Course Number: CSC825
Course Title: Advanced Automata Theory
Number of Credits: 3
Schedule: Three hours of lecture/discussion per week

Catalog Description:

CSC 825 Advanced Automata Theory
Prerequisites: *CSC 520 or equivalent*

Advanced topics in theoretical computer science and their application to a broad range of areas including bioinformatics, compilers, data and image compression, natural language processing, networking and web applications. Course Fee Required.

Expanded Description:

Finite State Automata

Review of algorithms relevant to deterministic and nondeterministic finite automata
Kleene's Theorem
Myhill-Nerode Theorem
Pumping Theorem
Closure and decidability properties of regular languages
Markov models and hidden Markov models
Proof that natural languages are not regular

Pushdown Automata and Context Free Grammars

Review of algorithms relevant to deterministic and nondeterministic pushdown automata
Context Free grammars
Derivations and derivation (parse) trees
Right linear and left linear grammars and regular languages
Equivalence of Pushdown Automata and Context Free Grammars
Nonequivalence of deterministic and nondeterministic pushdown automata
Closure and decidability properties of context free languages
Pumping theorem
Parikh's Theorem
Applications to natural languages and programming languages

Turing Machines

Decidable and semidecidable languages
Turing machines as computers of functions
Equivalent formulations of Turing machines
The Church-Turing Thesis
The Universal Turing machine

Unsolvability of the Halting Problem for Turing machines
Other unsolvable problems – reductions to the Halting Problem
Closure properties of the decidable and semidecidable languages
Unrestricted grammars – generation of semidecidable languages

Linear Bounded Automata

P and NP
NP-completeness and the Cook-Levin Theorem
Reduction in complexity proofs
Other NP-complete problems

Course Objectives:
Review the basics of the theory of computation
Examine more advanced topics not covered in CSC 520
Relate the results of computation theory to real-world computational problems
Sharpen students' logical and mathematical skills as they apply to computation in general

Method of Evaluation:
Students will be evaluated on the basis of their performance on a presentation involving an application of the material in advanced automata theory to a current problem in computer science.

Required Textbook:
Automata, Computability, and Complexity, by Elaine Rich, Pearson-Prentice Hall, 2008.