CS103 Syllabus

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Part One: Discrete Mathematics			
Date	**Topics**	**Readings**	**Assignments**
M September 21	*Can computers solve all problems?* Set Theory The Limits of Computing	Notes, Ch. 1	
W September 23	*How do we prove results with certainty?* Direct Proofs	Notes, Ch. 2	
F September 25	*How do we prove something without directly proving it?* Proof by Contradiction Proof by Contrapositive	Notes, Ch. 2	PS1 Out
M September 28	*How can we formalize our reasoning?* Propositional Logic		PS1 Checkpoint Due
W September 30	*How can we reason about collections of objects?* First-Order Logic I		
F October 2	*How do we rigorously define our terms and definitions?* First-Order Logic II		PS1 Due PS2 Out
M October 5	*How do we model relationships between objects?* Binary Relations I Equivalence Relations	Notes, Ch. 5	PS2 Checkpoint Due
W October 7	*What does it mean to compare two objects?* Binary Relations II Order Relations	Notes, Ch. 5	
F October 9	*How do we model transformations between objects?* Functions Injections, Surjections, Bijections	Notes, Ch. 6	PS2 Due PS3 Out
M October 12	*Why does the quantity of an object matter?* Functions II Cardinality and Diagonalization	Notes, Ch. 6	PS3 Checkpoint Due
W October 14	*How do we model linked structures?* Graphs I Graph Connectivity	Notes, Ch. 4	
F October 16	*How "random" can large objects be?* Graphs II The Pigeonhole Principle	Notes, Ch. 4	PS3 Due PS4 Out

Date	Topics	Readings	Assignments
M October 19	*How do we model stepwise processes?* Mathematical Induction I	Notes, Ch. 3	PS4 Checkpoint Due
W October 21	*How do we model stepwise processes?* Mathematical Induction II	Notes, Ch. 3	
F October 23	*Fun and exciting discrete math topics!*		PS4 Due PS5 Out
Part Two: Computability Theory			
M October 26	*How do we mathematically model computers?* Formal Language Theory DFAs I	Sipser 1.1	
First Midterm Exam 7PM – 10PM, Location TBA Covers material from PS1 – PS3			
W October 28	*Does computation have to be deterministic?* DFAs II NFAs	Sipser 1.2	
F October 30	*How can we transform machines?* Equivalence of DFAs and NFAs Closure Properties of Regular Languages	Sipser 1.2	PS5 Due, PS6 Out
M November 2	*Can we generate new programs from old programs?* Regular Expressions Equivalence of Regular Expressions and NFAs	Sipser 1.3	
W November 4	*Can computers with finite memory solve all problems?* Nonregular Languages The Myhill-Nerode Theorem		
F November 6	*How do natural and formal languages overlap?* Context-Free Grammars Context-Free Languages	Sipser 2.1	PS6 Due PS7 Out
M November 9	*How do we model realistic computers?* Turing Machines Designing Turing Machines	Sipser 3.1	
W November 11	*How powerful are Turing machines?* The Church-Turing Thesis The Universal Turing Machine	Sipser 3.3	
F November 13	*What does it mean to solve a problem with a computer?* **R** and **RE** Languages The Recursion Theorem	Sipser 4.1 Sipser 6.1	PS7 Due, PS8 Out
M November 16	*How do proofs relate to computability?* Undecidability	Sipser 4.2	
Second Midterm Exam 7PM – 10PM, Location TBA Covers material from PS4 – PS6			

Date	Topics	Readings	Assignments
W November 18	*What is the full scope of computing power?* Verifiers Verifiers and **RE** Languages		
F November 20	*What are the hardest problems computers can touch?* Unrecognizable Languages		PS8 Due, PS9 Out
	Thanksgiving Break		
Part Three: Intro to Complexity Theory			
M November 30	*How do we measure the difficulty of problems?* The **P** versus **NP** Question **NP**-Completeness I	Sipser 7.2 Sipser 7.3	
W December 2	*What makes hard problems hard?* **NP**-Completeness II	Sipser 7.4	
F December 4	*How does everything fit together?* The Big Picture Where to Go from Here		PS9 Due *No late submissions*
W December 9	**Final Exam: 3:30PM – 6:30PM** Location TBA Cumulative final exam, slightly focused on material from PS7 – PS9		