CSCI 26500-06 – Computer Theory 1

TuTh 5:35-6:50pm | North Bldg C002

Instructor: Justin Tojeira Semester: Spring 2020

Text: *Introduction to Automata Theory, Languages, and Computation*, 3rd Edition. Hopcroft, Motwani, Ullman. 2006. ISBN-10: 0321455363 ISBN-13: 978-0321455369

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Office Hours: Tuesdays 5:00-5:30 and 7:00-7:30, North Bldg 1009

Course Description:

Computer Theory 1 covers formal languages, the expressions that define them, the grammars that generate them, and the computational models that recognize them. We will cover regular languages with regular expressions and finite automata, context-free languages with context-free grammars and pushdown automata, context-sensitive languages with context-sensitive grammars and linearly-bounded automata, and recursive and recursively enumerable languages with unrestricted grammars and Turing machines.

Studying these topics provides insight into what can and cannot be computed, and how efficiently different types of problems can be solved. Being a course in theory, there is a significant amount of abstract math, especially in the form of formal definitions, algorithms, theorems, and proofs. There will also be an emphasis on basic set theory and first-order logic.

More specifically, we will learn concepts and formal definitions about topics including computability, complexity theory, automata theory, formal languages, determinism, and relations between sets. We will prove properties about all the aforementioned topics, using a variety of formal and informal proof techniques. And we will design automata, expressions, and/or grammars to describe formal languages.

Grading:

Exams:	75%
Homework:	20%
Class Participation:	5%

Exams:

There will be 4 exams in this course, spaced as evenly as possible, so there will be an exam about every 7th class. Exams are not cumulative, and the last exam will be given during the time normally reserved for final exams. Exact exam dates will be announced about a week in advance, in class and on Blackboard. Exams will take about an hour on average, so you will be given the entire class session to complete your exam.

You may drop your lowest exam grade (or a missed exam), but you must attend the classes and do the homework corresponding to the dropped exam. Dropping an exam does not mean missing one-quarter of the semester. You may skip the final if you're satisfied with your grades on the first 3 exams, but you must not miss more than 1 or 2 (at most) out of the last 6 classes in this case. Latenesses count as one-half of an absence.

Homework:

Homework will be given on a regular basis, and I will go over it in class. Homework must be submitted on Gradescope by 5:30pm on its due date. There will be about 12 assignments, each graded as “complete” for 1 point, “partially complete” for 0.5 points, and “incomplete” for 0 points, for a maximum of 10 points. For the other 10 points, I will review each student's homework for the semester during the last few classes, so you must keep all your homework assignments. I will be looking to see that you corrected all of your wrong answers. **Missing assignments at the end of the semester will be 2 points off each, with no maximum penalty**. If you do your homework in a notebook, please keep them in one place (on consecutive pages).

Class Participation:
Your class participation grade in this class will be relative to your grade before class participation is factored in. All students are expected to attend every class they can. For students who get high scores on exams, they will also be expected to actively contribute to class to get the maximum points for class participation.

Blackboard (http://bb.hunter.cuny.edu/) will be used to post announcements, exam dates, and homework. If any material beyond the textbook is used, that will be posted there as well. You should check Blackboard on a regular basis.

Course Content:
The first 2 exams will be on **finite automata**, which are the simplest and most efficient but least versatile of the computational models we will study - that is, they solve only simple problems, but they solve them quickly. The 3rd exam will be on **push-down automata**, which employ a stack and are used for tasks such as parsing, source code compilation, and modeling natural languages. The 4th exam will be on topics related to computability, and **Turing Machines**, which are capable of computing anything which can be computed, and thus may be used to determine if any given problem is computable or not.
Below is the approximate class schedule, with one class of slack time and exam 4 during finals week:

Class	Topic	Class	Topic
1	Formal languages, regular languages, review of set theory and first-order logic	15	Context-Free Languages and Grammars
2	DFAs, string searching, regular expressions	16	Parse Trees, Derivations
3	More examples of DFAs and regexes	17	Generating Expressions, Ambiguity
4	Infinite sets, proofs; formal definitions	18	Pushdown Automata, CFGs to PDAs
5	DFA minimization; determinism and NFAs	19	CNF; Closure Properties of CFLs
6	Thompson's Construction; Review	20	Review
7	**Exam 1**	21	**Exam 3**
8	Kleene's theorem, subset construction	22	CSLs, Recursive and RE Langs/Grammars
9	State elimination algorithm	23	Turing Machines; Chomsky Hierarchy
10	Closure properties and proofs	24	Diagonalization, Infinity, Unsolvability
11	Pumping Lemma for Regular Languages	25	P/NP, Reductions; Simulations
12	Myhill-Nerode Theorem	26	L_u, Halting problem
13	Review	27	Review
14	**Exam 2**	28	-

Additional Contact Information:
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