CSCI 0510 – Models of Computation

John E. Savage
Semester I, 2012 - 2013

Course Description

This is a core undergraduate Computer Science course on the foundations of computing. It explores a variety of formal models for machines and languages including memoryless machines (logic circuits), machines with memory (the finite-state, random-access and Turing machines), language models (regular expressions and formal languages) and complexity classes identifying problems with the same general complexity, such as the **NP**-complete problems.

The course has lectures and written assignments. Its recommended, but not required, prerequisite is CSCI 0220, Introduction to Discrete Mathematics. CSCI 0510 serves as a prerequisite for upper-level courses in theory (e.g., CSCI 2560, Advanced Complexity), algorithms (e.g., CSCI 1570, Design and Analysis of Algorithms), and cryptography (e.g., CSCI 1510, Introduction to Cryptography and Computer Security).

Staff		Login ID	Office	Phone
Instructor:	Prof. John E. Savage	jes	CIT 503	37642

TAs:	cs051tas@cs.brown.edu
Nathan Malkin (Head TA)	nmalkin
Eli Wald	ewald
Hannah Rosen	hdrosen
James Walsh	jmw7
Jon Leavitt	jsleavit
Patrick Clay	pclay
Zach Kahn	zkahn

Course Credit	
Mid-semester Exam I	15%
Mid-semester Exam II	15%
Final Exam	20%
Labs	5%
Homework	45%

Late Policy Late homeworks will *not* be accepted. If circumstances are such that an extension is necessary, please discuss the matter with Professor Savage before the assignment is due. One homework can be omitted or the lowest graded homework can be dropped.

LaTeX Writing up homeworks in LaTeX is strongly encouraged. Help with LaTeX will be provided. Homeworks do not have to be typed, but illegible work may not be graded. We also recommend using diagrams liberally in your homeworks. Both `/course/cs051/bin/jflap` (for FSMs) and `/contrib/bin/logisim` (for circuits) will help you help us understand your work.

Textbook The course textbook is **Models of Computation**, *Exploring the Power of Computing*, John E. Savage (1998). It is available free of charge at `http://www.cs.brown.edu/people/jes/book/`. Also, **Introduction to the Theory of Computation**, Michael Sipser (2005) is recommended but not required.

Labs Students will be divided into lab sections at the beginning of the course. These sections will be split into rotating groups each week.

Most homework assignments have "lab problems." Each member of each group will be assigned one lab problem by the TAs and be responsible for presenting a solution to it to his or her lab group during their

weekly lab section. All students are responsible for writing up the solutions to all lab problems as well all regular problems.

Lab attendance and participation in each lab will be graded by the TAs on an A, B, C, F scale. Students who have prepared a solution to their lab problem before arriving for a lab session, present that solution to their lab group, and participate in solving other lab problems, will receive an A for the lab. Students who have not prepared a solution but participate in finding solutions to all lab problems will receive a B. Students who attend the lab with no preparation and do not paricipate will receive a C. Students who miss their lab time without notifying the TAs beforehand will receive an F. If you need to switch into a different lab, you must let the TAs know by the Wednesday before your lab.

Information Sources The CS051 webpage (http://www.cs.brown.edu/courses/cs051/) will be a primary source of information for this course. It will contain electronic versions of the lecture slides and homeworks. Please read your CS email regularly, as announcements, corrections, and clarifications will be emailed to the class. If you do not have a CS account, please email `cs051headtas@cs.brown.edu` and arrangments will be made.

Dates In Brief The syllabus is tentative, and changes will be made as the semester progresses. There will be two midterms and a final. The first midterm will be a take-home exam distributed on Tuesday, October 23 and due on Tuesday, October 30. The second exam will be a proctored exam given on Thursday, November 15. The final will be at 2:00pm on Wednesday, December 19.

Homeworks will usually be assigned on Tuesdays and due the following Tuesday.

Syllabus

Date		Lect	Topic
Sep	6	1	Overview of the Course
Sep	11	2	Finite Computational Models
Sep	13	3	Proof Methodologies
Sep	18	4	Design of Logic Circuits
Sep	20	5	Shifting and Other Problems
Sep	25	6	The Random Access Machine
Sep	27	7	Turing Machines
Oct	2	8	Nondeterministic Computation
Oct	4	9	TM Language Recognition
Oct	9	10	Introduction to Complexity Classes
Oct	11	11	A First NP-Complete Language
Oct	16	12	Proving a Language NP-Complete
Oct	18	13	Review I
Oct	23	14	Equivalence of the DFSM and FSM
Oct	25	15	Regular Expressions are Recognized by FSMs
Oct	30	16	FSMs Recognize Regular Expressions
Nov	1	17	The Chomsky Language Hierarchy
Nov	6	18	Parsing Context-Free Languages
Nov	8	19	Context-Free and Phase Structure Languages
Nov	13	20	Review II
Nov	15		**Midterm** II
Nov	20	21	Limits to Language Recognition
Nov	22		**Thanksgiving**
Nov	27	22	Approximations to Hard Problems
Dec	1	23	Space-Time Tradeoffs
Dec	4	24	Memory Hierarchies
Dec	6	25	Review III