CS103 Syllabus

Part One: Discrete Mathematics			
Date	**Topics**	**Readings**	**Assignments**
M March 30	*Can computers solve all problems?* Set Theory The Limits of Computing	Notes, Ch. 1	
W April 1	*How do we prove results with certainty?* Direct Proofs	Notes, Ch. 2	
F April 3	*How do we prove something without directly proving it?* Proof by Contradiction Proof by Contrapositive	Notes, Ch. 2	PS1 Out
M April 6	*How do we reason about discrete structures?* Mathematical Induction I	Notes, Ch. 3	PS1 Checkpoint Due
W April 8	*How can we model stepwise processes?* Mathematical Induction II	Notes, Ch. 3	
F April 10	*How can we formalize our reasoning?* Propositional Logic		PS1 Due PS2 Out
M April 13	*How can we reason about collections of objects?* First-Order Logic I		PS2 Checkpoint Due
W April 15	*How do we rigorously define our terms and definitions?* First-Order Logic II		
F April 17	*How do we model linked structures?* Graphs	Notes, Ch. 4	PS2 Due PS3 Out
M April 20	*How do we model how objects relate to one another?* Binary Relations	Notes, Ch. 5	PS3 Checkpoint Due
W April 22	*How do we model transformations between objects?* Functions Cardinality	Notes, Ch. 6	
F April 24	*Why does the quantity of an object matter?* Diagonalization The Pigeonhole Principle	Notes, Ch. 6	PS3 Due PS4 Out

Part Two: Computability Theory			
Date	**Topics**	**Readings**	**Assignments**
M April 27	*How do we mathematically model computers?* Formal Language Theory DFAs I	Sipser 1.1	PS4 Checkpoint Due
W April 29	*Does computation have to be deterministic?* DFAs II NFAs	Sipser 1.2	
Th April 30	**Midterm I** 7PM – 10PM, Location TBA Covers material from PS1 – PS3		
F May 1	*Can we generate new programs from old programs?* Equivalence of DFAs and NFAs Closure Properties of Regular Languages	Sipser 1.2	
M May 4	*Can we build all programs out of smaller programs?* Regular Expressions Equivalence of Regular Expressions and NFAs	Sipser 1.3	PS4 Due, PS5 Out
W May 6	*Can computers with finite memory solve all problems?* Nonregular Languages The Myhill-Nerode Theorem		
F May 8	*How do natural and formal languages overlap?* Context-Free Grammars Context-Free Languages	Sipser 2.1	
M May 11	*How do we model realistic computers?* Turing Machines Designing Turing Machines	Sipser 3.1	PS5 Due, PS6 Out
W May 13	*How powerful are Turing machines?* The Church-Turing Thesis The Universal Turing Machine	Sipser 3.2	
F May 15	*What does it mean to solve a computational problem?* **R** and **RE** Languages Algorithms and Semialgorithms		
M May 18	*How do proofs relate to computability?* Verifiers and NTMs Mathematical Proof and Computability		PS6 Due, PS7 Out
W May 20	*What is the full scope of computing power?* The Recursion Theorem Undecidable Problems	Sipser 4.2 Sipser 6.1	
Th May 21	**Midterm II** 7PM – 10PM, Location TBA Covers material from PS1 – PS6, weighted toward material on PS4 – PS6		
F May 22	*What are the hardest problems we can touch?* Unrecognizable Languages Intro to Complexity Theory	Sipser 7.1	

Part Three: Complexity Theory			
Date	**Topics**	**Readings**	**Assignments**
M May 25	**Memorial Day** **No Class**		
W May 27	*How do we measure the difficulty of problems?* The Complexity Class **P** The Complexity Class **NP**	Sipser 7.2 Sipser 7.3	PS7 Due, PS8 Out
F May 29	*How can we link problems together?* Reducibility **NP**-Completeness	Sipser 7.4	
M June 1	*How do we embed problems inside one another?* **NP**-Completeness Reductions	Sipser 7.5	
W June 3	*How does everything fit together?* The Big Picture Where to Go from Here		PS8 Due *No Late Submissions*
M June 8	**Final Exam: 8:30AM – 11:30AM** Location TBA Cumulative final exam, slightly focused on material from PS7 – PS8		