CMPT 308 - D100 Computability and Complexity

Instructor(s): Valentine Kabanets

Calendar Objective/Description:
This course introduces students to formal models of computations such as Turing machines and RAMs. Notions of tractability and intractability are discussed both with respect to computability and resource requirements. The relationship of these concepts to logic is also covered.

Instructor’s Objectives:
This course focuses on the inherent "complexity" of solving problems using a computer. The goal is to understand why some seemingly simple problems cannot be solved on computers and others have no efficient (ie fast) solution. In the course, we will see the formal notions of computers, computability and complexity. At the successful completion of this course students will understand why, for example, computer viruses are so pervasive and why no one will ever write a perfect virus checker. We will see how these concepts are related to logic, in particular, the famous Incompleteness Theorem of Godel. Finally, we will see a few surprising results from modern complexity, in particular, the results making use of randomness in computation.

Prerequisites:
MACM 201.

Topics:
- Preliminaries (if needed) - sets, functions, relations, alphabets, strings, asymptotics.
- Turing Machines as a formalization of the intuitive notion of an algorithm.
- Computability (Does a program exist?): basic computability (checking if a program is in an infinite loop), reducibilities and oracles, the Recursion Theorem (existence of computer viruses).
- Review of Logic and Godel's Incompleteness Theorem.
- Complexity Theory: Non-determinism, the class NP, reductions.
- Randomness in Computation: Interactive Proofs.
- Approximation algorithms and hardness of approximation: Probabilistically Checkable Proofs and the PCP Theorem.

Grading:
There will be 4 assignments, 1-2 midterms and a final examination. The exact grade distribution will be announced at the start of classes.

Required Books:

Reference Books:

Academic Honesty Statement:
Academic honesty plays a key role in our efforts to maintain a high standard of academic excellence and integrity. Students are advised that ALL acts of intellectual dishonesty will be handled in accordance with the SFU Academic Honesty and Student Conduct Policies (http://www.sfu.ca/policies/gazette/student.html).