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Notes COP4020: Programming Languages

Mathematical models called "machines." Collection of successful inputs are called the language of the machines.

0.1 History

Cantor (1845-1918) - Theory of sets (union, intersections, cardinality, etc) Discovered paradoxes such as the idea that infinity comes in different sizes, some set is bigger than the universal set.
Hilbert (1906-1978) Methodology for finding proofs. Each true proposition is provided with a rigorous proof in which every line is either an axiom or follows from the axioms and previously proved theorems by a specified small set of rules of inference.
Godel (1906-1978) Incompleteness theorem. There was no algorithm to provide proofs for all true statements in mathematics. He showed that either there were some true statements in mathematics that had no proofs, or else there were some false statements that did have proofs.
Church, Kleene, Post, Markov, von Neumann, Turing - Which statements have proofs? Building blocks of mathematical algorithms Turing proved that there were mathematically definable fundamental questions about the machine itself that the machine itself could not answer.

The term computer is never used in this course. We study computers by building mathematical models called **machines**, and then studying their limitations by analyzing the types of inputs on which they operate successfully. The collection of successful inputs is called the **language** of the machine.

1 Chapter 2: Languages

- Mathematical models of computers
  - Analysis of the input **language**
    - study of their limitations

1.1 Definitions

- alphabet - a finite set of symbols, denoted Σ

- letter - an element of an alphabet
- word - a finite sequence of letters from the alphabet
- Λ (empty string) - a word without letters
- language - a set of words formed from the alphabet

Two words are considered the same if all their letters are the same and in the same order. There is a difference between the word that has no letters (Λ), and the language that has no words (Φ). It is not true that Λ is a word in the language Φ since this language has no words at all.