Global Learning Semesters
Course Syllabus
Course: COMP-611 Algorithms and Computational Complexity
Department: Computer Science
Host Institution: University of Nicosia, Nicosia, Cyprus

Course Summary		
Course Code	**Course Title**	**Recommended Credit Hours**
COMP-611	Algorithms and Computational Complexity	4
Semester Offered	**Contact Hours**	**Prerequisites**
Please contact us	42-45	Students are expected to have undergraduate-level knowledge of programming, Data Structures, Algorithms, Discrete Mathematics. Basic knowledge of probability theory is an added advantage. Referring to the Computer Science undergraduate-level courses offered at Intercollege, the students are expected to have covered the syllabus of the following: COMP-255 C++ Language Programming or COMP-511 Initial Programming, COMP-301 Data Structures or COMP-516 Data Structures and Algorithms and MATH-340 Discrete Mathematics or COMP-513 Mathematics for Computer Science.
Department	**Level of Course**	**Language of Instruction**
Computer Science	Upper Division	English

Course Description

This course is designed for graduate students pursuing a Master's degree in Computer Science. The aim of this course is to provide both a critical study of theory and research related to advanced topic areas of algorithms and an introduction to the computational complexity. Topic areas include uncertain: advance data structures, divide-and-conquer algorithms, dynamic programming, greedy algorithms, backtracking algorithms, randomized algorithms, NP-Completeness, approximation algorithms.

Prerequisites

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Topic Areas

1. Introduction and Mathematical Foundations
   Algorithms. Asymptotic notation. Recurrences.
2. Tree Structures for Dynamic Dictionaries
   AVL Trees. 2-3 Trees and B-Trees
3. Divide-and-Conquer Algorithms
   Strassen's algorithm for matrix multiplication

4. Dynamic Programming
   Matrix-chain multiplication. Longest common subsequence. Optional polygon triangulation
5. Greedy Algorithms
   Theoretical foundations for greedy methods. A task-scheduling problem.
6. Backtracking Algorithms
   The stable marriage problem.
7. Randomized Algorithms
   Introduction to tools and techniques. Moments and Deviations. Tail Inequalities. The Probabilistic method. Markov Chain. Algebraic techniques.
8. NP-Completeness
   Polynomial-time verification. NP-completeness and reducibility. NP-completeness proofs. NP-complete problems.
9. Approximation Algorithms.
   Linear Programming relaxation. Covering and Partitioning Problems: set cover, vertex cover, independent set. Geometric problems: traveling salesman problem.
10. Selected topics.
    On-line algorithms (a brief introduction). The vertex colouring problem.

Course Assessment

Students will be assessed through a series of weekly assignments, semester project and presentation, a midterm and a final exam. The percentages contributing to the final grade are as follows:

Weekly Assignments:	10%
Project Work:	20%
Midterm Exam:	20%
Final Exam:	50%

Description of course assessment:

Weekly assignments: These will consist of non-programming questions/exercises based on the chapter covered during that week.

Project work: These will consist of non-programming exercises with a 5-week deadline projects. The students have to:

- Provide algorithms to solve problems given in the exercises of the project. They have to design and analyse the performance of their algorithms.
- Find in the internet/library and study algorithms that are already known and solve problems given in the exercises and finally they have to write a report presenting these algorithms.
- study papers given by the instructor and present them.

Midterm exam: It will contain the material covered up to the time of the midterm.

Final Examination: This examination will be comprehensive and it will include all the material covered throughout the semester.

Readings and Resources

Required Textbooks

1. Introduction to Algorithms, T. Cormen, C.E. Leiserson, and R.L. Rivest; MIT Press, 1990. Or second edition.
2. Approximation Algorithms for NP-hard Problems, edited by D.S. Hochbaum, PWS Publishing, Boston, MA, 1997.
3. Randomized Algorithms, R. Motwani and P. Raghavan, Cambridge University Press, Cambridge, UK, 1995.
4. Approximation Algorithms, Vijay V. Vazirani, Springer, 2001.
5. Combinatorial Optimization: Algorithms and Complexity, C. Papadimitriou and Steiglitz, Prentice hall, 1982

6. Data Structures and Network Algorithms, Tarjan, SIAM Series in Applied Mathematics 44, 1983
7. Date Structures& their Algorithms, H.R. Lewis and L. Denenberg, 1991.
8. Complexity and Approximation: Combinatorial Optimization Problems and Their Approximability Properties, G. Ausiello, P. Crescenzi, G. Gambosi, V. Kann, A. Marchetti-Spaccamela, M. Protasi, Springer, 1999.