Refutation of justification based reasoning for dynamic conflict resolution

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Abstract: We first evaluate the last of seven examples, which is not tautologous. This refutes the conjecture of justification based reasoning for dynamic conflict resolution, to form a non tautologous fragment of the universal logic VŁ4.

We assume the method and apparatus of Meth8/VŁ4 with Tautology as the designated proof value, F as contradiction, N as truthity (non-contingency), and C as falsity (contingency). The 16-valued truth table is row-major and horizontal, or repeating fragments of 128-tables, sometimes with table counts, for more variables. (See ersatz-systems.com.)

LET ~ Not, ¬; + Or, ∨, ∪; - Not Or; & And, ∧, ∩, ·, ⊓; \ Not And;
> Imply, greater than, ⇒, ⊳, ⊃, ↑; < Not Imply, less than, ∈, ⊵, ⊍, ≤;
≡ Equivalent, ≡, ≜, ↔, ⇔, ∼⃗, ≈, ≃, ≡, ≅; @ Not Equivalent, ≠, ⊖;
% possibility, for one or some, ∃, ◊, M; # necessity, for every or all, ∀, □, L;
(z=z) T as tautology, T, ordinal 3; (z@z) F as contradiction, Ø, Null, ⊥, zero;
(%z>#z) N as non-contingency, ∆, ordinal 1; (%z<#z) C as contingency, V, ordinal 2;
¬( y < x) ( x ≤ y), ( x € y), ( x ⊆ y); (A=B) (A~B).
Note for clarity, we usually distribute quantifiers onto each designated variable.

From: Damm, W.; et al.  Dynamic conflict resolution using justification based reasoning.
arxiv.org/pdf/1911.07290.pdf  werner.damm@uol.de

Abstract  We study conflict situations that dynamically arise in traffic scenarios, where different agents try to achieve their set of goals and have to decide on what to do based on their local perception. We distinguish several types of conflicts for this setting. In order to enable modelling of conflict situations and the reasons for conflicts, we present a logical framework that adopts concepts from epistemic and modal logic, justification and temporal logic. Using this framework, we illustrate how conflicts can be identified and how we derive a chain of justifications leading to this conflict. We discuss how conflict resolution can be done when a vehicle has local, incomplete information, vehicle to vehicle communication (V2V) and partially ordered goals.

2 Conflict  … We assume that an agent’s goals are achievable.

Remark 2.0.1: Assuming goals are achievable is not necessary because the purpose of mapping the conjecture(s) into Meth8 script and processing in the universal logic VŁ4 is to determine resulting truth value table(s) as the gauge of measurability.

Figure 1: Car A wants to circumvent the obstacle (grey box). Car B is approaching from behind.

An agent A has a set of actions act_A and exists within a world. At a time the world has a certain state. The world “evolves” (changes state) as determined by the chosen actions of the agents within the world and events determined by the environment within the world. The agent perceives the world only via a set of observation predicates, that are predicates whose valuation is determined by an
observation of the agent. Without an observation the agent has no (direct) evidence for the valuation of the respective observation predicate. …

**Remark 2.0.1:** We commence evaluating the last example 7 of 7 below before others.

**Example 7.** Let A’s and B’s highest priority goal be collision-freedom, reflected in goals $\phi_{A,\text{col}}$ and $\phi_{B,\text{col}}$. Further let A want to go fast $\phi_{A,\text{fast}}$ and change lane immediately $\phi_{A,\text{lc}}$. Let also B want to go fast $\phi_{B,\text{fast}}$ so that A cannot change immediately.

\[ (2.7.0) \]

\[
\begin{align*}
\text{LET} & \quad p, q, r, s: \quad \text{car}_A, \text{car}_B, \text{lane}_1, \text{lane}_2 \quad \text{[rightmost lane in flow of traffic]}. \\
\text{We rewrite Eq. 2.7.0 below:} \\
\text{If} & \quad \text{If A does not want to collide with B, and vice versa,} \\
& \quad ((p@q)&(q@p)), \\
\text{then} & \quad (\text{If A is in lane}_1, \text{then B is not in lane}_1 \; (B \text{ is in lane}_2), \text{and} \\
& \quad (\text{If B is in lane}_1, \text{then A is not in lane}_1 \; (A \text{ is in lane}_2)) \\
& \quad (((p<r)>(q<s))&((q<r)>(p<s)))) \\
\text{then} & \quad \text{A wants to go faster than B to change from lane}_1 \text{ to lane}_2, \text{or vice versa lanes.} \\
\text{and} & \quad \text{B wants to go faster than A so block A in changing from lane}_1 \text{ to lane}_2. \\
& \quad (((p>q)>((p>r)+(p>s)))&(q>r)+(q>s)))) \\
\text{and} & \quad (((p@q)&(q@p))>((((p<r)>(q<s))&((q<r)>(p<s))))) \\
& \quad (((p>q)>((p>r)+(p>s)))&(q>r)+(q>s)))) \\
\text{TTTF} & \quad \text{TFFF} \quad \text{TFFF} \quad \text{TTTT} \quad \text{TTTT} \quad \text{TTTT} \quad \text{TTTT} \\
\text{TTTT} & \quad \text{TTTT} \quad \text{TTTT} \quad \text{TTTT} \\
\end{align*}
\]

Now in step (C4) A and B negotiate what goals shall be accomplished. In our scenario collision-freedom is valued most, and B’s goals get priority over A’s, since B is on the fast lane. Hence our resolution is to agree on a strategy accomplishing $\{\phi_{A,\text{col}},\phi_{B,\text{col}},\phi_{B,\text{fast}}\}$, which is the set of goals having the highest value among all those for which a combined winning strategy exists. Note that additional agents are captured as part of the environment here. At each step an agent can also decide to negotiate with some other agent than B in order to resolve its conflict.

Eq. 2.7.2 as rendered is *not* tautologous, refuting the conjecture of justification based reasoning for dynamic conflict resolution. Evaluation of previous examples was not needed.