CS530: Theory of Computation

CS DEPARTMENT, IIT. FALL 2008

INSTRUCTOR: PROF. XIANG-YANG LI

Course Objectives:

This course discusses basic computation models including finite automata, push-down automata, and Turing machines. Recursive function theory and logical theories will also be discussed. Computability issues (including undecidability) as well as complexity issues related to the various models will also be discussed.

General Information:

The class homepage is http://www.cs.iit.edu/~cs530. All handouts and important information will be posted there. Please check it regularly for new information.

Teaching Personnel

	name	office	phone	email	office hour
Instructor	Xiang-Yang Li	SB 237D	567-5207 (O)	xli@cs.iit.edu	T, R, 1:00PM-2:00 PM
TA		SB 019B	567-5869 (O)		M, T 2:00PM-3:00PM.

Time and Location:

Start Date	End date	Time	ClassRoom	Midterm	Final
Aug-21-08	Dec-13-08	T, R: 11:25-12:40 PM	SB213	10/21/08, 11:25–12:040PM	see schedule

Fall Break: Oct 16-18, 2008.

Textbook:

The official course textbook is `Introduction to the Theory of Computation (Hardcover)` by Michael Sipser; second edition, # ISBN-10: 0534950973, # ISBN-13: 978-0534950972, published in 2005. Or first Edition, published in June 1996. # ISBN-10: 053494728X, # ISBN-13: 978-0534947286

Course Theme:

1. Finite Automata and Regular Sets
   (a) Formal definitions of automata, regular expressions and equivalence with automata
   (b) Non-deterministic FA and their equivalence to deterministic FA
   (c) Pumping Lemma to show that a language is not regular
2. Push-down Automata
   (a) Formal definition of push-down automata and equivalence with context-free grammars
3. Turing Machines
   (a) Formal definition of a Turing machine
   (b) Various models of TM's and their equivalence
4. Decidability, Reducibility, and Undecidability
   (a) The Halting problem
   (b) Mapping reducibility
   (c) Undecidable problems in language models
5. Recursive Function Theory
6. Decidability of Logical Theories
7. Time Complexity of Turing Machine Computations
   (a) The classes P and NP
   (b) NP-Completeness and the Cook-Levin theorem
   (c) Polynomial reducibility
   (d) NP-Complete problems
8. Space Complexity
   (a) Savitch's Theorem
   (b) PSPACE and PSPACE-complete theorems
9. Additional topics in Complexity: Probabilistic Algorithms, Alternation

We will mainly cover the topics listed above, but we can not guarantee that all topics will be fully covered because of the time limit. And we will try to cover some other topics if the time is permitted and there are enough students who are interested in those.

Grading:

There will be **five** homeworks, one **on-class** midterm, and one **on-class** final exam. They will count toward the grade as follows:

Homework	40%	MidTerm	25%	Final	30%	Writing Lecture Notes	5%

However, the instructor reserves the right to make adjustments to these weights based on his a posteriori evaluation of the relative difficulty of the exams and homework.

Each problem will be graded 80% for correctness and 20% for style and clarity. Good style means giving a sound logical argument and a clear presentation, sufficient to convince someone who knows the material, but not the answer, that your answer is correct. Consider your audience to be a skeptical classmate. Good style also implies that an answer should be reasonably thorough, as well as reasonably concise.

Final Grade:

A: $85 \leq W$

B: $70 \leq W < 85$

C: $60 \leq W < 70$

D: $50 \leq W < 60$

E: $0 \leq W < 50$

Here $W = \frac{W_1+W_2}{2}$, W_1 is the final weighted score (40% of homework + 25% of midterm + 30% of final + 5% of writing lecture notes) and $W_2 = 100 \times \frac{W_1}{AverageTopFive}$. Here AverageTopFive is the average of W_1 of the best five students in the class. For example, if your $W_1 = 70$, and $AverageTopFive = 90$, then your $W = \frac{70+70*100/90}{2} \simeq 73.89$. Then you will get B for this course. Notice, undergraduate will get F if $W < 60$. You have to do well enough in each category: homework, presentation, programming, midterm and final exam to get a good grade. In particular, grade will be reduced by one level for those who skip much homework and classes and rely on stellar exam scores. For example, if you did not submit one homework and you have $W = 80$, you will have grade C instead of grade B. The instructor reserves the right for some small changes of grading.

Regrades: If you feel that a problem was graded incorrectly, please contact the TA first. Contact the instructor if there is still a disagreement. For best results, please attach a short note stating what you want regraded and why.

NOTE: For students who registered for Internet session, or TV session, you are also required to write 2 lecture notes.

We want everyone happy and satisfied in learning.

Homework:

You may take an automatic extension by submitting the solution of an assignment on the specified extended due date and time, but with 10% deduction on this homework's grade.

No late assignments handed in after the extended deadline will be accepted. Requests for an additional extension will almost always be denied.

In this course you are **encouraged** to discuss the problems with your classmates, however, you are not allowed to work together on the final solution of the problems. If you discuss the problems with others, you should acknowledge this in your solution. Discussions should **not** lead to any level of common detailed solutions in the submissions. If we find such common solutions, it will be treated as cheating! Keep in mind that you could **NOT** discuss exact proof strategies, or algorithms with other students in the course. You could **NOT** collaborate in the detail development or actual writing of problem sets. Using past solutions, etc., is expressly forbidden. Refer to the Campus Code regarding academic integrity.

You get zero on the cheated assignment if you are caught once in any form of the cheating. You **fail** the course automatically if you are caught in cheating **TWICE** or more in homeworks and programming, or once during the exams (midterm or final). In addition, the violation and the sanction may be reported to the associate dean of either undergraduate or graduate college, as appropriate.

Please help us by stapling all written pages, labeling them with your name, and clearly labeling each problem. You don't want us to lose part of your assignment or not see your answers, do you?