LEBANESE INTERNATIONAL UNIVERSITY

School of Arts and Sciences
Department of Computer Science and Information Technology
Fall 2018 – 2019
CSCI440 Algorithms

Class Day	: _____	**Class Time :** _____	**Room:** _____
Instructor	: _____
E-mail	: _____
Office	: _____	**Office Hours :** _____	**Extension No:** _____

Description

In this course we will learn basic to fundamental algorithms for solving problems, such as searching, sorting, dynamic programming, divide-and-conquer, greediness, and probabilistic approaches in addition to graph algorithms. Students will learn algorithm analysis and how to compute the time complexity of these algorithms and will focus on general design and analysis techniques that lie beneath these algorithms.

Learning Objectives

- Understand efficiency and complexity of algorithms
- Understand popular algorithms related to searching and sorting.
- Able to build efficient algorithms to solve different type of problems.

Learning Outcomes

- Principles of Algorithm Analysis: Big-Oh Notation
- Set find and union algorithms
- Recursion: Recursive Algorithms, Divide and Conquer, Dynamic Programming.
- Sorting Methods: Selection Sort, Insertion Sort, Bubble Sort, Shellsort, Quicksort, Mergesort, Heapsort.
- Searching: Symbol Tables

Weekly Schedule

Week 1

Syllabus: reading and explaining.

Chapter 1: Fundamentals
1.4: Analysis of Algorithms.
Introduction, Scientific method
Observations (Example, Stopwatch, Analysis of experimental data – concisely)
Mathematical models (Tilde approximations, approximate running time, and Order-of-growth hypothesis)

Week 2

Chapter 1: Fundamentals
1.4: Analysis of Algorithms.
Mathematical models – continued - (Analysis of algorithms, Cost model, Summary)
Big- Oh Notation (External resources should be used as it is mentioned concisely in the book on pages 206 and 207) + Problem solving (1.4.5, 1.4.6, 1.4.12 + extra exercises)

Week3

Chapter 1: Fundamentals
1.4: Analysis of Algorithms.
Order-of-growth classifications + Problem solving
Designing faster algorithms (Warmup: 2-sum, Fast algorithm for 3-sum, Lower bounds
Doubling ratio experiments (Estimating the value of using a faster computer – only)
Caveats

Week 4

Basic Recurrences + analysis + problems solving (external resources)
Recursive vs iterative Algorithms + Examples: Power, Factorial, Tower of Hanoi + Analysis (external resources)

Week 5

Divide-and-conquer, Dynamic Programming: Fibonacci Numbers + analysis (external resources)

Week 6

Chapter 1: Fundamentals
1.5: Case Study: Union-Find.
Dynamic connectivity (Networks, Variable-name equivalence, Mathematical sets, Union-find API, Algorithm 1.5 Union-find implementation)
Implementations (Quick-find, Quick-find analysis)
Problem solving (1.5.1)

Week 7

Assignment 1 due on first lecture (Chapter 1.4)
Assignment 1 Correction

Chapter 1: Fundamentals
1.5: Case Study: Union-Find.
Implementations – continued - (Quick-union, Forest-of-trees representation, Quick-union analysis, Weighted quick-union, Weighted quick-union analysis, Union-find implementation (weighted quick-union))
Problem solving (1.5.2, 1.5.3, 1.5.9)

Week 8

Test (not common)
Chapter 2: Sorting
2.1: Elementary Sorts
Rules of the game (Template for sort classes)
Selection sort, Insertion sort, Visualizing sorting algorithms (Show some examples)

Week 9

Chapter 2: Sorting
2.1: Elementary Sorts
Problems solving (2.1.1, 2.1.2, 2.1.3)
Problems solving (2.1.4, 2.1.5, 2.1.6)

Week 10

Chapter 2: Sorting
Shellsort + problem solving (2.1.9)

Week 11

2.2: MergeSort
Abstract in-place merge, Top-down mergesort, Bottom-up mergesort
Problems solving (2.2.1, 2.2.2, 2.2.3)
Assignment 2 due (Chapters 1.4 and 2.1)
Correction of Assignment 2

Midterm Exam (Chapters 1.4 and 2.1) Fri 14 Dec 9:30 a.m. – 10:45 a.m.

Week 12

Chapter 2: Sorting
2.3: QuickSort
The basic algorithm, Performance characteristics, Algorithmic improvements, Quicksort with 3-way partitioning
Problems solving (2.3.1, 2.3.2, 2.3.3)

Week 13

Chapter 2: Sorting
2.4: Priority Queues
API, Elementary implementations, Heap definitions, Algorithms on heaps (Bottom-up reheapify (swim),
Top-down reheapify (sink), Insert, Remove the maximum, Heapsort
Problems solving (2.4.1, 2.4.5, 2.4.6)
2.5: Applications
Stability, Which sorting algorithm should I use?

Week 14

Chapter 3: Searching
3.1: Symbol Tables
API, Ordered symbol tables, Sequential search in an unordered linked list, Binary search in an ordered array,
Analysis of binary search, Preview
Problems solving (3.1.10, 3.1.11)

Week 15

Problems solving

Course Prerequisite(s)

CSCI350 Data Structures

Course Corequisite(s)

None

Textbook(s)

Algorithms, Fourth Edition (Deluxe): Book and 24-Part Lecture Series – by **Robert Sedgewick** and **Kevin Wayne** – Publisher: **Addison-Wesley**. ISBN-13: **978-0134384689**
ISBN-10: **0134384687**

Software Needed

Java Netbeans IDE 8.2

Further Reading(s)

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Website(s) to Visit

- https://www.toptal.com/developers/sorting-algorithms/
- https://algs4.cs.princeton.edu/home/

Grading Policy and Withdrawal Deadline

Assignments	05%	
Test	25%	**Week 07** (not common)
Midterm Exam	35%	**Week 11 Fri 14 Dec 9:30 a.m. – 10:45 a.m.**
Final Exam	35%	

Withdrawal Deadline   Week 14

Students must bring a **hard copy** of the **textbook**
otherwise they will
not be allowed to enter the classroom

This policy is for your own good

Class Rules & Discipline

Attendance Policy

The student is administratively withdrawn (AW) from the class if he/she is absent for more than one third of the classes (15 class sessions for courses offered 3 times a week, 10 for courses offered twice a week, and 5 for courses offered once a week). If the number of absences exceeds the limit after the withdrawal deadline, i.e. including all the period up-to the end of the semester, the student will not receive an AW grade, therefore, the final examination must be written, otherwise, an F grade will be granted. When absent, you are responsible for all material presented in class. Missed exams will only be excused by documented evidence as explained in the make-up examination policy below.

Cheating

The University policy on cheating will be strictly applied. Students are required to adhere to the policy on academic irregularities contained in the LIU student handbook. Collaboration among students in solving assignments is not acceptable. It is okay to ask another student for advice when stuck on a problem, but if the instructor receives assignments that are substantially equivalent, all involved students will be punished with a grade of zero.

Classroom Manners

All students are expected to conduct themselves in a professional manner. If a student arrives more than 5 minutes late to the class he/she will not be allowed in. Students should not: keep their cell phones on during the class, disrupt the class, do other course work in class, have side conversations with other students, be rude towards anyone. The first failure to respect these rules will result in a warning from the instructor. If a student chooses to disregard the warning he/she will be dismissed from class.

Instructor late to the class

In case the instructor is late the students should wait for 15 minutes before leaving the class.

Abuse of Computing Privileges

The Office of Information Technology maintains policies posted in the computer labs regarding proper behavior in the labs. Failure to adhere to these policies may result in loss of computer privileges, and possible legal action.

Make-Up Examination Policy

As per university council decision, a student that misses an exam should fill a petition. The petition is accepted if and only if he/she had the following incidents:
   a. Sickness; proved by hospitalization report; that is; a discharge summary is necessary.
   b. Death in the family proved by a death certificate and personal identification.
   c. Accidents proved by an expert report.
The petition should be filled within one week from the examination date.

Missing Exams, Assignments and Projects Policy

If the student has 3 exams (or more) on the same day and wishes to skip the exam of this course
− The weight of Test would be credited toward Midterm Exam.
− The weight of Midterm Exam would be credited toward Final Exam.
If the student missed an exam and has an accepted petition
− The weight of Test would be credited toward Final Exam.
− The weight of Midterm Exam would be credited toward Final Exam.

As for late assignments, a zero will be granted on the next day

Curriculum, Yearly Plan, and Advising

If a student majoring in Computer Science or Information Technology is planning to graduate in three years then he/she should follow the corresponding major yearly plan. A copy of the yearly plan and the curriculum (which contains the prerequisites and co-requisites of courses) can be picked up from the office of the school of Arts and Science. When not sure about anything please contact your advisor prior to or during the registration period.

Probation Policy

If a student who has attempted 19 credits has a GPA or a major GPA below 2.0 then the student is considered under probation

LIU E-mails

LIU students should use their LIU e-mails in communicating with the instructors. Important announcements, assignments, and solutions will be sent to your LIU e-mail accounts.

Textbook

Students must bring a hard copy of the textbook otherwise they will not be allowed to enter the classroom.

Snapshots

Students are not allowed to take snapshots of the whiteboard in classrooms using their mobile-phones.

Equivalent Lettering Grades

Percent (%)	QPTS	Letter Grade (G)	Percent (%)	QPTS	Letter Grade (G)
<60	0	F	67	1.7	
60	1	D	68	1.8	
61	1.1		69	1.9	
62	1.2		70	2	C
63	1.3		71	2.1	
64	1.4		72	2.2	
65	1.5	D+	73	2.3	
66	1.6		74	2.4	
75	2.5	C+	83	3.3	
76	2.6		84	3.4	
77	2.7		85	3.5	B+
78	2.8		86	3.6	
79	2.9		87	3.7	
80	3	B	88	3.8	
81	3.1		89	3.9	
82	3.2		>=90	4	A

Grade	Description	QPTS
A	Excellent	4.00
B+	Very Good	3.50
B	Good	3.00
C+	Above Average	2.50
C	Average	2.00
D+	Fair	1.50
D	Poor	1.00
F	Fail	0.00

IP	Course in Progress
I	Incomplete work
W	Student has withdrawn from the course
AW	Administrative withdrawal from the course
R	Course has been repeated
S	Satisfactory work
U	Unsatisfactory work
%G	Final Grade
QPTS	Quality Points