Course description (as listed in the undergraduate catalog): Introduces computation theory including grammars, finite state machines and Turing machines; and graph theory.

Special emphasis will be placed on basic models, unifying ideas, problem solving, the “scientific method”, as well as elegance, insights, and generalizability in constructing mathematical proofs.

Prerequisites: Discrete mathematics (CS2102) or equivalent

Supplemental reading: How to Solve It, by George Polya, Princeton University Press
Selected papers at: http://www.cs.virginia.edu/~robins/CS_readings.html

Office hours: right after every class lecture, and other times by appointment (also Email Q&A and course blog)

TAs: Mustafizur Rahman, office: TBA, hours: TBA
Jinlong Feng, office: TBA, hours: TBA

Class structure: two exams (midterm and final), several problem sets, with problems taken from the textbook and other sources, and a term project (involving implementing and demoing some theory-related concepts, ideas, and/or algorithms). Extra credit will be given throughout the semester for solving challenging problems.

Course progression:
- Formal Logic
- Set Theory
- Gödel’s Incompleteness Theorem
- Natural Numbers
- Rational Numbers
- Real Numbers
- Surreal Numbers
- Cantor’s Theorem
- Continuum hypothesis
- Axiom of Choice
- Formal Languages
- Regular expression
- Finite State Automata
- Non-determinism
- Closure Properties
- Context Free Grammars
- Push Down Automata
- Turing Machines
- Decidability
- Halting Problem
- Recognizability
- Rice’s Theorem
- Entscheidungsproblem
- Reductions
- Computational Universality
- Complexity Theory
- NP Completeness
- Cook Reductions
- Karp Reductions
- Probabilistic Computation*
- Alternation*
- Approximation*
- Zero Knowledge Proofs*
- Cryptography*
- Quantum Computing*
- Spectral Graph Theory*
- Gap Theorems*
- Berman-Hartmanis Conjecture*
- Unique Games Conjecture*
- Descriptive Complexity*
- Computational Universality
- Complexity Theory
- NP Completeness
- Cook Reductions
- Karp Reductions
- Probabilistic Computation*
- Alternation*
- Approximation*
- Zero Knowledge Proofs*
- Cryptography*
- Quantum Computing*
- Spectral Graph Theory*
- Gap Theorems*
- Berman-Hartmanis Conjecture*
- Unique Games Conjecture*
- Descriptive Complexity*

*Depending on time and student interest