PACE UNIVERSITY

SCHOOL OF COMPUTER SCIENCE AND INFORMATION SYSTEMS

DEPARTMENT:	Computer Science
SUBJECT CODE/ COURSE TITLE:	CS 608/Algorithms and Computing Theory
CLASS HOURS:	3 Hours per Week
CREDITS:	3
PRE/CO-REQUISITE:	CS 502
TEXTBOOKS:	M. Goodrich and R. Tamassia/ Algorithm Design and Applications/ Wiley/ 2015
REFERENCES:	Internet. Algorithms and computing theory related magazines and journals
SEMESTER:	Fall 2019
Preparer:	Dr. A. Joseph

Course Description: The purpose of this course is to acquire a thorough grounding in the core principles and foundations of computer science. Students will learn methods for expressing and comparing algorithm complexity (worst- and average-case upper bounds, lower bounds) as well as to verify correctness. Algorithm-design techniques (divide-and-conquer, dynamic programming) as well as data structures (trees, heaps, hash tables) widely used in modern software development will be studied. The knowledge gained will be applied to a variety of practical problems, such as searching, sorting, and graph problems (shortest paths, minimum spanning trees). The question of what problems are hard to compute will be addressed with an introduction to NP-completeness theory, including the development of the NP-complete classification and the identification of NP-hard problems by reductions.

PROFESSOR'S PROFILE

Professor:	Dr. A. Joseph
Office:	163 Williams St., 2nd floor, Room 231
Telephone:	212 346 1492
Email:	ajoseph2@pace.edu
Office Hours:	Tuesday & Thursday:10:30 am – 12:00 pm; Thursday: 2:30 pm – 4:30 pm

COURSE PROFILE

ASSESSMENT AND EVALUATION

Grading Policy

Final Examination:	35%
Exams:	25%
Preparation and Participation:	25% (Participatory and active)
Project and Presentation	15%
Total	100%
Extra credit assignment (Optional):	10% (Due by week 12)

Note: You may be asked to participate in out-of-class professional career development related activities sponsored by school, University, or community for extra credit if these opportunities become available. These professional activities are intended to expose you to the professional world of work. Your participation in these opportunities is optional.

Final grade Determination

Graduate:

Above 92%	A
90% -- 92%	A-
85% -- 89%	B+
80% -- 84%	B
75% -- 79%	B-
65% --74%	C
Below 65%	F

Note: Grades are computed to the nearest whole number.

Learning outcomes

1. Ability to analyze efficiency of algorithms and data structures.
2. Ability to utilize and/or design data structures in problem solving.
3. Ability to devise correct algorithms using various algorithm design techniques.
4. Understand the difference between inefficient algorithms and "hard" problems.

Tentative Examination Schedule:

Course Section	Midterm Examination Date	Project Due date	Final Examination Date
CS 608/ CRN: 72148	October 23, 2019	November 20, 2019	December 18, 2019

Procedures for Disabilities, Emergencies and Academic Integrity

Procedure for Students with Disabilities Who Wish to Obtain Reasonable Accommodations for a Course: The University's commitment to equal educational opportunities for students with disabilities includes providing reasonable accommodations for the needs of students with disabilities. To request a reasonable accommodation for a qualified disability a student with a disability must self-identify and register with the Office of Disability Services for his or her campus. No one, including faculty, is authorized to evaluate the need for or grant a request for an accommodation except the Office of Disability Services. Moreover, no one, including faculty, is authorized to contact the Office of Disability Services on behalf of a student. For further information, please see Resources for Students with Disabilities at http://www.pace.edu/counseling-center/resources-students-disabilities.

Continuity Plan: In the event of a major campus emergency, course requirements, deadlines and grading percentages are subject to change when necessitated by revised course delivery, semester calendar or other circumstances. Information will be communicated online. If the course is not able to meet face-to-face, students should immediately read any announcements and/or alternative assignment. Students are also encouraged to continue the readings and assignments as outlined on this syllabus or subsequent syllabi.

Academic integrity: For academic integrity procedures, please visit:

Pace University Academic Integrity Code

http://www.pace.edu/sites/default/files/files/Pace%20University%20Academic%20Integrity%20%20%20Code_9_1_2017.pdf

University Policies in the Student Handbook

http://www.pace.edu/student-handbook/university-policies-disciplinary-and-grievance-procedures

Form to report a case (for faculty)

http://www.pace.edu/provost/academic-policies-forms

Other important resources and information that will help support your success:

Academic and Related Support Services

Career Services

Center for Academic Excellence

Learning Center NYC | PLV

Library Services

Office of Prestigious Fellowships and Awards

Office of Student Assistance

Office of Student Success

Pace Top 100 Scholars

Pace University Policy and Procedure – Discrimination, Non-sex Based Harassment and Retaliation

Sex-based Misconduct Policy and Procedure

Student Handbook

Writing Center

Note 1: In general, the lessons might highlight inquiry-based lecture-discussion, storytelling, and active learning strategies. A central focus of the course will be critical thinking and problem-solving. To get the most out of the course, each student must study including do the reading assignments and genuinely attempt each homework problem before coming to class. The idea is to come to class ready to **learn**, which may include asking questions about concepts relating to the course materials and associated problems.

Note 2: In the interest of **learning**, it is very important to come to class prepared to **learn** – do all required assignments. Failure to do so could diminish your ability to get the most out of each lesson and subsequently the course. Remember that learning is active process. That is, it is **not** enough to come to class to listen and observe to what others have to say or do. You should come to class prepared and willing to become engage in **all** classroom activities because learning is an **active process**, and if you come to class to learn, then you must put the time in: at **least 2-3 hours for every hour** spent in class.

Note 3: In order to do well in class **you are expected to study 2 to 3 hours per week for every credit hour** for which you are registered.

Note: **Learning** is a process that involves repetitive actions of doing the same thing over and over again to gain knowledge, acquire skills, and develop mastery over many repeated actions on the same thing. You must put the time in if you are to get the most out of your college experience.

TOPICS

Weeks	Topics	Assignments
1	**Algorithm analysis**: Analyzing algorithms; a quick mathematical review; a case study in algorithm analysis; algorithms correctness; time and space complexity and tradeoffs; and amortization.	1. Read chapter 1 2. Problems: R/2, 14, & 20; C/8 & 10; A/11 &13.
2-3	**Basic data structures and binary search trees**: Stacks and queues; lists; trees; searches and updates; range of queries; index-based searching; randomly constructed search trees; ranks and rotations; AVL trees; red-black trees; weal AVL trees; and Splay trees.	1. Read chapters 2, 3, and 4 2. Problems: Chap 2 R/5, C/12 & 13; A/2. Chap 3 R/4, 9, &13; C/10; A/2. Chap 4 A/4
4	**Priority queues and heaps**: Priority queues; PQ-sort, selection sort, and insertion sort; heaps; heap sort; and extending priority queues.	1. Read chapter 5 2. Problems: To be announced
5	**Hash tables**: Maps; hash functions; handling collisions and rehashing; cuckoo hashing; and universal hashing.	1. Read chapter 6 2. Problems: To be announced
6	**Sorting and selection**: Merge sort; quick sort; lower bound on comparison based sorting; bucket sort and radix sort; selection; and weighted medians.	1. Read chapters 8 and 9 2. Problems: To be announced
7-8	**Greedy method and divide and conquer**: Fractional Knapsack problem; tasking scheduling; text compression and human coding; recurrences and the master theorem; integer multiplication; matrix multiplication; and maxima-set problem.	1. Read chapters 10 and 11 2. Problems: To be announced
8-9	**Dynamic programming**: matrix chain products; general technique; telescope scheduling; game strategies; longest subsequence problem; 0-1 Knapsack problem; and Warshall's and Floyd's algorithms.	1. Read chapter 12 2. Problems: To be announced
10	**Graphs and traversals**: Graph terminology and representations; depth-first search; breadth-first search; directed graphs; and biconnected components.	1. Read chapter 13 2. Problems: To be announced
11	**Shortest paths and minimum spanning trees**: Single source shortest paths; Dijkstra's algorithm; Bellman-Ford algorithm; shortest paths in directed acyclic graphs; all-pairs shortest paths; properties of minimum spanning trees; Kruskal's algorithm; Prim-Jarnik algorithm; and Baruvka'algorithm.	1. Read chapter 14 & 15 2. Problems: To be announced
12-13	**NP-completeness and approximation algorithms**: P and NP; NP-completeness; CNF-SAT and 3SAT; vertex-cover, clique, and set-cover; subset-sum and Knapsack; Hamiltonian cycle and TSP; metric traveling salesman problem; approximations for covering problems; polynomial time approximations schemes; and back tracking and branch and bound	Read chapter 17 & 18 2. Problems: To be announced
13	**Project submission and presentation**	
14	**Final examination**.	

This course is structured around collaborative teams in a cooperative learning environment. Students are encouraged to work together in their respective teams to create effective and productive real teams that share their learning experiences within the context of the course, help each other with learning difficulties, spend time to get to know each other, and spend time each week to discuss and help one another with the course work (content and assignments). Each team member is responsible for the completion and submission of each assignment. Each team member will be individually graded.

Team project: Students in teams of two to four will participate in a project or research assignment that produce prepare a report that involves the use of a low level or high-level programming language. In this project, students will write a program to determine the solution of a technical problem, and then demonstrate their knowledge and understanding of how the program works. The assignment of grade to an individual student for a team project will be based on his/her participation in the following: programming, report writing, proofreading and correction of programming codes and the written report, and combinations of the above.

Web support: This course is supported with some or most of the following Blackboard postings: lesson questions, lessons (PowerPoint), instructions and guidelines pertaining to the course, news items, team and class discussions boards, email correspondence about the course, homework solutions, examination grades, and miscellaneous course related activities and information.

Supplementary materials: Handouts in class or web postings of current events and issues affecting the course. Some books that may be helpful for the course will be posted on Blackboard.

In class team activity and participation: Students are recommended to bring to class current newsworthy events relevant to the course to share with the class. Students will inform the class of the news events and their significance to computing. Devote 15-20 minutes to this activity.

The collaborative teams are designed to function in and out of the classroom. Collaborative team activities will be reinforced inside the class during the lessons. Student teams are encouraged to function cohesively and to participate in class activities. Devote 30-45 minutes of each class period to collaborative team activities.

The key elements of a story are the following: causality, conflict, complication, and character.

The following excerpts about collaborative learning are from research documents:

- In the university environment, *educational success and social adjustments ⋯ depend primarily on the availability and effectiveness of developmental academic support systems.*

- *Most organized learning occurs in some kind of [team] ⋯ [team] characteristics and [team] processes significantly contribute to success or failure in the classroom and directly effect the quality and quantity of learning within the [team]*.

- *[Team] work invariably produces tensions that are normally absent, unnoticed, or suppressed in traditional classes. Students bring with them a variety of personality types, cognitive styles, expectations about their own role in the classroom and their relationship to the teacher, peers, and the subject matter of the course.*

- Collaborative learning involves both management and decision-making skills to choose among competing needs. The problems encountered with collaboration have management, political, competence, and ethical dimensions

- *The two key underlying principles of the collaborative pedagogy are that active student involvement is a more powerful learning tool than the passive attendance and that students working in [team] can make for more effective learning than students acting alone.* The *Favorable outcomes of collaborative learning include greater conceptual understanding, a heightened ability to apply concepts, and improved attendance.* Moreover, *students become responsible for their own learning is likely to increase their skills for coping with ambiguity, uncertainty, and continuous change, all of which are characteristics of contemporary organizations.*

Who creates a new activity in the face of risk and uncertainty for the purpose of achieving success and growth by identifying opportunities and putting together the required resources to benefit from them?
Creativity is the ability to develop new ideas and to discover new ways of looking at problems and opportunities

Innovation is the ability to apply creative solutions to those problems and opportunities to enhance or to enrich people's lives.