

## CS103 Syllabus

<i>Part One: Discrete Mathematics</i>			
Date	Topics	Readings	Assignments
Monday, September 24	<i>Can computers solve all problems?</i> Set Theory The Limits of Computing	Notes, Ch. 1 Handouts Online Guides	PS0 Out
Wednesday, September 26	<i>How do we prove results with certainty?</i> Direct Proofs	Notes, Ch. 2 Handouts	
Friday, September 28	<i>How do we prove something without directly proving it?</i> Proof by Contradiction Proof by Contrapositive	Notes, Ch. 2 Handouts	PS0 Due PS1 Out
Monday, October 1	<i>How can we formalize our reasoning?</i> Propositional Logic		PS1 Checkpoint Due
Wednesday, October 3	<i>How can we reason about collections of objects?</i> First-Order Logic, Part I		
Friday, October 5	<i>How do we rigorously define key terms?</i> First-Order Logic, Part II	Handouts Online Guides	PS1 Due PS2 Out
Monday, October 8	<i>How do we model relationships between objects?</i> Binary Relations Equivalence Relations	Notes, Ch. 5	PS2 Checkpoint Due
Wednesday, October 10	<i>What does it mean to compare two objects?</i> Fundamental Theorem of Equivalence Relations Strict Order Relations	Notes, Ch. 5	
Friday, October 12	<i>How do we model transformations and associations?</i> Functions Injections, Surjections, and Bijections	Handouts Notes, Ch. 6	PS2 Due PS3 Out
Monday, October 15	<i>How do we reason about infinity?</i> Cardinality Diagonalization	Notes, Ch. 6 Online Guides	PS3 Checkpoint Due
Wednesday, October 17	<i>How do we model network structures?</i> Graphs Paths, Cycles, and Connectivity	Notes, Ch. 4	
Friday, October 19	<i>Is disorder truly possible at a large scale?</i> The Pigeonhole Principle Ramsey-Type Results	Notes, Ch. 4	PS3 Due PS4 Out
Monday, October 22	<b><i>First Midterm Exam (No Class)</i></b> 7:00PM – 10:00PM, Location TBA Covers topics from PS0 – PS2.		

<b>Date</b>	<b>Topics</b>	<b>Readings</b>	<b>Assignments</b>
Wednesday, October 24	<i>How can we reason about sequential processes?</i> Mathematical Induction	Notes, Ch. 3	
Friday, October 26	<i>How does recursion relation to mathematical proof?</i> Variations on Induction Complete Induction	Notes, Ch. 3 Handouts	PS4 Due PS5 Out
<b>Part Two: Computability Theory</b>			
Monday, October 29	<i>How do we mathematically model computers?</i> Formal Language Theory DFAs	Sipser 1.1	
Wednesday, October 31	<i>What happens if computation involves choices?</i> Regular Languages NFAs	Sipser 1.2	
Friday, November 2	<i>How can we transform machines?</i> Equivalence of DFAs and NFAs Closure Properties of Regular Languages	Sipser 1.2	PS5 Due PS6 Out
Monday, November 5	<i>Can we generate new programs from old programs?</i> Regular Expressions Equivalence of Regular Expressions and NFAs	Sipser 1.3	
Wednesday, November 7	<i>Can computers with finite memory solve all problems?</i> Nonregular Languages The Myhill-Nerode Theorem		
Friday, November 9	<i>How do natural and formal languages overlap?</i> Context-Free Grammars Context-Free Languages	Sipser 2.1	PS6 Due PS7 Out
Monday, November 12	<b>Second Midterm Exam (No Class)</b> 7:00PM – 10:00PM, Location TBA Covers topics from PS3 – PS5.		
Wednesday, November 14	<i>How do we model realistic computers?</i> Turing Machines Designing Turing Machines	Sipser 3.1	
Friday, November 16	<i>How powerful are Turing machines?</i> The Church-Turing Thesis	Sipser 3.3	PS7 Due PS8 Out
<b>Thanksgiving Break</b> November 19 – 23 No Class			
Monday, November 26	<i>What does it mean to solve a problem with a computer?</i> <b>R</b> and <b>RE</b> Languages The Universal Turing Machine	Sipser 4.1, 4.2	
Wednesday, November 28	<i>What is the limit of algorithmic problem-solving?</i> Self-Reference Undecidability	Sipser 6.1	
Friday, November 30	<i>What is the full scope of computing power?</i> Verifiers Unrecognizability	Online Guides	PS8 Due PS9 Out

Date	Topics	Readings	Assignments
<b><i>Part Three: Complexity Theory</i></b>			
Monday, December 3	<i>How do we measure the difficulty of problems?</i> The <b>P</b> versus <b>NP</b> Question Reducibility, Part I	Sipser 7.2 Sipser 7.3	
Wednesday, December 5	<i>What makes hard problems hard?</i> Reducibility, Part II <b>NP</b> -Completeness	Sipser 7.4	
Friday, December 7	<i>How does everything fit together?</i> The Big Picture Where to Go from Here		PS9 Due <i>No late submissions</i>
Monday, December 10	<b><i>Final Exam</i></b> 3:30PM – 6:30PM, Location TBA Covers Topics from PS0 – PS9		