTTT TTTT` (**4**.1.2)

B: p → □ ◊ p ; reflexive and symmetric (**B**.1.1) p>#%p ; `TTTT TTTT TTTT TTTT` (**B**.1.2)

D: □ p → ◊ p ; serial (**D**.1.1)
#p>%p ; `TTTT TTTT TTTT TTTT` (**D**.1.2)

5: ◊ p → □ ◊ p (**5**.1.1)
%p>#%p ; `TTTT TTTT TTTT TTTT` (**5**.1.2)

The definitions of systems are as follows:

K:= **K** (no conditions) (*K*.1.1)
#(p>q)>(#p>#q) ; `TTTT TTTT TTTT TTTT` (*K*.1.2)

alternatively, **K** & **N** is used (viz, en.wikipedia.org/wiki/Modal_logic) (*K*.2.1)
(#(p>q)>(#p>#q))&(p>#p) ; `TNTN TNTN TNTN TNTN` (*K*.2.2)

Eq. *K*.2.2 subsequently taints all results as having some value of truth (`TNTN`), but *not* tautology (`TTTT`).

D:= *K* & **D** (serial) (*D*.1.1)
(#(p>q)>(#p>#q))&(#p>%p) ; `TTTT TTTT TTTT TTTT` (*D*.1.2)

M:= *K* & **T** (*T*.1.1)
(#(p>q)>(#p>#q))&(#p>p) ; `TCTT TCTT TCTT TCTT` (*T*.1.2)

S4:= *M* & **4** ; reflexive and transitive (*S4*.1.1)
((#(p>q)>(#p>#q))&(#p>p))&(#p>##p) ; `TTTT TTTT TTTT TTTT` (*S4*.1.2)

B:= *M* & **B** (*B*.1.1)
((#(p>q)>(#p>#q))&(#p>p))&(p>#%p) ; `TTTT TTTT TTTT TTTT` (*B*.1.2)

S5:= *M* & **5** ; reflexive and Euclidean (*S5*.1.1)
((#(p>q)>(#p>#q))&(#p>p))&(%p>#%p) ; `TTTT TTTT TTTT TTTT` (*S5*.1.2)

alternatively, *M* & **B** & **4** (*S5*.2.1)
(((#(p>q)>(#p>#q))&(#p>p))&(p>#%p))&(#p>##p) ;

2. We also evaluated (Steward, Stoupa, 2004) to derive by replication some systems of interest.

K: [](p ⊃q) ⊃([]p ⊃[]q) (3.1.1)
#(p>q)>(#p>#q) ; `TTTT TTTT TTTT TTTT` (3.1.2)

Axiom **T**: []p ⊃p (3.2.1)
#p>q ; `TTTT TTTT TTTT TTTT` (3.2.2)

M, obtained by extending system **K** with rule **T** [not Gödel's system T] (3.3.1)
(#(p>q)>(#p>#q))>(#p>q) ; `TCTT TCTT TCTT TCTT` (3.3.2)

"The strongest system from these modal logics that is perfectly straightforward to formulate in a sequent system and to prove cut-free is system **G-M** (for Gentzen system **M**)".

We remark that the subsequent derivations of *S4*, *B*, and *S5* are tautologous, as are **K** and **T** as demonstrated in section 1.

2. We found other mistakes in (Steward, Stouppa, 2004).

2.1. "The following lemma is a straightforward exercise in theoremhood over **K**:

LEMMA 6 If A ⊃B is a theorem of **M**, then so are: (L.6.0.1)
1. A ∧C ⊃B ∧C; (L.6.1.1)
2. A ∨C ⊃B ∨C; (L.6.2.1)
3. []A ⊃[]B; (L.6.3.1)
4. <>A ⊃<>B." (L.6.4.1)

To map Eq. L.6.0.1 we use Eq. 3.3.2.

((#(p>q)>(#p>#q))>(#p>q)) > (p>q) ; TNTT TNTT TNTT TNTT (L.6.0.2)

We then reuse Eq. L.6.0.2 to map L.6.1.2 - 6.4.2.

(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > ((p&r)>(q&r)) ; TTTT TCTT TTTT TCTT (L.6.1)
(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > ((p+r)>(q+r)) ; TCTT TTTT TCTT TTTT (L.6.2)
(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > (#p>#q) ; TCTT TCTT TCTT TCTT (L.6.3)
(((#(p>q)>(#p>#q))>(#p>q))>(p>q)) > (%p>%q) ; TCTT TCTT TCTT TCTT (L.6.4)

2.2. These inference rules were flagged by Meth8, with page number for equation.

LET: p uc_Gamma; q uc_Delta; r A; s B

(p&r)>(%p&#r) ; 1.#1 ; TTTT TNTN TTTT TNTN (315, []1)
(%p&r)>(%p&#r) ; TTTT NNNN TTTT NNNN (323, []2)
((%p&q)&r)>((%p&#q)&#r) ; TTTT TTNN TTTT TTNN (324, []5)

"we recommend the reader works ... example (A ⊃B ⊃C) ⊃(A ⊃C) ⊃B ⊃C" (321.1)
((((p>q)>r)>(p>r))>q)>r ; TFFF TTTT TFFF TTTT (321.2)

We conclude that **N** the axiom or rule of necessitation is *not* tautologous Because system *M* as derived and rendered is not tautologous, system *G-M* also *not* tautologous.

What follows is that systems derived from using *M* are tainted, regardless of the tautological status of the result so masking the defect, such as systems *S4*, *B*, and *S5*.

We also find that Gentzen-sequent proof is suspicious, perhaps due to its non bi-valent lattice basis in a vector space.

References

Steward, Charles; Stouppa, Phiniki. (2004). A systematic proof theory for several modal logics; also at textproof.com/supervision/phiniki04sbm.pdf

Meth8 applied to Jan Woleński (2015) ***On Leonard Nelson's Criticism of Epistemology***

We evaluate Leonard Nelson proofs in the words from pages 5-7 (Woleński 2015) for the first proof (α), but ignore the second proof (β) because it is based on set theory (which we dispense with elsewhere). The expressions are keyed to that paper.

We restate the problem as:

> (*) The fundamental task of epistemology consists in demonstrating objective truth or validity of human knowledge.

We use the Meth8 modal logic checker in five models, as based on our system variant VŁ4 that resuscitates the quaternary logic of Łukasiewicz.

Assume Meth8 script where:

> + Or, - Not or, & And, \ Not and, > Imply, < Not imply, = Equivalent, @ Not equivalent, ~ Not, vt tautologous, nvt not tautologous, Contradiction is nvt with all contradictory

LET: s = "epistemological criterion C"
p = problematic domain
q = knowledge

(2) s = (q+~q) ; "C is either knowledge or not"
(a) (s>q) ; "assume C is knowledge"
(a1) (s>q) > (~s>p) ; "If C is knowledge, it belongs to the domain of what is just problematic (Nelson assumes that a piece of cognition is problematic before checking it by C)"
(a2) (s>~q) > p ; "However, C is not knowledge, it is problematic only"
(a3) Test: We ask is "Contradiction (a)-(a2)".
Results: ((s>q)>(~s>p)) > ((s>~q)>p) ; nvt ; TTTT TTTT FTTT FTTT ;
We answer "The fundamental problem (*) is not a contradiction, but nvt".

(b) (s=~q) ; "assume C is not knowledge"
(b1) (s=(q+~q)) > (s>q) ; "If C is to be successfully applied, it must be known as suitable to perform its role as the standard of knowledge"

(b2) ((s=(q+~q)) > (s>q)) > (s=q) ; "If (b1), then C is knowledge"
(b3) Test: We ask is "Contradiction (b)-(b2)".
Results: ((s=(q+~q)) > (s>q)) > (s=q) ; nvt ; TTFF TTFF TTTT TTTT ;
We answer "The fundamental problem (*) not a contradiction, but nvt".

(3) Since we do not obtain a contradiction in every case listed in (2) and because (2) depicts the complete and exhaustive list of possibilities, the problem of epistemology has the solution that it is not validated as a tautologous problem. This just means that epistemology is not impossible.

We further evaluate Eqs (a)-(a3) and (b)-(b3) in a format that renders all possibilities based on (2)(a3) and (2)(b3). We note that (2) serves as the primary antecedent where "C is either knowledge or not" from which all arguments follow. This renders (a3) and (b3) as:

(a3') (s=(q+~q)) > (((s=q)>(~s>p)) + ((s=~q)>p)) ; vt ;
"If C is either knowledge or not, then
either if C is knowledge, then if not C then a problematic domain
or if C is not knowledge, then a problematic domain.

(b3') (s=(q+~q)) > ((((s=~q)>(s>p))>(s=q)) + (((s=q)>(s>p))>(s=~q))) ; vt ;
"If C is either knowledge or not, then
either
if (C is not knowledge, then if C implies a problematic domain), then C is knowledge
or
if (C is knowledge, then if C implies a problematic domain),
then C is not knowledge.

Our conclusion is contra Nelson, that is, epistemology is not a problem and further epistemology is possible from which knowledge is derived.

Thanks are due to Professor Woleński for presenting the arguments of Leonard Nelson as readable.

von Neuman-Bernays-Gödel [NBG]

From en.wikipedia.org/wiki/Axiom_schema_of_specification, more on Axiom schema of specification using other expressions for von Neumann-Bernays-Gödel (NBG):

In von Neumann-Bernays-Gödel set theory, a distinction is made between sets and classes. A class *C* is a set if and only if it belongs to some class *E*. In this theory, there is a theorem schema that reads

[1.] ∃D ∀C ([C ∈D] ↔ [P (C) ∧∃E (C ∈E)])

that is, "There is a class *D* such that any class *C* is a member of *D* if and only if *C* is a set that satisfies *P*.", provided that the quantifiers in the predicate *P* are restricted to sets.

This theorem schema is itself a restricted form of comprehension, which avoids Russell's paradox because of the requirement that *C* be a set. Then specification for sets themselves can be written as a single axiom

[2.] ∀D ∀A (∃E [A ∈E] → ∃B [∃E (B ∈E) ∧ ∀C (C ∈B ↔ [C ∈A ∧C ∈D])])

that is, "Given any class *D* and any set *A*, there is a set *B* whose members are precisely those classes that are members of both *A* and *D*.", or even more simply "The intersection of a class *D* and a set *A* is itself a set *B*.".

In this axiom, the predicate *P* is replaced by the class *D*, which can be quantified over. Another simpler axiom which achieves the same effect is

[3.] ∀A ∀B ([∃E (A ∈E) ∧ ∀C (C ∈B → C ∈A)] → ∃E [B ∈E])

that is, "A subclass of a set is a set.".

[1.] **Not validated, so the theorem as published is not tautologous.**

1.1. substituting CDE as ABC with, per Quine, P(C) = (C=C) below as (A=A)

((%B&#A)&(A&B))=((%B&#A)&((A=A)&(%C&(A&C)))) ; sets as classes as theorems ;

Model 2.2; **nvt**

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTCC TTCC  EEEE EPEP EEII EPIU  EEEE EEEE EEEE EEEE  EEEE EPEP EEEE EPEP  EEEE EEEE EEII EEII
```

1.2 substituting CDE as pqr with, per Quine, P(C) = (C=C) below as (p=p)

((%q&#p)&(p&q)) = ((%q&#p)&((p=p)&(%r&(p&r)))) ; sets as classes as propositions ;

Model 2.2; **nvt**

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTC TTTT TTTC TTTT  EEEU EEEE EEEU EEEE  EEEE EEEE EEEE EEEE  EEEP EEEE EEEP EEEE  EEEI EEEE EEEI EEEE
```

[2.] **Validated in the form of implication (>), as published, and also in the form of equivalence (=).**

((#s&#p)&(%p&(p&t))) > ((#s&#p)&(%q&((%t&(q&t))&(#r&((r&q)=((r&p)&(r&s))))))) ; vt

((#s&#p)&(%p&(p&t))) = ((#s&#p)&(%q&((%t&(q&t))&(#r&((r&q)=((r&p)&(r&s))))))); vt

[3.] **This is validated elsewhere as Axiom 3**.

((#A&#B)&((%D&(A&D))&(#C&((C&B)>(C&A))))) > ((#A&#B)&(%D&(B&D))); vt

Re: **Deducibility theorems in Boolean logic** Florentin Smarandache University of New Mexico 200 College Road Gallup, NM 87301, USA E-mail: smarand@unm.edu
http://vixra.org/abs/1003.0171

As presumably a basis for neutrosophic logic these mistakes were found:

Assume the Meth8 apparatus.

LET: pqrs A1 B1 An Bn

(p>q)>((p&r)>(q&s)) ; TTTT TTTF TTTT TTTT ; Theorem 1
This formula is not tautologous.

(p>q)>((p+r)>(q+s)) ; TTTT FTTT TTTT TTTT ; Theorem 2
This formula is not tautologous.

If the above are "made by complete induction", then it is an example of why induction is defective.

LET: pqr ABC

((p&q)+r)>(p&(q&r)) ; TTTF FFFT TTTF FFFT ; Section 2(ii)
This formula is not deducible as such and is not tautologous.

((p>p)&(q<p))>((p&q)>(p&p)) ; TTTT TTTT TTTT TTTT ; 2a
[This is not a counter example of anything other than a contradiction, which Theorem 1 is not as TTTT TTTF TTTT TTTT.
For 2a to be a contradiction of Theorem 1, the 2a truth table should read:
FFFF FFFT FFFF FFFF]

((p>p)&(p<q))>((p+p)>(p+p)) ; TTTT TTTT TTTT TTTT ; 2b
[This is not a counter example of anything other than a contradiction, which Theorem 2 is not as TTTT FTTT TTTT TTTT.
For 2b to be a contradiction of Theorem 2, the 2b truth table should read:
FFFF TFFF FFFF FFFF.]

Refutation of neutrosophic logic by Florentin Smarandache as generalized intuitionistic, fuzzy logic

We rely on:

Smarandache, F. 2010. Neutrosophic Logic - A Generalization of the Intuitionistic Fuzzy Logic.
vixra.org/abs/1004.0008; vixra.org/pdf/1004.0008v2.pdf
arxiv.org/ftp/math/papers/0303/0303009.pdf

We assume the apparatus and method of Meth8/VŁ4.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; & And; \ Not And; + Or; - Not Or;
> Imply, greater than; > Not Imply, less than; = Equivalent to;
necessity, for all; % possibility, for some (one); (p-p) zero; (p\p) one;
q>(p-p) q>zero; q<(p\p) q<one; q=(p-p) q=zero; q=(p\p) q=one

The designated *proof* value is T(autology). The 16-valued result table is presented in row-major and horizontally.

For neutrosophic logic (N), we map the respective values of truth, falsity, and indeterminacy as:

Nt (%p>#p); Nf (%p<#p); Ni (((%p>#p)+(%p<#p))+~((%p>#p)+(%p<#p))). (1.1)

We simplify our evaluation by ignoring the numeric scaling factor of lower-case_epsilon ε. That serves to push a single numeric value of the combined, summed state of Nt+Ni+Nf outside an interval definition of q on "]0,1[" and into "]0,3[", or ultimately to natural numbers, including a number zero.

#(((q>(p-p))&(q<(p\p)))+((q=(p-p))+(q=(p\p)))) >
%(q=(((%p>#p)+(%p<#p))+~((%p>#p)+(%p<#p)))) ; TCTT TCTT TCTT TCTT (1.2)

In Eq. 1.2 the antecedent establishes the necessity of $0 \leq q \leq 1$.

In Eq. 1.2 the consequent establishes the possibility that q is the summation of Nt+Ni+Nf.

In Eq. 1.2 the result of the literal is *not* tautologous, meaning neutrosophic logic is refuted and hence its use as a generalization of intuitionistic, fuzzy logic is likewise unworkable.

We expand our evaluation by including more neutrosophic values for absolute truth +1, absolute falsity -0, and absolute indeterminacy on the interval written "]-0,1+[", as respectively:

N+t (#p>#p); N+f (#p<#p); N+i (((#p>#p)+(#p<#p))+~((#p>#p)+(#p<#p))). (2.1)

We substitute values of Eq. 2.1 into Eq. 1.2.

```
#(((q<(p-p))&(q>(p\p)))+((q=(p-p))+(q=(p\p)))) >
%(q=(((#p>#p)+(#p<#p))+~((#p>#p)+(#p<#p)))) ;          TCTT TCTT TCTT TCTT     (2.2)
```

In Eq. 2.2 the antecedent establishes the necessity of $1 \leq q \leq 0$.

In Eq. 2.2 the consequent establishes the possibility that q is the summation of (N+t) + (N+i) + (N+f).

In Eq. 2.2 the result of the literal is *not* tautologous, with the same table result as in Eq. 1.2 and generalization as likewise unworkable.

Logic not tautologous in neutrosophic sets

From: Wang, H; et al. Single valued neutrosophic sets. vixra.org/pdf/1004.0051v1.pdf [raj@cs.gsu.edu]

We test a theorem and two properties from above.

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to;
@ Not equivalent to; # all; % some; (p@p) zero ; (p=p) one

Results are the proof table of 16-values in row major horizontally.

Theorem 3 [sic]; read Theorem 1. $A \subseteq B \leftrightarrow c(B) \subseteq c(A)$

~(B<A)=~((C&A)<(C&B)) ; TTFT TFFT TTFT TFFT (1.1)

Property 5. $A \cup X = X$, where ...

(((((t&q)=(u&q))=(p@p))&((s&q)=(p=p)))&((((t&r)=(u&r))=(p=p))&((s&r)=(p@p))))
> ((p+r)=r) ; TTTT TTTT TTTF TTTT (5.2)

Property 6. $A \cup \varphi = A$, where ...

(((((t&q)=(u&q))=(p@p))&((s&q)=(p=p)))&((((t&r)=(u&r))=(p=p))&((s&r)=(p@p))))
> ((p+q)=p) ; TTTT TTTT TTFT TTTT (6.1)

Eqs. 1.1, 5.2, and 6.1 should be tautologous, but are not.

Refutation of neutrosophic soft lattice theory

Taken from:

> Uluçay, Vakkkas; Şahin, Mehmet; Olgun, Necati; and Kilicman, Adem.
> "On neutrosophic soft lattices".
> Afr. Mat. DOI 10.1007/s13370-016-0447-7. vixra.org/pdf/1706.0269v1.pdf
>

We evaluate the neutrosophic logic based on its most atomic level of soft latices, as published by Springer-Verlag in 2016.

Of interest to us is the seminal Theorem 3.17 on un-numbered page 7 is this theorem:

> Every neutrosophic soft lattice is a one-sided distributive neutrosophic soft lattice. (3.17)

We assume the apparatus and method of Meth8 implementing variant logic system VŁ4.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

Due to problematic font presentation of symbols in the paper, we substitute equations here, as:

LET: p q r F_A F_B F_C ;
~ Not; = Equivalent to; & And; \ Not And; + Or; - Not Or; > Imply; < Not Imply;
\ ˜∧, Not And; - ˜∨, Not Or;
˜≤, Not less than or equal to (n.L.T.E): "p ˜≤ q" is equivalent to "~((p<q)+(p=q))".

The designated *proof* value is T. The 16-valued tables are horizontal as row-major.

We evaluate Eq. 3.17 as stand-alone first, then as a consequence of the build up farther below.

$F_A \tilde{\wedge} F_B = (F_A \tilde{\wedge} F_B)\tilde{\wedge}(F_A \tilde{\wedge} F_B)\tilde{\leq} F_A \tilde{\wedge}(F_B \tilde{\vee} F_C)$ (a) (3.17.1)

This renders in Meth8 as:

(p\q) = ((p\q) \ ~(((p\q)<(p\(q-r))) + ((p\q)=(p\(q-r))))); `TTTF TTTF TTTF TTTF` (3.17.2)

Eq. 3.17.2 as rendered by Meth8 is *not* tautologous (all `T`) and hence not a theorem.

Without repeating build up arguments to Eq. 3.17.1, as "*Proof* Let ... Since ... and ..., ... Therefore,", we present the entire argument rendered in Meth8 in 123 steps as:

```
(((p\~((q<p)+(q=p)))&(p\~((q<~((q<~((q<(q-r))+(q=(q-r))))+(q=~((q<(q-r))+(q=(q-r))))))
+(q=~((q<~((q<(q-r))+(q=(q-r))))+(q=~((q<(q-r))+(q=(q-r)))))))))>((p\~((q<p)+(q=p)))
&(p\~((q<(q\r))+(q=(q\r))))))>((p\q)=((p\q)\~(((p\q)<(p\(q-r)))+((p\q)=(p\(q-r)))))) ;
                                        TTTF TTTF TTTF TTTF     (3.17.3)
```

Eq. 3.17.3 as rendered by Meth8 is *not* tautologous (all T), at which we stopped.

The proof tables from Eqs. 3.17.2 and 3.17.3 are identical which means the build up arguments are confirmed to produce Eq. 3.17.1, but for which Eq. 3.17 is refuted as a conjectured theorem.

This brief evaluation implies that the field of soft set theory as originally introduced by D. Molodtsov is suspicious and specifically that the field of neutrosophic logic, as evidenced in its basis of soft set theory, is unworkable.

This conclusion is multitudinal because of the plethora of duplicated papers as translations in multiple fields at vixra.org regarding the neutrosophic logic system of Florentin Smarandache.

Unification by neutrosophic logic not tautologous

From: Christianto, V.; Smarandache, F. (2017). How a synthesizer works. vixra.org/pdf/1711.0442v1.pdf

"Neutrosophic Logic is a general framework for unification of many existing logics, such as fuzzy logic (especially intuitionistic fuzzy logic), paraconsistent logic, intuitionistic logic, etc.

The main idea of NL is to characterize each logical statement in a 3D Neutrosophic Space, where each dimension of the space represents respectively the truth (T), the falsehood (F), and the indeterminacy (I) of the statement under consideration, where T, I, F are standard or non-standard real subsets of]-0, 1+[with not necessarily any connection between them.

For software engineering proposals the classical unit interval [0, 1] is used.

For single valued Neutrosophic logic, the sum of the components is:

$0 \leq t+i+f \leq 3$ when all three components are independent; (3.1.1)
$0 \leq t+i+f \leq 2$ when two components are dependent,
while the third one is independent from them; (2.1.1)
$0 \leq t+i+f \leq 1$ when all three components are dependent. (1.1.1)

When three or two of the components T, I, F are independent, one leaves room for incomplete information (sum < 1), paraconsistent and contradictory information (sum > 1), or complete information (sum = 1). (3.2.1)

If all three components T, I, F are dependent, then similarly one leaves room for incomplete information (sum < 1), or complete information (sum = 1)." (1.2.1)

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; = Equivalent to; @ Not equivalent to; > Imply, greater than;
all, necessity; % some, possibility; (p=p) 11, three; (%p>#p) 01, one;
p q r s f i t sum=f+i+t; Note ($0 \leq s$) is equivalent to ~(s < 0).

Results are the repeating proof table(s) of 16-values in row major horizontally.

We evaluate Eqs. 3.1.1 and 3.2.1 as an axiom or definition with rules.

(s=((p+q)+r))&((~((p@p)>s)&~(s>(p=p)))>(((s<(%p>#p))+(s>(%p>#p)))+(s=(%p>#p)))) ;
TFFF FFFF FTTT TTTT (3.3)

We do not evaluate Eq. 2.1.1 because it has no rules.

We evaluate Eqs. 1.1.1 and 1.2.1 as an axiom or definition with rules.

(s=((p+q)+r))&((~((p@p)>s)&~(s>(%p>#p)))>((s<(%p>#p))+(s=(%p>#p)))) ;

`TFFF FFFF FTTT TTTT` (1.3)

Eqs 3.3 and 1.3 are *not* tautologous, and in fact produce the same proof table.

This means neutrosophic logic is not bivalent, but a probabilistic vector space, and hence inexact.

What follows is that neutrosophic logic cannot unify other logics in a tautology.

P=NP resolution, with 3-SAT not tautologous

1. **NP**

We use the definition of NP as “nondeterministic polynomial time” from Stephen Cook at claymath.org/sites/default/files/pvsnp.pdf as:

$$w \in L \iff \exists y(|y| \leq |w|^k \text{ and } R(w, y)) \quad (1)$$

where:

$$R(w, y) \iff w \in L \quad (2)$$

$$R(\sim a, \sim b) \iff 1 < b < a \text{ and } b|a \qquad \text{(with negation replacing the obtuse vinculum)} \quad (3)$$

We substitute the expression $R(a, b)$ as:

$$R(\sim a, \sim b) \iff [\ R(w, y) \iff 1 < b < a \text{ and } b|a\ ] \quad (4)$$

then substitute $R(w, y)$ in Eq. 1 with Eq. 4 for:

$$w \in L \iff \exists y(|y| \leq |w|^k \text{ and } [\ R(\sim a, \sim b) \iff [\ R(w, y) \iff 1 < b < a \text{ and } b|a\ ]\ ]. \quad (5.1)$$

We assume the apparatus and method of Meth8/VŁ4.

```
LET:   a b L R (w,y)   as   t u p q (w, y);  (r, s) = (w, y)
~ Negation, % modal possibility, existential quantifier for all, ∃;
& And, \ Not And, + Or, - Not Or, = Equivalent, @ Not Equivalent, > Imply, < Not Imply;
```

and where:

```
|w| :: (w+((w<((w\w)-(w\w)))>(w&((w\w)-((w\w)-(w\w))))));          (6)
|y| :: (y+((y<((y\y)-(y\y)))>(y&((y\y)-((y\y)-(y\y))))));          (7)
|y| <= |w|  :: (y' = w') or (y' < w') :: |w| > |y|.                 (8)
```

We note that in the modal propositional logic of Meth8, as based on system VŁ4, an exponential expression reduces to the mantissa such that w^3 is w&w&w = w. This means that in Eq. 5.1 the power series term $|w|^k$, with k as a natural number, reduces to $|w|$. In other words, in Meth8 a power series is effectively reduced to a linear expression.

```
(w<p)  =  (%y&(((w+((w<((w\w)-(w\w)))>(w&((w\w)-((w\w)-(w\w))))))>(y+((y<((y\y)-
(y\y)))>(y&((y\y)-((y\y)-(y\y)))))))&((q&(~r&~s))=((q&(w&y))=(((t\t)<(t<u))&(t+u)))))) ;
                                                                                (5.2)
```

Eq. 5.2 is evaluated on the five logical models of Meth8 as *not* tautologous.

The truth table for Eq. 5.2 is presented below as two different segments of two repeating blocks of 16 lines. The designated truth values are `T`autologous and `E`valuated.

```
(w<p)=(%y&(((w+((w<((w\w)-(w\w)))>(w&((w\w)-((w\w)-(w\w))))))>(y+((y<((y\y)-(y\y)))>(y&((y\y)-((y\y)-
(y\y)))))))&((q&(~r&~s))=((q&(w&y))=(((t\t)<(t<u))&(t+u)))))) ;  Step: 81; not tautologous for: =, >, <.

Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTNN TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEUU EEEE EEEE EEEE  EEII EEEE EEEE EEEE  EEPP EEEE EEEE EEEE
TTNN TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEUU EEEE EEEE EEEE  EEII EEEE EEEE EEEE  EEPP EEEE EEEE EEEE
NNTT NNNN NNNN NNNN  EEEE EEEE EEEE EEEE  UUEE UUUU UUUU UUUU  IIEE IIII IIII IIII  PPEE PPPP PPPP PPPP
TTNN TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEUU EEEE EEEE EEEE  EEII EEEE EEEE EEEE  EEPP EEEE EEEE EEEE
TTNN TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEUU EEEE EEEE EEEE  EEII EEEE EEEE EEEE  EEPP EEEE EEEE EEEE
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Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
```

2. **P**

We use the definition of P as "deterministic polynomial time", that is, ~NP as the negation of Eq. 5.1.

3. Problem statement: *Does* **P** = **NP**? (9.1)

We test Eq. 9.1 as equivalent to Eq. 5.1. For ~NP = NP, obviously the expression is contradictory.

4. 3-SAT

Cook describes an example of the 3-SAT test as NP-complete for the expression (with negation replacing the vinculum):

$$(p \lor q \lor r) \land (\sim p \lor q \lor \sim r) \land (p \lor \sim q \lor s) \land (\sim p \lor \sim r \lor \sim s) \tag{10.1}$$

((p+(q+r)) & (~p+(q+~r))) &((p+(~q+s)) & (~p+(~r+~s))) ;
`FTFT TFFT FTTT TFTF` (10.2)

with

$\tau(P) = \tau(Q) =$ *Tautologous* and $\tau(R) = \tau(S) =$ *contradictory* (11.1)

(((p=q)=(p=p))&((r=s)=(r@r))) ; `FFFF TFFT TFFT FFFF` (11.2)

Eqs. 10.2 and 11.2 as rendered are *not* tautologous.

We combine Eq. 10.1 and its qualification with clause of Eq. 11.1.

If $\tau(P) = \tau(Q) =$ *Tautologous* and $\tau(R) = \tau(S) =$ *contradictory*, then

$$(p \lor q \lor r) \land (\sim p \lor q \lor \sim r) \land (p \lor \sim q \lor s) \land (\sim p \lor \sim r \lor \sim s) \tag{12.1}$$

(((p=q)=(p=p))&((r=s)=(r@r))) > (((p+(q+r))&(~p+(q+~r)))&((p+(~q+s))&(~p+(~r+~s)))) ;
`TTTT TTTT FTTT TTTT` (12.2)

Eq. 12.2 as rendered is *not* tautologous, but nearly so with deviation by one `F` value. This means the 3-SAT test is *not* tautologous, and hence incapable of testing NP-completeness.

What follows is that the logical foundation supporting satisfiability is suspicious.

Jesse Alma (2013). **A machine-assisted view of paraconsistency.**

We use the variant system VŁ4 in the Meth8 logic model checker on five models, where: % existential quantifier; # universal quantifier; ~ Negation; & And; > Imply; vt tautologous; nvt Validated not tautologous.

In Experiment 1: Trivializing triviality

~(%x&(p&x))>~(%x&(#y&(p&y))) ; vt
(%x>x) > (%x&(#y>y)) ; vnt
(%x&(x>x)) > (%x&(#y>(y>y))) ; vt

Experiment 2: Possibility of explosiveness

p>(~p>q) ; explosion principle ; vt

Conclusion:

(#p&%q)>(#p&(#r&(((p&~p)&q)>r))) ; nvt

Here is the non repeating truth table fragment for the above, with designated truth values Tautologous, Evaluated (the UIP are unevaluated, improper, proper):

TTT**C** TTTT	EEE**U** EEEE	EEEE EEEE	EEE**P** EEEE	EEE**I** EEEE	Step: 15
Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2	

We find this conclusion in the abstract is suspicious: "paraconsistent logic points are indeed genuine".

Logical contradiction context: paraconsistent versus classical

Arenhart, J.R.B. (2016). Paraconsistent contradiction in context.

At: https://periodicos.ufrn.br/saberes/article/download/9730/6950

We evaluate the difference between paraconsistent contradiction and classical contradiction.

We assume the Meth8-VŁ4 apparatus with s **B**, t **T.** The designated proof value is Tautology, Result fragments are the repeating row on the 16-value truth table.

1. **B**(*p* ^ ~*p*) (assumption) ;	(s&(p&~p))
2. **B***p* ^ **B~***p* (distribution of **B**) ;	((s&p)&(s&~p))
3. **B***p* ^ ~**B***p* (from 2, with Exclusion) ;	((s&p)&~(s&p))

(4.) Eqs. ((1.=3.)=(1.=2.))=(2.=3.):

((((s&p)&(s&~p))=((s&p)&~(s&p)))=((s&(p&~p))=((s&p)&(s&~p))))
= ((s&(p&~p))=((s&p)&~(s&p))); TTTT

(5.) **BT~***p* → **B~T***p* (exclusion for truth) ;	((s&r)&~p)>(s&~(r&p)) ;	TTTT
(6.) **B~T***p* → ~**BT***p* ;	((s&~r)&p)>~((s&r)&p) ;	TTTT
(7.) **B~***p* → ~**B***p* (dropping **T** from 2) ;	(s&~p)>~(s&p) ;	TTTT

(We see a possible typo: for "~(**B***p*^~**B***p*)", read "(**B***p*^~**B***p*)", presumably to mean the paraconsistent contradiction and the doxastic contradiction are both contradictions.)

Meth8 finds equivalency with Eqs. 1, 2, 3 (all contradictions) in (4). Therefore we find no logical distinction of inside context or outside context or in paraconsistent logic or doxastic logic.

The axiom of induction in Peano arithmetic

Summary: The axioms for Peano arithmetic (PA) are numbered 1-8 below. Axiom 1 is not tautologous (the designated proof value), but a truth value. Axioms 2-8 are tautologous. The the axiom of induction as published is not tautologous; however, with the correction of one connective in the equation script, it is s tautologous.

We assume the Meth8 apparatus where:

@ Not =; < Not >; % possibility, universal quantifier; # necessity, existential quantifier.

Result fragments are repeating rows of a truth table of 16-values for the 128 tables of the proof.

For system variant VL4, these are the numbered definitions of axiom, symbol, name, meaning, 2-tuple, and ordinal value.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>%#p	N	Non-contingency	truth	01	1
4	%p<%#p	C	Contingency	falsity	10	2

Numbered definitions of axioms with symbol, name, meaning, 2-tuple, and ordinal values. The designated proof value is T tautology. Note the meaning of (%p>%#p): a possibility of p implies a possibility of the necessity of p; and some p implies some of all p. In other words, if a possibility of p then a possibility of the necessity of p; and if some p then some of all p. This shows the equivalence and interchangeability of respective modal operators and quantified operators. (That correspondence is proved by VŁ4 corrections to the vertices of the Square of Opposition and subsequent corrections to the syllogisms of Modus Cesare and Modus Camestros.)

From en.wikipedia.org/wiki/Peano_axioms:

1. p>%#p ; TNTN (This truth table is a closer level to tautology than the truth value of NNNN.)

2. #p>(%p=#p) ; TTTT

3. #(p&q)>((q=p)>(p=q)) ; TTTT

4. #((p&q)&r)>(((p=q)&(q=r))>(p=r)) ; TTTT

5. #(u&v)>(((v>(v>%#v))&(u=v))>(u>(u>%#u))) ; TTTT

6. #x>((s&x)>((((s&x)\(s&x))-((s&x)\(s&x)))+((s&x)\(s&x)))) ; TTTT

7. #(w&x)>(((s&w)=(s&x))>(w=x)) ; TTTT

8. #(x>(%x<%#x))>(((s&x)=((%x>%#x)=(%x>%#x)))@((s&x)=(s&x))) ; TTTT

9.2. The axiom of induction as published, second definition:
(((y&(%y<%#y))=(t=t)) & ((#x&((y&x)=(t=t))) > (y&((y&(s&x))>(t=t))))) > ((#x&(y&x))=(t=t)) ;
_ _||
(((y&(%y<%#y))=(t=t)) & ((#x&((y&x)=(t=t))) > (y&((y&(s&x))>(t=t))))) > ((#x&(y&x))>(t=t)) ;
Corrected above; Meth8 validates as tautologous in 45-steps. _ _ _ _ _ _ _ _ _ _ _ _ _ _||

The consequent has its connective marked above. In words,
For the original: "then phi(n) **is tautologous** for every natural number n",
Read the corrected: "then phi(n) **is implied tautologous** for every natural number n".

Under the section First-order theory of arithmetic there, we number and present the scripts of the axioms as validated tautologous:

Fol-1. (#x&(((%x>%#x)-(%x>%#x))-(%x>%#x))) > (#x&(((%x>%#x)-(%x>%#x))@(s&x))) ; TTTT
Fol-2. ((#x&(((%x>%#x)-(%x>%#x))-(%x>%#x)))&(#y&(((%y>%#y)-(%y>%#y))-(%y>%#y)))) >
(#(x&y)&(x=y)) ; TTTT
Fol-3. (#x&(((%x>%#x)-(%x>%#x))-(%x>%#x))) > (#x&((x+((%x>%#x)-(%x>%#x))) = x)) ; TTTT
Fol-4. ((#x&(((%x>%#x)-(%x>%#x))-(%x>%#x))) & (#y&(((%y>%#y)-(%y>%#y))-(%y>%#y)))) >
(#(x&y)&((x+(s&y))=(s&(x+y)))) ; TTTT
Fol-5. (#x&(((%x>%#x)-(%x>%#x))-(%x>%#x))) >
(#x&((x&((%x>%#x)-(%x>%#x))) = ((%x>%#x)-(%x>%#x)))) ; TTTT
Fol-6. ((#x&(((%x>%#x)-(%x>%#x))-(%x>%#x)))&(#y&(((%y>%#y)-(%y>%#y))-(%y>%#y)))) >
(#(x&y)&((x&(s&y))=((x+y)+x))) ; TTTT
Fol-7. ((#y&((p&((%p>%#p)-(%p>%#p)))&(p&y))) & (#x&((p&x)&(p&y)))) > (((s&x)&(p&y)) >
(#x&((p&x)&(p&y)))) ; first-order induction axiom ; TTTT

Subsequent expressions 1-12 under Equivalent axiomizations were not mapped to scripts for PA.

Refutation of Poincaré recurrence theorem

This paper began by reading a physics paper, subsequently published in *Science* (2018):

> Rauer, B. (brauer@ati.ac.at); Erne, S.; Schweigler, T.; Cataldini, F.; Tajik, M.; Schmiedmayer, J. (schmiedmayer@atomchip.org. (2017). Recurrences in an isolated quantum many-body system. arxiv.org/pdf/1705.08231.pdf.

wherein:

> "Half way to this full recurrence the system rephases to the mirrored initial state. As we initially start from a nearly flat relative phase profile and our observable *C* is insensitive to the transformation $\varphi(z) \rightarrow \varphi(-z)$ this point is equivalent to the full recurrence." (1.1)

To evaluate Eq. 1.1 we assume the Meth8/VŁ4 apparatus and method with the designated *proof* value of `T` tautologous. Other values are: `F` contradiction; `N` truthity; `C` falsity. The 16-valued truth table results are row-major and presented horizontally.

> LET p q: φ lc_phi; z;
> ~ Not; > Imply, greater than; = Equivalent to; @ Not Equivalent to; - Not Or.
>
> (p&q)>(p&~q) ; `TTTF TTTF TTTF TTTF` (1.2)

Eq. 1.2 as rendered is *not* tautologous. Eq. 1.1 on its face reads phi-z implies phi-not-z, or alternatively phi-z as potentially true implies something false as phi-not-z. Of course, that is mistaken because truthity may not imply falsity.

This led us to look at the basis of the captioned paper, which from paragraph one relies on the recurrence theorem of Poincaré and Zermillo. (We previously showed elsewhere that ZMC set theory is *not* tautologous, except for the trivial axiom of specification, so we evaluate the former author).

From: planetmath.org/proofofpoincarerecurrencetheorem1

> $\mu(E\text{-}A_n) \leq \mu(A_0\text{-}A_n) = \mu(A_0)\text{-}\mu(A_n) = 0.$ (2.1)
>
> LET p q r s: μ lc_mu, E, A_n A-sub-n, A_0 A-sub-zero;
> % possibility, existential for one or some; # necessity, universal for all; ~(p>q) (p≤q);
> (p@p) logical 00; (%p>#p)-(%p>#p) numerical zero, as one minus one.
>
> Using the main connective in Eq. 2.1 as equivalent to and the logical 00,
> (~((p&(q-r))>(p&(s-r))) = ((p&s)-(p&r))) = (p@p) ; `TTTT TFTF TTTF TFTF` (2.2.1)

Eq. 2.2.1 as rendered is *not* tautologous. This refutes the Poincaré recurrence theorem.

We modify Eq. 2.2.1 by *changing* the first Equivalent to into the Imply connective.

> ~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) = (p@p)) ; `TTTT TTTT TTTT TTTT` (2.2.2)

Eq. 2.2.2 is tautologous.

We modify Eq.2.2.2 by *changing* the logical 00 into a numeric zero, as one minus one.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) = ((%p>#p)-(%p>#p))) ;
TTTT TNTT TTTT TTTT (2.2.3)

Eq. 2.2.3 is *not* tautologous, diverging by one value N for truthity as Non-contingent.

Next, we modify Eq.2.2.2 again by *changing* the second Equivalent to into the Imply connective.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) > (p@p)) ; TTTT TTTT TTTT TTTT (2.2.4)

Eq. 2.2.4 is tautologous.

Finally, we modify Eq.2.2.3 by *changing* the second Equivalent to into the Imply connective.

~((p&(q-r))>(p&(s-r))) > (((p&s)-(p&r)) > ((%p>#p)-(%p>#p))) ;
TTTT TTTT TTTT TTTT (2.2.5)

Eq. 2.2.5 is tautologous.

What the *change* modifications of Eqs. 2.2.2-2.2.5 as rendered demonstrate is that the formula to prove Eq. 2.1 can only be coerced into a proof by using the Imply connective instead of the Equivalent to connective.

Remark: Eq. 2.2.3, using a numeric zero, shows a finer level of proof value and contradicts Eq. 2.2.2 using a logical zero.

What follows is that the Poincaré recurrence theorem as a starting point for quantum theory and quantum physics is suspicious.

We then ask how the experimental results of the captioned paper can be reconciled with the refuted Poincaré recurrence theorem. We reply that assuming the physical experiment cannot be falsified (such as by probabilistic objections), then the experimental results are obviously misinterpreted into a mistaken conclusion.

Prenex normal form with prefix and matrix refuted as not bivalent

We evaluate the prenex normal form using equations from en.wikipedia.org/wiki/Prenex_normal_form . We assume the Meth8/VŁ4 apparatus and method.

LET: p q r s t u φ phi, ψ psi, ρ rho, x, y, z; (p=p) true;
necessity, all; % possibility, some or one; & And; + Or; > Imply; = Equivalent.

The designated *proof* value is T for tautology. Truth tables with 16-values and 128-values are row-major. Non-repeating truth table rows are row-major and presented horizontally.

Every formula in classical logic is equivalent to a formula in prenex normal form. For example, if $\phi(y)$, $\psi(z)$, and $\rho(x)$ are quantifier-free formulas with the free variables shown then

Prenex normal form:
$\forall x\,\exists y\,\forall z(\phi(y) \vee (\psi(z) \rightarrow \rho(x)))$ (1.0.1.1)
((#s&(%t&#u))&((p&t)+((q&u)>(r&s)))) = (p=p) ; (1.0.1.2)
`FFFF FFFF FFFF FFFF, . . . . NNFN NNNN`

Prefix:
$\forall x\,\exists y\,\forall z$ (1.0.1.1.1)
(#s&(%t&#u)) (1.0.1.1.2)

Matrix:
$\phi(y) \vee (\psi(z) \rightarrow \rho(x))$, (1.0.2.1)
((p&t)+((q&u)>(r&s))) (1.0.2.2)

Not prenex normal form:
$\forall x((\exists y\,\phi(y)) \vee ((\exists z\,\psi(z)) \rightarrow \rho(x)))$ (1.0.3.1)
(#s&((%t&(p&t))+((%u&(q&u))>(r&s)))) = (p=p) ; (1.0.3.2)
`FFFF FFFF NNNN NNNN, . . . . NNFN NNNN, . . . . NNFF NNNN`

The prenex and not prenex forms are supposed to be logically equivalent.

((#s&(%t&#u))&((p&t)+((q&u)>(r&s)))) =
(#s&((%t&(p&t))+((%u&(q&u))>(r&s)))) ; `TTTT TTTT CCTT CCCC` (1.0.4.2)

Eq. 1.0.4.2 is *not* tautologous. From the text example, prenex is supposed to be equivalent to a not-prenex rendition, but the prenex model fails at this point.

LET: p q r x, φ, ψ

The rules for conjunction and disjunction say that

$(\forall x\,\phi) \wedge \psi$ is equivalent to $\forall x(\phi \wedge \psi)$ (1.1.1)
((#p&q)+r)=(#p&(q+r)) ; `TTTT FNFN TTTT FNFN` (1.1.2)

$(\forall x\,\phi) \vee \psi$ is equivalent to $\forall x(\phi \vee \psi)$ (1.2.1)
((#p&q)&r)=(#p&(q&r)) ; `TTTT TTTT TTTT TTTT` (1.2.2)

and

$(\exists x\, \phi) \wedge \psi$ is equivalent to $\exists x(\phi \wedge \psi)$ (2.1.1)
((%p&q)+r)=(%p&(q+r)) ; `TTTT CTCT TTTT CTCT` (2.1.2)

$(\exists x\, \phi) \vee \psi$ is equivalent to $\exists x(\phi \vee \psi)$ (2.2.1)
((%p&q)&r)=(%p&(q&r)) ; `TTTT TTTT TTTT TTTT` (2.2.2)

The equivalences are valid when x does not appear as a free variable of ψ.

Negation

The rules for negation say that

$\neg\exists x\phi$ is equivalent to $\forall x\neg\phi$ (3.1.1)
~%p&q)=(#p&~q) ; `TCCT TCCT TCCT TCCT` (3.1.2)

$\neg\forall x\phi$ is equivalent to $\exists x\neg\phi$ (3.2.1)
(~#p&q)=(%p&~q) ; `NFFN NFFN NFFN NFFN` (3.2.2)

Implication

There are four rules for implication: two that remove quantifiers from the antecedent and two that remove quantifiers from the consequent. These rules can be derived by rewriting the implication $\phi \rightarrow \psi$ as $\neg \phi \vee \psi$ and applying the rules for disjunction above. As with the rules for disjunction, these rules require that the variable quantified in one subformula does not appear free in the other subformula.

The rules for removing quantifiers from the antecedent are:

$(\forall x\, \phi) \rightarrow \psi$ is equivalent to $\exists x(\phi \rightarrow \psi)$ (4.1.1)
((#p&q)>r)=(%p&(q>r)) ; `CTFN CTCT CTFN CTCT` (4.1.2)

$(\exists x\, \phi) \rightarrow \psi$ is equivalent to $\forall x(\phi \rightarrow \psi)$ (4.2.1)
((%p&q)>r)=(#p&(q>r)) ; `FNCT FNFN FNCT FNFN` (4.2.2)

The rules for removing quantifiers from the consequent are:

$\phi \rightarrow (\exists x\, \psi)$ is equivalent to $\exists x(\phi \rightarrow \psi)$ (5.1.1)
(q>(%p&r))=(%p&(q>r)) ; `CTTT CTTT CTTT CTTT` (5.1.2)

$\phi \rightarrow (\forall x\, \psi)$ is equivalent to $\forall x(\phi \rightarrow \psi)$ (5.2.1)
(q>(#p&r))=(#p&(q>r)) ; `FNTT FNTT FNTT FNTT` (5.2.2)

The unnumbered examples in the text are *not* tautologous.

The intutionistic logic equations listed in the text are supposed to fail. We found the first one was tautologous.

$\forall x\, (\phi \vee \psi)$ implies $(\forall x\, \phi) \vee \psi$ (6.1.1)
(#p&(q+r))>((#p&q)+r) ; `TTTT TTTT TTTT TTTT` (6.1.2)

Two Eqs. 1.2.2 and 2.2.2 as rendered were tautologous for the rules to map conjunction as quantified. This suggests that if all the connective rules are derived from the And connective, then there could be a better chance for success. However, that exercise pales in light of rules for negation and implication as found *not* tautologous. Hence, the prenex model was *not* tautologous. What follows is that the prenex model is not bivalent.

> Remark: Since about 1933 when Kurt Gödel reduced his quantified equations to prenex normal form, the format was adopted by many for exposition. We previously showed that one explanation for why the incompleteness theorems are not tautologous is because the Gödel's misuse of bivalent logic via the the prenex format. That finding is further supported by this instant analysis of the format.

What further follows is that many theorems produced with prenex for computer science, mathematics, and physics are now suspicious. A notable example is the satisfiability algorithms produced by Martin Davis and Hilary Putnam which are now mistaken.

Meth8 on Karl Popper proof Ex(Gx)

Reference: "Demarcation between science and metaphysics" (1972)

“Science is testable and falsifiable, but metaphysics is not.”

So Popper proves the *arch-metaphysical assertion* that “There is a personal spirit named God who is omnipresent, omnipotent, omniscient.”

Once asserted it's not disprovable (Fischer P=1) per Carnap.

If morality is non physicalistic, then not the moral Christian God.

However, this counter example proves *morality is physicalistic*:

When the existentialist utters “I ought to” conscience is invoked, and the moral imperative is asserted. Thus Ex(Gx) becomes a moral God.

What forms of pure monotheism exist other than Orthodox Christianity?

Baha'i, Judaism, Muhammadanism

By what reasons do they admit they are not truthful?

No avatar; Revelation ceased; Impersonal contradictory rules

Meth8 scripts: Popper predicates

Meth8 scripts for a,b,c,d as p,q,r,s	Predicates	Descriptions
1: p&q	1: Pos(a,b)	1: a occupies a position in region b
2: (p&q)>r	2: Put(a,b,c)	2: a can put thing b into position c
3: p&q	3: Utt(a,b)	3: a makes the utterance b
4: p&q	4: Ask(a,b)	4: a is asked the truth of b
5: (%p&#q)>(p&#q)	5: Opos(a)=((Ea)(b)Pos(a,b)>(b)Pos(a,b))	5: a is omnipresent
6: ((%p&#q)>#r)>((p&#q)>#r)	6: Oput(a)=((Ea)(b)(c) Put(a,b,c)>(b)(c) Put(a,b,c))	6: a is omnipotent
7: (p&q)>(p&q)	7: Th(a,b)=(Ask(a,b)>Utt(a,b))	7: a thinks b
8: (p&%q)>(p&%q);	8: Thp(a)=(Eb)Th(a,b)	8: a is a thinking person
9: (((p&%q)>(p&%q))&~(p&#q)) +(p&#q)	9: Sp(a)=(Thp(a)&((b)~Pos(a,b))VOpos(a))	9: a is a (personal) spirit
10: (q&r)>((p&(q&r))>(p&(q&r)))	10: Knpos(a,b,c)=(Pos(b,c)>Th(a,"Pos(b,c)")	10: a knows that b is in position c
11: (q&r)>s)>((p&((q&r)>s))>(p&((q&r)>s)))	11: Knput(a,b,c,d)=(Put(b,c,d)>Th(a,"Put(b,c,d)")	11: a knows that b can put c into position d
12: ((q&r)>(q&r))&((p&((q&r)>(q&r)))>(p&((q&r)>(q&r))))	12: Knth(a,b,c)=(Th(b,c)&Th(a,"Th(b,c)"))	12: a knows that b thinks c

Meth8 scripts for a,b,c,d as p,q,r,s	Predicates	Descriptions
13: ((((p&q)>(p&q))&(p@r))&(~((r&q)>(r&q))))=~(((p&q)>(p&q))&((r&((p&q)>(p&q)))>(r&((p&q)>(p&q)))))	13: Unkn(a)=Th(a,b)&(a≠c)&~Th(c,b))=~Knth(c,a,b))	13: a is unfathomable: a thinks b and a is not c and c does not think b is equivalent to c does not know that a thinks b.
14: ((p&q)>(p&q))&(q=q)	14: Kn(a,b)=Th(a,b)&T(b), where T(b) means b is tautologous	14: a knows the fact b
15: ((p&#q)>(p&#q))>(q=q)	15: Verax(a) =((b)Th(a,b)>T(b))	15: a is truthful
16: (#q=#q)>(((p&q)>(p&q))&(q=q)	16: Okn(a)=(b)T(b)>Kn(a,b)	16: a is omniscient
17: ((p&#q)&((p&#q)>#r)>(((#q=#q)>(((p&q)>(p&q))&(q=q))))&(((p&#q)>(p&#q))>(q=q)))	17: (Opos(a)&Oput(a))=(Okn(a)&Verax(a))	17: a as omnipresent and a as omnipotent is equivalent to a as omniscient and a as truthful
18: (((((%p&#q) >(p&#q)) & (((%p&#q) >#r) >((p&#q)>#r))) >((#q=#q) >(((p&q)>(p&q))&(q=q)))) & ((((p&#q) >(p&#q)) > (q=q)) & ((((p&%q) >(p&%q))&~(p&#q))+(p&#q)))) & (((((p&q) > (p&q))&(p@r)) & ~((r&q) > (r&q))) = ~(((p&q) >(p&q)) & ((r&((p&q) >(p&q))) >(r&((p&q) > (p&q))))))	18: Ex(Gx)=(((Opos(a)&Oput(a)) >Okn(a))&((Verax(a)& Unkn(a)) &Sp(a)))	18: There exists a personal spirit named God whose omnipresence and omnipotence implies omniscience, and who is truthful and unfathomable.

Meth8 validation tables

Table fragments for two of the four rows (The designated truth values are T and E.)

Expression	Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
5.-18. Validated	TTTT TTTT	EEEE EEEE	EEEE EEEE	EEEE EEEE	EEEE EEEE
4. (p&q)	FFFT FFFT	UUUE UUUE	UUUE UUUE	UUUE UUUE	UUUE UUUE
3. (p&q)	FFFT FFFT	UUUE UUUE	UUUE UUUE	UUUE UUUE	UUUE UUUE
2. (p&q)>r	TTTF TTTF	EEEU EEEU	EEEU EEEU	EEEU EEEU	EEEU EEEU
1. (p&q)	FFFT FFFT	UUUE UUUE	UUUE UUUE	UUUE UUUE	UUUE UUUE

PowerEpsilon mathematical induction

Zhu, Ming-Yuan. Godel's incompleteness theorem verified by PowerEpsilon. 2013. DOI: 10.13140/RG.2.2.31985.68961

From: researchgate.net/publication/308194289

From 2.2.4, page 7, we evaluate an equation for "[m]athematical induction as an inference rule formalized as a second-order axiom".

We assume the Meth8 apparatus.

LET: p P; q k; r n;
& And; + Or; > Imply; = Equivalent to; @ Not Equivalent to;
# universal quantifier, modal necessity; (r@r) 0 [Zero]; (r=r) 1 [One]
T tautology; F contradiction

Result fragment is the repeating row from the truth table of 16-values.

$$\forall P \, . \, P(0) \wedge \forall k \, . \, P(k) \Rightarrow P(k+1) \Rightarrow \forall n \, . \, P(n) \tag{1.1}$$

(((#p&p)&(r@r))&((#q&p)&q)) > ((p&(q+(r=r)))>((#r&p)&r)) ; TTTT ; (1.2)

From the script rendition in Eq 1.2, Meth8 validates Eq 1.1 as tautologous.

Difference between ordinary logic (Prover9) and VŁ4

We use Prover9 (P9) to check ordinary logic, and use Meth8 to check system variant VŁ4.

The main difference is that the modal operators and quantifiers are *not* distributive and interchangeable in ordinary logic, but they are in VŁ4 (as shown elsewhere). This is borne out because ordinary logic is based on a vector space, but VŁ4 is bivalent.

For example consider this "egregious" example using Schrödinger's Cat:

> *If possibly the Cat is alive and possibly the Cat is dead, then*
> *possibly both the Cat is alive and the Cat is dead.* (1)

LET p "the Cat is alive", q "the Cat is dead"

For ordinary logic in P9 Eq 1 should not be proved as:

Assumptions: (exists(p) & exists(q)).
Goal: (exists((p) & (q))) Not proved (2)

For VŁ4 in Meth8 Eq 1 should be tautologous (and indeed as an equivalence or theorem) as:

(%p & %q) > %(p & q); vt (3)

The problem in the example is two contradictory possibilities being held as possible at the same time, for the Cat surely cannot be both alive and dead concurrently as Schrodinger's paradox asserts (but before it is resolved by Meth8 elsewhere).

To preserve the two variables p and q for the intended distinction of the Cat alive and the Cat dead, we embellish the assertion in Eq 1 with a prefix to the antecedent in the constraint that the Cat alive as p implies the Cat not dead as ~q:

> *If necessarily the Cat alive implies the Cat not dead, then if possibly the Cat is alive and possibly the Cat is dead, then possibly both the Cat is alive and the Cat is dead.* (4)

as: #(p>~q) > ((%p&%q)>%(p&q)) ; vt (5)

P9 writes this as:

Assumptions: (all(p -> -q)).
Goal: ((exists(p) & exists(q)) -> (exists(p & q))). Not proved (6)

Eq 5 is modified from Eq 3 to exclude a contradiction from words and is still tautologous. The same expression in Eq 6 on P9 is still not proved.

Our experiment to embellish the input expressions on P9 to make it compatible with Meth9 was unsuccessful. We conclude that system variant VŁ4 implemented in Meth8 is not compatible with ordinary logic implemented in P9.

We note here that it is possible to fix up Eq 1 by rewriting it so that P9 proves it. Consider this rendition in *one* variable:

If possibly the Cat is alive and not possibly the Cat is alive, then possibly both the Cat is alive and the Cat is not alive. (7)

P9 writes this as:

Assumptions: ((exists(p) & -exists(p))).
Goal: (exists(p & -p)). Proved (8)

Meth8 writes this as:

(%p&~%p)>%(p&~p) ; vt (9)

Rewriting Eq 1 as Eq 7 in one variable causes conformity of result for Eq 8 in P9 and Eq 9 in Meth8. Unfortunately differences remain between P9 and Meth8 for more than one variable in Eqs 2-6 due to the vector space for arity of ordinary logic and the bivalence of VŁ4.

Refutation of control by quantum observation

From: Biele, R; Rodríguez-Rosario, CA; Frauenheim, T; Rubio, A. 2016. Controlling heat and particle currents in nanodevices by quantum observation. arxiv.org/ftp/arxiv/papers/1611/1611.08471.pdf. Emails: (robert.biele@gmx.net), (crodrig@mpsd.mpg.de), and (angel.rubio@mpsd.mpg.de).

"*A quantum observer has zero entropy flow.* Examining the entropy flow due to the local observation shows that the quantum observer does not add a new entropy flow to the system in contrast to a standard thermodynamic heat bath. Inserting [Eq. (10)] into Eq. (9) shows that the entropy flux due to the quantum observer is zero. This means that a quantum observer changes the energy flow in the system directly, without having an entropy flow connected with it."

We assume the apparatus and method of Meth8/VŁ4, where T is the designated proof value. (Other values are F for contradiction, C for falsity, and N for truth; 16-valued truth tables are row-major.)

```
LET:  p q r s        p;  |k>;  Tr;  vD^2;
      1 2 0          (%p>#p);  (%p<#p);  (%p>#p)-(%p>#p)
      lc_sigmaD      |k><k|
      ln(p)          0<p<1

 LDp = ~(vD^2)[2|k><k|p|k><k| - |k><k|p - p|k><k|]                                  (10.1)

LDp = s&(((%p<#p)&(((q&~q)&p)&(q&~q))) - (((q&~q)&p) – (p&(q&~q))))                  (10.2)

0=-Tr[LDp(ln (lc_sigmaD))                                                            (9.1)

((%p>#p)-(%p>#p)) = (~r&((LDp)&(((p&~q)<(%q>#q))&((q&~q)>((%p>#p)-(%p>#p))))))
                                                                                     (9.2)

Eq. 10.1 is substituted into Eq. 9.1:                                                (11.1)

((%p>#p)-(%p>#p)) = (~r&((s&(((%p<#p)&(((q&~q)&p)&(q&~q))) - (((q&~q)&p) -
      (p&(q&~q)))))&(((q&~q)<(%q>#q))&((q&~q)>((%q>#q)-(%q>#q)))))) ;
                                                 NNNN  NNNN  NNNN  NNNN              (11.2)
```

Eq. 11.2 as rendered is *not* tautologous. This means that control by quantum observation is refuted.

Refutation of the direct correspondence of quantum gates to reversible classical gates

Taken from:

Faugère, J-C., Horan, K., Kahrobaei, D., Kaplan, M, Kashefi, E., Perret, L. (2017). "Fast quantum algorithm for solving multivariate quadratic equations". arxiv.org/pdf/1712.07211.pdf

"2.3 Quantum Gates: The following gates are quantum gates of interest which operate on qubits, each directly corresponding to reversible classical gates. For qubits $|x\rangle$, $|y\rangle$, $|z\rangle$ the gates perform the following operations:

– CNOT (XOR, Feynman)	$\mathrm{CNOT}|x\rangle|y\rangle = |x\rangle|x + y\rangle$	[1.1]
– Toffoli (AND)	$T|x\rangle|y\rangle|z\rangle = |x\rangle|y\rangle|z + xy\rangle$	[2.1]
– X (NOT)	$X|x\rangle = |\bar{x}\rangle = |1 + x\rangle$	[3.1]
– n-qubit Toffoli (AND)	$T_n|x_1\rangle \ldots |x_n\rangle = |x_1\rangle \ldots |x_{n-1}\rangle|x_n + (x_1 \ldots x_{n-1})\rangle$	[4.1]
– Swap	$S|x\rangle|y\rangle = |y\rangle|x\rangle$"	[5.1]

LET: p q r $|x\rangle$ $|y\rangle$ $|z\rangle$; also p q r s $|x_1\rangle$ $|x_2\rangle$ $|x_3\rangle$ $|x_4\rangle$; n 4;
~ Not; + Or; & And; = Equivalence; @ Not Equivalence, XOR

T is tautology as the designated *proof* value, with F as contradiction
The 16-valued truth tables are presented row-major and horizontally.

Using the Meth8/VŁ4 apparatus and method, we render Eqs. 1.1-5.1 as:

(p@q)=(p&(p+q)) ;	TTFF TTFF TTFF TTFF	(1.2)
((p&q)&r)=((p&q)&(r+(p&q))) ;	TTTF TTTT TTTF TTTT	(2.2)
~p=((p\p)+p) ;	TFTF TFTF TFTF TFTF	(3.2)
(((p&q)&r)&s)=((((p&p)&q)&r)&(s+(((p&p)&q)&r))) ;	TTTT TTTF TTTT TTTT	(4.2)
(p&q)=(q&p) ;	TTTT TTTT TTTT TTTT	(5.2)

Eqs. 1.2-4.2 are *not* tautologous. This means those quantum gates do not directly correspond to reversible classical gates. (Eq. 5.2 is tautologous, although trivial.)

Remark: Eqs. 2.2 and 4.2 are nearly tautologous but not, due to the single F contradiction value.

What follows is that quantum gates *cannot* map to bivalent logic.

Remark: We obtained the above conclusion in unpublished work (2008) where: the qubit was proved to be a probabilistic vector (not bivalent); and the various quantum gates were mapped to non-bivalent truth tables to show where bivalent corrections *would be*. Hence, this paper demonstrates a shorter refutation of quantum gates as reversible bivalent operators.

Refutation of operator for quantum simulation of Hamiltonian spectra

Taken from:

> Santagati, R., et al. (2018)."Witnessing eigenstates for quantum simulation of Hamiltonian spectra", Sci. Adv. 2018;4:eaap9646. advances.sciencemag.org/content/4/1/eaap9646.full

We assume the apparatus and method of Meth8/VŁ4 to evaluate this quantum operator, excluding the scalar of (1/(2^0.5)), for:

$$|0\rangle_C \otimes \hat{I}|\Psi\rangle_T + |1\rangle_C \otimes \hat{U}|\Psi\rangle_T \qquad (3.1)$$

LET: pqrstuv |1>, |0>, uc_C, uc_I-circumflex, uc_T, uc_U-circumflex, uc_Psi;
& And; @ Not equivalent, XOR; + Or

The designated proof value is `T`; `F` is contradiction.
Repeating fragments of the 128-rows of 16-valued truth tables are row-major, as horizontally.

((q&r)@(s&(v&t)))+((p&r)@(u&(v&t))) ;
`FFFF FTTT TTTT TTFT, FFFF FTTT FFFF FTTT, TTTT TFTT TTTT TTTF` ; (3.2)

Eq. 3.2 as rendered is *not* tautologous. This means the quantum operator is not bivalent, but rather an operator for a probabilistic vector space.

Ramsey theorem for the 2-color case

From en.wikipedia.org/wiki/Ramsey%27s_theorem

2-color case:

Lemma 1. $R(r, s) \leq R(r - 1, s) + R(r, s - 1)$

Meth8 maps Eq 8.1 as

LET: q = R

((q&((r-(r=r))&s)) + (q&(r&(s-(s=s))))) > (q&(r&s)); Ramsey's theorem ; vt;
TTTT (L1.1)

If both parts of main antecedent are even, then the theorem is strengthened as

((q&((r-(r=r))&s)) + (q&(r&(s-(s=s))))) > ((q&(r&s)) + (s=s)) ; vt; TTTT (L1.2)

Unsolved problem by **A. Ranjan**

From quora.com/Are-there-any-unsolved-problems-in-Mathematical-Logic

LET: # Necessity; % Possibility; > Imply; = Equivalent to; (n=n) Tautologous; p Assertion or Answer; q Question.

1. Mathematical Logic: Is it tautologous that for any question there is at least an answer?

(#q>%p)>(p=p) ;
validated TTTT TTTT

2. ; Reciprocally: Is any assertion the result of at least a question?

(#p>%q)>(q=q) ;
validated TTTT TTTT

Refutation of realizability Semantics for QML

From:

Rin, B.G.; Walsh, S. (2016). Realizability semantics for quantified modal logic: generalizing Flagg's 1985 construction. arxiv.org/pdf/1510.01977.pdf

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to; @ Not equivalent to; # all ∀; % some ∃; (p@p) 00 zero; (p=p) 11 one

Results are the repeating proof table(s) of 16-values in row major horizontally.

"The resulting semantics generalize the important but little-understood construction of Flagg (1985), whose goal was to provide a consistency proof of Epistemic Church's Thesis together with epistemic arithmetic, a modal rendition of first-order arithmetic. *Epistemic Church's Thesis* (ECT) is the following statement:

(1.1) [□ (∀n∃m□]φ(n,m))] ⇒ [∃e□]∀n∃m∃q(T(e,n,q)∧U(q,m)∧□φ(n,m))]" (1.1)

LET: pqtuwxy pqtuemn

#((#y&%x)&(#p&(y&x))) >
((%w&#(#y&(%x&(%x&%q))))&(((t&(w&(y&q)))&(u&(q&x)))&(#p&(y&x)))) ;
TTTT TTTT TTTT TTTT, TCTC TCTC TCTC TCTC, TCTT TCTT TCTT TCTT (1.2)

"EZF ... is built from Q_{eq}.S4 by the addition of the following axioms: ...

II. Induction Schema: [∀x((∀y∈x φ(y))⇒φ(x))]⇒[∀xφ(x)]" (2.1)

LET: pxy φxy

We distribute the quantification in the antecedent to ensure clarity.

((#x&((#y<x)&(p&y)))>(#x&(p&x))) > (#x&(p&x)) ;
FFFF FFFF FFFF FFFF, FNFN FNFN FNFN FNFN (2.2)

"III. Scedrov's Modal Foundation: [□∀x(□(∀y∈xφ(y))⇒φ(x))]⇒[□∀xφ(x)]" (3.1)

We distribute the quantification in the antecedent to ensure clarity.

(#(#x&#((#y<x)&(p&y)))>(#x&(p&x))) > #(#x&(p&x)) ;
FFFF FFFF FFFF FFFF, FNFN FNFN FNFN FNFN (3.2)

Eqs. 1.2, 2.2, and 3.2 as rendered are *not* tautologous. Eqs. 2.2 and 3.2 result in the same truth table because Eq. 3.2 reduces to Eq. 2.2.

We did not test subsequent axioms.

This means respectively that the following are not theorems: Epistemic Church's Thesis; EZF induction schema; and Scedrov's modal foundation.

What follows is that Flagg's construction, Goodman's intensional set theory, and epistemic logic are suspicious.

Hans Reichenbach's event-splitting formula

From: Wolfgang Spohn. "On Reichenbach's principle of the common cause". Logic, Language, and the Structure of Scientific Theories: proceedings of the Carnap-Reichenbach Centennial, Universit of Konstanz, 2w1-24 May 1991. Ed. by Wesley Salmon. Univ.-Verl. Konstanz. 1994. pp 215-239.
at pdfs.semanticscholar.org/81ae/627c2f1c80b3b3c78f5ba5a54daca242309c.pdf, page 2:

"The principle of the common cause specifies an important relation between probability and causality", where A and B are are two positively correlated events, satisfying these conditions:

LET p P; q A; r B; s C
(p&(q&r)) > ((p&q)&(p&r)) ; vt ; TTTT TTTT TTTT TTTT ; (1.2)
(p&(q+s)) > (p&q) ; nvt ; TTTT TTTT TFTT TFTT ; (2.1.2)
(p&(r+s)) > (p&r) ; nvt ; TTTT TTTT TFTF TTTT ; (2.2.2)
(p&((q&r)+s)) = ((p&(q+s))&(p&(r+s))) ; vt ; (3.2)

The argument is that ((Eqs 2.1.2 and 2.2.2) and Eq 3.2) imply Eq 1.2 (4.1)
With the inequalities reversed in Eq 2.1.2, 2.2.2, and 3.2, those imply Eq 1.2 (5.1)
Whereas Eq 2.1.2 or 2.2.2 with only one inequality reversed would imply the reverse of Eq 1. 2
(6.1, 7.1)

((((p&(q+s))>(p&q))&((p&(r+s))>(p&r)))&((p&((q&r)+s))=((p&(q+s))&(p&(r+s)))))
>((p&(q&r))>((p&q)&(p&r))) ; vt ; (4.2)

((((p&(q+s))<(p&q))&((p&(r+s))<(p&r)))&((p&((q&r)+s))=((p&(q+s))&(p&(r+s)))))
>((p&(q&r))>((p&q)&(p&r))) ; vt ; (5.2)

((((p&(q+s))<(p&q))&((p&(r+s))>(p&r)))&((p&((q&r)+s))=((p&(q+s))&(p&(r+s)))))
>((p&(q&r))>((p&q)&(p&r))) ; vt ; (6.2)

((((p&(q+s))>(p&q))&((p&(r+s))<(p&r)))&((p&((q&r)+s))=((p&(q+s))&(p&(r+s)))))
>((p&(q&r))>((p&q)&(p&r))) ; vt ; (7.2)

The full argument is that (Eq 1.2, 2.1.2, 2.2.2, and 3.2) is equivalent to (Eq 4.2, 5.2, 6.2, and 7.2).
(8.1)
((((p&(q&r))>((p&q)&(p&r)))&(((p&(q+s))>(p&q))&((p&(r+s))>(p&r))))&((p&((q&r+s))=((p&(q+
s))&(p&(r+s))))) =
((((((((p&(q+s))>(p&q))&((p&(r+s))>(p&r)))&((p&((q&r+s))=((p&(q+s))&(p&(r+s)))))>((p&(q&r))
>((p&q)&(p&r))))&(((((p&(q+s))<(p&q))&((p&(r+s))<(p&r)))&((p&((q&r+s))=((p&(q+s))&(p&(r+
s)))))>((p&(q&r))>((p&q)&(p&r)))))&(((((p&(q+s))<(p&q))&((p&(r+s))>(p&r)))&((p&((q&r+s))=((
p&(q+s))&(p&(r+s)))))>((p&(q&r))>((p&q)&(p&r)))))&(((((p&(q+s))>(p&q))&((p&(r+s))<(p&r)))
&((p&((q&r+s))=((p&(q+s))&(p&(r+s)))))>((p&(q&r))>((p&q)&(p&r))))) ;
nvt ; TTTT TTTT TFTF TFTT (8.2)

In 269 logical steps, Meth 8 finds Reichenbach's event-splitting principle is not validated as tautologous.

Riemann hypothesis rendered as not provable

Given i = (-1)^(1/2) and lower case Zeta (Z) as ζ (lc_case zeta):

1. For **any** complex number (*a* + *b*i), ζ(*a* + *b*i) is another complex number (*c*+*d*i).
2. A zero is a point (*a* + *b*i) where *f*(*a* + *b*i)=0, such as for example ζ(0)=0.
3. Trivial zeroes occur at (0 + *b*i) for **some** *b*.

   Hence if *a* and *c* = 0, then ζ(*a* + *b*i) is rewritten in ζ((0) + *b*i) as another complex number ((0)+*d*i).
4. Non trivial zeroes occur at (1/2 + *b*i) for **some** *b*.

   Hence, if *a* and *c* = 1/2, then ζ(*a* + *b*i) is rewritten in ζ((1/2) + *b*i) as another complex number ((1/2)+*d*i).

A sentence to test is if known zeroes imply other zeroes:

> Trivial zeroes ζ((0) + *b*i) for **some** *b,* implying other complex numbers as **all** ((0)+*d*i), and non trivial zeroes ζ((1/2) + *b*i) for **some** *b,* implying other complex numbers as **all** (((1/2) + *d*i), imply possibly other zeroes ζ(*a* + *b*i) for **some** *b,* implying other complex numbers as **all** (*a* + *d*i). (5.0)

This effectively tests if a location of zeroes (trivial based on even numbers) and a location of zeroes (non trivial based on odd numbers) imply another possible location of zeroes as a tautology, because the question is "Are there possibly other zeroes".

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows us to mix four logical values with four analytical values. The designated proof value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: + Or; & And; \ Not and; > Imply; < Not imply; @ Not equivalent to;
all; % some; (p@p) 00, zero ; (%p<#p) 10, two ; (%p>#p) 01, one;
pqrs *bd*ζi ; (p@p) trivial *a*,*c* as (0) ; ((%p>#p)\(%p<#p)) non trivial *a*,*c* as (1/2);

Results are the proof table of 16-values in row major horizontally.

((((r&#((p@p)+(%q&s)))>(p@p))>(p@p)) & ((r&#(((%p>#p)\(%p<#p))+(%q&s)))>(p@p)))
> %((r&#(p+(%q&s)))>(p@p)) ; TTTT TTTT TTTT TTTT (5.1)

Eq. 5.1 shows other zeroes are possible. We conclude that the Riemann hypothesis, as stated and rendered, is *not* tautologous, and hence is denied.

Reimann zeta function, Caceres Proposition 6

We evaluate this paper:

Caceres, P. (2018). "Riemann zeta function – constants, approximations, and some related functions". vixra.org/pdf/1803.0150v1.pdf

We assume the apparatus and method of Meth8/VL4, with the designated *proo*f value of `T`.

LET p, q, r, s, v, w, x, y, z:
x1; x2; y1; y2; zeta; w; x; y; z.
w = +(-1)^0.5; ~w = -(-1)^0.5; i* = (w+~w).

And let's call:

x(z) = x1(z) +i* x2(z) (7.1.1)
(x&z) = ((p&z)+((w+~w)&(q&z))) ;
`TFFF TFFF TFFF TFFF, FTTT FTTT FTTT FTTT` (7.1.2)

y(z) = y1(z) +i* y2(z) (7.2.1)
(y&z) = ((r&z)+((w+~w)&(s&z))) ;
`TTTT FFFF FFFF FFFF, FFFF TTTT TTTT TTTT` (7.2.2)

In general, we can now express that any solution in ℂof ζ(z) as:

ζ(z) = [x1(z)-y1(z)] + i * [x2(z)-y2(z)] (7.3.1)
(v&z) = (((p&z)-(r&z))+((w+~w)&((q&z)-(s&z)))) ;
`FFFT FFTT FTFT TTTT, TTTF TTFF TFTF FFFF` (7.3.2)

and: [**Caceres Proposition 6**]

ζ(z) = x(z) - y(z) (7.4.1)
(v&z) = ((x&z)-(y&z)) ; `FFFF FFFF FFFF FFFF, TTTT TTTT TTTT TTTT` (7.4.2)

Eqs. 7.3.2 and 7.4.2 as rendered are *not* tautologous.

While Eq. 7.3.2 is supposed to equal 7.4.2, and obviously is not

(((p&z)-(r&z))+((w+~w)&((q&z)-(s&z)))) = ((x&z)-(y&z)) ; `FFFT FFTT FTFT TTTT` (7.5.2)

we try to coerce Eq. 7.5.2 into tautology by replacing the Equivalent connective with the Imply connective, but the result table is the same as for Eq. 7.5.2 as *not* tautologous.

This refutes Caceres Proposition 6.

Roman Catholic Church: Erasmus contra Luther controversy

Erasmus stayed in the Church to counter contradictory doctrine and purge it.

Luther, while minimally in the Church, effectively departed from the Church (as evidenced by his subsequent non Swedish followers).

The issue to stay and cleanse or to leave and commence anew is tested by Meth8.

The conjecture is:

> If the necessity of the body of Christ implies the Church, and that implies the necessity of Christians as members of the Church, then possibly contradictory doctrines arise from members (due to the nature of original sin),
> it follows then that
> the necessity of members in the Church in the Body of Christ implies that no contradictory doctrine can survive coming from the members and the Church.
>
> LET: p Church; q Body of Christ; r Christian, a member; s contradictory doctrine
>
> ((#(q>p) > (#r<p)) > %(s<r)) > ((#(r<p)<q) > (~s<(r&p))); validated as tautology

This means Erasmus did the logically correct thing.

Roman Catholic Church: Infallibility and the Historic Church

Logical evaluation of infallibility of Pius IX from First Vatican Council (1869/70)

We evaluated the sequential assertions in the captioned as conjectures using the Meth8 modal logic model checker. The tool implemented variant system VŁ4, the resuscitated four valued logic of Łukasiewicz, in five models. Truth tables are presented as the first two rows of four of Model 1, with the designated truth value of Tautologous. The other logical values mean Contingent, Non contingent, and contradictory for the 2-tuple {11, 10, 01, 00}.

The argument proceeds in four Chapters as:

I. Institution of apostolic primacy of Peter
II. Perpetuity of apostolic primacy in Roman pontiffs
III. Power and authority of apostolic primacy in Pius IX
IV. Infallible teaching of the Roman pontiff, viz, Pius IX

From: catholicplanet.org/councils/20-Pastor-Aeternus.htm

> This English translation by Cardinal Henry Edward Manning, 1871 is attributed to unspecified editing by Ronald L. Conte Jr.

First Vatican Council 1869 to 1870 under Pope Pius IX

FIRST DOGMATIC CONSTITUTION ON THE CHURCH OF CHRIST

PASTOR AETERNUS [of our predecessors]

> (This section is not relevant to the conjectures.)

CHAPTER I.
ON THE INSTITUTION OF THE APOSTOLIC PRIMACY IN BLESSED PETER.

We therefore teach and declare that, according to the testimony of the Gospel, the primacy of jurisdiction over the universal Church of God was immediately and directly promised and given to Blessed Peter the Apostle by Christ the Lord.

For it was to Simon alone, to whom he had already said, "You shall be called Cephas" (John 1:42), that the Lord, after the confession made by him, saying, "You are the Christ, the Son of the living God", addressed these solemn words: "Blessed are you, Simon son of Jonah. For flesh and blood has not revealed this to you, but my Father, who is in heaven. And I say to you, that you are Peter, and upon this rock I will build my Church, and the gates of Hell shall not prevail against it. And I will give you the keys of the kingdom of heaven. And whatever you shall bind on earth shall be bound, even in heaven. And whatever you shall release on earth shall be released, even in heaven." (Mt 16:16-19).

LET: p papacy; q apostolic primacy; r Peter
> Imply; & And; = Equivalent to; ~ Not
necessarily, the universal quantifier ∀;
% possibly, the existential quantifier ∃
vt tautologous; nvt not tautologous

We map the above into the words:

> "Both Peter appointed the chief apostle as equivalent to apostolic primacy, and apostolic primacy as equivalent to holding the keys of a papacy imply the existence of a papacy as equivalent to Peter." (1.1)

In Meth8 this is:

> ((r= q) & (q= p)) > (%p= r) ; nvt; NTTT TTTT (1.1.1)

Eq 1.1 may be rewritten as the logical equivalent in words as

> "Both Peter appointed the chief apostle as equivalent to apostolic primacy, and apostolic primacy as equivalent to holding the keys of a papacy imply a papacy as equivalent to the existence of Peter." (1.2)
>
> ((r= q) & (q= p)) > (p=%r) ; nvt; NTTT TTTT (1.2.2)

The truth table fragments are in the state closest to proof, but denied by the Non contingent value.

We note that that a stronger refutation replaces the existential quantifier % as "the existence of" with the universal quantifier # as "the necessity of".

We purposely avoid an analysis of the derivative word meanings for Petros and Cephas, such as that of St Augustine who stated the Church was not built on Peter (*super Petrum*) but rather explicitly on the rock (*super petram*), viz, on the confession of the faith of the Apostle. (See Bishop Joseph Strossmayer in a speech opposing papal infallibility to the Vatican Council of 1870, from an Italian version published at Florence, reprinted from "The Bible Treasury", No. 195, August, 1872, pamphlet published by Loizeaux Brothers, New York. The speech also appeared in the Sydney Morning Herald, Monday, October 16, 1871, pg. 3.)

And it was upon Simon alone that Jesus, after His Resurrection, bestowed the jurisdiction of Chief Pastor and Ruler over all His fold, by the words: "Feed my lambs. Feed my sheep." (John 21:15-17).

At open variance with this clear doctrine of Holy Scripture, as it has ever been understood by the Catholic Church, are the perverse opinions of those who, while they distort the form of government established by Christ the Lord in His Church, deny that Peter, in his single person, preferably to all the other Apostles, whether taken separately or together, was endowed by Christ with a tautologous and proper primacy of jurisdiction; or of those who assert that the same primacy was not bestowed immediately and directly upon Blessed Peter himself, but upon the Church, and through the Church on Peter as her Minister.

If anyone, therefore, shall say that Blessed Peter the Apostle was not appointed the Prince of all the Apostles and the visible Head of the whole Church Militant; or that the same, directly and immediately, received from the same, Our Lord Jesus Christ, a primacy of honor only, and not of tautologous and proper jurisdiction; let him be anathema.

We note that from the character or word count above, about 50% of Chapter I relates to institution of apostolic primacy of Peter, and 50% relates to the penalty of anathema for its contradiction. (In each of the subsequent three chapters remaining, shortened declarations of anathema are also included, rather than at the end of the document, as is customary, to avoid self-conscious repetition.)

CHAPTER II.
ON THE PERPETUITY OF THE PRIMACY OF BLESSED PETER IN THE ROMAN PONTIFFS.

We restate this argument in the abstract state and without citation as:

"The perpetuity of episcopal orders, excluding claims of primacy, as accepted by all geographical branches of the Historic Church, is a historical fact." (2)

CHAPTER III.
ON THE POWER AND NATURE OF THE PRIMACY OF THE ROMAN PONTIFF.

We restate this argument in the abstract state and without citation as:

"The span of control of the Roman pontiff as successor to Peter extends over all geographical branches of the Historic Church, as declared by Roman Catholic Ecumenical Councils not recognized universally by the Historic Church." (3)

CHAPTER IV.
ON THE INFALLIBLE TEACHING OF THE ROMAN PONTIFF

We restate this argument in the abstract state and without citation as:

"Apostolic primacy includes the supreme power of inerrant teaching *ex Cathedra*." (4)

From Chapter I, Eq 1.1.1 and 1.2.2, we showed such apostolic primacy,
as defined by the Roman Church, is not tautologous by modal logic.

Hence Chapters II, III, IV are rendered moot.

Roman Catholic Church: Magisterium

A logical assessment of tradition, scripture, and authority in "Dei Verbum", 1965

[The text of Chapter 2 in *Dei Verbum* follows at the end with assertions in bold.]

1. We evaluate the order of appearance of non scriptural citations in Articles 7-10 based on Church dates in bold:

7.: 2. Council of Trent, **1545**; 3. Irenaeus, **180**
8.: 4. Second Council of Nicea, **787**, Fourth Council of Constance, **1414**;
5. First Vatican Council, **1869**
9.: 6. Council of Trent, **1545**
10.: 7. Pius XII, **1950**; 8. First Vatican Council, **1869**; 9. Pius XII, **1950**

The argument of Articles 7-10 does not draw on citations to be sequentially increasing in time, viz:

180, 787, 1414, 1545, 1545, 1869, 1869, 1950, 1950.

2. We next evaluate the final assertion in Article 10 of:

[T]hat sacred tradition, Sacred Scripture and the teaching authority of the Church ... **are so linked and joined together that one cannot stand without the others.** (1)

We map this using the Meth8 modal logic model checker in script.

LET: p sacred tradition; q sacred scripture; r teaching authority;
necessity (for all instances, the universal quantifier ∀);
% possibility (for at least one instance, the existential quantifier ∃);
#q the necessity of Sacred Scripture;
%r the possibility of teaching authority of the Church;
& And; + Or; > Imply; nvt not tautologous

We rewrite Eq 1 as:

If the sacred tradition and the necessity of Sacred Scripture and the possibility of Church teaching authority, then not either the sacred tradition or the necessity of Sacred Scripture or the possibility of
the Church teaching authority. (2)

Eq 2 is also rewritten in an equivalent expression as:

The sacred tradition and the necessity of Sacred Scripture and the possibility of Church teaching authority all imply not separately that either the sacred tradition or the necessity of Sacred Scripture or the possibility of the Church teaching authority. (3)

(p & (#q & %r)) > ~(#p + (#q +%r)) ; nvt (4)

In the five models of Meth8, repeating fragments of the respective truth tables are:

TTTT TTT**C** EEEE EEE**U** EEEE EEEE EEEE EEE**P** EEEE EEE**I**

where the designated truth values are T and E with the first letter definiens as Tautologous, Evaluated, Unevaluated, Proper, and Improper.

This means according to the VŁ4 logic system of Meth8 that Eq 2 or 3 is not tautologous, and hence Eq 1 is found to be non sequitur and mistaken.

From: http://www.cin.org/v2revel.html:

CHAPTER II HANDING ON DIVINE REVELATION

7. In His gracious goodness, God has seen to it that what He had revealed for the salvation of all nations would abide perpetually in its full integrity and be handed on to all generations. Therefore Christ the Lord in whom the full revelation of the supreme God is brought to completion (see Cor. 1:20; 3:13; 4:6), commissioned the Apostles to preach to all men that Gospel which is the source of all saving truth and moral teaching,[1] and to impart to them heavenly gifts. This Gospel had been promised in former times through the prophets, and Christ Himself had fulfilled it and promulgated it with His lips. This commission was faithfully fulfilled by the Apostles who, by their oral preaching, by example, and by observances handed on what they had received from the lips of Christ, from living with Him, and from what He did, or what they had learned through the prompting of the Holy Spirit. The commission was fulfilled, too, by those Apostles and apostolic men who under the inspiration of the same Holy Spirit committed the message of salvation to writing.[*2. citing Council of Trent, 1545*]

But in order to keep the Gospel forever whole and alive within the Church, the Apostles left bishops as their successors, "handing over" to them "the authority to teach in their own place."[3] This sacred tradition, therefore, and Sacred Scripture of both the Old and New Testaments are like a mirror in which the pilgrim Church on earth looks at God, from whom she has received everything, until she is brought finally to see Him as He is, face to face (see 1 John 3:2).

8. And so the apostolic preaching, which is expressed in a special way in the inspired books, was to be preserved by an unending succession of preachers until the end of time. Therefore the Apostles, handing on what they themselves had received, warn the faithful to hold fast to the traditions which they have learned either by word of mouth or by letter (see 2 Thess. 2:15), and to fight in defense of the faith handed on once and for all (see Jude 1:3) [*4. citing Second Council of Nicea, 787, and Fourth Council of Constance, 1414*]

Now what was handed on by the Apostles includes everything which contributes toward the holiness of life and increases in faith of the people of God; and so the Church, in her teaching, life and worship, perpetuates and hands on to all generations all that she herself is, all that she believes. **This tradition which comes from the Apostles develops in the Church with the help of the Holy Spirit.**[*5. citing First Vatican Council, 1869*] For there is a growth in the understanding of the realities and the words which have been handed down. This happens through the contemplation and study made by believers, who treasure these things in their hearts (see Luke, 2:19, 51) through a penetrating understanding of the spiritual realities which they experience, and through the preaching of those who have received through episcopal succession the sure gift of truth. For as the centuries succeed one another, the Church constantly moves forward toward the fullness of divine truth until the words of God reach their complete fulfillment in her.

The words of the holy fathers witness to the presence of this living tradition, whose wealth is poured into the practice and life of the believing and praying Church. Through the same tradition the Church's full canon of the sacred books is known, and the sacred writings themselves are more profoundly understood and unceasingly made active in her; and thus God, who spoke of old, uninterruptedly converses with the bride of His beloved Son; and the Holy Spirit, through whom the living voice of the Gospel resounds in the Church, and through her, in the world, leads unto all truth those who believe and makes the word of Christ dwell abundantly in them (see Col. 3:16).

9. Hence there exists a close connection and communication between sacred tradition and Sacred Scripture. For both of them, flowing from the same divine wellspring, in a certain way merge into a unity and tend toward the same end. For Sacred Scripture is the word of God inasmuch as it is consigned to writing under the inspiration of the divine Spirit, while sacred tradition takes the word of God entrusted by Christ the Lord and the Holy Spirit to the Apostles, and hands it on to their successors in its full purity, so that led by the light of the Spirit of truth they may in proclaiming it preserve this word of God faithfully, explain it, and make it more widely known. **Consequently it is not from Sacred Scripture alone that the Church draws her certainty about everything which has been revealed. Therefore both sacred tradition and Sacred Scripture are to be accepted and venerated with the same sense of loyalty and reverence.** [*6. citing Council of Trent, 1545*]

10. **Sacred tradition and Sacred Scripture form one sacred deposit of the word of God, committed to the Church.** Holding fast to this deposit the entire holy people united with their shepherds remain always steadfast in the teaching of the Apostles, in the common life, in the breaking of the bread and in prayers (see Acts 2, 42, Greek text), so that holding to, practicing and professing the heritage of the faith, it becomes on the part of the bishops and faithful a single common effort.[*7. citing Pius XII, 1950*]

But the task of authentically interpreting the word of God, whether written or handed on,[*8. citing First Vatican Council, 1869*] has been entrusted exclusively to the living teaching office of the Church.[*9. citing Pius XII, 1950*] whose authority is exercised in the name of Jesus Christ. **This teaching office is not above the word of God, but serves it**, teaching only what has been handed on, listening to it devoutly, guarding it scrupulously and explaining it faithfully in accord with a divine commission and with the help of the Holy Spirit, it draws from this one deposit of faith everything which it presents for belief as divinely revealed.

It is clear, therefore, that **sacred tradition, Sacred Scripture and the teaching authority of the Church,** in accord with God's most wise design, **are so linked and joined together that one cannot stand without the others,** and that all together and each in its own way under the action of the one Holy Spirit contribute effectively to the salvation of souls.

CHAPTER II

1. cf. Matt. 28:19-20, and Mark 16:15; Council of Trent, session IV, Decree on Scriptural Canons: Denzinger 783 (1501).
2. cf. Council of Trent, loc. cit.; First Vatican Council, session III, Dogmatic Constitution on the Catholic Faith, Chap. 2, "On revelation:" Denzinger 1787 (3005).
3. St. Irenaeus, "Against Heretics" III, 3, 1: PG 7, 848; Harvey, 2, p. 9.
4. cf. Second Council of Nicea: Denzinger 303 (602); Fourth Council of Constance, session X, Canon l: Denzinger 336 (650-652).
5. cf. First Vatican Council, Dogmatic Constitution on the Catholic Faith, Chap. 4, "On Faith and Reason:" Denzinger 1800 (3020).
6. cf. Council of Trent, session IV, loc. cit.: Denzinger 783 (1501).
7. cf. Pius XII, apostolic constitution, "Munificentissimus Deus," Nov. l, 1950: A.A.S. 42 (1950) P. 756, Collected Writings of St. Cyprian, Letter 66, 8: Hartel, III, B, p. 733: "The Church [is] people united with the priest and the pastor together with his flock."
8. cf. First Vatican Council, Dogmatic Constitution on the Catholic Faith, Chap. 3 "On Faith." Denzinger 1792 (3011).
9. cf. Pius XII, encyclical "Humani Generis," Aug. 12, 1950: A. A.S. 42 (1950) PP. 568-69: Denzinger 2314 (3886).

Roman Catholic Church: Tradition above scripture

Logical evaluation of infallibility in the formula for the Historic Church

We previously evaluated infallibility using the Meth8 modal logic model checker as follows in words:

"Both Peter appointed the chief apostle as equivalent to apostolic primacy, and apostolic primacy as equivalent to holding the keys of a papacy imply the existence of a papacy as equivalent to Peter." (1.1)

or

"Both Peter appointed the chief apostle as equivalent to apostolic primacy, and apostolic primacy as equivalent to holding the keys of a papacy imply a papacy as equivalent to the existence of Peter." (1.2)

with

LET: p Papacy; q Apostolic primacy; r Peter
> Imply; & And; = Equivalent to; ~ Not
necessarily, the universal quantifier ∀;
% possibly, the existential quantifier ∃
vt tautologous; nvt not tautologous

for

((r= q) & (q= p)) > (%p= r) ; nvt ; NTTT TTTT (1.1.1)

or

((r= q) & (q= p)) > (p=%r) ; nvt ; NTTT TTTT (1.2.1)

We noted a stronger refutation replaces the existential quantifier % as "the existence of" with the universal quantifier # as "the necessity of", with the same net effect where explicitly:

((r= q)& (q= p)) > (#p= r) ; nvt ; TTTN TTTT (1.3.1)

For the formula of the Historic Church we include additional items:

LET: s Scripture; t Tradition; u Church

We are careful to define the Church as the Body of Christ, viz, pre-existent as to physical scripture, tradition, or ecclesiastical infallibility.

The formula we test in words is as follows:

"If both Peter appointed the chief apostle as equivalent to apostolic primacy, and apostolic primacy as equivalent to holding the keys of a papacy imply the existence of a papacy as equivalent to Peter, then if both the Church implying scripture and scripture implying tradition imply the existence of a Church as equivalent to scripture and tradition." (2.1)

where

((((r= q)& (q= p))> (%p= r))= u) > (((u> s)& (s> t))> (%u= (s & t))) ;
nvt ; NTTT TTTT TTTT TTTT [fragment from 128-row table] (2.1.1)

Eq 2.1 is not validated as tautologous because the Church as equivalent to the definition of infallibility was not validated as tautologous in Eqs 1.1.1 or 1.2.1.

A definition of the Church as the Body of Christ is terms of scripture and tradition is in words as follows:

> "If both the Church implying scripture and scripture implying tradition imply a Church implies the existence of both Scripture and Tradition." (3.1)

> ((u> s)& (s> t))> (u>%(s & t)) ;
> vt ; TTTT TTTT TTTT TTTT (3.1.1)

However, the consequent in Eq 2.1 above reads:

> "[I]f both the Church implying scripture and scripture implying tradition imply the existence of a Church as equivalent to scripture and tradition."
> (2.1)

A difference between Eq 2.1 and 3.1 is in Eq 3.1 where the existential quantifier is applying to the Church and not to scripture and tradition. This is because the object is to prove the existence of the Church as previously evaluated in terms of infallibility in the antecedent of Eqs 1.1.1 and 1.2.1, but with additional terms in Eq 3.1.

Another difference is in Eq 2.1 where the existence of a Church is held equivalent to both scripture and tradition, a higher level of truth than in Eq 3.1 where there is not equivalency but an implication.

Rota lattice theory distributive axiom

From: Gian-Carlo **Rota**. "The Many Lives of Lattice Theory". Notices of the AMS. 44:11. 1440-1445. December, 1997.

p. 1440, distributive:

(p+(q&r)) = ((p&q)+(p&r)) ; *not* tautologous

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TFTT TTFT TFTT TTFT  EUEE EEUE EUEE EEUE  EUEE EEUE EUEE EEUE  EUEE EEUE EUEE EEUE  EUEE EEUE EUEE EEUE
```

Russell paradox (See en.wikipedia.org/wiki/Russell%27s_paradox)

LET: nvt not tautologous

R = { x | x ∉x }, then R ∈R <=> R ∉R. (R.1)
(r = (x>x)) > ((r<r) = (r>r)) ; nvt (R.2)

Russell's paradox as stated is nvt, but it is not a paradox or a contradiction.

In the formal presentation of Russell's "Naive Set Theory (NST), as the theory of predicate logic with a binary predicate ∈and the following axiom schema of unrestricted comprehension:

∃y ∀x (x ∈y <=> P (x)) (R.5)

for any formula *P* with only the variable *x* free. Substitute x ∉x for P (x).
Then by existential instantiation (reusing the symbol *y*) and universal instantiation
y ∈y <=> y ∉y is a contradiction. Therefore, NST is inconsistent.": [∉ is >]

(%y&#x)&((x<y)=(p&x)) ; nvt (R.6)
for (p&x) substitute (x>x)
(%y&#x)&((x<y)=(x>x)) ; nvt *and* contradictory (R.7)

However there is a problem with the substitution of (p&x)=(x>x) if (p&x) is removed from the expression as in (7); the correct expression is (p&x)=(x>x), not (x>x) with truth table fragment:

(%y&#x)&((x<y)=((p&x)=(x>x))) ; nvt [but not *and* contradictory] (R.8)

```
FFFF FFNF   UUUU UUEU   UUUU UUUU   UUUU UUIU   UUUU UUPU    Step: 15
Model 1     Model 2.1   Model 2.2   Model 2.3.1Model 2.3.2
```

Therefore Russell's NST is nvt, but it is *not* inconsistent as a contradiction.

S5Π+ for propositional quantification

Holliday, Wesley H. "A note on algebraic semantics for S5 with propositional quantifiers". *Notre Dame Journal of Formal Logic*. March 2017

From:researchgate.net/publication/313838323_A_Note_on_Algebraic_Semantics_for_S5_with_Propositional_Quantifiers

We use the Meth8 apparatus to evaluate equation (W) on which S5II+ is based for propositional quantification.

∃q(q∧∀p(p→(q→p))) (W.1)

%q&(q&(#p&(p>#(q>p)))) ; `FFFN` ; (W.2)

Because Meth8 does not validate Eq. W.2 as tautology, we conclude that S5Π+ for propositional quantification is not bivalent. This also confirms S5 is not a bivalent logic.

Erwin Schrödinger's cat thought experiment

Findings:

The cat dies eventually regardless of if the radioactive monitor is stimulated or not.

Hence when opening the box at any time, the cat is either still alive or dead, but not "entangled" as both dead and alive (a contradiction). The experiment is not a paradox.

What follows is that quantum mechanics cannot fully evaluate the state of affairs because the experiment was not fully evaluated in propositional logic until now by the logic system VŁ4 in five models.

A detailed diagram of the apparatus is at wikipedia under the title.

There are five propositional variables as < box, cat, poison, monitor, death > are < p, q, r, s, t >.

The logical operator symbols as { =, @, &, >, ~ } are { Equivalent to, Not equivalent to, And, Imply, Not}.

The words to be mapped, translation to symbolic expressions, and resulting truth tables follow.

H0. If the monitor is tautologous, that is not activated, along with the box, cat, and poison apparatus in place, then there is no death.

H0. ((s=s)&((p&q)&r)) > ~t ; not validated in all models.

However, the proof tables show H0 to be "almost" tautologous in all models, for which one exemplary row out of 93-rows suffices:

Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
TTTT TTTF	EEEE EEEU	EEEE EEEU	EEEE EEEU	EEEE EEEU

H1. If the monitor is contradictory, that is activated, along with the box, cat, and poison apparatus in place, then there is death.

H1. ((s@s)&((p&q)&r)) > t ; validated in all models; Tautologous.

One exemplary row out of 93-rows suffices:

Model 1	Model 2.1	Model 2.2	Model 2.3.1	Model 2.3.2
TTTT TTTT	EEEE EEEE	EEEE EEEE	EEEE EEEE	EEEE EEEE

Note: ((s@s)&((p&q)&r)) = t ; not validated, so an implication is tautologous but not an equivalence.

The comprehensive evaluation in propositional logic of Schrödinger's cat thought experiment could not be undertaken until now with the logic system VŁ4 in five models using the model checker Meth8.

Law of self-equilibrium: not law; not paradox

The law of self-equilibrium sometimes uses this example:

> Too much work produces sickness; sickness produces less work;
> therefore, too much work implies less work. (1.0)

We rewrite the sentence to replace the connective verb with "causes" for better meaning and also include a modal operator for clarity:

> Too much work causes possible sickness; sickness causes less work;
> therefore, too much work causes less work. (2.0)

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values.* The designated *proo*f value is T.

LET: p too much work; ~p less work; q sickness; ~ Not; > Imply; % possibly

((p>%q)&(q>~p))>(p>~p) ; `TNTT TNTT TNTT TNTT` (2.1)

Eq. 2.1 shows the law of self-equilibrium is not tautologous, and hence not a theorem and not a paradox.

*

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

Results are the proof table of 16-values in row major horizontally.

Resolution of **Sorites Paradox**

((q>#p) & ~(q-%p)) > (q=q); tautologous

LET p is grain of sand; #p is the necessity of grains of sand; %p is the possibility of a grain of sand; q is heap of sand; & is and; - is not or, ~+; > is imply; = is equivalent to; ~ is not

In words: If both a heap implies the necessity of grains and a heap is not possibly less than one grain, then the heap is in fact truly a heap.

In other words, a heap has to have one or more grain(s) to be a heap.

```
(q>#p)
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTFN TTFN TTFN TTFN  EEUE EEUE EEUE EEUE  EEUU EEUU EEUU EEUU  EEUI EEUI EEUI EEUI  EEUP EEUP EEUP
EEUP

~(q-%p)
CTTT CTTT CTTT CTTT  UEEE UEEE UEEE UEEE  EEEE EEEE EEEE EEEE  PEEE PEEE PEEE PEEE  IEEE IEEE IEEE
IEEE

((q>#p)&~(q-%p))
CTFN CTFN CTFN CTFN  UEUE UEUE UEUE UEUE  EEUU EEUU EEUU EEUU  PEUI PEUI PEUI PEUI  IEUP IEUP IEUP
IEUP

(q=q)
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE
EEEE

((q>#p)&~(q-%p))>(q=q)
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE
EEEE
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
```

Square of Opposition Meth8 corrected

The modern revision of the square of opposition is not validated as tautologous by the Meth8 logic model checker, as based on system variant VŁ4. Consequently we redefine the square so that it is validated as tautologous my Meth8. Instead of definientia using implication for universal terms or conjunction for existential terms, we adopt the equivalent connective for all terms. The modal modifiers necessity and possibility map quantifiers as applying to the entire terms rather than to the antecedent within the terms.

The Meth8 symbols are: ~ Negation ; \ Nand ; > Imply ; + Or ; # modal necessity for universal quantifier ; % modal possibility for existential quantifier ; ? unspecified connective.

Sources		* Modern Revision		** Meth8 Correction	
Type	Definientia	Script	Valid as	Script	Valid as
Corner	A	#s> p		#(s= p)	
	E	#s>~p		#(s=~p)	
	I	%s&p		%(s= p)	
	O	%s&~p		%(s=~p)	
Contraries	AE	(#s>p) + (#s>~p)	A + E	#(s= p) \ #(s=~p)	A \ E
Subalterns	AI	(#s>p) ? (%s&p)		#(s= p) > %(s= p)	A > I
Contradictories	AO	(#s>p) + (%s&~p)	A + O	#(s= p) \ %(s=~p)	A \ O
Contradictories	EI	(#s>~p) + (%s&p)	E + I	#(s=~p) \ %(s= p)	E \ I
Subalterns	EO	(#s>~p) ? (%s&~p)		#(s=~p) > %(s=~p)	E > O
Subcontraries	IO	(%s&p) \ (%s&~p)	I \ O	%(s= p) + %(s=~p)	I + O

* The quantifier may refer to the entire term as #(p=q) or to the antecedent of the term as (#p=q). In Meth8 there is a difference. We adopt the latter because it returns more validated connectives. For example from the traditional square: #(A?E), #(I?O) versus (A+E), (I\O).

The modern revision of the square of opposition is not validated as tautologous by the Meth8 logic checker in five models for all expressions. This leads us to consider that any logic system based on the square of opposition is spurious. What follows then is that a first order predicate logic based on the square of opposition is now suspicious.

** The Meth8 validated square of opposition redefines A, E, I, O to match the words more clearly. For example on A, "All S is P" is mapped as "#(s=p)", not as in the note above with "#s=p" because the connective of equivalence is stricter than that of implication and consistent for all definiens. By changing the connective in the term from implication or conjunction to equivalence makes the Meth8 validated square of opposition suitable as a basis for other logics such as first order predicate logic.

We note the validating connectives for the edges on the square are: \ Nand for the Contraries and Contradictories; > Imply for the Subalterns; and + Or for the Subcontraries.

References

James, C. (2015). Theorem prover Meth8 applies four valued Boolean logic for modal interpretation. First World Conference: Analogy. Beneméita Universidad Autónoma de Puebla, Mexico, November 4-6, 2015, Handbook, ISBN 978-83-65273-01-1, 50-51.

Łukasiewicz, J. (1951). *Aristotle's Syllogistic from the Standpoint of Modern Logic*, Oxford: Clarendon Press.

Westerståhl, D. (2012). "Classical vs modern Squares of Opposition, and beyond", in Jean-Yves Béziau & Gillman Payette (eds.), *The Square of Opposition: A General Framework for Cognition*, Bern: Peter Lang.

Square of Opposition Modern Revised: not validated as tautologous

The definens are from plato.stanford.edu/entries/square/#ModRevSqu, by Terence Parsons (2012).

The Meth8 symbols are: ~ Negation ; \ Nand ; > Imply ; + Or ; # modal necessity for universal quantifier ; % modal possibility for existential quantifier ; ? unspecified connective.

Sources		Original Fragment		Original Tradition		* Modern Revision		Swanon Defense	
Type	Defin-ientia	Script	Valid as	Script	Valid as	Script	Valid as	Script	Valid as
Corner	A	#s>p		#s>p		#s> p		#s>p	
	E	~s>p		~s>p		#s>~p		#s>~p	
	I	%s&p		%s&p		%s&p		%s&p	
	O	%s&~p		%s&~p		%s&~p		%s&~p	
Con-traries	AE	(#s>p) + (~s>p)	A + E	(#s>p) + (~s>p)	A + E	(#s>p) + (#s>~p)	A + E	(#s>p) + (#s>~p)	A + E
Sub-alerns	AI			(#s>p) ? (%s& p)		(#s>p) ? (%s&p)		(#s>p) ? (%s&p)	
Contra-dictories	AO	(#s>p) + (%s&~p)	A + O	(#s>p) + (%s&~p)	A + O	(#s>p) + (%s&~p)	A + O	#s>p) + (%s&~p)	A + O
Contra-dictories	EI	(~s>p) ? (%s&p)		(~s>p) ? (%s&p)		(#s>~p) + (%s&p)	E + I	(#s>~p) + (%s& p)	E + I
Sub-alterns	EO			(~s>p) ? (%s&~p)		(#s>~p) ? (%s&~p)		(#s>~p) ? (%s&~p)	
Sub-contraries	IO			(%s&p) \ (%s&~p)	I \ O	(%s&p) \ (%s&~p)	I \ O	(%s&p) \ (%s&~p)	I \ O

* The quantifier may refer to the entire term as #(p=q) or to the antecedent of the term as (#p=q). In Meth8 there is a difference. We adopt the latter because it returns more validated connectives. For example from the traditional square: #(A?E), #(I?O) versus (A+E), (I\O).

The square of opposition is not validated as tautologous by the Meth8 logic checker in five models for all expressions. This leads us to consider that any logic system based on the square of opposition is spurious. What follows then is that a first order predicate logic based on the square of opposition is now suspicious.

Proportions in the square of opposition

Prade, Henri; Richard, Gilles. "From the structures of opposition between similarity and dissimilarity indicators to logical proportions". *Representation and reality in humans, other living organisms and intelligent machines*. Springer. 2017. pp.279-299. doi: 10.1007/978-3-319-43784-2_14.

From:researchgate.net/publication/319401583_From_the_Structures_of_Opposition_Between_Similarity_and_Dissimilarity_Indicators_to_Logical_Proportions

On page 280 of the free Springer preview, only, we find:

(A/D)=(A-B)/(C-D) where B=C. (1.0)

We evaluate this using the Meth8 modal logic model checker, implementing our resuscitation of Łukasiewicz Ł4 as system variant VŁ4.

LET: p q r s A B C D ;
\ / Not And; = Equivalent to; > Implication; & And; - - Not Or
T tautology; F contradiction

(p\s)=((p-q)\(r-s)) ; FTTT TTTT TFTF TFFF ; (1.1)
(q=r)>((p\s)=((p-q)\(r-s))) ; FTTT TTTT TFTT TTTF ; (1.2)
(q=r)&((p\s)=((p-q)\(r-s))) ; FTFF FFTT TFFF FFTF ; (1.3)

Eqs 1.1, 1.2, 1.3 are not validated as tautology by Meth8. We therefore conclude that proportions as such from the Square of Opposition are not bivalent but a vector space.

Stone space type lattice logic model

From: Haykazyan, L. (2017). Spaces of types in positive model theory. arxiv.org/pdf/1711.05754.pdf

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to;
@ Not equivalent to; # all; % some; (p@p) 00, zero; (p=p) 11, one

Results are the proof table of 16-values in row major horizontally.

"Example 5.8. ... To make sure this theory is countably categorical, we need to ensure that there are infinitely many points without colour. So we add a binary relation Q(x, y) (and its negation ¬Q) that will pair the points that do not have a colour. The theory asserts the following.

Q is symmetric and irreflexive:

∀x, y(Q(x, y) → Q(y, x))" (5.8.1)
(#p&#q)&((q&(p&r)) > (q&(r&p)) ; TTTC TTTC TTTC TTTT (5.8.2)

To ensure Eq. 5.8.1 is quantification ∀x, y distributed on the literal (Q(x, y) → Q(y, x)), we rewrite Eq. 5.8.2.

((#p&#q)&(q&(p&r))) > ((#p&#q)&(q&(r&p))) ; TTTC TTTC TTTC TTTT (5.8.3)

The truth table of Eq. 5.8.2 is identical to Eq. 5.8.3.

Eq. 5.8.2 as rendered is *not* tautologous, and hence the binary relation Q is not symmetric and irreflexive.

Stone-Wales rotation transforms on four proximal polygons only from a complex to a simple ring

1.1 We ask: "On four proximal polygons, is a simple ring reversible (bijective) with a complex ring?"

We assume the Meth8 scriptors, with vt Validated tautologous, nvt Not Validated tautologous, designated proof value as T tautology; other values are F contradiction and N non-contigency (a truth value).

The truth tables in five models are concatenated as four rows of four values.

LET: p q r s polygon edges,
p & q & r & s simple ring of four proximal polygons,
(p-1) & (q-1) & (r+1) & (s+1) complex ring of four proximal polygons,
(p-1) (p-(%p>%#p)) , (p+1) (p+(%p>%#p)), ...

((p&r)&(q&s)) = (((p-(%p>%#p))&(r-(%r>%#r)))&((q+(%q>%#q))&(s+(%s>%#s)))) ;
TTTT TTTT TTNT TTTF (1)

1.2 We answer 1.1: "Not bijective." However, the near match to a proof is cause for further testing

2.1 We then ask: "On four proximal polygons, does a simple ring imply a complex ring?"

((p&r)&(q&s)) > (((p-(p\p))&(r-(r\r)))&((q+(q\q))&(s+(s\s)))) ;
TTTT TTTT TTTT TTTF (2)

The truth tables for Eq 2 are the same as for Eq 1.

2.2 We then answer 2.1: "No implication." However, the same proof tables repeated from Eq 1 are cause for further testing.

3.1 We now ask: "On four proximal polygons, does a complex ring imply a simple ring?"

(((p-(%p>%#p))&(r-(r\r)))&((q+(q\q))&(s+(s\s)))) > ((p&r)&(q&s)) ;
TTTT TTTT TTNT TTTT (3)

3.2 We now answer: "No implication." This means the sequence of Stone-Wales rotation for four proximal polygons does not transform from a complex ring to a simple ring, or vice versa.

Refutation of the principle of superposition of states

From: Hari Dass, N.D. (2013). "The superposition principle in quantum mechanics - did the rock enter the foundation surreptitiously?". arxiv.org/pdf/1311.4275.pdf

$$|\psi\rangle = \alpha|1\rangle + \beta|2\rangle \quad (1.1)$$
$$|good\rangle = 1/\sqrt{2}\ \{\ |red\rangle + |yellow\rangle\ \} \quad (2.1)$$
$$|bad\rangle = 1/\sqrt{2}\ \{\ |red\rangle - |yellow\rangle\ \} \quad (3.1)$$
$$|red\rangle = 1/\sqrt{2}\ \{\ |good\rangle + |bad\rangle\ \} \quad (4.1)$$
$$|yellow\rangle = 1/\sqrt{2}\ \{\ |good\rangle - |bad\rangle\ \} \quad (5.1)$$

Eq. 1.1 as "the principle of superposition of states" [asserts] that the *complex linear superpositions* also represent *quantum states* of the system".

We assume the Meth8/VŁ4 apparatus and method where the designated *proof* value is T. Other values are F contradiction, N truthity (non-contingence), and C falsity (contingence). The 16-valued proof table is row-major and presented horizontally.

LET p q r s: good, smell, red rose, yellow rose; ~p bad, as Not good;
~ Not; + Or; - Not Or; = Equivalent to; > Imply; < Not Imply, less than, ∈;
% possibility, for one or some; # necessity, for all.

The irrational constant (1/(2^0.5)) is ignored throughout this demonstration.

We treat Eqs.1.1-5.1 as expressions on the complex plane ℂ. Meth8/VŁ4 maps them by substituting the Equivalent connective for ℝreal numbers with the Imply connective for imaginary numbers.

"(red Nor yellow) Implies (Not(red Or yellow))" (0.2.1)
(r-s)>~(r+s) ; TTTT TTTT TTTT TTTT (0.2.2)

p>(r+s) ; TFTF TTTT TTTT TTTT (2.2.2)
~p>(r-s) ; TTTT FTFT FTFT FTFT (3.2.2)
r>(p+~p) ; TTTT TTTT TTTT TTTT (4.2.2)
s>(p-~p) ; TTTT TTTT FFFF FFFF (5.2.2)

We rewrite Eqs. 2.2.2 and 3.2.2 as Eq.0.2.2.

By substitution from the text we write:

"the states [good, not good] have *definite values* of some other *attribute* which we could call *smell*" (6.1)
(p+~p)<q ; TTFF TTFF TTFF TTFF (6.2)

"Suppose we start with [good] and make a *colour* measurement.
The outcome will be red or yellow with equal probability." (7.1)

Because probability (possibility) is now invoked, we rely on our previous proof that the modal operators as equivalent to the respective quantifiers for this application.

%p>#(r+s) ; NFNF NNNN NNNN NNNN (7.2)

We remark that Eq. 7.2 expresses that a possible state of good implies the necessity of the color as red or yellow. Eq. 7.2 does not state the necessity of a probability. (Author Hari Dass later changes that possible state of good into a necessary state of good at Eq. 12.1.)

"If it is red, the state after the measurement is [red],
and likewise for the outcome yellow." (8.1)
(r>r)&(s>s) ; TTTT TTTT TTTT TTTT (8.2)

Let us say that the outcome is *red*." (9.1)

Because Eq. 9.1 is a conclusion, we write it as the consequent of both Eqs. 7.1 and 8.l.

((%p>#(r+s))&((r>r)&(s>s)))>r ; CTCT TTTT CCCC TTTT (9.2)

"Now imagine a *smell* measurement on the system." (10.1)
q ; FFTT FFTT FFTT FFTT (10.2)

"Because the state after the last measurement i.e [red] is an *equal* superposition
of the good and bad smell states, the outcome will be one of these randomly
and with equal probability." (11.1)

Eq. 11.1 has two parts, the antecedent resulting in the combination of Eqs. 9.2 and 10.2 and the consequent as the equal probability (%p=%~p).

(((%p>#(r+s))&((r>r)&(s>s)))>r)>(q>#(%p=%~p)) ;
TTNF TTFF TTNN TTFF (11.2)

"Therefore, even though we started with a state whose *smell* was *certain* i.e good,
an intervening colour measurement has completely destroyed this certainty!" (12.1)

A state which *smell* was *certain* as good is (q>#p), and when connected with an intervening measurement for red, produces the antecedent below. The consequent is the *possibility* of good from Eq. 7.2 above.

((q>#p)&((((%p>#(r+s))&((r>r)&(s>s)))>r)>(q>#(%p=%~p))))>~#p ;
TCTT TCTT TCTC TCTT (12.2)

In Eq 12.2 we change the "%p" from Eq. 7.2 into "#p", but the table result is the same as in Eq. 12.2.

"Instead, the smell information has become totally *unpredictable*! This is the
inherent *indeterminacy* of quantum theory." (13.1)

We remark on 13.1 that the smell information as a required variable was unpredictable from Eq. 7.2. What was predictable above was the possible determination of red or yellow, and good or not good.

"This is also a demonstration that the pair of observables *colour, smell* are
mutually *incompatible*." (14.1)

Statement 14.1 does not follow from 13.1 or from our results because compatibility is not a consideration.

> "Existence of incompatible observables is the essential content of the *Heisenberg Uncertainty Relations*." (15.1)

Elsewhere we show the Heisenberg uncertainty principle is *not* tautologous.

The combined literal Eqs. as rendered above show the principle of superposition of states in Eq. 1.1 is *not* confirmed, and hence is refuted.

Refutation of Tarski's undefinability of truth theorem

From: Salehji, S. Theorems of Tarski's undefinability and Gödel's second incompleteness--computationally". 2017. arxiv.org/pdf/1509.00164.pdf

"Gödel's first incompleteness theorem is usually stated as "*no sound and R*[ecursively] *E*[numerable] *extension of P*[eano's] *A*[rithmetic] *can be complete*"; in notation $\mathrm{PA} \subseteq T \;\&\; T \in \Sigma_1 \;\&\; T \subseteq \mathrm{Th}(N) \Rightarrow T \neq \mathrm{Th}(N)$." (2.2.1)

"So, Tarski's theorem states that for any n, $\mathrm{Th}(N) \notin \Sigma_n$. For the sake of unifying it with Gödel's theorem let us present this theorem as $(*)_n$ $\mathrm{PA} \subseteq T \;\&\; T \in \Sigma_n \;\&\; T \subseteq \mathrm{Th}(N) \Rightarrow \mathrm{Th}(N) \nsubseteq T$ stating that "no definable and sound extension of PA can be complete"." (2.2.2)

We rewrite Eq. 2.2.2 because "for any n, $\mathrm{Th}(N) \notin \Sigma_n$" is not expressed correctly.

$\mathrm{PA} \subseteq T \;\&\; \mathrm{T} \in \Sigma_n \;\&\; T \subseteq \mathrm{Th}(N) \Rightarrow \mathrm{Th}(N) \nsubseteq \forall n \Sigma_n$. (2.2.3)

We assume the apparatus and method of Meth8/VŁ4 to evaluate Eq. 2.2.3.

The designated proof value is `T` for tautology; `F` is for contradiction.
The 16-valued truth table is presented row-major and horizontally.

LET: ~ Not; & And; + Or; > Imply, greater than; < Not Imply, less than;
\# necessity, all; % possibility, some;
pqrs: "PA"; T; *n*; *N*
r Σ_n; #r $\forall n\Sigma_n$; (%s>#s) non-contingency truth value for Th(N); ~(q<p) (p $\subseteq$q).

(~(q<p) & ((q<r)&~((%s>#s)<q))) > (#r<(%s>#s)) ; `TTTF TTTT TTTF TTTT` (2.2.4)

Eq. 2.2.4 as rendered for Eq. 2.2.3 is *not* tautologous.

Time as God conjecture

If God knows that past, present, and future are tautologous [and that past implies present, implies future], then:

God as past implies God as present, implies past as present;
or
God as past implies God as future, implies past as future;

or

God as present implies God as future, implies present as future
{ or past as present implies pas as future, implies present as future }

Proof for time as God in Meth8 script.

LET p God, q past, r present, s future, [also t time = q & r & s]

```
(p & (((q=q)&(s=s))&(r=r)))
>
(   ((((p=q)>(p=r))>(q=r))
    +
     (((p=q)>(p=s))>(q=s)))
+
(((p=r)>(p=s))>(r=s))  ) ; tautologous
```

For the additional bracketed and braced expressions:

```
((p&(((q=q)&(s=s))&(r=r)))&(((q=q)>(s=s))>(r=r)))
>
(   ((((p=q)>(p=r))>(q=r))
    +
      (((p=q)>(p=s))>(q=s)))
+
((((p=r)>(p=s))>(r=s))+(((q=r)&(q=s))&(r=s)))  ) ; tautologous
```

Proof that the transition function of the topological manifold is not tautologous (but incredibly close to being tautologous!)

From public source: en.wikipedia.org/wiki/Topological_manifold, under Coordinate Charts

> "Given two charts φ and ψ with overlapping domains *U* and *V* there is a transition function
>
> $$\psi\varphi^{-1}\colon \varphi(U \cap V) \to \psi(U \cap V). \qquad (1)$$
>
> Such a map is a homeomorphism between open subsets of $\mathbf{R}^n$. That is, coordinate charts agree on overlaps up to homeomorphism. Different types of manifolds can be defined by placing restrictions on types of transition maps allowed. For example, for differential manifolds the transition maps are required to be diffeomorphism."

We map Eq 1 into Meth8 script to validate it:

LET: p q r s, ψ φ *U* *V*, nvt not tautologous, Tautologous (Evaluated) Designated truth values
& ∩ And, \ Not And, → ":" > Imply, ($\psi\varphi^{-1}$) (ψ \ φ)

(p\q)>((q&(r&s))>(p&(r&s))) ; nvt (2)

The truth table of Eq 2 (each model is the concatenation of four table rows of four values):

```
Model 1          .Model 2.1       .Model 2.2       .Model 2.3.1     .Model 2.3.2
TTTTTTTTTTTTTTFT.EEEEEEEEEEEEEEUE.EEEEEEEEEEEEEEUE.EEEEEEEEEEEEEEUE.EEEEEEEEEEEEEEUE
(p\q)>((q&(r&s))>(p&(r&s)))   Step: 15
```

The non truth values contradictory (Unevaluated) are in bold above to show how closely Eq 2 diverges.

(If in Eq 2 the main connective > Imply is changed to & And or to < Not Imply, or the order of main terms are juxtaposed around those connectives, or the order of p,q is changed in combinations, then those expressions are also nvt.)

We ask what does this mean regarding the transition function of the topological manifold?

If it is not tautologous, then the notion of manifolds is suspicious for:

Discrete spaces (0-manifold); Curves (1-manifold); Surfaces (2-manifolds);
Volumes (3-manifolds); and General (n-manifolds).

This is troubling because Volumes (3-manifolds) resulting from Thurston's geometrization conjecture was proved by Grigori Perelman, but the prize was not accepted.

If the transition function of the topological manifold is not validated, then the set theory of Volumes (3-manifolds) apparently fails.

What follows is that branes, as predicated on manifolds, are also suspicious.

Refutation of the halting problem: not a problem

Taken from: en.wikipedia.org/wiki/Halting_problem

Given:

There is at least one n such that N(n) is equal to the statement H(a, i) meaning a halts on input i.

What follows is that:

Either there is an n such that N(n) = H(a,i), (1.1)
or there is an n' such that N(n') =~H(a,i). (2.1)

This means that this gives an algorithm to decide the halting problem [as Eq. 1.1 or Eq. 2.1 is a proof].

[There is an n such that N(n)=H(a,i)] Or [There is an n' such that N(n')=~H(a,i)] = proof (3.1)

"Since we know that there cannot be such an algorithm, it follows that the assumption that there is a consistent and complete axiomatization of all true first-order logic statements about natural numbers must be false." (4.1)

We assume the apparatus and method of Meth8 implementing variant logic system VŁ4.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: p q r s N n n' H(a,i); % possibility, for some (one); # necessity, for all;
~ Not; & And; + Or; > Imply; = Equivalent; @ Not equivalent
(p=p) 11, Tautology; (p@p) 00, Contradiction

The designated *proof* value is T.
The 16-valued truth tables are presented horizontally as row-major.

Eq. 1.1 is mapped as

(%q>((p&q)>s)) (1.2)

Eq. 2.1 is mapped as

(%r>((p&r)>~s)) (2.2)

Eq. 3.1 is mapped as

((%q>((p&q)>s)) + (%r>((p&r)>~s))) = (p=p) ; TTTT TTTT TTTT TTTT (3.2)

Because the truth table of Eq. 3.2 is tautologous (all T), this means the halting problem is in fact a theorem and not a problem. In other words:

> The assumption that there is a consistent and complete axiomatization of all true first-order logic statements about natural numbers must be *tautologous*. (4.2)

However, if Eq. 3.1 is written to replace the ">s" (implies s) in the antecedent parts with "=s" (equivalent to s), then Eq. 3.1 maps as

((%q>((p&q)=s)) + (%r>((p&r)=~s))) = (p=p) ; `TTNT TTTT TTTT TNTT` (3.3)

Because the truth table of Eq. 3.3 is not tautologous (not all T, but with some N as the non-contingent value of truth), this means the halting problem is not a problem of contradiction but rather an expression with values close to but not quite tautologous.

If the universal quantifier is applied to Eq. 3.3 on both main segments of the antecedent and consequent, then Eq. 3.3 maps as

#((%q>((p&q)=s)) + (%r>((p&r)=~s))) = #(p=p) ; `TTTT TTTT TTTT TTTT` (3.3)

and the halting problem becomes tautologous with the same status of theorem and result as in Eq. 3.2.

We conclude that Alan Turing's difficulty was in expressing the halting problem in the format of a two-valued logic which was not as expressive as in a four-valued logic to show nuances of what exactly the equation stated.

In comparison to Gödel's incompleteness theorems, Turing's halting problem has no superficial similarities other than being refuted as not a problem. Hence in contrast, both expressions are disparate and ultimately unrelated as to content meaning.

The twin paradox is not a paradox by mathematical logic

We define the twin paradox without resort to stopping because we assume that instant velocity commences and terminates at an instant state of rest.

> Twins occupy the same fiducial point from which one twin obtains
> an instant velocity to a non-fiducial point, then obtains another instant velocity
> back to the fiducial point. The question is are the twins the same
> at the fiducial point before and after the separation and travel of the one twin. (0.0)

We test this in words as:

> If the fiducial point implies the twins are equivalent, then
> if a twin implies a velocity to a non-fiducial point,
> then if that same twin implies a reverse velocity to the fiducial point,
> then the fiducial point point implies the twins are equivalent. (1.1)

We assume the apparatus and method of Meth8/VŁ4: ~ Not; > Imply; = Equivalent to.

LET: pq twins; r the fiducial point; ~r not the fiducial point;
s velocity to a non-fiducial point; ~s velocity from a non-fiducial point.

> The designated *proof* value is T for tautology; F is the designated *contradiction* value.
> The 16-valued truth table is presented row-major and horizontally.

> ((r>(p=q))>(p>(s>~r))) > ((p>(~s>r))>(r>(p=q))) ; TTTT TFFT TTTT TFFT (1.2)

This describes the state of affairs *without* special relativity. Eq. 1.2 as rendered is *not* tautologous.

We test the counter example in words as:

> If the fiducial point implies the twins are equivalent, then
> if a twin implies a velocity to a non-fiducial point,
> then if that same twin implies a reverse velocity to the fiducial point,
> then the fiducial point point implies the twins are *not* equivalent. (2.1)

> ((r>(p=q))>(p>(s>~r))) > ((p>(~s>r))>(r>~(p=q))) ; TTTT FTTF TTTT FTTT (2.2)

The describes the state of affairs *with* special relativity. Eq. 2.2 as rendered is *not* tautologous.

The paradox is supposed to arise by numerical calculation of special relativity. This would mean that the respective states of affairs are both tautologous (or both contradictory) at the same time.

However Eqs. 1.2 and 2.2 are not both tautologous (or both contradictory), and *not* inversive.

This means the twin paradox is not a paradox, but rather something else, namely, a state of affairs that is *not* tautologous and *not* contradictory. What follows is that special relativity is suspicious.

Refutation of the universal finite set

From:

Hamkins, J.D.; Woodin, W.H. (2017). The universal finite set.
arxiv.org/pdf/1711.07952.pdf. jdh.hamkins.org/the-universal-finite-set/

We evaluated two parts of the proof of Lemma 2 (Folklore).

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proof* value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < Not imply; = Equivalent to;
@ Not equivalent to; # all; % some; (p@p) 00; (p=p) 11

Results are the proof table of 16-values in row major horizontally.

(3 -> 2):
Not evaluated (3.2)

(2->1):
LET pqrs ψ lc_psi θ lc_theta uc_V x

((%q&r)&(q>p)) = ((%q&%s) & (((s=(r&q))&s)>p)); NNNN TTNC NNFF TTTT (2.1)

(1-> 3:

LET pqrs φ lc_phi x y H; k is uncountable, so k=(p>(p=p)).

((%q&#r)&((p&(p@p))&(q&r))) = ((%(p>(p=p))&(s&(p>(p=p))))
>((%q&#r)&((p&(p@p))&(q&r)))) ; FFFF FFFF TTTT TTTT (1.3)

Eqs. 2.1 and 1.3 as rendered are *not* tautologous.

Validation of **Veblen's Axiom** for Euclidean geometry

From en.wikipedia.org/wiki/List_of_first-order_theories# , Veblen's axiom is published as:

if *ab* and *cd* lie on intersecting lines, then so do *ac* and *bd*. (1)
as ∀a∀b∀c∀d∀e∀G∀HaH∧bH∧eH∧cG∧dG∧eG → ∃f∃I∃JaI∧cI∧fI∧bJ∧dJ∧fJ (2)

LET p,q, r,s, t,u,v,w, x,y = a,b,c,d,e,f,G,H,I,J; #, % as universal, existential quantifier; > as Imply.
This maps (2) into Meth8 script of (3):

```
((#p&(#q&(#r&(#s&(#t&(#v&#w))))))&((p&w)&((q&w)&((t&w)&((r&v)&((s&v)&(t&v)))))))
>
((%u&(%x&%y))&((p&x)&((r&x)&((u&x)&((q&y)&((s&y)&(u&y))))))) ; not validated
```
(3)

These 16 rows are repeated 128 times in the truth tables Note that the last truth value is not designated as T or E.

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTC* EEEE EEEE EEEE EEEU* EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEP* EEEE EEEE EEEE EEEI*
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TTTT TTTT TTTT TTTC* EEEE EEEE EEEE EEEU* EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEP* EEEE EEEE EEEE EEEI*
. . . . . . . . . ^  . . . . . . . . . ^                       . . . . . . . . . ^  . . . . . . . . . ^
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
```

Inspection of this schema shows a case which does not hold when the points labeled *ac* and *bd* fall on parallel lines. To accommodate this anomaly, the following code is included on the main antecedent to produce:

"and *ac* plus a constant *z* is not equivalent to *bd*"(3) to mean " (4)

```
(((p&r)+z)@(q&s))
```
(5)

```
(((#p&(#q&(#r&(#s&(#t&(#v&#w))))))&((p&w)&((q&w)&((t&w)&((r&v)&((s&v)&(t&v)))))))
&
(((p&r)+z)@(q&s))) >
((%u&(%x&%y))&((p&x)&((r&x)&((u&x)&((q&y)&((s&y)&(u&y))))))); tautologous
```
(6)

This is an example of correcting a logical expression to its intended meaning from the result as rendered by a Meth8 script.

On difficulties with definitions of the Veronoï region

LET: E a plane, x all points, s a generating point, q another generating point

$\| x - s \| \leq \| x - q \|$: point x is necessarily nearer generating point s than any other possible generating point q. (1)

We rewrite Eq 1 in a single operator with negation as $\sim(\| x - s \| > \| x - q \|)$. (2)

To avoid absolute value arithmetic, we specify that x, s, q are not less than zero:

~((x+(s+q))<((x+(s+q))-(x+(s+q)))) ; (3)

We rewrite Eq 2 with Eq 3:

(~((x-s)>(x-q))&~((x+(s+q))-(x+(s+q)))) ; (4)

The generating points (s, q) are a part of necessarily all points in a plane (E):

((s&q)<(#x<E)). (5)

A Veronoï region for generating point (s) is then the combination of Eq 5 and 4:

((s&q)<(#x<E)) & (~((x-s)>(x-q))&~((x+(s+q))-(x+(s+q)))) ; (6)

In Meth8 model checker, in Eq 6 we redefine (x, E) as (p, r):

((s&q)<(#p<r)) & (~((p-s)>(p-q))&~((p+(s+q))-(p+(s+q)))) ; nvt; contradictory (7)

We simplify Eq 7 by removing the plane r (as E):

((s&q)<#p) & (~((p-s)>(p-q))&~((p+(s+q))<((%p<%#p)))) ; nvt; contradictory (8)

We further simply Eq 8 by removing the expressions to avoid absolute value arithmetic:

((s&q)<#p) & ~((p-s)>(p-q)) ; nvt; contradictory (9)

We turn to another definition from en.wikipedia.org/wiki/Voronoi_diagram:

"Let X be a metric space with distance function d. Let K be a set of indices and let $(P_k)_{k \in K}$ be a tuple (ordered collection) of nonempty subsets (the sites) in the space X. The Voronoi cell, or Voronoi region, R_k, associated with the site P_k is the set of all points in X whose distance to P_k is not greater than their distance to the other sites P_j, where j is any index different from k. In other words, if $d(x, A) = \inf \{ d(x, a) \mid a \in A \}$ denotes the distance between the point x and the subset A, then

$$R_k = \{ x \in X \mid d(x, P_k) \leq d(x, P_j) \text{ for all } j \neq k \} \quad (10)$$

The Voronoi diagram is simply the tuple of cells $(R_k)_{k \in K}$."

We map this into Meth8 assuming a metric space to be all space for this region:

~((x-k)>(x-j)) & ~(#j=#k) (11)

We rewrite Eq 11 by redefining (x, j, k) as (p, q, r):

~((p-r)>(p-q))&~(#q=#r) ; nvt (12)

```
FFNF FFFF FFNF FFFF   UUEU UUUU UUEU UUUU   UUUU UUUU UUUU UUUU   UUIU UUUU UUIU UUUU   UUPU UUUU UUPU UUUU
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
```

What concerns us in Eq 10 is the phrase "of nonempty subsets", and later on "subset A", because that assumes such a thing as an empty set, which we do not validate tautologous.

This leads us to believe that Eq 10 is mistaken, which reminds one again that wikipedia can be a source of misinformation.

Our conclusion is that the Veronoï region is not tautologous.

W in system **K4W** from (1971) Sergerberg, p. 68.

#(#p>p)>#p ; not tautologous

Well ordering property

From plato.stanford.edu/entries/logic-higher-order/

$$\exists x\ Px \rightarrow \exists x(Px\ \&\ \forall y(Py \rightarrow (y = x \text{ v } x < y))) \quad (1)$$

$$\forall P[\exists x\ Px \rightarrow \exists x(Px\ \&\ \forall y(Py \rightarrow (y = x \text{ v } x < y)))] \quad \text{(formalization)} \quad (2.1)$$

```
(#p&(%x&(p&x))) > (#p&(%y&((p&x)&(#y&((p&y)>((y=x)+(x<y))))))) ; nvt  (2.2)
```

```
Model 1              Model 2.1            Model 2.2            Model 2.3.1          Model 2.3.2
TTTT TTTT TTTT TTTT  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE
TCTC TCTC TCTC TCTC  EUEU EUEU EUEU EUEU  EEEE EEEE EEEE EEEE  EPEP EPEP EPEP EPEP  EIEI EIEI EIEI EIEI
```

Wittgenstein's *ab*-notation (and **Quine-McCloskey algorithm**)

Lampert, Timm. "Wittgenstein's *ab*-notation: an iconic proof procedure". *History and Philosophy of Logic.* 2017. dx.doi.org/10.1080/01445340.2017.1312222.

From:
researchgate.net/publication/316898292_Wittgenstein%27s_ab_-Notation_An_Iconic_Proof_Procedure

We use the apparatus of Meth8 modal logic model checker (system Ł4 as resuscitated in variant VŁ4).

The designated proof value is T (tautology); other logic values are: Contingent (contradictory); Non-contingent (tautologous); and F (contradiction). The 2-tuple is respectively { 11, 10, 01, 00 }.

Truth tables are presented in16-values with four row major horizontally.

We evaluate two of Wittgenstein's expressions.

LET: p q r s x y z F; ~ Not; & And;
universal quantifier; % existential quantifier

(~#p&(q&p)) = (%p&(~q&p)) ; TFTN TFTN TFTN TFTN ; (*9.01, pg 16)

Eq *9.01 contains the expression "&p" in both the antecedent and consequent. If that is removed, then the following equation is tested with a different, more negative result.

(~#p&q)=(%p&~q) ; NFFN NFFN NFFN NFFN ; (*9.01.1)

((#r&(%q&(#p&(s&(p&(q&r))))))&(#p&(%q&(s&(p&(q&p)))))) &
((#p&(#q&(s&(p&(p&q)))))&(%p&(s&(p&(p&p))))) ;
FFFF FFFF FFFF FFF*N* ; (7), pg 28

We note that Eq 7 results in a truth which is one logical value off (*N*) from being a proof of contradiction (F).

We surmise that the *ab*-notation of Ludwig Wittgenstein is not bivalent.

In the process of evaluation above, we validated the equations given for the Quine-McCloskey algorithm to minimize reductive disjunctive normal forms (RDNFs) as follows.

LET p q r P Q R; + Or

((p&~q)+(~p&q)) + ((p&r)+(q&r)) ; FTTF FTTT ; (4) pg 14
((p&~q)+(~p&q)) + (p&r) ; FTTF FTTT ; (5)
((p&~q)+(~p&q)) + (q&r) ; FTTF FTTT ; (6)

Yalcin log

Holliday, W.H.; Icard, III, T.F. "Indicative conditionals and dynamic epistemic logic". July 2017. DOI: 10.4204/EPTCS.251.24. From: researchgate.net/publication/318709156

Figure 1. Axioms of the Yalcin logic, page 339:

LET p lc_phi, q lc_psi, r lc_alpha, s lc_beta

(p>r) > (p>#r) ; `TNTN TTTT TNTN TTTT` ; (14)

((p>(r+%s))&(p>~s)) > (p>r) ; `TNTN TTTT TTTT TTTT` ; (16)

Yalcin logic has two axioms not validated as tautology by Meth8.

First Zadeh's logical operators on fuzzy logic

Said Broumi, Said; Majumdar, Pinaki; Smarandache, Florentin. 2014. "New operations on intuitionistic fuzzy soft sets based on First Zadeh's logical operators". doi: 10.5281/zenodo.30235.

From: researchgate.net/publication/281103677_New_Operations_on_Intuitionistic_
Fuzzy_Soft_Sets_Based_on_First_Zadeh%27s_Logical_Operators

We assume the Meth8 apparatus of VŁ4 (variant of our resuscitated Łukasiewicz modal B_4). Table fragments of 16-values are from the full proof of 128-valued truth tables. The designated proof value is T.

LET: p q r s t u v A B C F G H; ~ Not; & And; \ Nand; + Or; - Nor;
= Equivalent to; @ Not Equivalent to; > Imply; < Not Imply;
~(A>B) A<=B; T tautology; F contradiction

pg 279. Def. 2.7:

(r=(p+q))>(((s&p)+(t&q))=(u&r)) ; TTTT TTFF TTTT TFFF

pg. 281. Prop. 3.2.2:

(r=(p&q))>(((s&p)\(t&q))=(u&r)) ; FFFT TTTF FFFT TTTF

pg 282. Prop. 3.2.3:

((s&p)\(t&q))>~((u&r)<(((s&p)>(t&q))\((t&q)>(u&r)))) ; TTTT FFFF TTTT FTFT

pg 283. Ex. 3.3.2:

(r=(p&q))>(((s&p)-(t&q))=(u&r)) ; FFFT TTTT FTFT TTTF

pg 284. Prop. 3.3.4:

((s&p)-(t&q))>~((u&r)<(((s&p)>(t&q))-((t&q)>(u&r)))) ; TTTT FFTT TTTT FTTT

Evaluation:

Because Meth8 does not validate the above definition, example, and propositions as tautology, we deem Zadeh fuzzy logic as not bivalent, a probabilistic vector space, and hence suspicious.

Axiom of empty set (null set)

From plato.stanford.edu/entries/set-theory/ZF.html:

∃*x*¬∃*y*(*y*∈*x*) [1.1]

LET: p x; q y; (p<q) *y*∈*x;* ~ ¬; % some, possibly, ∃

(%p&~%q)&(q<p) ; `FFFF FFFF FFFF FFFF` (1.2)

If Eq. 1.1 is construed to mean "There is a set such that there is not the existence of a set and an element with that element as a member of that set.", then Eq. 1.1 can be rewritten as:

%p>~((%q&%p)&(q<p)) ; `TTNT TTNT TTNT TTNT` (1.3)

Eq. 1.1 as rendered in either Eq 1.2 or Eq. 1.3 is *not* tautologous.

See also below where Eq. 1.1 is written using the universal quantifier with the negation placed as:

∃x ∀y ¬ (y ∈x) or in words "There is a set such that no element is a member of it."

Axiom of extensionality

$$\forall A\ \forall B\ (\ \forall X\ (\ X \in A \leftrightarrow X \in B\ ) \Rightarrow \forall Y\ (\ A \in Y \leftrightarrow B \in Y\ )\ ) \qquad (2.1)$$

Untyped logic with ur-elements:

$$\forall A\ \forall B\ (\ \exists X\ (\ X \in A\ ) \Rightarrow [\ \forall Y\ (\ Y \in A \leftrightarrow Y \in B\ ) \Rightarrow A = B\ ]\ ) \qquad (3.1)$$

LET: p q r A B X Y; ↔, =: = ; ⇒: > ; ∈: < ; ∀: # ; ∃: %.

((#p&#q)&(#r&((r<p)=(r<q)))) > ((#p&#q)&(#s&((p<s)=(q<s)))) ;
TTTT TTTC TTTT TTTT (2.2)

Untyped logic with ur-elements:

((#p&#q)&(%r&(r<p)))>((#p&#q)&((#q&((s<p)=(s<q)))>(p=q))) ;
TTTT TTTT TTTT TTTT (3.2)

The **axiom of specification** (Axiom 3 in ZFC) is supposed to imply the existence of the axiom of the empty set, which becomes important for ZFC as a prophylactic to Russell's Paradox and naive set theory, among other things.

Axiom 3 is: `((#A&#B)&((%D&(A&D))&(#C&((C&B)>(C&A))))) > (((#A&#B)&%D)&(B&D));`

where `#` is necessity, `%` is possibility, `&` is And, > is imply, theorems `A`,`B`,`C`,`D`.

The logic model checker named Meth8* validates Axiom 3 in five models as tautologous.

```
(%A&#B)&~(A&B)
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
FFFF FFFF FFFF FFFF   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU
```

For Axiom 3 to imply the axiom of the empty set, this expression should be tautologous, but it contradictory:

```
(((#A&#B)&((%D&(A&D))&(#C&((C&B)>(C&A)))))>(((#A&#B)&
%D)&(B&D)))>((%A&#B)&~(A&B))
Model 1               Model 2.1             Model 2.2             Model 2.3.1           Model 2.3.2
FFFF FFFF FFFF FFFF   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU   UUUU UUUU UUUU UUUU
```

Therefore the validated Axiom 3 does not imply the invalidated axiom of the empty set. If the axiom of the empty set is not tautologous, and subsequently Axiom 3 can not imply it, then ZFC fails.

As additional information, the axiom of extensionality (Axiom 1 of ZFC) is also not validated:

```
(((#s&#p)&#q)&((s&p)=(s&q)))>(((#p&#r)&#q)&((p&r)=(q&r)))
Model 1;              Model 2.1;            Model 2.2;            Model 2.3.1;          Model 2.3.2
TTTT TTTT TTTC TTTT; EEEE EEEE EEEU EEEE; EEEE EEEE EEEE EEEE; EEEE EEEE EEEP EEEE; EEEE EEEE EEEI EEEE
```

Here is the truth table in theorems for 7-rows out of the 16-rows, in order as rows: 5,7, 15; ; 9,10, 11; and 13:

```
(((#D&#A)&#B)&((D&A)=(D&B)))>(((#A&#C)&#B)&((A&C)=(B&C)))
Model 1;              Model 2.1;            Model 2.2;            Model 2.3.1;          Model 2.3.2
TTTT TTTT TTTT TTTT; EEEE EPEP EEEE EPEP; EEEE EEEE EEEE EEEE; EEEE EPEP EEEE EPEP; EEEE EEEE EEEE EEEE
TTTT TTTT TTCC TTCC  EEEE EEEE EEII EEII  EEEE EEEE EEEE EEEE  EEEE EEEE EEEE EEEE  EEEE EEEE EEII EEII
TTTT TTTT TTCC TTCC  EEEE EPEP EEII EPIU  EEEE EEEE EEEE EEEE  EEEE EPEP EEEE EPEP  EEEE EEEE EEII EEII
```

*Meth8 is based on a logic system named VŁ4, after the four valued logic Ł4 of Łukasiewicz, where validation requires Tautologous for five models, with the designated truth values as Tautologous and Evaluated as in Axiom 3 above.

Further results for other Axioms follow.

Axiom 1 extensionability: (((#s&#p)&#q) & ((s&p)=(s&q))) > (((#p&#r)&#q) & ((p&r)=(q&r))) ; nvt.
However we found another definition which could be rigged for a better result at:

math.uni-bonn.de/people/koepke/Preprints/Computing_a_model_of_set_theory.pdf

$\forall a, b(\forall \alpha(\alpha \in a \leftrightarrow \alpha \in b) \rightarrow a = b)$; LET: p q r α a b ;
(#(p&r)&(#p&((p<q)=(p<r)))) > (#(p&r)&(q=r)) ; distributing #(p&r) ; `TTTT TTTT TTTT TTTT`
#(p&r)&((#p&((p<q)=(p<r)))>(q=r)) ; `FFFF FNFN FFFF FNFN`

Axiom 2 regularity, foundation: (#p&(%s&(s&p))) > (#p&(%q&((q&p)&(~%r&((r&q)&(r&p)))))); nvt

Axiom 3 schema of specification, schema of separation or of restricted comprehension: vt

Axiom 3.1 NBG "a subclass of a set is a set":
((#A&#B)&((%D&(A&D))&(#C&((C&B)>(C&A))))) > ((#A&#B)&(%D&(B&D))) ; vt

Axiom 3.2 empty set from: en.wikipedia.org/wiki/Axiom_of_empty_set

∃x ∀y ¬ (y ∈x) or in words "There is a set such that no element is a member of it."

We rewrite in words as:

"If not the state of all elements as members of a possible set, then that set possibly exists."

~(#q<%p)>%p ; CTTT CTTT CTTT CTTT

Axiom 4 pairing: ((#p&#q)&%r) & ((p&r)&(q&r)) ; nvt

Axiom 5 union: ((#q&%p)&#r)&(#s&(((s&r)&(r&q))>(s&p))) ; nvt

Axiom 6 schema of replacement: undefined; assumes Axiom 3.2 empty set is tautologous.

Axiom 7 infinity (existence of a limit ordinal):

However we found another definition at:

math.uni-bonn.de/people/koepke/Preprints/Computing_a_model_of_set_theory.pdf

∃α(∃β(β < α) ∧ ∀β(β < α → ∃γ(β < γ ∧γ < α))); LET: p q r s   α a β γ ;
(%p&(%r&(r<p)))&(%p&((#r&(r<p))>(#r&(%s&((r<s)&(r<p)))))) ; distributing %p, then internally #r;   FFFF CFCF FFFF CFCF
%p&((%r&(r<p))&(#r&((r<p)>(%s&((r<s)&(r<p))))));   FFFF FFFF FFFF FFFF

From: Banks, A. "A new axiom for ZFC set theory that results in a problem".
vixra.org/abs/1709.0391

"Axiom of Infinity (INF).
∈x(0 ∈ x ∧ ∀y ∈ x(S(y)∈ x))."   (2.1)

LET: p x; 0 (p@p); q y; r S; < ∈; % ∈; & ∧.

%p&(((p@p)<p)&((#q<p)&((r&q)<p))) ; FFFF FFFF FFFF FFFF   (2.2)

Because %p is the existential quantifier, distributing that over the other terms in Eq. 2.2 produces the same result.

Eq. 2.2 as rendered is a contradiction, hence Eq. 2.1 as INF is suspicious.

Axiom 8 power set: ((#p&%q)&#r)&((r&q)=(#s&((s&r)>(s&p)))) ; nvt.

However we found another definition where we could rig a tautologous result at:

math.uni-bonn.de/people/koepke/Preprints/Computing_a_model_of_set_theory.pdf

$\forall a \exists b (\forall z (\exists \alpha (\alpha \in z) \land \forall \alpha (\alpha \in z \to \alpha \in a) \to \exists{=}1 \xi \forall \beta (\beta \in z \leftrightarrow g(\beta, \xi) \in b)))$.
LET: p q r s t u v   *α a β b ξ g z*

((#q&%s)&(#v&((%p&(p<v))&(#p&((p<v)>(p<q)))))) >
((#q&s)&((%t&#r)&((r<v)=((u&(r&t))<s)))) ; distributing (#q&%s) ;   TTTT TTTT TTTT TTTT
(#q&%s)&((#v&(%p&(p<v)))&(#p&((p<v)>(p<q)))>(%t&#r)&((r<v)=((u&(r&u))<s)) ;
FFFF FFFF FFFF FFFN

Axiom 9 well ordering: undefined due to non measurable set per Banach-Tarski and assumes Axiom 3.2 empty; vt tautologous with canonical rank zero.

However we found another definition at:

math.uni-bonn.de/people/koepke/Preprints/Computing_a_model_of_set_theory.pdf

$\forall \alpha, \beta, \gamma (\neg \alpha < \alpha \land (\alpha<\beta \land \beta<\gamma \to \alpha<\gamma) \land (\alpha<\beta \lor \alpha=\beta \lor \beta<\alpha)) \land \forall a (\exists \alpha (\alpha \in a) \to \exists \alpha (\alpha \in a \land \forall \beta (\beta<\alpha \to \neg \beta \in a)))$;
LET: p q r s   *α a β γ* ;
#((p&r)&s)>((((~p<p)&(((p<r)&(r<s))>(p<s)))&(((p<r)&(p=r))&(r<p)))&((#q&(%p&(p<q)))>(%p&((p<q)&(#r&((r<p)>(~r<q))))))) ;   TTTT TTTT TTTT TCTC;

Axiom 10 choice: undefined due to Axiom 9 well ordering undefined; hence nvt.

ZF Law of Excluded Middle on Infinite sets (LEMI)

From: Banks, A. "A new axiom for ZFC set theory that results in a problem". vixra.org/abs/1709.0391

Law of excluded middle on infinite sets (LEMI):
"∃n¬P(n)∨ ∀nP(n)" (1.1)

LET: q n; p P; % ∃; # ∀; ~ ¬; + ∨.

(%q&~(p&q)) + (#q&(p&q)) ; `CCTN CCTN CCTN CCTN` (1.2)

Because

~(p&q)=(p\q) ; `TTTT TTTT TTTT TTTT` (1.3)

we rewrite Eq. 1.2 by distributing the quantified operators as:

((%q&p)\(%q&q)) + ((#q&p)&(#q&q)) ; `TTTN TTTN TTTN TTTN` (1.4)

Eqs. 1.2 and 1.4 as rendered are *not* tautologous. Hence Meth8/VL4 finds LEMI suspicious.

Meth8\VŁ4 on zero and one in fractions

LET: ~ Not; & And; \ Not And; + Or; - Not Or; = Equivalent; > Imply;
(r-r) zero value; (r\r) one value; ~(r-r) non-zero value.

The designated proof value is T for tautology; F as contradiction. Proof tables of 16-values are row major, horizontally

((p=(r-r))&(q=(r\r)))>((r\ r)= q) ; TTTT TTTT TTTT TTTT ; 1\1=1 (1.1)
((p=(r-r))&(q=(r\r)))>((q\ p)=~(p& q)) ; TTTT TTTT TTTT TTTT ; 1\0=~(0&1); undefined (1.2)
((p=(r-r))&(q=(r\r)))>((p\ q)=~(p& q)) ; TTTT TTTT TTTT TTTT ; 0\1=~(0&1); undefined (1.3)
((p=(r-r))&(q=(r\r)))>((p\ p)=~ p) ; TTTT TTTT TTTT TTTT ; 0\0=~(0); undefined (1.4)

The test of 0\0 = 1 is:

((p=(r-r))&(q=(r\r)))>((p\p)= q) ; TTTF FTTT TTTF FTTT ; 0\0=~(1) ; not tautologous (1.4.1)

A recent advance is that Meth8/VŁ4 finds 0\1 to be undefined, instead of 0.

What follows is that zero is *not* a natural number as commonly used.

We generalize Eqs. 1.1-1.4 from 0 and 1 onto 0 and n.

((#(p=(r-r))&(q=(r\r)))&#(s=~(r-r)))>((s\ s)= q) ; TTTT TTTT TTTT TTTT ; n\n=1 (2.1)
((#(p=(r-r))&(q=(r\r)))&#(s=~(r-r)))>((s\ p)=~(p& s)) ; TTTT TTTT TTTT TTTT ; n\0=~(0&n) (2.2)
((#(p=(r-r))&(q=(r\r)))&#(s=~(r-r)))>((p\ s)=~(p& s)) ; TTTT TTTT TTTT TTTT ; 0\n=~(0&n) (2.3)
((#(p=(r-r))&(q=(r\r)))&#(s=~(r-r)))>((p\~s)=~ p) ; TTTT TTTT TTTT TTTT ; 0\0=~(0) (2.4)

Generalized Eqs. 2.1-2.4 match the results of Eqs. 1.1-1.4, confirming consistency.

Definition of the zero knowledge proof refuted

From: en.wikipedia.org/wiki/Zero-knowledge_proof

"A formal definition of zero-knowledge has to use some computational model, the most common one being that of a Turing machine. Let P, V, and S be Turing machines. An interactive proof system with (P,V) for a language L is zero-knowledge if for any probabilistic polynomial time (PPT) verifier V-hat there exists an expected PPT simulator S such that

$$\forall x \in L, z \in \{0,1\}^*, \mathrm{View}_{V\text{-hat}}\,[P(x) \leftrightarrow V\text{-hat}(x,z)] = S(x,z)." \quad (1.1)$$

We assume the apparatus of the Meth8 modal logic model checker implementing variant system VŁ4. Meth8 allows to mix four logical values with four analytical values. The designated *proo*f value is T.

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

LET: ~ Not; + Or; & And; \ Not and; > Imply; < ∈Not imply; = ↔ Equivalent to;
@ Not equivalent to; # all; % some; (p@p) 00, zero; (p=p) 11, one;
p q s u v x z P L S View V-hat x z

Results are the repeating proof table(s) of 16-values in row major horizontally.

We render Eq. 1.10 as:

(((#x<q)&(z<((p@p)+(p=p))))&((u&v)&((p&x)=(v&(x&z))))) = (s&(x&z)) ;
TTTT TTTT TTTT TTTT, TTTT TTTT FFFF FFFF (1.2)

Eq. 1.2 means the formal definition of the zero-knowledge proof as rendered is *not* tautologous.

What follows is the assumption that in **NP** all problems and all languages have zero-knowledge proofs is mistaken. What also follows is that one-way functions do not exist.

Appendix: Rationale of rendering quantifiers as modal operators

Definition	Axiom	Symbol	Name	Meaning	2-tuple	Ordinal
1	p=p	T	Tautology	proof	11	3
2	p@p	F	Contradiction	absurdum	00	0
3	%p>#p	N	Non-contingency	truth	01	1
4	%p<#p	C	Contingency	falsity	10	2

Numbered definitions of axioms with symbol, name, meaning, 2-tuple, and ordinal values. The designated proof value is T tautology. Note the meaning of (%p>#p): a possibility of p implies the necessity of p; and some p implies all p. In other words, if a possibility of p then the necessity of p; and if some p then all p. *Note*: "nvt" is not validated Tautologous

The rationale for rendering quantifiers as modal operators in Meth8 has arguments from satisfiability (contra Kuhn) and reproducability of invalidating and validating syllogisms.

1. Satisfiability

From Steven T Kuhn (1979), "Quantifiers as modal operators", Studia Logica 39, 2-3/80, page 147:

> "Either [with Montague's approach as first order models or with Prior's approach as "sequences of individuals"], there is a problem. The atomic formulas of predicate logic cannot all be treated as atoms in the modal language. If we regard *Pxy* and *Pyx*, for example, as distinct sentence letters of the modal language then $\exists x\ \exists y\ Pxy\ \&\ -\exists \mathbf{x}\ \exists \mathbf{y}\ Pyx$ will be satisfiable. If we regard them as identical sentence letters then $\exists x\ \exists y\ (Pxy\ \&\ -Pyx)$ will be unsatisfiable."

If Pxy and Pyx are distinct sentence letters of the modal language, then this is "satisfiable" as:

((%x&%y)&(p&(x&y))) & ~((%x&%y)&(p&(y&x))) ; nvt; and contradictory; (1.1)

If Pxy and Pyx are identical sentence letters of the modal language, then this is "unsatisfiable" as:

(%x&%y)&(((p&(y&x))&~ ((p&(x&y))); nvt; and contradictory; (1.2)

We ask if Eq 1.1 and Eq1.2 are equivalent as:

(((%x&%y)&(p&(x&y))) & ~((%x&%y)&(p&(y&x)))) =
((%x&%y)&((p&(y&x))&~(p&(x&y)))) ; vt; (1.3)

This means rendition of the quantifiers to modal operators in Meth8 is satisfiable, and hence correct.

What follows is that there is no reason to rely on "the variable-free formulations of logic by Tarski, Bernays, Halmos, Nolin and Quine ... [for] the effect of arbitrary permutations and identifications of the variables occurring in a formula."

2. Reproducability of 24 syllogisms deemed valid in predicate logic

The Square of Opposition (original) produced four combinations for each corner A, I, E, O for 4 ^ 4 = 256 syllogisms. Medieval scholars determined 24 of the 256 syllogisms were valid deductions. Of those, 9 were made valid but only after additional *known* assumptions were applied as fix ups. Meth8 Tautologous none of the 24 syllogisms *before* fix ups. Meth8 also *discovered* correct additional assumptions to render the other 15 syllogisms Tautologous. The fix ups in bold were verified independently by Prover9 (2007). The syllogisms fall into six groups of truth table values *before* fix ups and sorted nearest to the state of Tautologous in Table 2.1.

LET: p x, q F, r G, s H, ~ Not, # Necessity (all), % Possibility (exists), & And, > Imply,
vt Tautologous, nvt Not Tautologous   * known fixes (9 of 24 syllogisms)

The expressions for the syllogisms below are derived using functions FGH as qrs for instances of the variable x as p and with the > Imply connective between functions.

<u>Syllogism number</u>   <u>Fix up code in bold</u>

```
 II AEE (((#p&((q&p)>( s&p)))&(#p&((r&p)>(~s&p))))&(%p&(r&p)))>(#p&((r&p)&(~q&p)))
 II AEO*(((#p&((q&p)>( s&p)))&(#p&((r&p)>(~s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
 II AOO (((#p&((q&p)>( s&p)))&(%p&((r&p)>(~s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
 IV AEE (((#p&((q&p)>( s&p)))&(#p&((s&p)>(~r&p))))&(%p&(r&p)))>(#p&((r&p)&(~q&p)))
 IV AEO*(((#p&((q&p)>( s&p)))&(#p&((s&p)>(~r&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
  TCTTTTTTTCTCTTTT.EUEEEEEEEUEUEEEE.EEEEEEEEEEEEEEEE.EPEEEEEEEPEPEEEE.EIEEEEEEEIEIEEEE
  Model 1.        Model 2.1        Model 2.2        Model 2.3.1      Model 2.3.2

 IV AAI*(((#p&((q&p)>( s&p)))&(#p&((s&p)>( r&p))))&(%p&(q&p)))>(%p&((r&p)&( q&p)))
 IV IAI (((%p&((q&p)>( s&p)))&(#p&((s&p)>( r&p))))&(%p&(q&p)))>(%p&((r&p)&( q&p)))
  TCTTTCTTTTTTTCTT.EUEEEUEEEEEEEUEE.EEEEEEEEEEEEEEEE.EPEEEPEEEEEEEPEE.EIEEEIEEEEEEEIEE

  I AAA (((#p&((s&p)>( q&p)))&(#p&((r&p)>( s&p))))&(%p&(r&p)))>(#p&((r&p)&( q&p)))
  I AAI*(((#p&((s&p)>( q&p)))&(#p&((r&p)>( s&p))))&(%p&(r&p)))>(%p&((r&p)&( q&p)))
  I AII (((#p&((s&p)>( q&p)))&(%p&((r&p)>( s&p))))&(%p&(r&p)))>(%p&((r&p)&( q&p)))
  TCTCTTTTTTTCTTTT.EUEUEEEEEEEUEEEE.EEEEEEEEEEEEEEEE.EPEPEEEEEEEPEEEE.EIEIEEEEEEEIEEEE

  I EAE (((#p&((s&p)>(~q&p)))&(#p&((r&p)>( s&p))))&(%p&(r&p)))>(#p&((r&p)&(~q&p)))
  I EAO*(((#p&((s&p)>(~q&p)))&(#p&((r&p)>( s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
  I EIO (((#p&((s&p)>(~q&p)))&(%p&((r&p)>( s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
 II EAE (((#p&((q&p)>(~s&p)))&(#p&((r&p)>( s&p))))&(%p&(r&p)))>(#p&((r&p)&(~q&p)))
 II EAO*(((#p&((q&p)>(~s&p)))&(#p&((r&p)>( s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
 II EIO (((#p&((q&p)>(~s&p)))&(%p&((r&p)>( s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
  TCTCTTTTTCTTTTTT.EUEUEEEEEUEEEEEE.EEEEEEEEEEEEEEEE.EPEPEEEEEPEEEEEE.EIEIEEEEEIEEEEEE

III EAO*(((#p&((s&p)>(~q&p)))&(#p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&(~q&p)))
III EIO (((#p&((s&p)>(~q&p)))&(%p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&(~q&p)))
III OAO (((%p&((s&p)>(~q&p)))&(#p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&(~q&p)))
 IV EAO*(((#p&((q&p)>(~s&p)))&(#p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&(~q&p)))
 IV EIO (((#p&((q&p)>(~s&p)))&(%p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&(~q&p)))
  TCTCTTTCTTTTTTTT.EUEUEEEUEEEEEEEE.EEEEEEEEEEEEEEEE.EPEPEEEPEEEEEEEE.EIEIEEEIEEEEEEEE

III AAI*(((#p&((s&p)>( q&p)))&(#p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&( q&p)))
III AII (((#p&((s&p)>( q&p)))&(%p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&( q&p)))
III IAI (((%p&((s&p)>( q&p)))&(#p&((s&p)>( r&p))))&(%p&(s&p)))>(%p&((r&p)&( q&p)))
  TCTCTCTTTTTTTTTT.EUEUEUEEEEEEEEEE.EEEEEEEEEEEEEEEE.EPEPEPEEEEEEEEEE.EIEIEIEEEEEEEEEE
  Model 1.        Model 2.1        Model 2.2        Model 2.3.1      Model 2.3.2
```

Table 2.1. 24 syllogisms as based on the Square of Opposition, in Meth8 script

Because the 24 syllogisms contain one variable p, they may be reduced in size by removing redundant occurrences of p from Table 2.1. For example the stepped process to do this is presented for II. AAO, of the 15 valid syllogisms and with an additional assumption.

```
 II AOO  (((#p&((q&p)>( s&p)))&(%p&((r&p)>(~s&p))))&(%p&(r&p)))>(%p&((r&p)&(~q&p)))
 Steps    ((#p&((q&p)>( s&p)))&(%p&((r&p)>(~s&p))))            >(%p&((r&p)&(~q&p)))
    1:    ((#p&( q   >  s   ))&(%p&( r   > ~s   )))            >(%p&( r   & ~q   ))
    2:    ((p&#( q   >  s   ))&(p&%( r   > ~s   )))            >(p&%( r   & ~q   ))
    3:   (((p&#( q   >  s   ))&(p&%( r   > ~s   )))&(%p&(r&p)))>(p&%( r   & ~q   ))
    4:   (((p&#( q   >  s   ))&(p&%( r   > ~s   )))&(p&% r   ))>(p&%( r   & ~q   ))
    5:   (((p&#( q   >  s   ))&(p&%( r   > ~s   )))&(p&% r   ))>(p&%( r   & ~q   ))
    6:   ((p&(#( q   >  s   ) &   %( r   > ~s   )))&   % r    )>(p&%( r   & ~q   ))
```

The reduced expression in Step 6 as ((p&(#(q>s)&%(r>~s)))&%r)>(p&%(r&~q)) represents a 50% reduction in the number of characters from the original expression in the Meth8 script. Table 2.1 is entirely rewritten in this way as Table 2.2.

Syllogism number — Fix up code bold

```
 II AEE  ((p&(#( q   >  s   ) &   #( r   > ~s   )))&   % r    )>(p&#( r   & ~q   ))
 II AEO* ((p&(#( q   >  s   ) &   #( r   > ~s   )))&   % r    )>(p&%( r   & ~q   ))
 II AOO  ((p&(#( q   >  s   ) &   %( r   > ~s   )))&   % r    )>(p&%( r   & ~q   ))
 IV AEE  ((p&(#( q   >  s   ) &   #( s   > ~r   )))&   % r    )>(p&#( r   & ~q   ))
 IV AEO* ((p&(#( q   >  s   ) &   #( s   > ~r   )))&   % r    )>(p&%( r   & ~q   ))

 IV AAI* ((p&(#( q   >  s   ) &   #( s   >  r   )))&   % r    )>(p&%( r   &  q   ))
 IV IAI  ((p&(%( q   >  s   ) &   #( s   >  r   )))&   % r    )>(p&%( r   &  q   ))

  I AAA  ((p&(#( s   >  q   ) &   #( r   >  s   )))&   % r    )>(p&#( r   &  q   ))
  I AAI* ((p&(#( s   >  q   ) &   #( r   >  s   )))&   % r    )>(p&%( r   &  q   ))
  I AII  ((p&(#( s   >  q   ) &   %( r   >  s   )))&   % r    )>(p&%( r   &  q   ))

  I EAE  ((p&(#( s   > ~q   ) &   #( r   >  s   )))&   % r    )>(p&#( r   & ~q   ))
  I EAO* ((p&(#( s   > ~q   ) &   #( r   >  s   )))&   % r    )>(p&%( r   & ~q   ))
  I EIO  ((p&(#( s   > ~q   ) &   %( r   >  s   )))&   % r    )>(p&%( r   & ~q   ))
 II EAE  ((p&(#( q   > ~s   ) &   #( r   >  s   )))&   % r    )>(p&#( r   & ~q   ))
 II EAO* ((p&(#( q   > ~s   ) &   #( r   >  s   )))&   % r    )>(p&%( r   & ~q   ))
 II EIO  ((p&(#( q   > ~s   ) &   %( r   >  s   )))&   % r    )>(p&%( r   & ~q   ))

III EAO* ((p&(#( s   > ~q   ) &   #( s   >  r   )))&   % r    )>(p&%( r   & ~q   ))
III EIO  ((p&(#( s   > ~q   ) &   %( s   >  r   )))&   % r    )>(p&%( r   & ~q   ))
III OAO  ((p&(%( s   > ~q   ) &   #( s   >  r   )))&   % r    )>(p&%( r   & ~q   ))
 IV EAO* ((p&(#( q   > ~s   ) &   #( s   >  r   )))&   % r    )>(p&%( r   & ~q   ))
 IV EIO  ((p&(#( q   > ~s   ) &   %( s   >  r   )))&   % r    )>(p&%( r   & ~q   ))

III AAI* ((p&(#( s   >  q   ) &   #( s   >  r   )))&   % r    )>(p&%( r   &  q   ))
III AII  ((p&(#( s   >  q   ) &   %( s   >  r   )))&   % r    )>(p&%( r   &  q   ))
III IAI  ((p&(%( s   >  q   ) &   #( s   >  r   )))&   % r    )>(p&%( r   &  q   ))
```

Table 2.2 24 syllogisms as based on the Square of Opposition, in minimal Meth8 format

Meth8 demonstrates correct replication of results from the syllogisms in this limited fragment on predicate logic. Meth8 is fully capable of fixing syllogisms deemed valid by predicate logic, and in a minimal format.

3. Pattern steps

Patterns were discovered in fix ups for syllogisms from the original Square of Opposition in the Figure for AEIO for the 24 syllogisms accepted as valid. The Meth8 truth tables of the 24 syllogisms are sorted in Table 2.2 and collated here by Groups.

LET: a *n*, c *n* for antecedent, consequent
in assumption $n = 1, 2$, additional assumption $n = 3$, conclusion $n = 4$

Group	Figure	AEIO combo	Assumption 1	Assumption 2	Additional 3	Conclusion 4
1	II	AEE = AEO* = AOO	q > s	r > ~s	r	r & ~q
1	IV	AEE = AEO*	q > s	s > ~r	r	r & ~q
2	IV	AAI* = IAI	q > s	s > r	q	r & q
3	I	AAAA = AAI* = AII	s > q	r > s	r	r & q
4	I	EAE = EAO* = EIO	s > ~q	r > s	r	r & ~q
4	II	EAE = EAO* = EIO	q > ~s	r > s	r	r & ~q
5	III	EAO* = EIO = OAO	s > ~q	s > r	s	r & ~q
5	IV	EAO* = EIO	q > ~s	s > r	s	r & ~q
6	III	AAI* = AII = IAI	s > q	s > r	s	r & q

Table 3. Patterns of assumptions and conclusions

The format of the syllogisms is with placeholders:

$$(a1 > c1) \ \& \ (a2 > c2) \ [\& \ a3] = (a4 \ \& \ c4). \qquad (3.1)$$

Because of the main & connective in Eq 3.1 the main literal groups may be reversed. In that case the placeholders remain in the same named order as above, that is, with the antecedent group (a1 > c1).

These rules in pseudo code produce the a3 results for the column Additional 3 above:

```
Step 1:     LET a2 = [assigned]
Step 2:     IF a2 = (a4 OR c4)  THEN
                LET a3 = a2 ! (Group 1, Figure II; Group 3, Figure 1; Group 4, Figures I, II)
Step 3:     ELSE IF a2 = a1 THEN
                LET a3 = a1 ! (Group 2, Figure IV; Group 3, Figure IV)
Step 4:     ELSE IF a2 = c1 THEN
Step 5:         IF c2 = Negated_function THEN
                    LET a3 = Non_negated_function ( c2)  ! (Group 1, Figure IV)
Step 6:         ELSE
                    LET a3 = a1 ! (Group 5, Figure III; Group 6, Figure III)
                END IF
            END IF
```

4. Test of two syllogisms in Meth8

We next test two expressions formatted as syllogisms, manufactured from I and O as IOE and OIA. We use the same technique for the 9 syllogisms above to supply an additional assumption as a fix up.

Example 4.1: IOE

LET	Assumption 1:	I	p&%(s>q)
	Assumption 2:	O	p&%(r>~s)
	Assumption 3:		[*To be determined below.*]
	Conclusion 4:	E	p&#(r&q)

((1) & (2))>(3): (p&(%(s>q)&%(r>~s)))>(p&#(r&~q)) ; nvt (4.1.1)

We build the additional assumption by the rules.

Step 1: a2 = r
Step 2: a3 = r
Assumption 3:p&%r

For: ((p&(%(s>q)&%(r>~s)))&%r)>(p&#(r&~q)) ; nvt (4.1.2)

We test Eq 4.1.2 independently in Prover9 (2007).

Assumption 1:	exists x (H(x) -> F(x)).	
Assumption 2:	exists x (G(x) -> -H(x)).	
Assumption 3:	exists x (G(x)).	
Conclusion 4:	all x (G(x) & -F(x)).	(4.1.3)
Result:	contradictory	

In Example 4.1 Meth8 and Prover9 produce the result of not Tautologous.

Example 4.2: OIA

LET	Assumption 1:	O	p&%(s>~q)
	Assumption 2:	I	p&%(r>s)
	Assumption 3:		[*To be determined below.*]
	Conclusion 4:	A	p&#(q&r)

((1) & (2))>(3): (p&(%(s>~q)&%(r>s)))>(p&#(q&r)) ; nvt (4.2.1)

We build the additional assumption by the rules.

Step 1: a2 = r
Step 2: a3 = r
Assumption 3:p&%r

For: ((p&(%(s>~q)&%(r>s)))&%r)>(p&#(q&r)) ; nvt (4.2.2)

We test Eq 4.2.1 independently in Prover9 (2007).

Assumption 1: exists x (H(x) -> -F(x)).
Assumption 2: exists x (G(x) -> H(x)).
Assumption 3: exists x (G(x)).
Conclusion 4: all x (F(x) & G(x)). (4.2.3)
Result: contradictory

In Example 4.2 Meth8 and Prover9 produce the result of not Tautologous.

5. Tests of syllogistic fallacies

See links from: en.wikipedia.org/wiki/Syllogism

5.1 Undistributed middle

Neither of the premises accounts for all members of the middle term, which consequently fails to link the major and minor term: All C is B. A is B. Therefore, C is A.

LET: q r s, A B C; "is" > Imply, or "is" & And

((#s>r)&(q>r))>(s>q) ; nvt (5.1.1)
((#s&r)&(q&r))>(s&q) ; vt (5.1.2)

Eq 5.1.2 means that the & And connective as the verb "is" does not represent the tautologous state of affairs.

Eq 5.1.1 correctly renders the > Imply connective as the verb "is" because Eq 5.1.1 returns the correct result of a fallacy as not Tautologous.

5.2 Illicit treatment of the major term

From: en.wikipedia.org/wiki/Illicit_major

"Illicit major" is a categorical syllogism that is invalid because its major term is undistributed in the major premise but distributed in the conclusion.

This fallacy has the following argument form: All A are B. No C are A. Therefore, no C are B. In words: All horses have hooves. No humans are horses. Therefore, no humans have hooves.

LET: q r s, A B C, horses hooves humans; "are" & And, or "are" > Imply

((#q>r)&(~s>q))>(~s>r) ; nvt (5.2.1)
((#q&r)&(~s&q))>(~s&r) ; vt (5.2.2)

This means the verb "are" is correctly rendered by the connective > Imply for the correct result of Eq 5.2.1, namely, that the expression is a fallacy as not Tautologous.

Modus Camestros is stated to be a valid syllogism, and not a fallacy, as: All A are B. No C are B. Therefore, no C are A. In words: All horses have hooves. No humans have hooves. Therefore, no humans are horses.

((q>r)&(~s>r))>(~s>q) ; nvt (5.2.3)
((q&r)&(~s&r))>(~s&q) ; vt (5.2.4)

However, by the same measure for the assignment of the verb "are" to the connective > Imply, modus Camestros returns a mistaken result in Eq 5.2.3, namely, that the expression is not a valid syllogism as not Tautologous. This means that modus Camestros is arguably a fallacy itself.

This leads us to the conclusion that in Meth8 script the correct mapping of the verb "to be" in syllogisms is the connective > Imply, and not the connective & And as mistakenly used.

5.3 Illicit treatment of the minor term

From: en.wikipedia.org/wiki/Illicit_minor

"Illicit minor" is committed in a categorical syllogism that is invalid because its minor term is undistributed in the minor premise but distributed in the conclusion.

For example: Donuts are good. Donuts are unhealthy. Thus, all good is unhealthy.

All A are B. All A are C. Therefore, all C are B.

LET: q r s, A B C

((#q>r)&(#q>s))>(#s>r) ; nvt (5.3.1)

5.4 Exclusive premises

From: en.wikipedia.org/wiki/Fallacy_of_exclusive_premises

Both premises are negative, meaning no link is established between the major and minor terms:

E: No cats are dogs.
O: Some dogs are not pets.
O: Therefore, some pets are not cats.

E: No planets are dogs.
O: Some dogs are not pets.
O: Therefore, some pets are not planets.

LET: q cats / planets, r dogs, s pets

((~q>r)&(%r>~s))>(%s>~q) ; nvt (5.4.1)

5.5 Negative conclusion from affirmative premises

If both premises are affirmative, the conclusion must also be affirmative. A negative conclusion from affirmative premises is a fallacy when a categorical syllogism has a negative conclusion yet both premises are affirmative. The inability of affirmative premises to reach a negative conclusion a basic rule of constructing a valid categorical syllogism.

Exactly one of the premises must be negative to construct a valid syllogism with a negative conclusion. (A syllogism with two negative premises commits the related fallacy of exclusive premises.)

Example of invalid AAE form: All A is B. All B is C. Therefore, no A is C.

LET: q A, r B, s C

((#q>r)&(#r>s))>(~q>s) ; nvt (5.5.1)

Example of invalid IV. AAO form: All A is B. All B is C. Therefore, some C is not A.

((#q>r)&(#r>s))>(%s>~q) ; nvt (5.5.2)

"This is valid only if A is a proper subset of B and/or B is a proper subset of C."

We write this additional assumption as:

((((q<r)+(r<s))+((q<r)&(r<s)))&((#q>r)&(#r>s)))>(%s>~q) ; nvt (5.5.3)

```
TTNNTTNNTTNNTTTT.EEEEEEEEEEEEEEEE.EEUUEEUUEEUUEEEE.EEIIEEIIEEIIEEEE.EEPPEEPPEEPPEEEE
```

The quoted assertion is mistaken according to Meth8.

However, this argument reaches a faulty conclusion if A, B, and C are equivalent. In the case that A=B=C, the conclusion of the following simple I. AAA syllogism would contradict the IV. AAO argument above: All B is A. All C is B. Therefore, all C is A.

((#r>q)&(#s>r))>(#s>q) ; vt (5.5.4)

5.6 Affirmative conclusion from a negative premise

From: en.wikipedia.org/wiki/Affirmative_conclusion_from_a_negative_premise

The "illicit negative" is a formal fallacy that is committed when a categorical syllogism has a positive conclusion, but one or two negative premises.

For example: No fish are dogs, and no dogs can fly, therefore all fish can fly.

LET: q dogs, r fish, s fly, p things

((~r>q)&(~q>s))>(#r>s) ; nvt (5.6.1)

"The only thing that can be properly inferred from these premises is that some things that are not fish cannot fly, provided that dogs exist."

The quoted assertion above using "some things" is mistaken and not Tautologous by Meth8:

((~r>q)&(~q>s))>(%q>((%p>~~r)>~~s)) ; nvt (5.6.2)

TTTTTTTTTTFFTTCT.EEEEEEEEEEUUEEUE.EEEEEEEEEEUUEEEE.EEEEEEEEEEUUEEPE.EEEEEEEEEEUUEEIE

"This could be illustrated mathematically as: If $A \cap B = \emptyset$ and $B \cap C = \emptyset$ then $A \subset C$." (5.6.3) (Because we dispense with the axiom of the empty set elsewhere, the set expression of Eq 5.6.3 is not evaluated.)

It is a fallacy because any valid forms of categorical syllogism that assert a negative premise must have a negative conclusion.

5.7 Existential fallacy

From: en.wikipedia.org/wiki/Existential_fallacy

In the existential fallacy, *we presuppose that a class has members* when we are not supposed to do so; that is, when we should not assume existential import.

Every *C is* B. Every *C is* A. So, some *A* is *B*.

((#s>r)&(#s>q))>(%q> r) ; nvt (5.7.1)

No *C* is *B*. Every *A* is *C*. So, some *A* is not *B*.

((~s>r)&(#q>s))>(%q>~r) ; nvt (5.7.2)

6. The 24 syllogisms derived by the & And connective

From: en.wikipedia.org/wiki/Syllogism

LET: q r s, M P S; # All, % Some; vt Tautologous, nvt Not Tautologous

In Table 6.1 we map the syllogisms by the & And connective for variables MPS, instead of by the > Imply connective for functions in section 2 above. The expressions below have about 20% fewer characters than those in Table 2.2.

\

Code	Name	Assumptions 1, 2	Assumption 3	Conclusion	Test	Comments
AAA-1	Modus Barbara	((#q&r)&(#s&q))		>(#s&r)	vt	
AAI-1	Modus Barbari	(((#q&r)&(#s&q))	&%s)	>(%s&r)	vt	* not needed
		((#q&r)&(#s&q))		>(%s&r)	vt	
AAI-4	Modus Bamalip	(((#r&q)&(#q&s))	&%r	>(%s&r)	vt	* not needed
		((#r&q)&(#q&s))		>(%s&r)	vt	
EAE-1	Modus Celarent	((~q&r)&(#s&q))		>(~s&r)	vt	
EAE-2	Modus Cesare	((~r&q)&(#s&q))		>(~s&r)	nvt	* Mistake
		(((~r&q)&(#s&q))	&%r)	>(~s&r)	vt	* Meth8 fix
AEE-2	Modus Camestres	((#r&q)&(~s&q))		>(~s&r)	vt	
AEE-4	Modus Calemes	((#r&q)&(~q&s))		>(~s&r)	vt	
EAO-1	Modus Celaront	(((~q&r)&(#s&q))	&%s)	>(~s&r)	vt	* not needed
		((~q&r)&(#s&q))		>(~s&r)	vt	
EAO-2	Modus Cesaro	(((~r&q)&(#s&q))	&%s)	>(%s&~r)	vt	* not needed
		((~r&q)&(#s&q))		>(%s&~r)	vt	
AEO-2	Modus Camestros	(((#r&q)&(~s&q))	&%s)	>(%s&~r)	vt	* needed
		((#r&q)&(~s&q))		>(%s&~r)	nvt	*
AEO-4	Modus Calemos	(((#r&q)&(~q&s))	&%s)	>(%s&~r)	vt	* not needed
		((#r&q)&(~q&s))		>(%s&~r)	vt	
AII-1	Modus Darii	((#q&r)&(%s&q))		>(%s&r)	vt	
AII-3	Modus Datisi	((#q&r)&(%q&s))		>(%s&r)	vt	
IAI-3	Modus Disamis	((%q&r)&(#q&s))		>(%s&r)	vt	
IAI-4	Modus Diamatis	((%r&q)&(#q&s))		>(%s&r)	vt	
EIO-1	Modus Ferio	((~q&r)&(%s&q))		>(%s&~r)	vt	
EIO-2	Modus Festino	((~r&q)&(%s&q))		>(%s&~r)	vt	
EIO-3	Modus Ferison	((~q&r)&(%q&s))		>(%s&r)	vt	
EIO-4	Modus Fresison	((~r&q)&(%q&s))		>(%q&~r)	vt	
AOO-2	Modus Baroco	((#r&q)&(%s&~q))		>(%s&~r)	vt	
OAO-3	Modus Bocardo	((%q&~r)&(#q&s))		>(%s&~r)	vt	
AAI-3	Modus Darapti	(((#q&r)&(#q&s))	&%q)	>(%s&r)	vt	* not needed
		((#q&r)&(#q&s))		>(%s&r)	vt	
EAO-3	Modus Felapton	(((~q&r)&(#q&s))	&%q)	>(%s&~r)	vt	* not needed
		((~q&r)&(#q&s))		>(%s&~r)	vt	
EAO-4	Modus Fesapo	(((~r&q)&(#q&s))	&%q)	>(%s&~r)	vt	* not needed
		((~r&q)&(#q&s))		>(%s&~r)	vt	

Table 6.1 Original syllogisms in Meth8 script

For those syllogisms with an additional Assumption 3, we test the same expression without the additional assumption. For those syllogisms not needing the given additional assumption in Meth8 to be Tautologous, we comment "not needed" by Meth8.

Meth8 found two anomalies:

6.1 EAE-2 Modus Cesare as written is not Tautologous, but with an additional assumption is corrected and Tautologous.

6.2 AEO-2 Modus Camestros as written is Tautologous, but the original expression without the additional assumption is not Tautologous. (This case is in variance to the other syllogisms with additional assumptions removed that are also Tautologous.)

We rewrite Table 6.1 with the non-redundant and corrected syllogisms according to Meth8 in Table 6.2.

Code	Name	Assumptions 1, 2	Assumption 3	Conclusion	Test	Comments
AAA-1	Modus Barbara	((#q&r)&(#s&q))		>(#s&r)	vt	
AAI-1	Modus Barbari	((#q&r)&(#s&q))		>(%s&r)	vt	
AAI-4	Modus Bamalip	((#r&q)&(#q&s))		>(%s&r)	vt	
EAE-1	Modus Celarent	((~q&r)&(#s&q))		>(~s&r)	vt	
EAE-2	Modus Cesare	(((~r&q)&(#s&q))	&%r)	>(~s&r)	vt	* Meth8 fix
AEE-2	Modus Camestres	((#r&q)&(~s&q))		>(~s&r)	vt	
AEE-4	Modus Calemes	((#r&q)&(~q&s))		>(~s&r)	vt	
EAO-1	Modus Celaront	((~q&r)&(#s&q))		>(~s&r)	vt	
EAO-2	Modus Cesaro	((~r&q)&(#s&q))		>(%s&~r)	vt	
AEO-2	Modus Camestros	(((#r&q)&(~s&q))	&%s)	>(%s&~r)	vt	* needed
AEO-4	Modus Calemos	((#r&q)&(~q&s))		>(%s&~r)	vt	
AII-1	Modus Darii	((#q&r)&(%s&q))		>(%s&r)	vt	
AII-3	Modus Datisi	((#q&r)&(%q&s))		>(%s&r)	vt	
IAI-3	Modus Disamis	((%q&r)&(#q&s))		>(%s&r)	vt	
IAI-4	Modus Diamatis	((%r&q)&(#q&s))		>(%s&r)	vt	
EIO-1	Modus Ferio	((~q&r)&(%s&q))		>(%s&~r)	vt	
EIO-2	Modus Festino	((~r&q)&(%s&q))		>(%s&~r)	vt	
EIO-3	Modus Ferison	((~q&r)&(%q&s))		>(%s&r)	vt	
EIO-4	Modus Fresison	((~r&q)&(%q&s))		>(%q&~r)	vt	
AOO-2	Modus Baroco	((#r&q)&(%s&~q))		>(%s&~r)	vt	
OAO-3	Modus Bocardo	((%q&~r)&(#q&s))		>(%s&~r)	vt	
AAI-3	Modus Darapti	((#q&r)&(#q&s))		>(%s&r)	vt	
EAO-3	Modus Felapton	((~q&r)&(#q&s))		>(%s&~r)	vt	
EAO-4	Modus Fesapo	((~r&q)&(#q&s))		>(%s&~r)	vt	

Table 6.2 Corrected syllogisms by Meth8

Table 6.2 represents the minimal and most compact mapping of the 24 syllogisms in Meth8. We reiterate that Meth8 found two anomalies which was easily corrected to render validated as tautologous.

Meth 8 on Modus Cesare and Modus Camestros

1. Introduction

The logic model checker Meth8 is based on variant system VŁ4, which corrects and resuscitates the quaternary logic of Łukasiewicz. Of the 24 valid syllogisms (from 256 combinations of the Square of Opposition), 15 are deemed valid, and 9 required additional known assumptions to become valid.

We use Meth8 to replicate the 24 valid syllogisms derived from the original Square of Opposition. In the process we make three recent advances.

2. A third assumption is needed to fix up Modus Cesare EAE-2

3. The third assumption cannot be removed from Modus Camestros AEO-2
(as in other syllogisms with known third assumptions); and

4. No third assumptions are required for the other 22 syllogisms.

In our discussion we also present:

5. Analysis of Modus Cesare EAE-2 with Modus Camestros AEO-2

We use public domain definitions from en.wikipedia.org/wiki/Syllogism as mapped to Meth8 script.

LET: # All, % Exists; vt Tautologous, nvt Not Tautologous;
T E, Tautologous Evaluated as designated values

2. Additional assumptions required for Modus Cesare EAE-2

LET: q r s, MPS; reptiles fur snakes

The original definition for Modus Cesare EAE-2 is:

No fur is on reptiles.	(PeM)	(~r&q) &
All snakes are reptiles.	(SaM)	(#s&q) >
∴No snakes have fur.	(SeP)	(~s&r) ; nvt

Here are truth tables in the five models:

```
TTTTTTTTTTCCTTTT.EEEEEEEEEEUUEEEE.EEEEEEEEEEEEEEEE.EEEEEEEEEEPPEEEE.EEEEEEEEEEIIEEEE
Model 1          .Model 2.1       .Model 2.2       .Model 2.3.1     .Model 2.3.2
((~r&q)&(#s&q))>(~s&r)   Step: 11
```

The original definition is not Tautologous by Meth8.

We test an additional existential assumption for "some fur exists".

No fur is on reptiles.	(PeM)	(~r&q) &
All snakes are reptiles.	(SaM)	(#s&q) &
Some fur exists.		(%r) >
∴No snakes have fur.	(SeP)	(~s&r) ; vt

Here are truth tables in the five models:

```
TTTTTTTTTTTTTTTT.EEEEEEEEEEEEEEEE.EEEEEEEEEEEEEEEE.EEEEEEEEEEEEEEEE.EEEEEEEEEEEEEEEE
Model 1          .Model 2.1       .Model 2.2       .Model 2.3.1     .Model 2.3.2
(((~r&q)&(#s&q))&%r)>(~s&r)   Step: 13
```

The modified definition is Tautologous by Meth8.

3. Additional known assumption required for Modus Camestros AEO-2

LET: q r s, MPS; reptiles snakes fur

The original definition is:

All snakes are reptiles.	(PaM)	(#r&q) &
No fur is on reptiles.	(SeM)	(~s&q) &
Some fur exists.		(%s) >
∴Some fur is not on snakes.	(SoP)	(%s&~r) ; vt

The original definition is validated by by Meth8.

In all syllogisms with a known additional assumption, it can be removed with the syllogism still being Tautologous by Meth8. We test Modus Camestros AEO-2 for this condition.

All snakes are reptiles.	(PaM)	(#r&q) &
No fur is on reptiles.	(SeM)	(~s&q) >
∴Some fur is not on snakes.	(SoP)	(%s&~r) ; nvt

The original definition without the known additional assumption is not Tautologous by Meth8.

Here are truth tables in the five models:

```
TTTTTTCCTTTTTTTT.EEEEEEUUEEEEEEEE.EEEEEEEEEEEEEEEE.EEEEEEPPEEEEEEEE.EEEEEEIIEEEEEEEE
Model 1          .Model 2.1       .Model 2.2       .Model 2.3.1     .Model 2.3.2
((#r&q)&(~s&q))>(%s&~r)   Step: 11
```

This means that Modus Camestros AEO-2 does not behave as all other valid syllogisms with known additional assumptions when those assumptions are removed.

4. No additional assumptions required for other 22 syllogisms

We show that the other valid syllogisms with known additional assumptions removed are Tautologous by Meth8 in Table 6.2 above.

5. Analysis of Modus Cesare EAE-2 with Modus Camestros AEO-2

We set Modus Cesare EAE-2 and Modus Camestros AEO-2 in opposite columns for comments about shaded variables.

	q r s MPS reptiles fur snakes			q r s MPS reptiles snakes fur	
EAE-2	**Modus Cesare**			**Modus Camestros**	**AEO-2**
(PeM)	No fur is on reptiles.	(~r&q) &	(#r&q) &	All snakes are reptiles.	(PaM)
(SaM)	All snakes are reptiles	(#s&q) &	(~s&q) &	No fur is on reptiles.	(SeM)
	Some fur exists.	(%r) >	(%s) >	Some fur exists.	
(SeP)	∴No snakes have fur.	(~s&r) ; vt	(%s&~r) ; vt	∴Some fur is not on snakes.	(SoP)

5.1 While syllogism models differentiate between first and second premises as antecedent and consequent around the & And connective, Meth8 does not. Therefore if the variable r is replaced by s or vice versa, in one column, then expressions are the same in both columns.

5.2 If the order of the premises is interchanged, then: Modus Cesare EAE-2 becomes Modus Camestres AEE-2 (without or with an additional assumption of %r); and Modus Camestros AEO-2 becomes EAO-3 or EAO-4 (without or with an additional assumption of %r) if the assignments change to q r s MPS fur reptiles snakes.

5.3 The respective conclusions are identical by variable replacement.

5.4 If the modal operators are removed then both syllogisms with the additional assumptions are still Tautologous. This speaks to what we name the *core voracity* of the syllogisms.

6. Conclusion

Variant system VŁ4 as implemented in the Meth8 modal logic checker in five models:

6.1 Corrects Modus Cesare EAE-2 by an additional assumption;

6.2 Shows Modus Camestros AEO-2 must retain its known additional assumption (unlike the other syllogisms that are Tautologous also without it); and

6.3 Presents the table of correct syllogisms in compact Meth8 scripts.

We further demonstrate that:

6.4 The modal operators of necessity and possibility are useful to map exactly the quantifiers of all and exists; and

6.5 The Meth8 tool is qualified to map, evaluate, analyze, and correct this limited fragment of predicate logic.