Lecture-1 Main Points

- What is Logic?
  - Logic is about reasoning.
  - That is deriving new facts from given facts.
- It has interested Mathematicians and Philosophers since ancient times.
  - Aristotle formulated some laws of reasoning
  - Interest has been in understanding limitations of reasoning also.
  - Apart from reasoning in mathematics, interest has also been in principles of reasoning for everyday life situations such as
    - reasoning about time.
    - reasoning about knowledge and beliefs etc.
- Logic of mathematics
  - Logical foundation for current mathematics was formulated in early twentieth century.
  - This was in response to paradoxes such as:
    - Liar's paradox
    - Russell's paradox about sets (similar to barber's paradox)
  - Formalization of logical languages.
  - Replacing naive concept of sets by ZF set theory.
- Meta-mathematical Results
  - Formalization of mathematical reasoning paved the way for studying these formal systems themselves as mathematical objects.

  - Some limitative results, for example Godel's theorems.
    - Any sufficiently rich mathematical theory can not prove its own consistency.
  - Study of mathematical logic flourished in first half of the twentieth century.

- Why is mathematical logic relevant to computer science?
  - We give two main reasons below.
  - First, in CS we are interested in developing formal models of computational systems or of computation itself.

    One is also interested in specifying and reasoning about these systems.

    In these tasks, conceptual tools and techniques developed in mathematical logic often provide some insight.
  - Second is automation. Using computers, we would like to automate as many routine tasks as possible.

    For rigorous and foolproof reasoning, computers need to be provided with formal description of objects and reasoning principles involving them.

    Techniques developed in mathematical logic can be useful in coming up with such formal descriptions.