東吳大學 SOOCHOW UNIVERSITY

COURSE INFORMATION

Course Title:	**Semester:**
COMP507 Advanced Algorithms & Data Structures	January Session, 2020
CLASS HOURS: Monday through Friday, 180 minutes each day, for three weeks. At the end of each week there will be a one-hour discussion session; the instructor will also be available by appointment. **Discussion Section**：1 hour each week. **Field Trip**: Not required.	**CREDITS(s)**：**3**

OVERVIEW

This course provides students with the opportunity to enhance the concepts learnt in introductory algorithms and data structures study. It covers advanced algorithmic paradigms and problem-solving techniques required to address real-world programming challenges. It deepens students' understanding of the design and analysis of memory and time-efficient data structures and problem solving strategies used in various complex applications. The course covers topics including advanced sorting and searching algorithms, dynamic programming and greedy approach, graph theories and algorithms, amortised analysis, and algorithm complexity analysis amongst others.

LEARNING OUTCOME

Upon successful completion of this course, the students should have basic expertise in the following areas:

- Expertise in analysing recursive and iterative algorithms.
- Understanding and performing simple proofs of algorithmic complexity and correctness.
- Understanding and deriving recurrences describing algorithms and properties of data structures.
- An ability to efficiently implement a range of data structures including trees and graphs.
- Understanding of a variety of well-known algorithms on some of the data structures learnt.
- The ability to implement and use these algorithms in code to solve real-world problems.
- A foundational understanding of intractability with an understanding of proof techniques for NP-Completeness.
- An ability to solve advanced algorithmic problems such as Travelling-salesman problem.

LEARNING RESOURCES

Suggested textbooks: Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, *Introduction to Algorithms, Third Edition,* MIT Press.

WEEKLY SCHEDULE			
Week	**Day**	**Topic**	**Reading**
1	1	Introduction Analysing algorithms - Time and space complexity - Worst-case and average-case complexity Evaluating efficiency - Rate of growth - Asymptotic notation, functions and time	Chapters 1, 2, 3
	2	Divide-and-conquer - Recursive approach - Divide, conquer and combine Solving recurrences using - Substitution method - Recursion-tree method - The master method	Chapter 4
	3	Probabilistic analysis and randomised algorithms - Probabilistic analysis - Quicksort - Randomised quicksort	Chapters 5, 7
	4	Dynamic programming - Optimal sub-structure - Overlapping sub-problems - Re-constructing an optimal solution Memorisation **Quiz 1**	Chapter 15
	5	Greedy algorithms - Optimal sub-structure of activity-selection problem - Greedy choice properties - Choosing between greedy and dynamic programming paradigms **Assignment 1 is due**	Chapter 16
2	1	**Mid-semester Examination**	
	2	Graph algorithms - Representations of graphs - Breadth-first search - Depth-first search - Topological sort	Chapters 22
	3	Minimal spanning trees - Generic form - Greedy choice strategy	Chapter 23
	4	Single-source shortest paths - Representing shortest path - Directed acyclic graph Dijkstra's algorithm **Quiz 2**	Chapter 24

	5	All-pairs shortest paths - Recursive solution - Floyd-Warshall algorithm - Johnson's algorithm for sparse graphs	Chapter 25
3	1	Amortised analysis - Aggregate analysis - The accounting method - The potential method **Assignment 2 is due**	Chapter 17
	2	Complexity classes - Polynomial time - Decision problems vs. optimisation problems - Polynomial time verification - Tractable and intractable problems	Chapter 34
	3	NP-completeness and Approximation algorithm - The classes P and NP - NP-complete - Reducibility - Travelling-salesman problem	Chapter 34, 35
	4	Revision	
	5	**Final Examination**	

ASSESSMENT

Assessment Task	**Score Percentage**
Attendance and Participation	10%
Quiz 1	5%
Quiz 2	5%
Assignment 1	10%
Assignment 2	10%
Mid-semester Examination	20%
Final Examination	40%
Total	**100%**

DETAILS ON GRADE COMPONENTS

1. Attendance and Participation

Students are required to attend all classes and participate actively. Students should treat their classroom obligations as they would treat any serious professional engagement. Your participation grade will be based on the instructor's assessment of how well you contribute to classroom dynamics relative to your class peers.

NB: In case of an absence, the student is responsible for the materials and assignments for that class; it is the student's responsibility to inform the instructor regarding absences and assignments that are missed. **Unexcused absence from three or more scheduled class sessions will be grounds for failure in this course.** If you do have to miss class due to a personal emergency, please let the instructor know as soon as possible. Such emergencies will be dealt with on a case-by-case basis.

Participation grades will be based on **quality** (in-class performance that reflects intellectual depth, insightfulness, and contribution to class learning) and **quantity** (consistency and

regularity of performance).

Accordingly, **you are expected to read the related chapters before participating the class**. Be prepared to be called upon to "open" a class discussion by presenting your full analysis and thoughts on the assigned topic at the start of class, or to be asked through a "cold call" for comment during the discussion.

The grading of class participation is necessarily a subjective exercise. However, high-quality comments have one or more of the following characteristics: **(1) insightfulness, (2) appropriate application of course concepts, and (3) advancement of the in-class discussion at hand**.

2. Quizzes

Quizzes will happen on the first and second weeks to review and reinforce what has been learned in the previous classes.

3. Assignments

To enhance the learning process, students have to submit two assignments. Each assignment weighs 10% of the total marks.

Assignment 1 covers Divide-and-conquer, Dynamic programming and Greedy algorithm. It is due on Friday of the first week.

Assignment 2 covers graph theories and graph algorithms. It is due on Monday of the third week.

4. Mid-semester Examination

The mid-semester examination will be held on Monday of the second week. It will cover the contents of the first week including but not limited to Divide-and-conquer, Randomised algorithms, Dynamic programming and Greedy algorithms.

5. Final Examination

An in-class final examination will be administered at the end of the course on Friday of the third week. Details of contents, exam format, etc. will be announced in class well before the examination dates.

6. Course Grading

Upon completion of this course, you receive a final grade. A final grade is a letter grade that carries with it a numerical value, as outlined below.

Grade	Mark
A	80-100
B	70-79
C	60-69
D	50-59
E	0-49

To pass this subject, students are required to obtain Grade B or above in order to satisfy all the intended learning outcomes.

CLASSROOM ETHICS & COURSE POLICIES

Being respectful of others' opinions, values and culture

Cell phones are only permitted when the usage is related to the course. Absolutely **NO TEXTING** during class will be tolerated. If you have an emergency situation and you must be able to be reached, set the phone to vibrate and leave the room immediately when it goes off.

Any student with a documented disability needing academic adjustments or accommodations should notify the instructor or the program administrator before the start of the program, so such an arrangement will be made accordingly.

Any student who anticipates a schedule conflict because of religious reasons should make arrangements within two weeks of the start of class.

Academic misconduct

Please follow the guideline of the university policy. Academic dishonesty or misconduct will not be tolerated and may result in disciplinary action including a grade F for the course. Work submitted must be the original work of the student. Original work may include the words and ideas of others, but the source of these words and ideas must be indicated in a manner consistent with an academically recognized form, style, and citation manual. Resubmission of work previously presented in another course is prohibited.