New York University Abu Dhabi
Data Structures

Course Information:

Course Title:	Data Structures
Course Number:	CS-UH 1050 (CS-AD 103)
Credit Hours:	4
Pre-requisite:	CS-AD 101, Introduction to Computer Science CS-AD 116, Discrete Mathematics
Semester:	Spring 2020
Class time:	M&W 1:15 – 2:30pm Room C2-E052, 4:05 – 5:20pm, Room C2-E047
Lab time:	W & Th 9:00 – 11:40 am.
Professor:	Sebti Foufou, sfoufou@nyu.edu, Room A2-109
Prof. Office Hours:	Tu, 11:00am- 12:30 pm
Teaching Assistant:	Khalid Mengal, kqm1@nyu.edu, Desk A2-186B
TA Office Hours	Th 1:00 – 2:00 pm, M 11:00 am – 12:00 pm

Course Description:
Organizing and managing large quantities of data using computer programs is increasingly essential to all scientific and engineering disciplines. This course teaches students the principles of data organization in a computer, and how to work efficiently with large quantities of data. Students learn how to design data structures for representing information in computer memory, emphasizing abstract data types and their implementation, and designing algorithms using these representations. Topics include arrays recursion, asymptotic analysis of algorithms, lists, stacks, queues, trees, hashing, priority queues, dictionaries, graph data structures etc. This course is taught using the C++ programming language.

In addition to the 2 theory lectures, this course includes a lab component of 2:40h weekly. Lab sessions are dedicated to the practice of C++ and implementation of data structure concepts covered in the theory lectures. Lab questions and problems are designed to effectively help students in the design and implementation of computerized solutions to real problems using appropriate data structures. Lab assessments and programming assignments count for a total of 40% of the course grade.

Learning Outcomes:
Students who successfully complete this course will be able to:
1. Design appropriate data structures for solving a given problem
2. Analyze and compare the performance of an algorithm with different data structures
3. Demonstrate proficiency in practical usage of standard data structures
4. Demonstrate proficiency in programming (in C++)
5. Design, develop and implement efficient and optimized programs to solve computing problems.

Teaching and Learning Methods:
There are four main teaching and learning methods employed in this course:
1. Theory lectures: to present the data structure concepts and discuss their implementations in C++
2. Class discussions: During each lecture, there will be numerous questions posed by the instructor to help students engage in the topics and to promote discussion.

3. *Programming* assignments: There will be several homework assignments which will sharpen the students' ability to think about problems, provide implemented solutions, and analyze their algorithms.
4. Labs: The lab sessions will include supervised programming questions that will help students to gain an in-depth understanding of the various data structures by implementing them. Students will also gain expertise in C++ and learn about the debugging process. Some lab quizzes will also be given to assess the students' practice abilities.

Assignments: There will be a total of 5 programming assignments covering the majority of the course topics. Students should submit their work through NYU Classes. All assignments are due at 11:55pm on the due date. Late submissions will be accepted only up to 3 days late, 30% will be deducted from the assignment grade per each late day, after the third day a zero score will be given. The programs submitted by the students must run without compiler or runtime errors.
Depending on the level of complexity of the programming assignment, the instructor may ask the students to work on the assignment individually or authorize them to work in groups of at most 3. Students are encouraged to answer each other's questions but should refrain from explicitly sharing their solutions. They may use online resources for help, but copying code is considered cheating.

Required Textbooks:

- Data Structures and Algorithms in C++ by Goodrich, Tamassia, Mount, 2nd Edition, Publisher: Wiley, Publication date: February 22, 2011.

Additional References

- Data Structures and Algorithm Analysis in C++ by Mark Allen Weiss, 4th Edition, Publisher: Pearson, Publication date: June 23, 2013.
- Data Structures Using C and C++ (2nd Edition). Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum. ISBN: 978-0130369970. Pearson.
- Algorithms in C++, Parts 1-4: Fundamentals, Data Structure, Sorting, Searching, 3rd Ed, July 1998. ISBN: 978-0201350883, Addison-Wesley Prof.

Grading policy

Lab assignments, Midterm Exam, Midterm Exam 2, quizzes, and participation will all count. The components of the Final Grade include:

● Theory Quizzes	15%	4 Quizzes
● Midterm Exam	25%	
● Midterm Exam 2	30%	
● Programming Assignments	20%	5 Assignments
● Lab Quizzes	10%	10 Quizzes

Questions about grading must be discussed within 3 days after the grades are posted on nyuclasses portal.

Grads to Letters Mapping

The below mapping from NYUclasses will be used for this course. However, this mapping might be slightly adjusted at the end of the course, so that a fair (and fairly generous) distribution is attained.

Grade	Letter
$[95 - 100]$	A
[90 - 95 [	A-
[87 - 90 [	B+
[83 - 87 [	B
[80 - 83 [	B-
[77 - 80 [	C+

[73 - 77 [	C
[70 - 73 [	C-
[67 - 70 [	D+
[63 - 67 [	D
[00 - 63 [	F

Academic Integrity: At NYU Abu Dhabi, a commitment to excellence, fairness, honesty, and respect within and outside the classroom is essential to maintaining the integrity of our community. By accepting membership in this community, students, faculty, and staff take responsibility for demonstrating these values in their own conduct and for recognizing and supporting these values in others. In turn, these values create a campus climate that encourages the free exchange of ideas, promotes scholarly excellence through active and creative thought, and allows community members to achieve and be recognized for achieving their highest potential.

All potential violations to this community academic integrity standard (including plagiarism) will be taken seriously and reviewed through NYUAD's Academic Integrity Procedure.

Mental Health Awareness: As a University student, you may experience a range of issues that can interfere with your ability to perform academically or impact your daily functioning, such as: heightened stress; anxiety; difficulty concentrating; sleep disturbance; strained relationships; grief and loss; personal struggles. If you have any well-being or mental health concerns please visit the Counseling Center on the ground floor of the campus center from 9am-5pm Sunday - Thursday, or schedule an appointment to meet with a counselor by calling: 02-628-8100, or emailing: nyuad.healthcenter@nyu.edu. If you require mental health support outside of these hours call NYU's Wellness Exchange hotline at 02-628-5555, which is available 24 hours a day, 7 days a week. You can also utilize the Wellness Exchange mobile chat feature, details of which you can find on the student portal. If you need help connecting to these supports, please contact me directly

Course content and tentative day-by-day schedule:

A tentative day-by-day schedule for the course is given bellow. The exact content, the order, and the number of lectures for each topic might be adjusted as the course develops.

W	Session	Date	Topic	Textbook Reading	Theory Evals	Lab Evals	Assignments
1	1	W 29-01	Introduction, Basics of C++ Programming	Chapter 1			
2	2	M 03-02	Pointers	Chapter 1			
	3	W 05-02	Arrays	Chapter 1			
3	4	M 10-02	Functions	32--60			
	5	W 12-02	Classes	32--60			**HW1, out**
4	6	M 17-02	Classes	32--60			
	7	W 19-02	Inheritance	70--87		Lab Quiz1	**HW1, due**
5	8	M 24-02	Templates	104--116	Quiz1	Lab Quiz2	
	9	W 26-02	Recursion	134--149			
6	10	M 02-03	Linked Lists	117--140			
	11	W 04-03	Linked Lists	117--140		Lab Quiz3	**HW2, out**
7	12	M 09-03	Analysis Tools	Chapter 4	Quiz2	Lab Quiz4	
	13	W 11-03	Stacks	194--208			**HW2, due**
8	**14**	**M 16-03**	**MIDTERM EXAM**				
9	15	M 30-03	Queues & Deques	208--213			
	16	W 01-04	Vectors,	228--237		Lab Quiz5	**HW3, out**
11	17	M 06-04	Vectors, List iterators, and Sequences	238--259			
	18	W 08-04	Trees & Traversal Algorithms	268--281			**HW3, due**
12	19	M 13-04	Binary Trees	281--309	Quiz3	Lab Quiz6	
	20	W 15-04	Priority Queues	322--336		Lab Quiz7	
13	21	M 20-04	Heaps	337--360			
	22	W 22-04	Maps	368--374		Lab Quiz8	**HW4, out**
14	23	M 27-04	Hash Tables & Dictionaries	375--415			
	24	W 29-04	BST & AVL Trees	424--445	Quiz4		**HW4, due**
15	25	M 04-05	(2,4) & Red-Black Trees	456--492		Lab Quiz9	
	26	W 06-05	Sorting Algos	500--545		Lab Quiz10	**HW5, out**
16	27	M 11-05	Graph Data Structures & graph traversal	593--636			
	28	W 13-05	**2nd MID TERM EXAM**				**HW5, due**