Syllabus (Content)

: Official name of the course:

Elementary Theory of Computation

: My name for the course:

Great Ideas in Computer Science

THEME: There have been many theoretical ideas in computer science that revolutionized the entire field of computer science (not just theory). This course is about those great ideas!

1. Conquering infinity: Countable and uncountable sets. Mention ind of CH from ZFC. (1 week)

2. Regular Languages: DFA's, NFA's, Regular expressions, pumping lemma, applications to pattern matching. GREAT IDEA: A simple model of computation that is surpisingingly powerful. (3 weeks)

3. P and NP: Turing Machines, Cook-Levin Theorem (SAT is NP-complete). Reductions. Some Complexity Theory. Ways to prove that a problem probably does not have a fast exact solution. Ways around NP-completeness. Mention other classes above NP. GREAT IDEA: Being able to prove that some problems DO NOT have fast algorithms. (3 weeks)

4. Midterm (1/2 a week)

5. The power of randomness: Comm Complexity, Poly Identidy testing, Interactive proof systems. GREAT IDEA: Randomness is a surpringly powerful computational aid. (2 weeks)

6. Decidable and enumerable Languages: Turing Machines and the HALTING problem. Ways to show that some problems are undecidable! Mention Hilbert's 10th problem and Godel's theorem. GREAT IDEA: There are some problems that cannot be solved AT ALL. (2 week)

7. Optional Topics: Zero Knowledge, PAC learning, Byz Generals problem, Property Testing, (Note- those topics may be put into the section on Randomness), Cryptography, Quantum computing, Parallelism, error-correcting codes.