



Logic and Computing

Level III: Sorites



A **sorites** is a chain of interlocking mediate inferences leading to one conclusion in the end.

E.g.,

1. All Spartans are warriors.
2. All warriors are brave persons.
3. All brave persons are strong persons.
4. So, all Spartans are strong persons.

Step 1: Standard Form

Make sure...

1. All statements are standard-form categorical statements.
2. Each term occurs twice.
3. The predicate term of the conclusion appears in the first premise.
4. Every statement up to the conclusion has a term in common with the statement immediately following.



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1. All Spartans are warriors.
2. All warriors are persons who are brave.
3. All persons who are brave are persons who are strong.
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Steps:

1. Pair together two premises that have a term in common and derive an intermediate conclusion. This conclusion should have a term in common with one of the unused statements in the sorites.
2. Pair together these two statements and draw a conclusion from this second pair.
3. Repeat until all premises have been used.
4. Evaluate each individual syllogism.



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4. All Spartans are warriors.
5. So, all Spartans are persons who are strong.

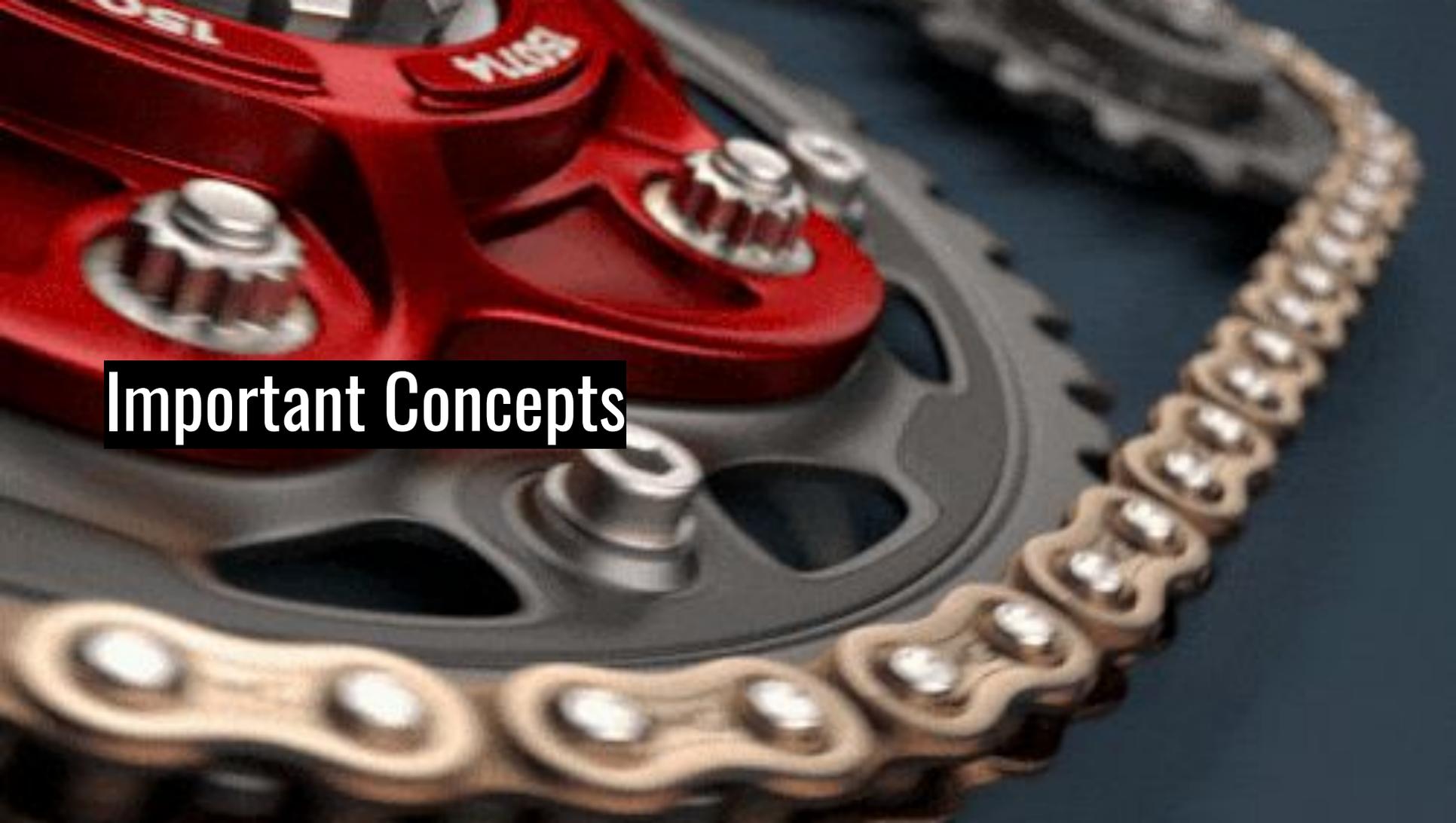
Rule:

If each individual syllogism is valid, the sorites is valid.

If even one syllogism in the chain is invalid, the sorites is invalid.

It's Valid!





Important Concepts

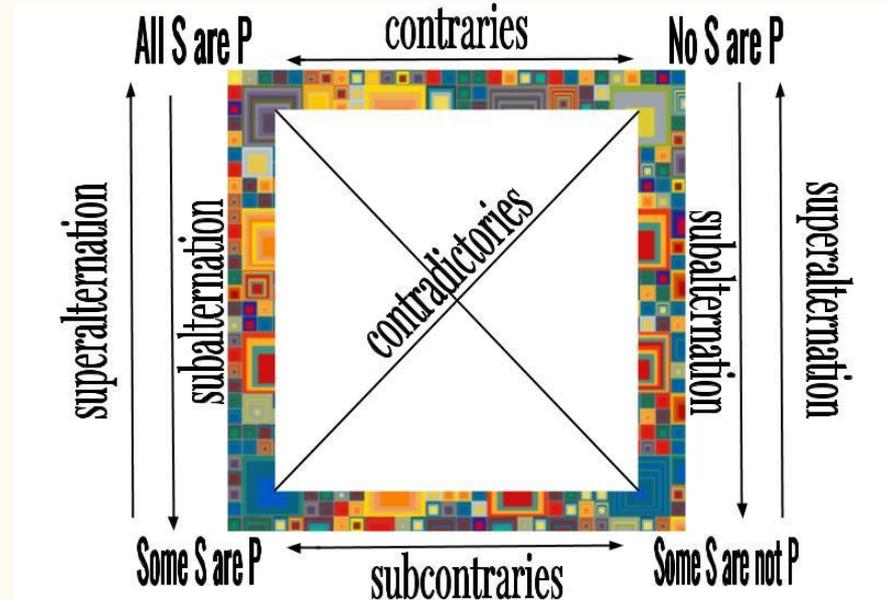
Question:

What is an algorithm?

An **algorithm** is a problem-solving procedure that has the following properties:

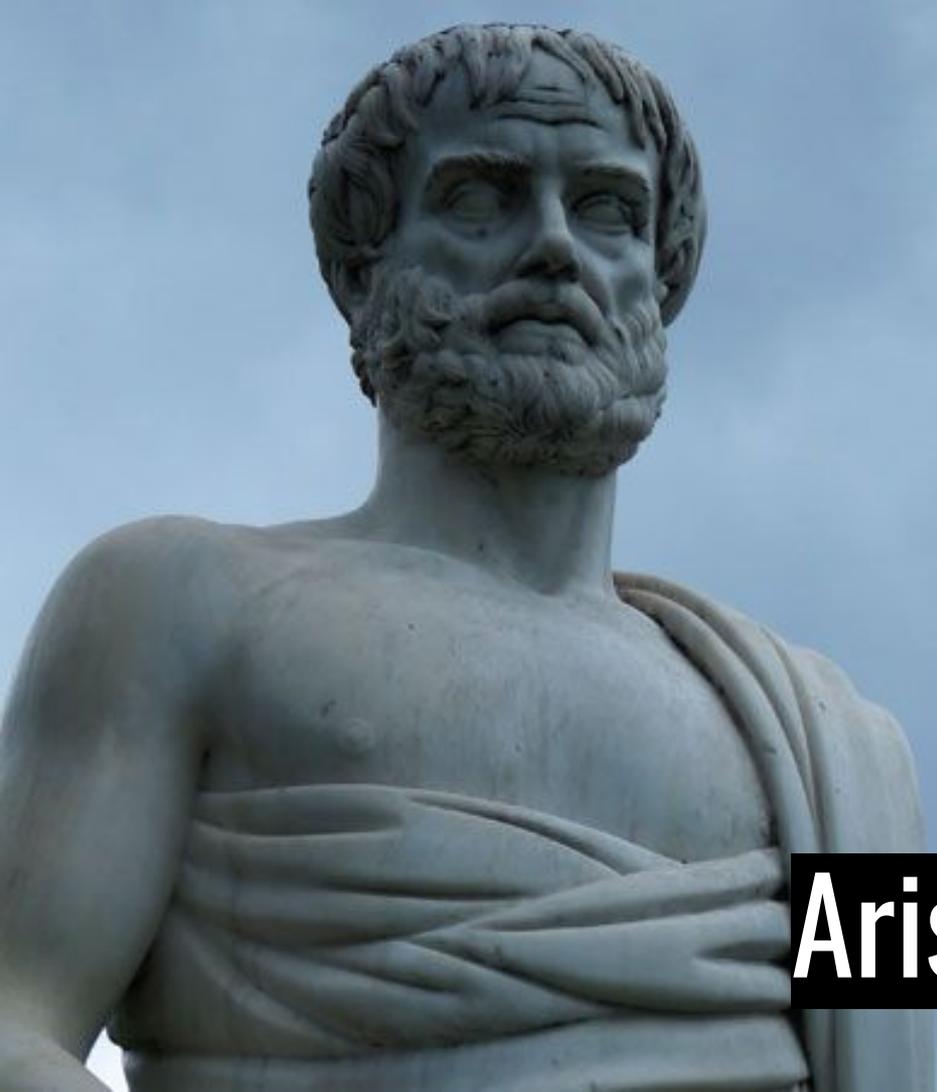
- A. it consists of finite steps;
- B. each step is precisely defined; and
- C. a definite answer is guaranteed at the end of the procedure.

The Square of Opposition was the first large-scale, general-purpose algorithm in the history of logic.

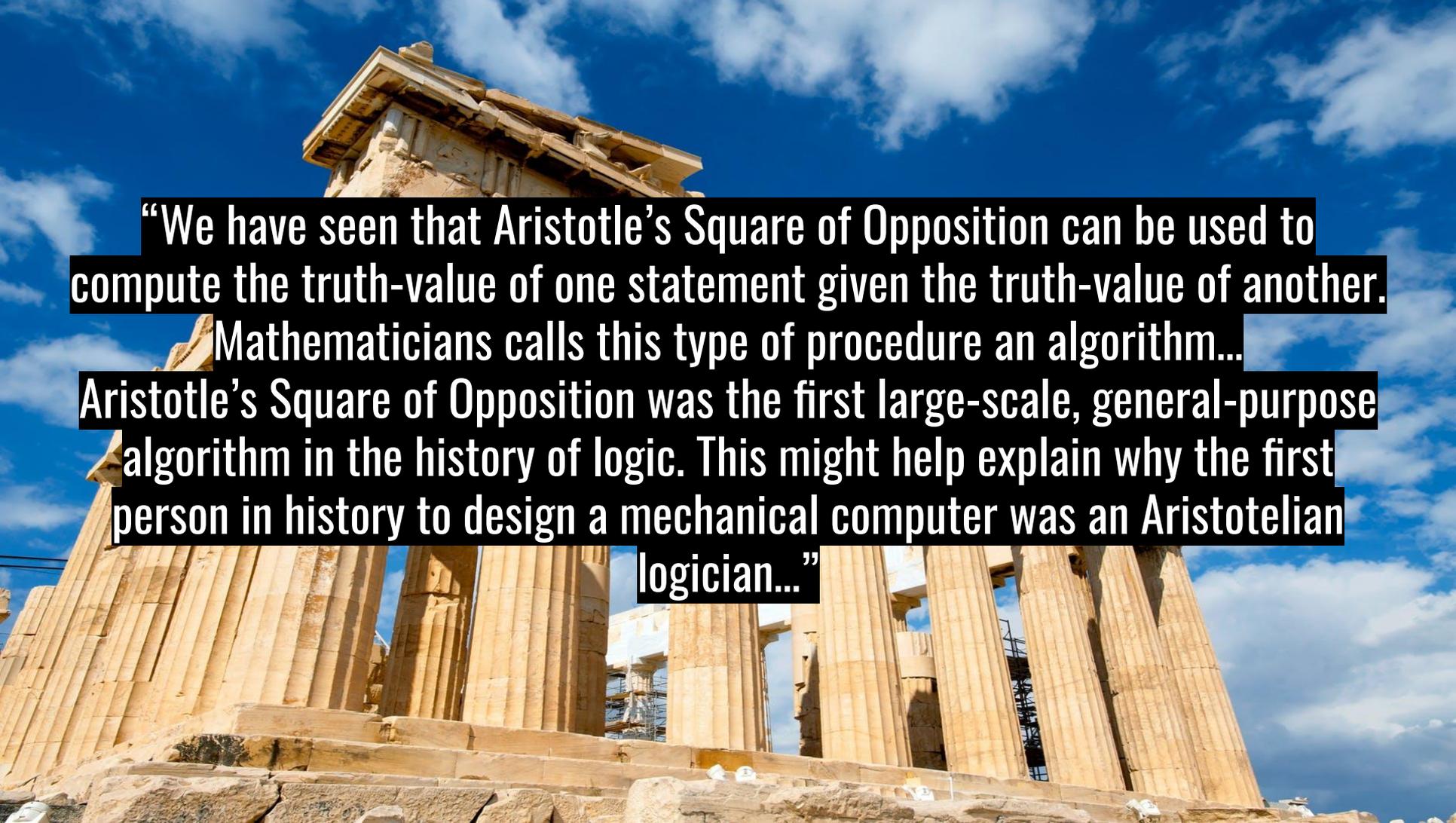


Storytime!





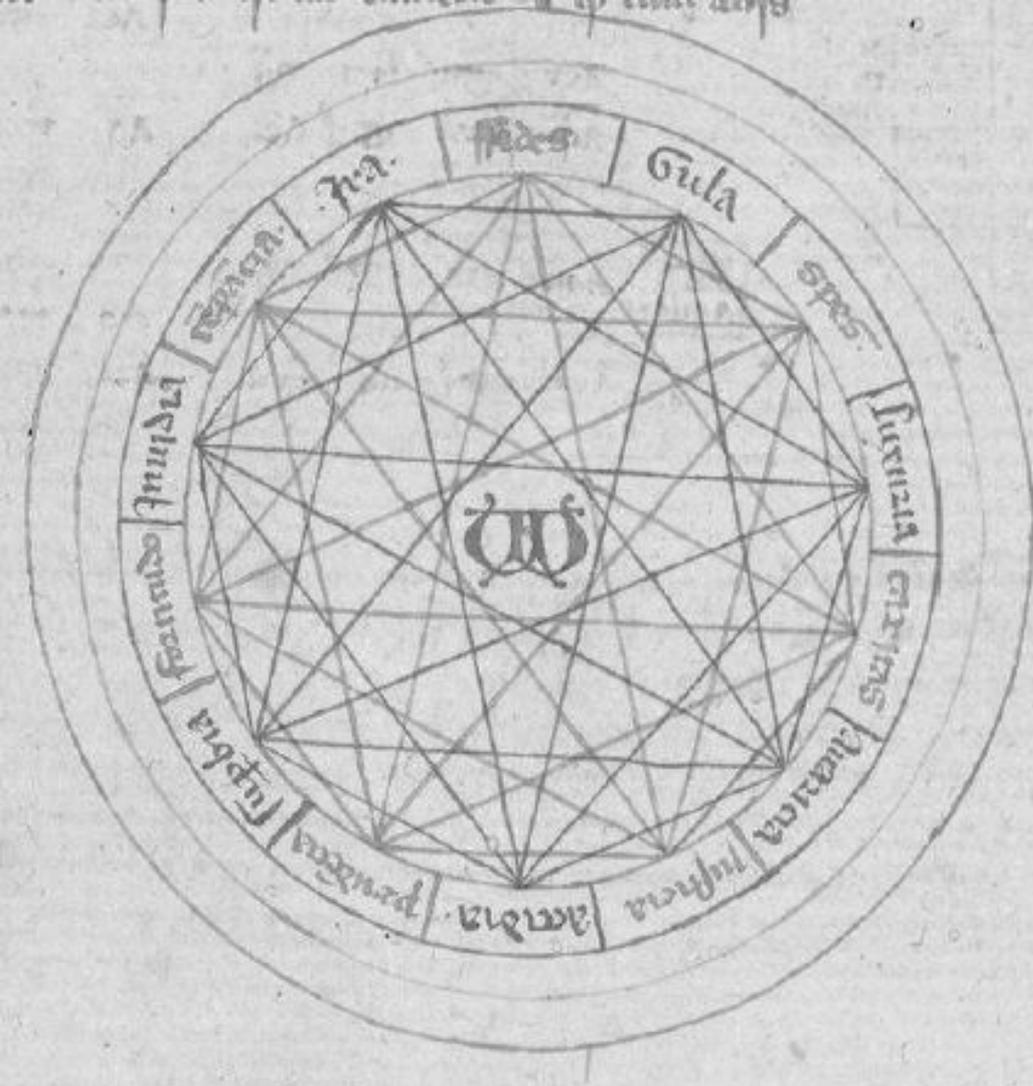
Aristotle, 384-322 BCE



“We have seen that Aristotle’s Square of Opposition can be used to compute the truth-value of one statement given the truth-value of another. Mathematicians call this type of procedure an algorithm... Aristotle’s Square of Opposition was the first large-scale, general-purpose algorithm in the history of logic. This might help explain why the first person in history to design a mechanical computer was an Aristotelian logician...”

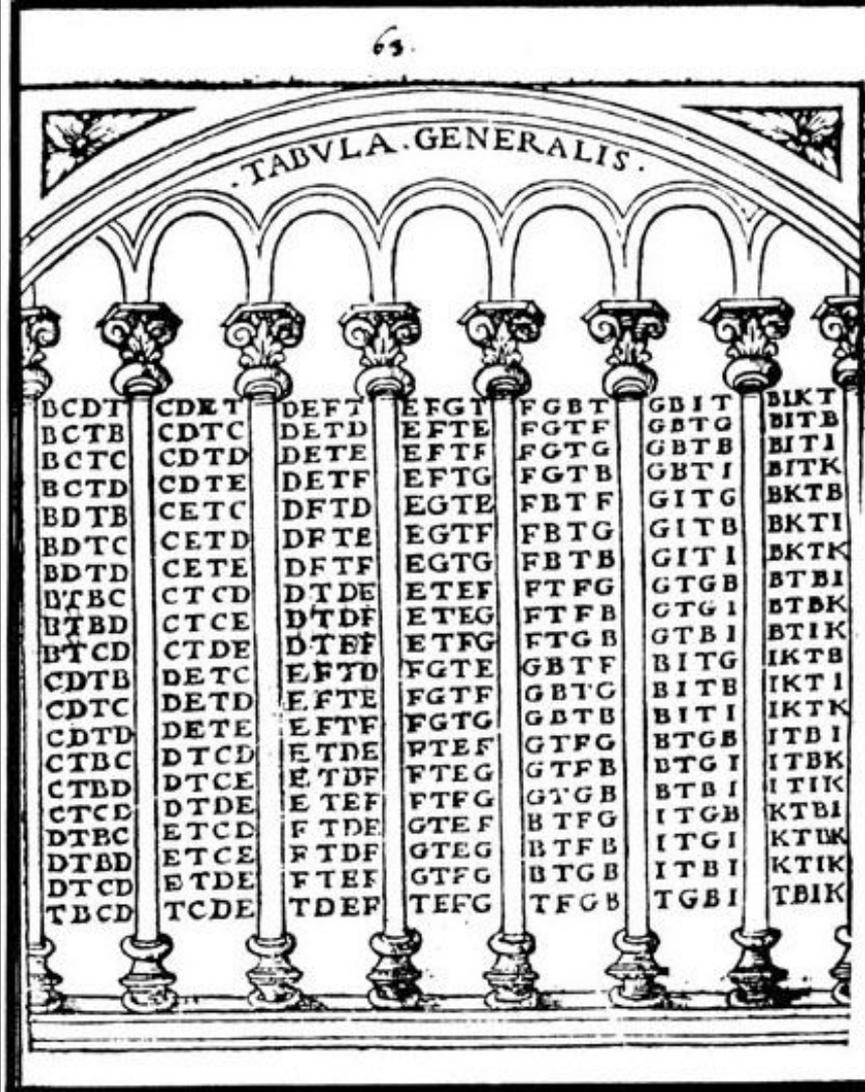
“Inspired by Aristotle’s Square of Opposition, Raymond Lull (1232-1315), a medieval logician who was also a Catholic priest, designed a computing machine consisting of two rotating disks, each inscribed with symbols for categorical propositions...”





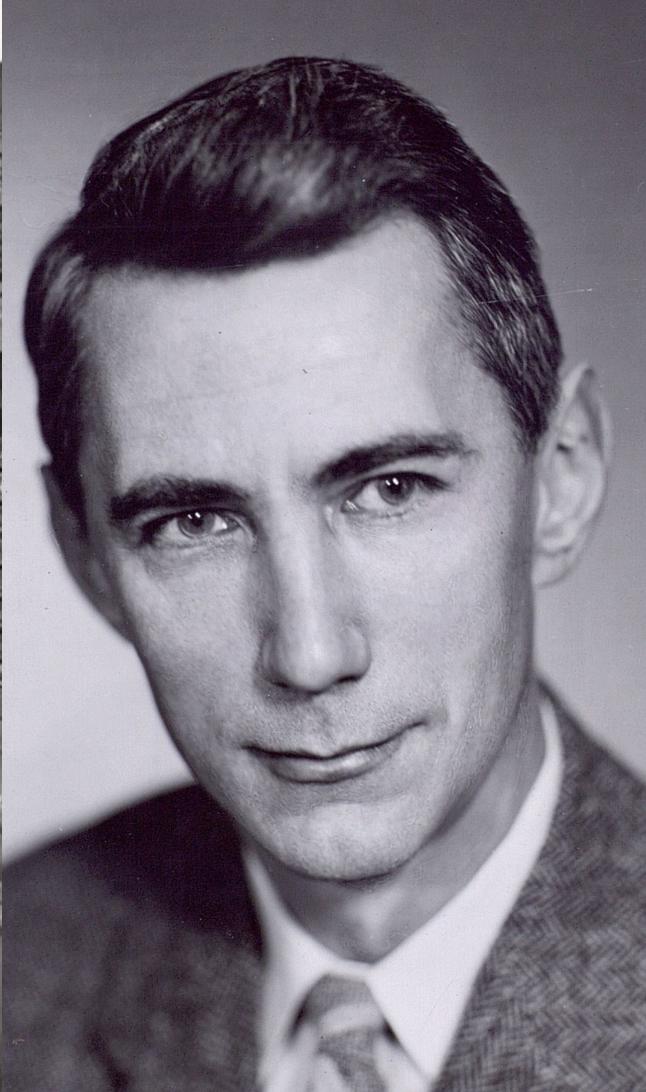
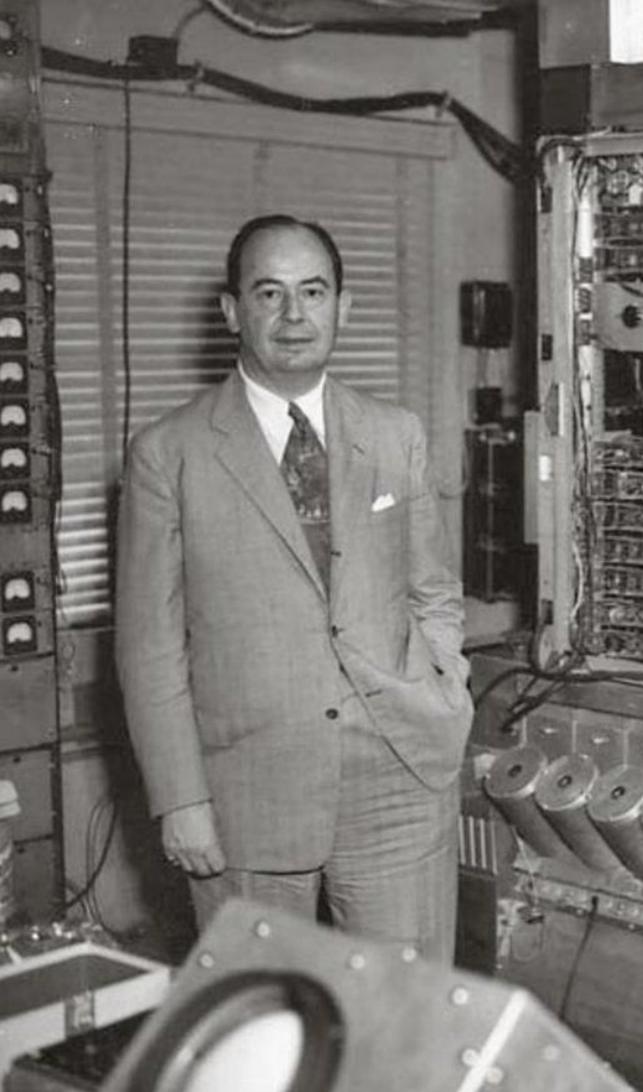
“The disks were aligned in such a way that one could turn a dial and see which statements validly follow from a given statement. Although extremely rudimentary, Lull’s basic idea underlies the modern digital computer...”

“For the first time in history, someone had conceived of a machine that takes inputs of a certain sort and then, on the basis of rules of logic, computes an exact answer, which is then read off some other part of the device...”





“The first designs in history for machines that compute were designs for mechanical devices that would operate according to the exact laws not of mathematics but of logic” (Herrick 2013: 121-2).









Food for thought...



According to a recent study, about 47% of US employment is at risk of being robotized (Frey & Osborne 2013).

**Both high-skill
and low-skill jobs are at risk...**











Individuals employed by Kodak
at its peak:

145,300

Current Instagram employees:

550

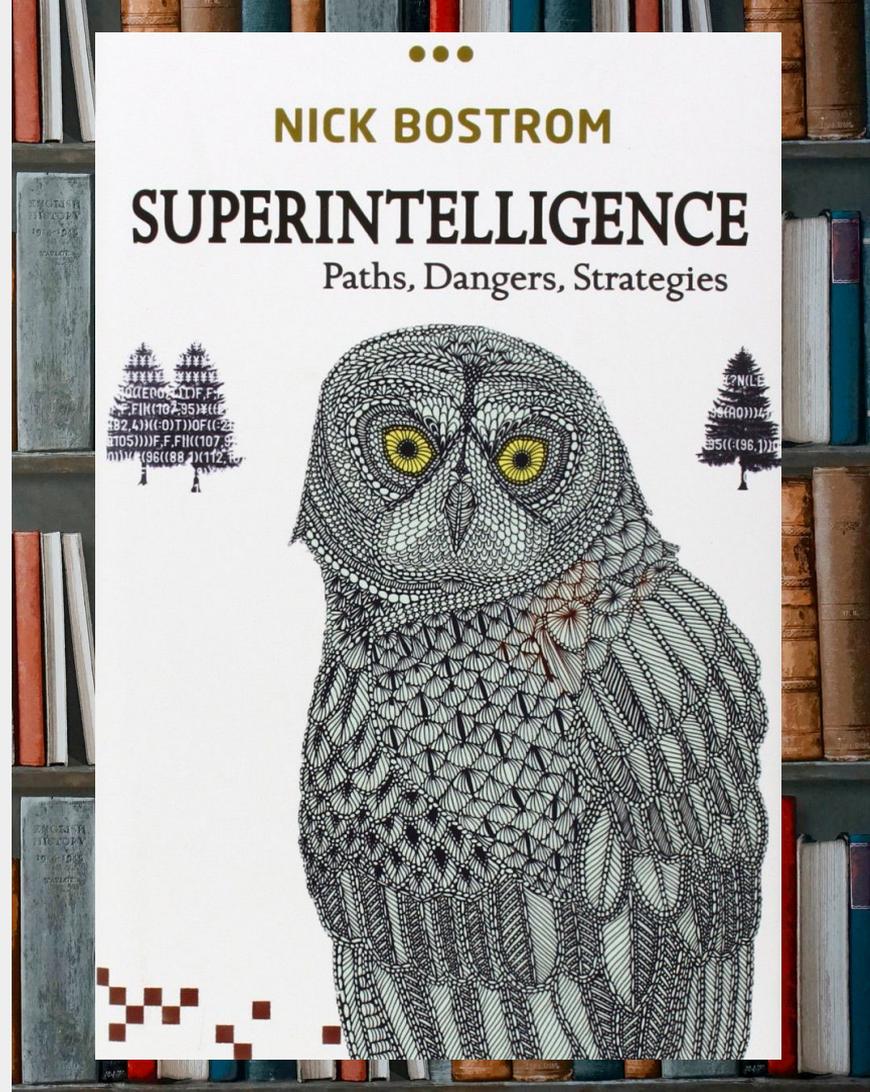
Overreacting?

**Another study says it's only
38%...**

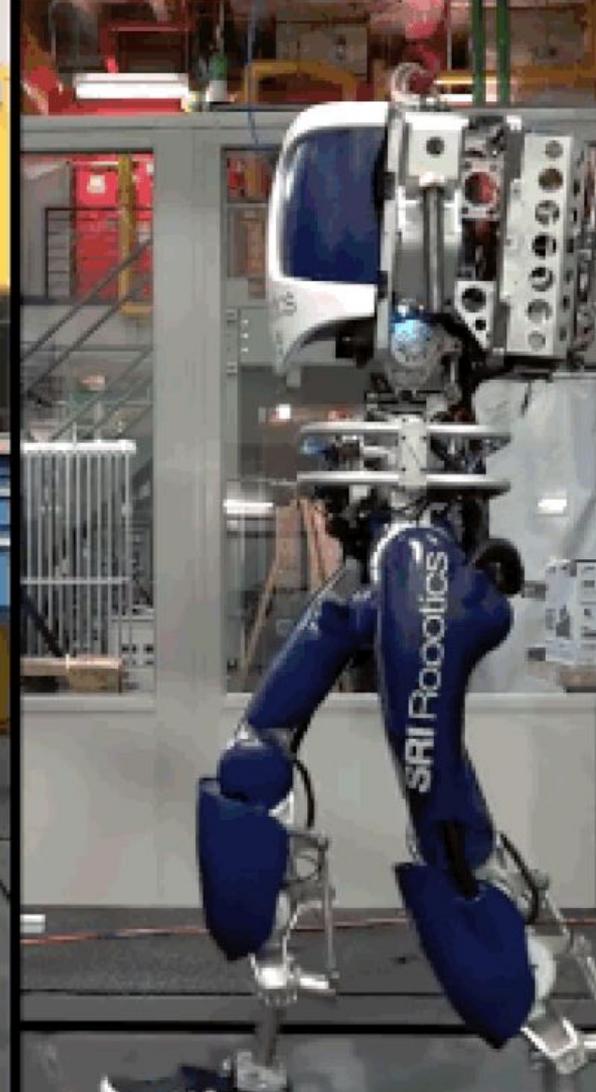
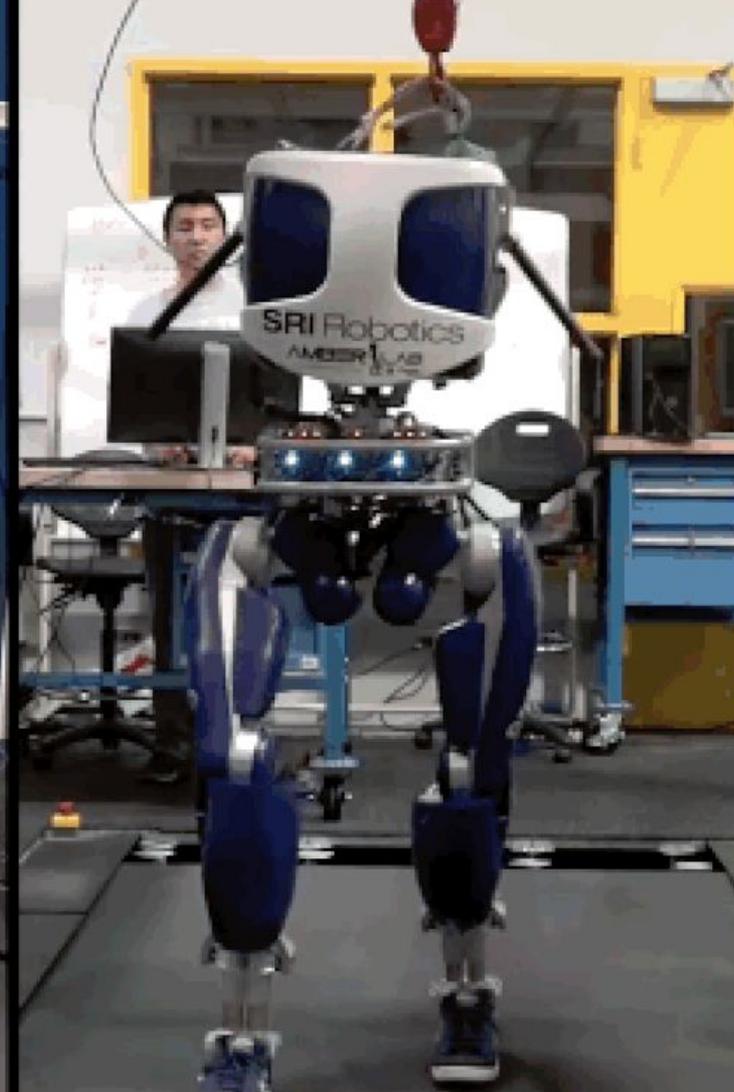
**And other researchers are
more worried about A.I.
starting nuclear war by 2040.**



The most alarming hypotheses, however, might be like those of philosopher Nick Bostrom (2014) who thinks that general-domain artificial intelligence will lead to an intelligence explosion that could spell the end of the human species.

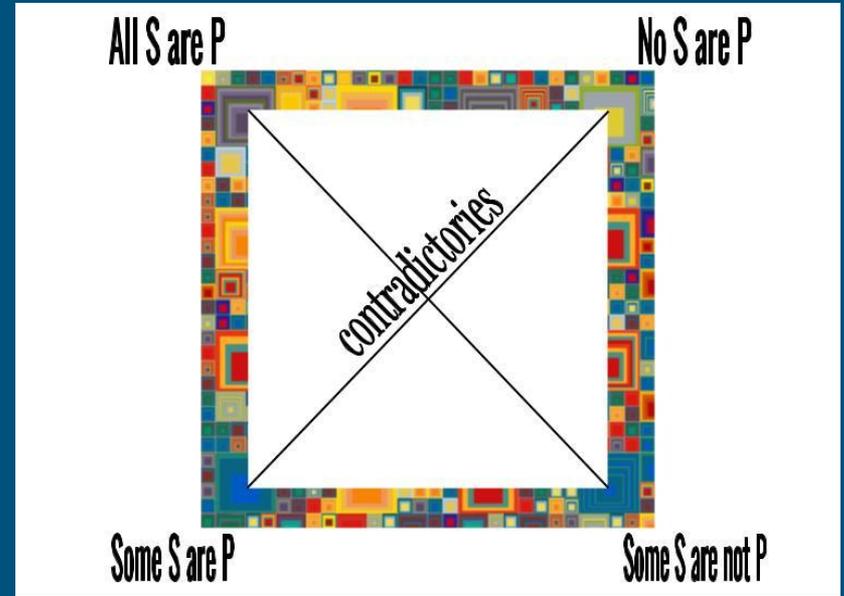
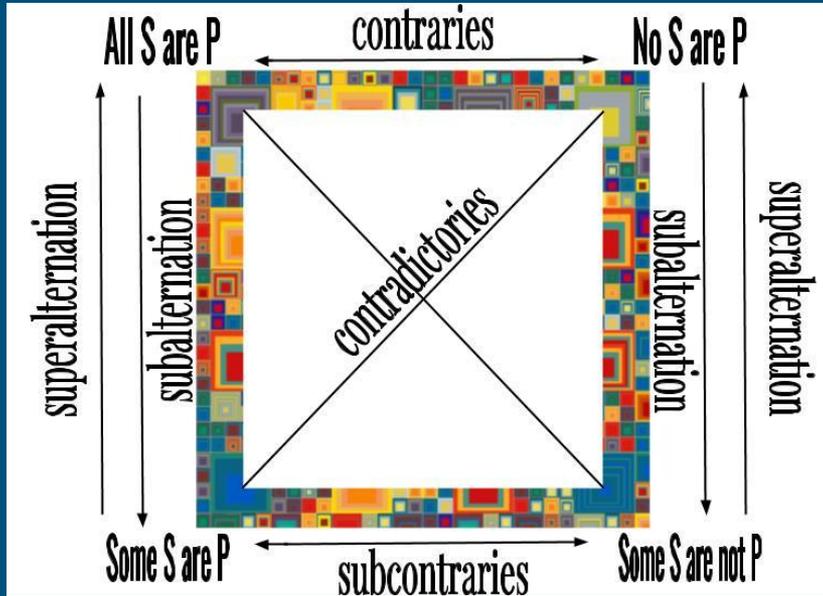






The Shortcomings of Categorical Logic

PROBLEM #1: Logical Relativity?



There must be a way for expressing which viewpoint we are taking within our symbolized statements.



PROBLEM #2:
It isn't obvious that all
arguments can be put
into categorical form...





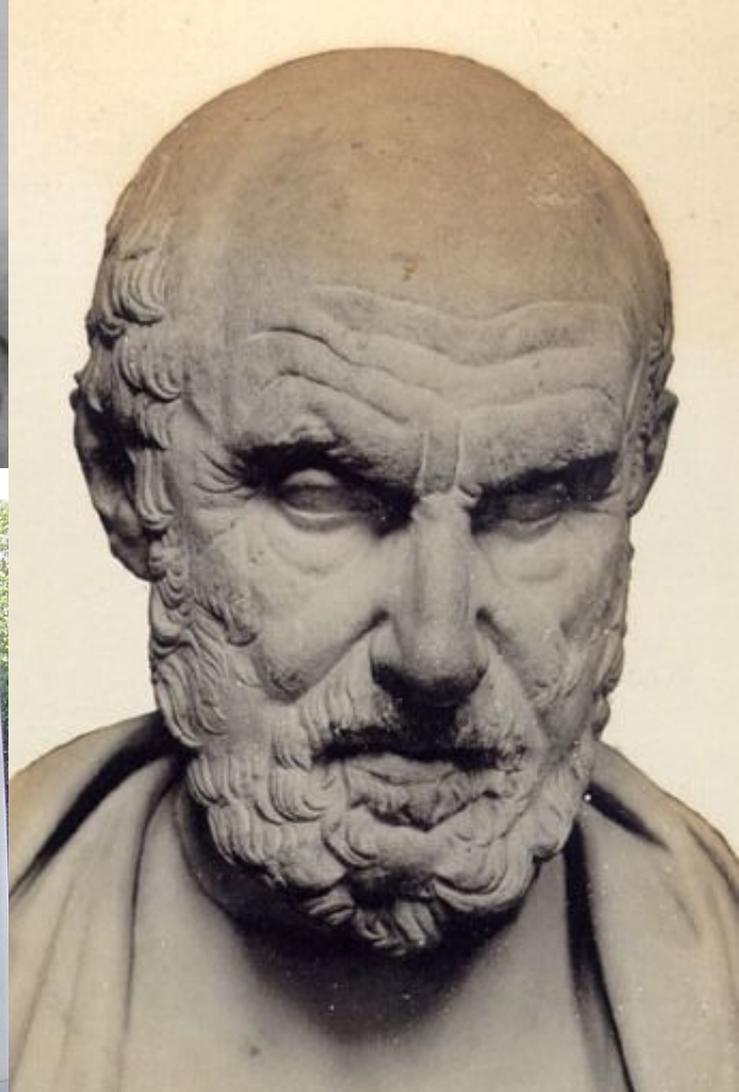
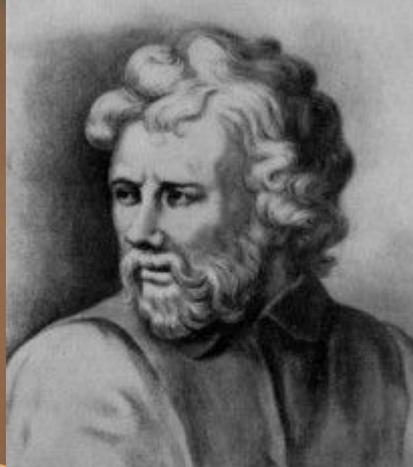
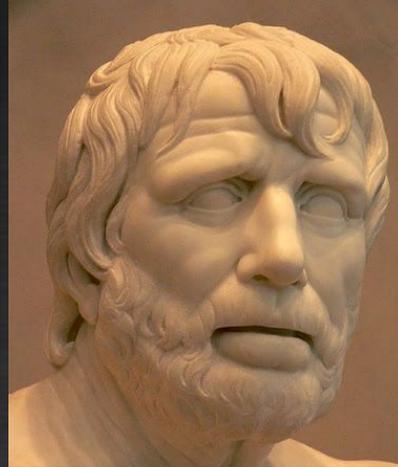
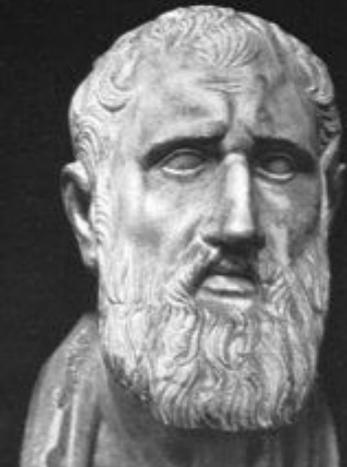
Exceptive statements

“All except truckers are happy with the new regulations.”

All non-truckers are persons who are happy with the new regulations;

No truckers are persons who are happy with the new regulations.





Chief Rival to Aristotle's Categorical Logic:

Truth-Functional Logic