CS345: Theory of Computation

Class schedule & room: Time: MWF 12:30-2:00 Room: KINSC Link 310

Instructor info: Name: *Steven Lindell* Office: KINSC Link 308
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Consultation hours: TBA and also by appointment. You can even call me at home from the lab using the tablet computers or the *Omnishare* (which allows sharing written information over the telephone).

Textbook: *Automata and Formal Languages: An Introduction*, Dean Kelly © 1995.

Supplementary texts: *JFLAP: An Interactive Formal Languages and Automata Package*
Susan H. Rodger, Thomas W. Finley © 2006. ISBN: 0763738344

Prerequisites: Discrete Mathematics 231 (or comparable familiarity with proofs).

Course Description: Formal languages and automata theory: finite-state automata, regular expressions, context-free grammars, pushdown automata, Turing machines, recursively enumerable languages, undecidability, models of computation, and elements of complexity theory.

Homework: Weekly exercises will be a combination of easy observations, moderate problems, and hard proofs. Late homework will be strictly downgraded with substantial grade penalties. *However, up to three late penalties will be retroactively erased if all assignments are completed.* Aside from attending lecture, doing the homework exercises conscientiously is the most important factor in succeeding in this course. You must show your work to receive partial correct for incorrect answers. Many hints and solutions will be provided, and additional credit will be awarded for harder problems (marked with an *).

Labs and discussions: JFLAP

Midterms: Two take-home examinations, the first covering through regular languages, and the second through context-free languages. All homework must be complete before doing these exams.

Final: A take-home comprehensive examination.

Grading:

Participation	5%	(in class)
Homework	25%	(ten assignments)
Midterms	40%	(two exams)
Final	30%	(cumulative)

Rules and regulations: Although everything turned in for a grade must be your own work, collaboration on problems is strongly encouraged (especially working in groups). *Ideas* on how to solve homework problems may be exchanged (orally, or at a board), but not specific detailed solutions (written on paper). Just acknowledge your collaborators.

Syllabus

Week	Description of Material
1.	Orientation, sets, logic (*no discussion section*).
2.	Relations and functions, equivalences and partitions, induction, cardinality, transitive closure, posets, trees.
3.	*Alphabets and Languages*
4.	*Regular Languages*: regular expressions, deterministic finite automata (DFA), non-deterministic finite automata (NFA), equivalence of NFA and DFA, FSA with epsilon moves
5.	*Finite Automata*: equivalence of finite automata and regular expressions, minimization of finite automata, algebra of regular expressions.
6.	*Properties of the regular sets*: pumping lemma, closure properties, decision algorithms
7.	*Context-free languages* (CFL): regular grammars, context-free grammars, derivation trees, grammar simplification
8.	*Pushdown automata* (PDA): acceptance, examples, equivalence with context-free grammars, Greibach normal form
9.	*Properties of context-free grammars*: pumping lemma, closure properties, decision algorithms
10.	*Turing machines*: acceptors, computors, enumerators, extensions and restrictions
11.	*Recursive and recursively enumerable languages*: total recursive and partial recursive functions, closure properties
12.	*Phrase-structure grammars* (PSA): context-sensitive languages, equivalence with Turing Machines
13.	*Decidability*: universal machines and undecidability, unsolvable problems, Rice's theorems
14.	*Computational complexity*: space and time complexity, hierarchy theorems, intractable problems