

<b>Program and Course Code</b>	Computing & Information Science CIS507
<b>Course Title</b>	Design and Analysis of Algorithms
<b>Credit Hours</b>	3
<b>Instructor</b>	Iyad Rahwan
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<b>Office Hours</b>	TBA
<b>Bulletin Course Description</b>	This is an advanced programming course, focusing on techniques for the design and analysis of efficient algorithms, emphasizing methods useful in practice. Topics include sorting; search trees, heaps, and hashing; divide-and-conquer; dynamic programming; greedy algorithms; graph algorithms; and shortest paths. Advanced topics may include network flow; approximation algorithms; and NP-completeness.
<b>Pre-requisites</b>	Knowledge of computer programming; undergraduate algorithms and data structures; undergraduate discrete mathematics; basic probability theory.
<b>Co-requisites</b>	None
<b>Course Objectives (Learning Outcomes of the Course)</b>	<ul style="list-style-type: none"> <li>(i) Describe and use major algorithmic techniques (divide-and-conquer, dynamic programming, linear programming, greedy paradigm, graph algorithms) and cite problems for which each technique is suitable;</li> <li>(ii) Argue the correctness of algorithms using inductive proofs and loop invariants;</li> <li>(iii) Evaluate and compare different algorithms using worst-, average-, and best-case analysis.</li> <li>(iv) Explain the difference between tractable and intractable problems, and identify the basic complexity classes, such as P, NP and NP-complete;</li> <li>(v) Use reduction techniques between algorithmic problems;</li> <li>(vi) Explain the basic properties of randomized algorithms and methods for analyzing them.</li> </ul>

<b>Week</b>	<b>Course Topics and Contents</b>
<b>1</b>	Review: Asymptotic notation, elementary data structures
<b>2</b>	Review: Divide-and-conquer, Search
<b>3</b>	Review: Sorting (Heap sort, Quick sort, Priority queues,

	Counting sort)
<b>4</b>	More sorting and searching
<b>5</b>	Hashing
<b>6</b>	Shortest path algorithms
<b>7</b>	Randomized Algorithms
<b>8</b>	Mid-semester break
<b>9</b>	Greedy algorithms
<b>10</b>	Dynamic Programming
<b>11</b>	Max flow min cut, and matching algorithms
<b>12</b>	Linear Programming
<b>13</b>	NP, P, and NP-Completeness
<b>14</b>	NP-Complete problems
<b>15</b>	Approximation algorithms and inapproximability
<b>16</b>	Final Exam

<b>Relationship of course objectives to program outcomes</b>	
<b>Program Outcome 1</b>	Use and apply current technical concepts and practices in core computing and information technologies.
<b>Program Outcome 2</b>	Analyze a problem, and identify and define the computing requirements appropriate to its solution.
<b>Program Outcome 3</b>	Design, implement, and evaluate computer-based systems, processes, components, and programs both in teams and individually to meet desired outcomes.

<b>Course Grading</b>	
<b>A mid-term exam</b>	20 %
<b>A final exam</b>	40 %
<b>Four home work assignments</b>	10 % each
<b>Total</b>	100 %

<b>Assignment</b>	<b>Handed</b>	<b>Due</b>	<b>Topic</b>
1	Week 3	Week 5	E.g. Asymptotic analysis
2	Week 5	Week 7	E.g. Sorting and searching
3	Week 9	Week 10	E.g. Randomized algorithms
4	Week 13	Week 15	E.g. Linear and dynamic programming

<b>Class/Laboratory schedule and Methodology</b>	
<b>Class</b>	The class meets 15 weeks, 2 lectures per week, 90 minutes each.

<b>Laboratory</b>	
<b>Teaching and learning methodologies</b>	A combination of white board use, Power-point slide presentation, and interactive class discussions to encourage student participation and enhance the learning.

<b>Course Materials</b>	
<b>Textbooks</b>	T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein. <i>Introduction to Algorithms</i> . MIT Press, 3rd Edition, 2009
<b>Recommended Readings</b>	<ul style="list-style-type: none"> <li>• S. Skiena. <i>The Algorithm Design Manual</i>. Springer, 2nd edition, 2008</li> <li>• J. Kleinberg and E. Tardos. <i>Algorithm Design</i>. Addison Wesley, 2005</li> <li>• S. Dasgupta, C. Papadimitriou, and U. Vazirani. <i>Algorithms</i>. McGraw-Hill, 2006</li> <li>• M. T. Goodrich and R. Tamassia. <i>Data Structures and Algorithms in Java</i>. Wiley, 5<sup>th</sup> edition, 2010</li> <li>• J. Edmonds. <i>How to Think About Algorithms</i>. Cambridge University Press, 2008</li> <li>• M. R. Garey and D. S. Johnson. <i>Computers and Intractability: A Guide to the Theory of NP-Incompleteness</i>. V. H. Freeman, 1979</li> <li>• O. Goldreich. <i>Computational Complexity: A Conceptual Perspective</i>. Cambridge University Press, 2008</li> <li>• C. H. Papadimitriou. <i>Computational Complexity</i>. Addison Wesley, 1993</li> <li>• S. Arora and B. Barak. <i>Computational Complexity: A Modern Approach</i>. Cambridge University Press, 2009</li> </ul>
<b>Instructional material and resources</b>	