CS103 Syllabus

This syllabus contains the topics and readings for lecture, as well as the assignment due dates and exam dates. Depending on how fast we're able to move through the material, we may end up covering the material at a slightly different pace. I recommend doing the readings before lecture.

Part One: Discrete Mathematics			
Date	**Topics**	**Readings**	**Assignments**
M September 23	*Can computers solve all problems?* Set Theory The Limits of Computing	Notes, Ch. 1	
W September 25	*How do we prove results with certainty?* Direct Proofs	Notes, Ch. 2	
F September 27	*How do we prove something without directly proving it?* Proof by Contradiction Proof by Contrapositive	Notes, Ch. 2	PS1 Out
M September 30	*How do we reason about discrete structures?* Mathematical Induction	Notes, Ch. 3	PS1 Checkpoint Due
W October 2	*How can we model stepwise processes?* Variations on Induction	Notes, Ch. 3	
F October 4	*How can we model interconnected structures?* Graphs	Notes, Ch. 4	PS1 Due PS2 Out
M October 7	*How can we model how objects interrelate?* Relations	Notes, Ch. 5	PS2 Checkpoint Due
W October 9	*Can we prove results simply by counting?* The Pigeonhole Principle		
F October 11	*How do we reason about the sizes of infinite sets?* Functions Cardinality	Notes, Ch. 6	PS2 Due PS3 Out
M October 14	*What are the laws of mathematical reasoning?* Diagonalization Propositional Logic	Notes, Ch. 6	PS3 Checkpoint Due
W October 16	*How do we reason about collections of objects?* First-Order Logic I		
F October 18	*How do we precisely define what we mean?* First-Order Logic II		PS3 Due PS4 Out

Part Two: Computability Theory			
Date	**Topics**	**Readings**	**Assignments**
M October 21	*How do we mathematically model computers?* Introduction to Computability Theory DFAs	Sipser 1.1	PS4 Checkpoint Due
W October 23	*Does computation have to be deterministic?* NFAs Equivalence of DFAs and NFAs	Sipser 1.2	
F October 25	*Can we assemble programs out of smaller programs?* Closure Properties of Regular Languages Regular Expressions	Sipser 1.3	PS4 Due, PS5 Out
M October 28	*Can computers with finite memory solve all problems?* Equivalence of Regular Expressions and NFAs The Pumping Lemma for Regular Languages I	Sipser 1.4	
T October 29	**Midterm Exam** 7PM – 10PM, Location TBA		
W October 30	*How do you model computation with infinite memory?* The Pumping Lemma for Regular Languages II Pushdown Automata	Sipser 2.1	
F November 1	*How can we generate strings in a language?* Context-Free Grammars The Pumping Lemma for Context-Free Languages	Sipser 2.2	
M November 4	*How do we model realistic computers?* Turing Machines Designing Turing Machines	Sipser 2.3	PS5 Due, PS6 Out
W November 6	*How powerful is the Turing machine?* Nondeterministic Turing Machines The Church-Turing Thesis	Sipser 3.1	
F November 8	*What problems cannot be solved by computers?* The Universal Turing Machine An Unrecognizable Language	Sipser 3.2–3.3	
M November 11	*What problems admit no algorithmic solution?* Decidability Undecidability I	Sipser 4.2	PS6 Due, PS7 Out
W November 13	*What is the full scope of computing power?* Undecidability II co-Recognizability		
F November 15	*How are problems fundamentally related to each other?* Mapping Reductions I	Sipser 5.1	
M November 18	*What problems can be solved efficiently?* Mapping Reductions II Introduction to Complexity Theory	Sipser 5.3	PS7 Due, PS8 Out

Part Three: Complexity Theory			
Date	**Topics**	**Readings**	**Assignments**
W November 20	*When can we check answers easily?* **P** **NP**	Sipser 7.1–7.3	
F November 22	*Can we solve problems whose answers we can check?* **P** $\stackrel{?}{=}$ **NP** **NP**-Completeness	Sipser 7.4	
Thanksgiving Break			
M December 2	*How do we embed problems inside one another?* **NP**-Completeness	Sipser 7.5	PS8 Due, PS9 Out
W December 4	*Are all hard problems created equal?* Hardness of Approximation **NP**-Hardness and Cryptography		
F December 6	*How does all this fit together?* Where to Go from Here		PS9 Due *No Late Submissions*
M December 9	**Final Exam: 12:15PM – 3:15PM**, Location TBA		