Intro to Logic Notes
1/27/2020

History of Formal Logic:

- First logician was Euclid in 350 BC
  - Euclidien "Magic"
  - Ex: Euclid's Theorem - There are an infinite number of primes
- Aristotle in 300 BC was the first to use formal logic
  - Wrote the book *Organon*
  - Claimed Euclid is using syllogisms
  - E.g. All As are Bs. All Bs are Cs. Therefore all As are Cs
- Little progress in logic for a long time (medieval period, dark ages, etc)
- 1666: Leibniz invented calculus
  - Dreams of a "Universal Computational Logic"
- 1854: George Boole
  - Wrote *An Investigation of the Laws of Thought*
  - Boolean operators actually invented by Leibniz earlier
- Entscheidungsproblem
  - Frege: Exceeds Leibniz and de-mystifies Euclid: The "compellingness" of these proofs consists in their being, at bottom, formal proofs in first-order logic (FOL)
  - Church
  - Turing
  - Post
  - Here's what a computer is, and given that, the *Entscheidungsproblem* can't be solved by such a machine!
- 1956: Simon
  - Logic Theorist (birth of modern logicist AI)
- 2021: The singularity?

First, the Theoremhood Decision Problem ($\text{Theorem}_{\text{PC}}$) for the Propositional Calculus
$((K \rightarrow A) \wedge \neg A) \rightarrow \neg K \longrightarrow$ Yes, proof
Hard to do in polynomial time!

And now, the Theoremhood Decision Problem, i.e., the *Entscheidungsproblem*, ($\text{THEOREM}_{\text{FOL}}$) for First-Order Logic (FOL)
input: $Llama(larry) \rightarrow \exists x(Llama(x)) \longrightarrow$ output: Yes, *proof*
Applying this to ... The Singularity Question

- **Premise 1** There will be AI (created by HI and such that AI=HI).
- **Premise 2** If there is AI, there will be AI^{+} (created by AI).
- **Premise 3** If there is AI^{+}, there will be AI^{++} (created by AI^{+}).
- $\therefore$ **S** There will be AI^{++} ($=S$ will occur).

(Good-Chalmers Argument)
(Kurzweil is an "extrapolationist".)

Applying this to ... The Singularity Question
So, these super-smart machines that will be built by human-level-smart machines, they can't *possibly* be smart enough to solve the *Entscheidungsproblem*. Hence they'll be just faster at solving problems we can routinely solve? What's so super-smart about *that*?