

## Refutation of Zadeh's Swedes and Italians challenge as a logic problem

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**Abstract:** For Zadeh's Swedes and Italians challenge problem, we evaluate the linguistic weighted average (LWA) for the conjecture that Swedes are on average taller than Italians. None is tautologous, refuting the challenge as a logic problem. These form a *non* tautologous fragment of the universal logic VL4.

We assume the method and apparatus of Meth8/VL4 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  $\sim$  Not,  $\neg$ ; + Or,  $\vee$ ,  $\cup$ ,  $\sqcup$ ; - Not Or; & And,  $\wedge$ ,  $\cap$ ,  $\square$ ,  $\cdot$ ,  $\otimes$ ; \ Not And;  
 $>$  Imply, greater than,  $\rightarrow$ ,  $\Rightarrow$ ,  $\mapsto$ ,  $>$ ,  $\supset$ ,  $\rightarrow$ ;  $<$  Not Imply, less than,  $\in$ ,  $<$ ,  $\subset$ ,  $\neq$ ,  $\neq$ ,  $\ll$ ,  $\lesssim$ ;  
 $=$  Equivalent,  $\equiv$ ,  $:=$ ,  $\Leftrightarrow$ ,  $\leftrightarrow$ ,  $\triangleq$ ,  $\approx$ ,  $\simeq$ ; @ Not Equivalent,  $\neq$ ,  $\oplus$ ;  
 $\%$  possibility, for one or some,  $\exists$ ,  $\diamond$ ,  $M$ ; # necessity, for every or all,  $\forall$ ,  $\square$ ,  $L$ ;  
 $(z=z)$  **T** as tautology,  $\top$ , ordinal 3;  $(z@z)$  **F** as contradiction,  $\emptyset$ , Null,  $\perp$ , zero;  
 $(\%z\>\#z)$  **N** as non-contingency,  $\Delta$ , ordinal 1;  $(\%z\<\#z)$  **C** as contingency,  $\nabla$ , ordinal 2;  
 $\sim(y < x)$  ( $x \leq y$ ), ( $x \subseteq y$ ), ( $x \sqsubseteq y$ );  $(A=B)$   $(A\sim B)$ .  
 Note for clarity, we usually distribute quantifiers onto each designated variable.

From: Rajati, M.R.; Mendel, J.M. (circa 2011). Solving Zadeh's Swedes and Italians challenge problem. [cs.utep.edu/vladik/nafips12special.sessions/104.pdf](http://cs.utep.edu/vladik/nafips12special.sessions/104.pdf)

**Abstract**—In this paper, we present a solution to Zadeh's Swedes and Italians challenge problem which involves linguistic quantifiers and linguistic attributes. First, we argue that Zadeh's solution to this problem via the Generalized Extension Principle is very difficult to implement. Then, we use a syllogism based on the entailment principle to interpret the problem so that it can be solved via Linguistic Weighted Averages. ...

### III. OUR SOLUTION TO THE SWEDES AND ITALIANS PROBLEM

This section presents our solution to the Swedes and Italians problem using Linguistic Weighted Averages (LWAs). ...

In such a framework, we can calculate the following LWA to obtain the average value that Swedes are taller than most Italians,  $AH^1$ :  $AH^1 \equiv \mathbb{E}\{\tilde{B}^1\} =$

$$[Most \times Much \text{ taller} + Few \times not \text{ Much taller}] / [Most + Few] \quad (18.1.1)$$

**Remark 18.1.1:** We reduce the number of variables where Most means Not Few, and Few means Not Most. [A separate variable for Few produces the *same* truth table values below.]

LET  $p, q, r, s$ : Most, Italians, Much taller, Swedes.

$$((p\&r)+(q\&\sim r))\backslash(p+\sim p); \quad \mathbf{TTF\ FTF\ TTF\ FTF} \quad (18.1.2)$$

**Remark 18.1.2:** Eq. 18.1.2 as rendered is *not* tautologous, in other words, the average value is *not* a theorem.

This implies that on average, Swedes are  $AH^1$  taller than most Italians. (18.2.1)

**Remark 18.2.1:** We write  $AH^1$  to mean the average value from Eq. 18.1.1.

$$(((p \& r) + (q \& \sim r)) \setminus (p + \sim p)) \supset (s \supset q) ;$$

TTTT TTTT **FTTT** **FTTT**

(18.2.2)

Eqs. 18.1.2 and 18.2.2 are *not* tautologous, hence refuting the Swedes and Italians challenge as a (fuzzy) logic problem.