CMPT 710 - G100 Computational Complexity

Instructor(s): Valentine Kabanets

Calendar Objective/Description:
This course provides a broad view of theoretical computing science with an emphasis on complexity theory. Topics will include a review of formal models of computation, language classes, and basic complexity theory; design and analysis of efficient algorithms; survey of structural complexity including complexity hierarchies, NP-completeness, and oracles; approximation techniques for discrete problems.

Instructor’s Objectives:
The main goal of Complexity Theory is to answer the question: What can be efficiently computed given limited resources? This is a more “practical” version of the main question of Computability Theory: What can be computed? In this course, we will see a rich landscape of complexity classes that are used to characterize problems according to the required resources (such as time, space, randomness, parallelism). We will discuss some known and conjectured relationships among these classes, obtaining a detailed map of the complexity world. Proving the correctness of this map would involve solving some of the deepest open problems in computer science, including the famous "P vs NP" question.

Prerequisites:
None

Topics:
- Time and Space Complexity Classes, Nondeterminism
- Nonuniformity and Circuit Complexity
- Randomness
- Alternation and the Polynomial-Time Hierarchy
- Interactive Proofs
- Counting Classes
- Relativization and Natural Proofs
- Probabilistically Checkable Proofs
- Current frontiers in Complexity Theory
- Quantum Computing

Grading:
To be discussed in the first week of classes.

Required Books:

Recommended Books:
Reference Books:
Computational Complexity, Christos H. Papadimitriou, Addison Wesley, 1995, 9780201530827

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).