COT 6200 Theory and Philosophy of Computation

Credits: 3 credits

Textbook, Title, Author, and Year: Detailed course documents that are posted on Blackboard.

Reference materials: N/A

Specific Course Information

Catalog Description: Study of major topics in the theory of computation and mathematical logic, such as Church's thesis, Gödel's incompleteness theorems, and the theory of recursively enumerable sets, and their philosophical interpretations

Prerequisites: MAD 2104. COT 6200 satisfies the theory requirement for the MSCS program and can be used as a technical elective in all CS and CE programs.

Specific Goals for The Course: Develop from scratch set theory, computability theory, and Gödel's Theorems, and consider their philosophical interpretations. Computability theory is presented by using small C programs that actually run, instead of by using Turing machines, so as to emphasize computability theory as a theory concerning the limits of programming

Brief List of Topics to Be Covered:

- Introduction to set theory.
- Church's thesis and the concept of computable function based on a programmer's approach to computability using the programming language C.
- Problems that cannot be solved on computers; unsolvability of the halting problem; recursive and recursively enumerable sets. These results are obtained by using small C programs that actually run, instead of by using Turing machines.
- Gödel's incompleteness theorems as limiting results about axiom systems that are adequate for proving properties of programs, and the implications of those theorems concerning the nature and limitations of mathematics (for example, no one axiom system can prove all true statements even about arithmetic).
- Views of Gödel, Post, and Turing regarding the implications of their results for the mind-machine problem (the mind-machine problem is the problem of ascertaining whether the human mind can be adequately viewed as some sort of executing program).
- The strong AI thesis that appropriately programmed computers have minds.
- The thesis of Roger Penrose (who won several awards with Stephen Hawking) that the mind is physically-based but non-mechanical, and that "new physics" is needed to account for the non-mechanical nature of mind.
- Computational complexity theory and the mind-machine problem.
- Interpretations of Gödel's incompleteness theorems concerning what mathematical objects really are, and whether they, in any way, can be said to exist independently of the human mind that is contemplating them.
- Gödel's view regarding the nature of time, and the implications of that view for the mind-machine problem.