

Sept. 3. 2013.

Lecture #1

Logic.

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Bud Mishra.

office hrs. Mon 1<sup>30</sup> pm.

J.R. Shoenfield, *Mathematical Logic.* 2001.

Syllabus.

- 1) Propositional Logic
- 2) First Order Logic
- 3) Incompleteness &  
undecidability
- 4) Second Order Logic  
Many-Sorted Logic  
& Modal Logic.

History of Logic

Notational Things.

History of Logic.  
(Based on a Lecture by Moshe Vardi). (2)

## Philosophical Logic

Aristotle. (Stoic) Greek: Philosophy vs Sophistry.

Epimenidis of Crete.

→ "All cretans are liars".

Example of Liar's Paradox

"I am a liar"

or

"This statement is false."

## Constructivist

Ramon Lull (1290) - Invention of Lullian Circle

Leibnitz (1646-1716) - Universal Language

Lingua Characteristica Universalis.

George Boole (1815-1864) - Making logic algebraic.

$x = xx$  Idempotent Rule.

⇒  $x(1-x) = 0$  - Contradiction.

Law of Excluded Middle LEM

Jevons (1835-1882).

Logic Machine  
Logical Piano

Claude Shannon (1916-2001) Relay cts.

Peirce/Markov (1889) - Logic → Calculation.  
A Logical Machine.

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Mathematical Logic

Deductive Logic.

Georg Cantor (1874)

Peano - Axiomatization of Number Theory.

Frege (1879) Begriffsschrift

Concept-Script.

} Problem of Self-Reference.

Russell (1872-1970)

Russell's Paradox.

$$t = \{s \mid s \notin s\}$$

A set of sets that do not contain themselves.

$$t \in t \Rightarrow t \notin t$$

$$t \notin t \Rightarrow t \in t$$

Solution: (Types) Principia Mathematica by Russell & Whitehead

David Hilbert (1862-1943)

27 Open Problems in 1900.

Wir müssen wissen; Wir werden wissen.

We must know; We will know.

Grundlagen der Mathematik (Hilbert/Bernays).

Gödel

Turing/Church

von Neumann (1903-1957)

} 1st & 2nd Incompleteness Thm.

- consistency of 1st order formula.

undecidability

→ Modern Stored-program

Computer.

Applications.

- Mathematics.
- Computer Science
- Linguistics.
- Game Theory.
- Philosophy.