Program and Course Code	Computing & Information Science CIS507
Course Title	Design and Analysis of Algorithms
Credit Hours	3
Instructor	Iyad Rahwan
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Office Hours	TBA
Bulletin Course Description	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.
Pre-requisites	Knowledge of computer programming; undergraduate algorithms and data structures; undergraduate discrete mathematics; basic probability theory.
Co-requisites	None
Course Objectives (Learning Outcomes of the Course)	(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; (ii) Argue the correctness of algorithms using inductive proofs and loop invariants; (iii) Evaluate and compare different algorithms using worst-, average-, and best-case analysis. (iv) Explain the difference between tractable and intractable problems, and identify the basic complexity classes, such as P, NP and NP-complete; (v) Use reduction techniques between algorithmic problems; (vi) Explain the basic properties of randomized algorithms and methods for analyzing them.

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

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

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

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

Assignment	**Handed**	**Due**	**Topic**
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

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

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

Course Materials	
Textbooks	T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein. Introduction to Algorithms. MIT Press, 3rd Edition, 2009
Recommended Readings	• S. Skiena. *The Algorithm Design Manual. Springer*, 2nd edition, 2008 • J. Kleinberg and E. Tardos. *Algorithm Design*. Addison Wesley, 2005 • S. Dasgupta, C. Papadimitriou, and U. Vazirani. *Algorithms*. McGraw-Hill, 2006 • M. T. Goodrich and R. Tamassia. *Data Structures and Algorithms in Java*. Wiley, 5th edition, 2010 • J. Edmonds. *How to Think About Algorithms*. Cambridge University Press, 2008 • M. R. Garey and D. S. Johnson. *Computers and Intractability: A Guide to the Theory of NP-Incompleteness*. V. H. Freeman, 1979 • O. Goldreic. *Computational Complexity: A Conceptual Perspective*. Cambridge University Press, 2008 • C. H. Papadimitriou. *Computational Complexity*. Addison Wesley, 1993 • S. Arora and B. Barak. *Computational Complexity: A Modern Approach*. Cambridge University Press, 2009
Instructional material and resources	