

# CS 325 – Analysis of Algorithms

Spring 2013

## Course Topics, tentative Schedule, and Coursework list

Last updated 28 March, 2013.

Note: the school is closed May 27 to observe Memorial Day

Discussion and projects will generally be due by 23:59 (Pacific Time Zone) of the day they are due.

Discussion and projects will each have their own length of time expected to be completed in.

**In the important notes column, discussions are denoted with a D and projects with a P**

Important Notes	Course Topics
	Review as needed to get ready for class
<b>Unit #0</b>  <b>Become familiar with binary search, doubling search, and merge sort</b>	<ul style="list-style-type: none"> <li>Lectures: <ul style="list-style-type: none"> <li>Course designer <a href="#">video introduction</a>,</li> <li><a href="#">Binary example</a>,</li> <li><a href="#">Interactive questions</a>,</li> <li><a href="#">Doubling search</a>,</li> <li><a href="#">Doubling search pseudocode</a>,</li> <li><a href="#">Animation of recursive merge sort</a>,</li> </ul> </li> <li>Reading: <a href="#">Section 2.2 of Algorithms by Sedgewick and Wayne</a></li> <li>Practice: play <a href="#">Robozzle</a>, after getting used to the game try puzzles <a href="#">330</a>, <a href="#">536</a>, <a href="#">656</a>, and <a href="#">1033</a>,</li> </ul>
<b>Unit #1, Week #1</b>  <b>01 April to 07 April</b>  <b>P0 assigned and due</b> <b>D1.1 assigned</b>	Is it correct?: by induction <ul style="list-style-type: none"> <li><b>Preparation</b> <ul style="list-style-type: none"> <li>Reading: <a href="#">JEL “98 Introduction”</a></li> <li>Khan academy: <a href="#">Proof by Induction</a>,</li> <li>Video: <a href="#">Depth of a Perfect Binary Tree with n Leaves</a>,</li> <li>PDF: <a href="#">Formal Proof</a>,</li> <li>Interactive Tutorial: <a href="#">Induction</a>,</li> <li>Lecture: <a href="#">Merge Sort Correctness</a>,</li> </ul> </li> <li><b>Assigned Coursework:</b> <ul style="list-style-type: none"> <li>Project0 (TEACH access) assigned, due 05 April,</li> <li>Discussion-based practice questions 1.1, due 14 April: <ul style="list-style-type: none"> <li><b>Question: water-gun induction</b>,</li> <li><b>Question: internal nodes and leaves</b>,</li> </ul> </li> </ul> </li> </ul>
<b>Unit #1, Week #2</b>  <b>08 April to 14 April</b>  <b>D1.2 assigned</b>  <b>D1.1 due</b>	Is it correct?: by contradiction <ul style="list-style-type: none"> <li><b>Preparation</b> <ul style="list-style-type: none"> <li>Reading: <a href="#">Section 5.1 of DPV</a>,</li> <li>Interactive Tutorial: <a href="#">Contradiction</a>,</li> <li>Video: <a href="#">MST correctness</a>,</li> <li>Video: <a href="#">Boruvka algorithm</a>,</li> </ul> </li> <li><b>Assigned Coursework:</b> <ul style="list-style-type: none"> <li>Discussion-based practice questions 1.2, due 21 April: <ul style="list-style-type: none"> <li><b>Question: unique MST</b>,</li> <li><b>Question: question 5.9 from DPV (on page 162 of <a href="#">Chapter 5 of DPV</a>)</b>,</li> </ul> </li> </ul> </li> </ul>
	Run-time Analysis

<p><b>Unit #2, Week #3</b></p> <p>15 April to 21 April</p> <p>P1 assigned D2.1 assigned D2.2 assigned</p> <p>D1.2 due</p>	<ul style="list-style-type: none"> <li>• <b>Project One:</b> <a href="#">Max Subarray</a>, due 28 April,</li> <li>• <b>Preparation</b> <ul style="list-style-type: none"> <li>◦ Video: <a href="#">Plotting in Matlab – loglogplots</a>,</li> </ul> </li> <li>• <b>Assigned Coursework:</b> <ul style="list-style-type: none"> <li>◦ Discussion-based observations: <ul style="list-style-type: none"> <li>▪ Observe run-time plots of other project submissions</li> </ul> </li> </ul> </li> <li>• <b>More Preparation</b> <ul style="list-style-type: none"> <li>◦ Reading: <a href="#">Chapter 0 of DPV</a>,</li> <li>◦ Khan Academy: <a href="#">Logarithms</a>,</li> <li>◦ Interactive Tutorial: <a href="#">Big Oh</a>,</li> <li>◦ <a href="#">Summary of Asymptotic Notation</a>,</li> <li>◦ Video: <a href="#">big-Oh vs. big-Theta</a>,</li> </ul> </li> <li>• <b>More Assigned Coursework:</b> <ul style="list-style-type: none"> <li>◦ Discussion-based practice questions 2.2, due 28 April: <ul style="list-style-type: none"> <li>▪ Question: Show <math>\log(n!) = \Theta(n \log n)</math>,</li> <li>▪ Question: Show <math>\sum_{i=1}^n (1/i) = \Theta(\log n)</math>,</li> </ul> </li> </ul> </li> </ul>
<p><b>Unit #3, Week #4</b></p> <p>22 April to 28 April</p> <p>D3.1 assigned</p> <p>D2.1, D2.2, and P1 due</p>	<p>Recurrence Relations and Divide and Conquer</p> <ul style="list-style-type: none"> <li>• <b>Preparation</b> <ul style="list-style-type: none"> <li>◦ Reading: <a href="#">JEL Section 3</a>,</li> <li>◦ Video: <a href="#">Make Postage Recurrence</a>,</li> <li>◦ Video: <a href="#">Binary Search Recurrence</a>,</li> <li>◦ Read: <a href="#">JEL 1.5-1.8</a>,</li> <li>◦ Video: <a href="#">Recursive Multiplication</a>,</li> <li>◦ Khan Academy: <a href="#">Computing a Geometric Series</a>,</li> <li>◦ Interactive Tutorial: <a href="#">Power Series</a>,</li> <li>◦ Video: <a href="#">Finishing Up Recursive Multiplication</a>,</li> <li>◦ Interactive Tutorial: <a href="#">General Recurrence</a>,</li> </ul> </li> <li>• <b>Assigned Coursework:</b> <ul style="list-style-type: none"> <li>◦ Discussion-based practice questions 3.1, due 05 May: <ul style="list-style-type: none"> <li>▪ Question: 2.5 from DPV (on p83 of <a href="#">Chapter 2 of DPV</a>), (All of the parts, rather than just parts a and b)</li> <li>▪ Questions related to STOOGESORT,</li> <li>▪ Question about some binary tree orderings,</li> <li>▪ Question related to Tree-ify (pre, post) algorithm,</li> <li>▪ Anything else to say about Project 1</li> </ul> </li> </ul> </li> </ul>
<b>Midterm</b>	<b>Be sure to schedule your exam to be taken sometime during week 5</b>
<p><b>Unit #4, Week #5</b></p> <p>29 April to 05 May</p> <p>P2 assigned and due D4 assigned</p> <p>D3.1 and P2 due</p>	<p>Dynamic Programming</p> <ul style="list-style-type: none"> <li>• <b>Project2</b> <a href="#">Dynamic Programming for Max Subarray</a>, due 12 May</li> <li>• <b>Preparation</b> <ul style="list-style-type: none"> <li>◦ Video: <a href="#">Introduction to DP Video</a>,</li> <li>◦ Reading: <a href="#">Longest common substring problem</a>,</li> <li>◦ Interactive Tutorial: <a href="#">Fibonacci DP</a>,</li> <li>◦ Read: <a href="#">DPV Chapter 6</a> (6.2),</li> <li>◦ Interactive Tutorial: <a href="#">Longest Increasing Sequence</a>,</li> <li>◦ Video: <a href="#">LIS Run Time Top Down</a>,</li> <li>◦ Read: <a href="#">DPV Chapter 6</a> (6.4),</li> </ul> </li> <li>• <b>Assigned Coursework:</b> <ul style="list-style-type: none"> <li>◦ Discussion-based practice questions 4, due 12 May: <ul style="list-style-type: none"> <li>▪ Question about longest increasing subsequence,</li> <li>▪ Question about modified knapsack,</li> <li>▪ Question about dynamic programming for a specific task,</li> </ul> </li> </ul> </li> </ul>
	Linear Programming

<div>Unit #5, Week #6</div> <div>06 May to 12 May</div> <div>P3 assigned</div> <div>D5 assigned</div> <div>D4 due</div>	<div><ul style="list-style-type: none"><li>• <b>Project3 Linear Programming, due 19 May,</b></li><li>• <b>Preparation</b><ul style="list-style-type: none"><li>○ Read: <a href="#">Section 7.1 of DPV</a>,</li><li>○ Interactive Tutorial: <a href="#">Simple LP</a>,</li><li>○ Document: <a href="#">Bicycle-Problem PDF</a>,</li><li>○ Video: <a href="#">Bicycle Problem Setup</a>,</li><li>○ Video <a href="#">Bicycle Problem Matlab</a>,</li><li>○ Video: <a href="#">Bicycle Problem Polyhedron</a>,</li></ul></li><li>• <b>Assigned Coursework:</b><ul style="list-style-type: none"><li>○ Discussion-based practice questions 5, due 19 May:<ul style="list-style-type: none"><li>▪ Consider a couple problems (problems 1 and 2)</li></ul></li></ul></li><li>• <b>More Preparation:</b><ul style="list-style-type: none"><li>○ Read: Section 7.2 of DPV,</li><li>○ Video: Shortest Paths LP,</li></ul></li><li>• More Assigned Coursework:<ul style="list-style-type: none"><li>○ More discussion-based practice questions 5, due 19 May:<ul style="list-style-type: none"><li>▪ Exercise 7.2 in Algorithms (problem 3 on the forums),</li><li>▪ Exercise 7.29 in Algorithms (problem 4 on the forums),</li></ul></li></ul></li></ul></div>
<div>Unit #6, Week #7</div> <div>13 May to 19 May</div> <div>P4 assigned</div> <div>D6.1 assigned</div>	<div>Computational Complexity: Complexity classes</div> <div><ul style="list-style-type: none"><li>• <b>Project 4 <a href="#">Traveling Salesperson Problem</a> (TSP), due 02 June</b></li><li>• <b>Preparation</b><ul style="list-style-type: none"><li>○ Video: <a href="#">Intro to Complexity</a>,</li><li>○ Read: <a href="#">Undecidable Problems</a>,</li><li>○ Read: <a href="#">An Undecidable Problem, the Halting Problem</a>,</li><li>○ Read: <a href="#">Story of Sissa and Moore-Chapter 8 of DPV</a>,</li><li>○ Interactive Tutorial: <a href="#">Polynomial Time and Exponential Time</a>,</li><li>○ Read: <a href="#">Sorting Lower Bound-Chapter 2 of DPV</a>,</li><li>○ Video: <a href="#">Sorting Lower Bound</a>,</li><li>○ Video: <a href="#">Non-Determinism, Certificates, NP and PvsNP</a>,</li><li>○ Video: <a href="#">Overview of P, NP, computable, TM, etc-Venn diagram</a>,</li></ul></li><li>• <b>Assigned Coursework:</b><ul style="list-style-type: none"><li>○ Discussion-based practice questions 6.1, due 26 May:<ul style="list-style-type: none"><li>▪ Exercise 2.2 in DPV,</li><li>▪ Show that some problems are in NP,</li></ul></li></ul></li></ul></div>
<div>Unit #6, Week #8</div> <div>20 May to 26 May</div> <div>D6.2 assigned</div> <div>D6.1 due</div>	<div>Computational Complexity: NP-completeness and reductions</div> <div><ul style="list-style-type: none"><li>• <b>Preparation</b><ul style="list-style-type: none"><li>○ Video: <a href="#">A working definition of NP-hard</a>,</li><li>○ Read: <a href="#">Section 29.3 and 29.5 of JEL</a>,</li><li>○ Video: <a href="#">Reduction</a>,</li><li>○ Interactive Tutorial: <a href="#">Decision Search Optimization</a>,</li><li>○ Read: <a href="#">DPV Chapter 8</a>,</li><li>○ Interactive Tutorial: <a href="#">NP v NP-hard</a>,</li><li>○ Video: <a href="#">TSP is NP-hard</a>,</li></ul></li><li>• <b>Assigned Coursework:</b><ul style="list-style-type: none"><li>○ Discussion-based practice questions 6.2, due 02 June:<ul style="list-style-type: none"><li>▪ Question about Experimental cuisine,</li><li>▪ Exercise 8.10 in DPV,</li></ul></li></ul></li></ul></div>
<div>Unit #6, Week #9</div> <div>27 May to 02 June</div> <div>D6.2 and P4 due</div>	<div>Computational Complexity: Project four: TSP</div> <div><ul style="list-style-type: none"><li>• Complete work on unit 6 materials,</li><li>• Complete TSP project,</li></ul></div>
	<div>Review and complete project four (TSP)</div>

Unit #7, Week #10 03 June to 09 June	<ul style="list-style-type: none"> <li>• Review for final exam,</li> <li>• Discuss topics, discussion questions, and projects,</li> <li>• Possible alterations to TSP may be allowed.</li> </ul>
Final	Schedule your exam to be taken sometime between 08 June and 12 June.