CS103 Syllabus

Part One: Discrete Mathematics			
Date	**Topics**	**Readings**	**Assignments**
M April 3	*Can computers solve all problems?* Set Theory The Limits of Computing	Notes, Ch. 1 Handouts Online Guides	
W April 5	*How do we prove results with certainty?* Direct Proofs	Notes, Ch. 2 Handouts	
F April 7	*How do we prove something without directly proving it?* Proof by Contradiction Proof by Contrapositive	Notes, Ch. 2 Handouts	PS1 Out
M April 10	*How can we formalize our reasoning?* Propositional Logic		PS1 Checkpoint Due
W April 12	*How can we reason about collections of objects?* First-Order Logic I		
F April 14	*How do we rigorously define key terms?* First-Order Logic II	Handouts Online Guides	PS1 Due PS2 Out
M April 17	*How do we model relationships between objects?* Binary Relations Equivalence Relations	Notes, Ch. 5	PS2 Checkpoint Due
W April 19	*What does it mean to compare two objects?* Strict Order Relations	Notes, Ch. 5	
F April 21	*How do we model transformations and associations?* Functions Injections, Surjections, and Bijections	Notes, Ch. 6	PS2 Due PS3 Out
M April 24	*How do we reason about infinity?* Cardinality Diagonalization	Notes, Ch. 6 Online Guides	PS3 Checkpoint Due
W April 26	*How do we model network structures?* Graphs, Part I	Notes, Ch. 4	
F April 28	*Is disorder truly possible at a large scale?* Graphs, Part II The Pigeonhole Principle	Notes, Ch. 4	PS3 Due PS4 Out

Date	Topics	Readings	Assignments
M May 1	*How can we reason about sequential processes?* Mathematical Induction, Part I	Notes, Ch. 3	PS4 Checkpoint Due
T May 2	***First Midterm Exam*** 7:00PM – 10:00PM, Location TBA Covers material from PS1 – PS2		
W May 3	*How does recursion relation to mathematical proof?* Mathematical Induction, Part II	Notes, Ch. 3 Handouts	
Part Two: Computability Theory			
F May 5	*How do we mathematically model computers?* Formal Language Theory DFAs I	Sipser 1.1	PS4 Due PS5 Out
M May 8	*What happens if computation involves choices?* DFAs II NFAs	Sipser 1.2	
W May 10	*How can we transform machines?* Equivalence of DFAs and NFAs Closure Properties of Regular Languages	Sipser 1.2	
F May 12	*Can we generate new programs from old programs?* Regular Expressions Equivalence of Regular Expressions and NFAs	Sipser 1.3	PS5 Due PS6 Out
M May 15	*Can computers with finite memory solve all problems?* Nonregular Languages The Myhill-Nerode Theorem		
W May 17	*How do natural and formal languages overlap?* Context-Free Grammars Context-Free Languages	Sipser 2.1	
F May 19	*How do we model realistic computers?* Turing Machines Designing Turing Machines	Sipser 3.1	PS6 Due PS7 Out
M May 22	*How powerful are Turing machines?* The Church-Turing Thesis	Sipser 3.3	
T May 23	***Second Midterm Exam*** 7:00PM – 10:00PM, Location TBA Covers material from PS3 – PS5		
W May 24	*What does it mean to solve a problem with a computer?* **R** and **RE** Languages The Universal Turing Machine	Sipser 4.1 Sipser 6.1	
F May 26	*What is the limit of algorithmic problem-solving?* The Recursion Theorem Undecidability	Sipser 4.2	PS7 Due PS8 Out
M May 29	***Memorial Day*** ***No Class***		

Date	Topics	Readings	Assignments
W May 31	*What is the full scope of computing power?* Verifiers Unrecognizability	Online Guides	
Part Three: Intro to Complexity Theory			
F June 2	*How do we measure the difficulty of problems?* The **P** versus **NP** Question **NP**-Completeness I	Sipser 7.2 Sipser 7.3	PS8 Due PS9 Out
M June 5	*What makes hard problems hard?* **NP**-Completeness II	Sipser 7.4	
W June 7	*How does everything fit together?* The Big Picture Where to Go from Here		PS9 Due *No late submissions*
F June 9	***Final Exam: 3:30PM – 6:30PM*** Location TBA Cumulative final exam, but focused on material from PS6 – PS9		