



# UNIVERSITY of HOUSTON

## DEPARTMENT OF COMPUTER SCIENCE

**COURSE TITLE/SECTION:** COSC 2436 Programming and Data Structures Class Number 15428/15430

**TIME:** TuTh 10:00AM - 11:30AM

**LOCATION:** PGH 232

TuTh 11:30AM - 1:00PM

**LOCATION:** PGH 232

**Workshop (additional 1 Credit ...Highly recommended)**

Course Title: IDNS 2136 Top-Natrl Sci &

**Section 20049** TuTh 1:00PM – 2:30

**SR2 128**

**Section 20050** TuTh 2:30PM - 4:00PM

**FH 218**

**FACULTY:** Nouhad Rizk    **OFFICE HOURS:** TTH 1:00 PM -  
2:00 PM

**E-mail:** njrizk@uh.edu

**Phone:** (713) 743- 3710

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### COSC 2436 Programming and Data Structures

**Catalog Description:** Introduction to fundamental data structures: arrays, lists, stacks, queues, hash tables, trees; sorting and searching; graph algorithms; design, analysis, and comparison of algorithms. Correctness verification techniques such as assertions and invariants. Review program specification, unit testing, and debugging.

**Extended Description:** The course is designed to develop skills to design and analyze simple linear and nonlinear data structures. It strengthens the ability to the students to identify and apply the suitable data structure for the given real-world problem. It enables them to gain knowledge in practical applications of data structures.

A strong background in C++ programming will be helpful in this course.

**Prerequisites:** COSC 1437 and credit for or concurrent enrollment in MATH 1432 with a grade of C- or better.

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### Learning Objectives:

The objective is to prepare students such that within a few years of graduation they will be able to secure for themselves a successful computer science career and contribute decisively to the improvement and development of technology by demonstrating their ability to:

1. Address and solve complex broadly defined problems related to their discipline and field of specialization.
  2. Work as team members, show leadership, and communicate technical concepts and ideas effectively.
  3. Manifest a high level of professional integrity and make ethical decisions that will have a positive impact on the organization and society.
  4. Embrace and practice lifelong learning, continue personal growth, and professional self- improvement.
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## Learning Outcomes:

Based on satisfactory completion of the course, a student should be able to:

- Demonstrate an understanding of basic data structures (such as an array-based list, linked list, stack, queue, binary search tree) and algorithms.
- Demonstrate the ability to analyze, design, apply and use data structures and algorithms to solve problems and evaluate their solutions.
- Demonstrate an understanding of analysis of algorithms. Study an algorithm or program code segment that contains iterative constructs and analyze the asymptotic time complexity of the algorithm or code segment.

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## Course Structure:

**Computer and internet access are required for this course.**

For the current list of minimum technology requirements and resources, see <http://www.uh.edu/online/tech/requirements>. For additional information, contact the office of Online & Special Programs at UHOnline@uh.edu or 713-743-3327. Canvas and possibly other online resources will be required for this course..

## Textbook:

Required	Recommended	Optional
<ul style="list-style-type: none"><li>• <a href="#">Data Structures</a> [Wikibooks]</li><li>• <a href="#">Open Data Structures (C++ edition)</a>, Pat Morin, et al. [<a href="https://open.umn.edu/opentextbooks/textbooks/open-data-structures-an-introduction">https://open.umn.edu/opentextbooks/textbooks/open-data-structures-an-introduction</a>]</li><li>• <a href="#">Data Structures and Algorithms in C++</a>, by M. T. Goodrich, R. Tamassia, and D. Mount, 2nd ed., 2011, Wiley, ISBN 13-978-0-470-38327-8.</li></ul>	<ul style="list-style-type: none"><li>• The C++ Standard Library 2e, 2012, Nicolai Josuttis [Pearson Education] ISBN: 0-321-62321-5</li><li>• C++ Primer, 6e, 2020, Lippman, Lajoie, Moo [Addison-Wesley Professional] ISBN: 978-0135161791</li><li>• Malik, D S. Data Structures in C++, 2nd Edition, Cengage Learning</li><li>• Weiss, Mark A. Data Structures and Algorithm Analysis in C++. 4th Edition. Pearson 2014. ISBN-13: 978-0-13-284737-7</li></ul>	<ul style="list-style-type: none"><li>• <a href="#">LearnCpp.com</a></li><li>• <a href="#">CPPReference.com</a></li><li>• <a href="#">Cplusplus.com</a></li><li>• Starting Out with C++: Early Objects, Gaddis et al. (previous 120/121 textbook)</li><li><b>Compiler</b></li><li>• Microsoft Windows Visual Studio 15 or higher</li><li>• GCC 5.3 for Linux</li><li>• Clang or g++ compilers for OS X (check online for latest versions)</li></ul>

## Expectations

- ✓ Workload: This is a *15-week-three semester credit* course. Students should expect 2.5 weekly hours of classroom faculty instruction, and a minimum of 5 hours of out-of-class student work per week.
  - ✓ Students are expected to meet with teaching assistants on Teams for any additional help.
  - ✓ Attendance is strongly recommended. It will not be checked, but it might be considered in borderline decisions for the final grade. Students with unexcused absences should not expect additional help outside of class and are still responsible for any material or instructions given in class, for turning in assignments on time, and for taking exams at the scheduled times.
  - ✓ Code Documentation: When assignments are graded, source code may be examined to verify the way a solution was achieved or to award partial credit. It is your responsibility to make sure that your source code is presented in a clear, readable, way.
  - ✓ Reading: Readings from the textbook are suggested in the course schedule. We will not be able to discuss all of it in class, but you are still responsible for keeping up with these readings.
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## Course Content:

This course will cover the following topical areas:

1. Review: data structure concepts, arrays,
2. Simple linked lists, different implementations of lists,
3. Introduction to complexity:  $O()$ -notation
4. Stacks and queues
5. Recursion and backtracking
6. Binary trees
7. Sorting and searching
8. Balanced trees, AVL
9. Heaps, priority queues, heapsort
10. Dictionaries/maps, hashing
11. Graphs

## Additional problems:

- ✓ Extra problems are optional; you can do up to 5 per week from the suggested problems in the syllabus and from the end of chapters. Extra problems are graded at the end of each month.

## Submission through the server!

- ✓ ALL HWs, LABS, GA and extras should be submitted to the **server**.
  - **Your username is coscxxxx and the hostname of the server is 2430.cs.uh.edu.**
  - **The default password for each account is the person's 7-digit PeopleSoft number followed by the capitalized last initial followed by the capitalized first initial.**
  - **Please, change your password soon to something that only you know.**

## Late submission Policy:

There is no late policy. Late submissions will be zero.

The following kinds of submission cannot be evaluated, and will be assigned a zero score:

- Late submissions (students will be unable to submit once the assignment is closed)
- eMail submissions
- Source code that cannot be compiled successfully.
- Input/output that is falsified or does not match the submitted source code.
- Submissions that are plagiarized or otherwise violate the collaboration guidelines.

## Make Up Policy

Exams and quizzes cannot be taken after they have been given in class. Due to an act of nature, personal medical emergency, a family crisis, an act of terrorism, severe civil unrest, etc., students have 10 calendar days **before** the test date to petition the instructor to retake any exam/quiz.

If exceptions are made (rare), they will be considered on a case-by-case basis given enough time and evidence to weigh the merits of the application.

## Communication(njrizk@uh.edu)

You have a UH-supplied email account, and that is the only way I have of reaching you outside class. Check that account daily for important class announcements and individual messages. I try to respond to all emails within two working days, but occasionally may take longer than that. I do not usually monitor Canvas or eMail on weekends or holidays. Plan accordingly, especially around deadlines. I do not use Canvas messaging but do forward received messages to eMail. Do not eMail me with homework questions, use the

Canvas Discussion Board instead. Use eMail only for private, personal administrative communication.

## Course Participation

In the context of this course, participation is defined as the following:

- Completing in-class and Canvas hosted participation activities
- Arriving to class prepared and on time.
- Taking notes.
- Actively listening to the lecture and asking questions when appropriate.
- Annotating code listings and handouts.
- Bringing any required materials to class.
- When needed/desired, seeking assistance to complete assignments.
- Barring an emergency, not leaving the class session early unless the instructor consents.
- Not distracting oneself or others with smartphones, games, online diversions, etc.
- Respecting and treating the instructor and the student's peers civilly.

## Collaboration

Unless specifically indicated, collaboration is not allowed on any exam, knowledge check, programming assignment, or textbook participation activities. You may work freely with your fellow classmates, but must limit the input you get:

- You may help each other understand the assignment and brainstorm general solutions, but each student must develop and submit their own distinct work.
- You may give each other technical support, for instance troubleshooting, installing compiler, or logging in to Canvas.
- You must separate to develop your own detailed solution to the problem, and type in your own code and report.
- You must not share (provide or receive) code in any way, form, or media. This includes, but not limited to, other students, scholastic on-line sites, discussion boards. For example, posting full or partial code snippets on Discord is cheating and will be handled as an Academic Dishonesty event. Showing (e.g., paper, Zoom, posting) another student your code is an Academic Dishonesty event, as is viewing another student's code. See Academic Dishonesty below.
- Given these requirements, any submissions with identical excerpts, or excerpts that are identical up to superficial rearrangements, will be considered highly suspect of plagiarism.

## Extra programs

Students can submit any program done in the class/lab or from the end of the book chapter as extra program and upload to the server under separate folders.

Each extra program should be in a separate folder's name named as extra\_m\_w\_n. (m means the month when the extra was given, should be between 1-5. w means the week of the extra was given, should be between 1-5. n means the number of the extra, if only one extra was given in that week, use 1, if two were given, use 1, 2, like extra\_2\_1\_1 and extra\_2\_1\_2. The order is important.)

All the extras should be under the root of your Linux server (upload .cpp and .h files) For example the dayType is extra\_1\_3\_1 Overloading extra\_1\_3\_2

Linetype      extra\_1\_3\_3

## Extras are NOT included in the Grading system

Extras are useful when the grade is on the upper end of an interval. For example, if a student has 82.9 upper end of B- and who has done many programs as extras, the grade might be pushed to B. However, if the student grade is 79.5 EXTRAS WILL NOT BE USEFUL.

## Course Requirements:

### A. Programming Assignments/ HW with topics(tentative)

HW ( <b>NO drop of any HW</b> )	Posted <b>Mondays</b>	Due Mondays
HW0	Before Week 1	Before Week 1
HW 1	Beginning of week 1	Beginning of week 2
HW 2	Beginning of week 2	Beginning of week 4
HW 3	Beginning of week 5	Beginning of week 8
HW 4	Beginning of week 8	Beginning of week 11
HW 5	Beginning of week 11	Beginning of week 13
<b>(Final regrade)</b>	Last Day of the semester	

### B. Group Assignments with topics(tentative)

GA	Posted ( <b>Tuesdays</b> )	Due (Tuesdays)
GA1	Mid of week 4	Mid of week 7
GA2	Mid of week 8	Mid of week 11
GA3	Mid of week 11	Mid of week 14

### C. Labs (tentative)

Labs	Posted ( <b>Wednesdays</b> )	Due (Wednesdays)
Lab1	Mid of week 1	Mid of week 2
Lab2	Mid of week 3	Mid of week 4
Lab3	Mid of week 5	Mid of week 6
Lab 4	Mid of week 7	Mid of week 8
Lab5	Mid of week 9	Mid of week 10
Lab6	Mid of week 11	Mid of week 12
Lab 7	Mid of week 13	Mid of week 14

### D. Kattis (tentative)

Kattis Competitions	( <b>Saturdays</b> )	Time
Kattis Competition I	7-Oct	12-2:00 PM
Kattis Competition II	4-Nov	12-2:00 PM
Kattis Competition III	2-Dec	12-2:00 PM

### Resubmission Policy

Students can resubmit each homework for a regrade in the next 48 hours after the deadline with 20% penalty. Students do not need to notify anybody; the homework will be regraded automatically.

### Regrading Policy

No HW will be dropped, however you can repeat any previous homework for a full grade, through final regrading.

## Grading Policy

The final numeric grade is computed based on student's performance in weekly assignments and exams/quizzes.

Plus and minus grading is used when determining final grades. Final grades are computed by first finding the average score in each category described in the table below on the right. All scores are normalized to a scale of 0 to 100 before being averaged. The average score for each category is then used to compute the weighted average according to the weights in the table.

Grade		% of Total Points
A	$92.5\% \leq X$	
A-	$89.5\% \leq X < 92.5\%$	
B+	$86.5\% \leq X < 89.5\%$	
B	$83.5\% \leq X < 86.5\%$	
B-	$79.5\% \leq X < 83.5\%$	
C+	$76.5\% \leq X < 79.5\%$	
C	$72.5\% \leq X < 76.5\%$	
C-	$69.5\% \leq X < 72.5\%$	
D+	$65.5\% \leq X < 69.5\%$	
D	$62.5\% \leq X < 65.5\%$	
F	$X < 62.5\%$	

Category	% of Final Grade
GA Assignment and/or In class Quizzes	10%
Lab work+ Kattis (drop the lowest)	10%
Homework Assignments (NO drop of any HW)	25%
Exam 1(Tuesday 9/26)	15%
Exam 2(Tuesday 10/31)	15%
Final Exam	25%

**Academic Honesty:** It is each student's responsibility to read and understand the Academic Honesty Policy found at <http://catalog.uh.edu/content.php?catoid=36&navoid=13063>.

The following rules apply to all exams for this class:

- Do not communicate about the exam with anyone (other than your instructor).
- Do not post information about the exam at any time (while you are taking it or afterward) on a website or any other forum where other people can find the information.
- Do not make or save a record of the exam questions. This includes screenshots, pictures, video, copying and pasting the text, etc.
- Do not use any electronic devices while taking the exam other than the calculator.

Academic Honesty proceedings may be initiated against any student who violates these rules.

**Honor Code Statement:** Students may be asked to sign an honor code statement as part of their submission of any graded work including but not limited to projects, quizzes, and exams:

***"I understand and agree to abide by the provisions in the (select: [University of Houston Undergraduate Academic Honesty Policy](#), [University of Houston Graduate Academic Honesty Policy](#)). I understand that academic honesty is taken very seriously, and, in the cases of violations, penalties may include suspension or expulsion from the University of Houston."***

**Counseling and Psychological Services (CAPS)** can help students who are having difficulties managing stress, adjusting to college, or feeling sad and hopeless. You can reach CAPS ([www.uh.edu/caps](http://www.uh.edu/caps)) by calling 713-743-5454 during and after business hours for routine appointments or if you or someone you know is in crisis. Also, there is no appointment necessary for the "Let's Talk" program, which is a drop-in consultation service at convenient locations and

hours around campus. <https://uh.edu/caps/outreach/lets-talk/>.

**Excused Absence Policy:** Regular class attendance, participation, and engagement in coursework are important contributors to student success. Absences may be excused as provided in the University of Houston [Undergraduate Excused Absence Policy](#) and [Graduate Excused Absence Policy](#) for reasons including: medical illness of student or close relative, death of a close family member, legal or government proceeding that a student is obligated to attend, recognized professional and educational activities where the student is presenting, and University-sponsored activity or athletic competition. Additional policies address absences related to [military service](#), [religious holy days](#), [pregnancy and related conditions](#), and [disability](#).

**Standard Disclaimer:** ***This syllabus is subject to change at the discretion of the instructor.***

**Recording of Class:** Students may not record all or part of class, livestream all or part of class, or make/distribute screen captures, without advanced written consent of the instructor. If you have or think you may have a disability such that you need to record class-related activities, please contact the [Center for Students with Disabilities](#). If you have an accommodation to record class-related activities, those recordings may not be shared with any other student, whether in this course or not, or with any other person or on any other platform. Classes may be recorded by the instructor. Students may use instructor's recordings for their own studying and notetaking. Instructor's recordings are not authorized to be shared with *anyone* without the prior written approval of the instructor. Failure to comply with requirements regarding recordings will result in a disciplinary referral to the Dean of Students Office and may result in disciplinary action.

**UH Email:** Email communications related to this course will be sent to your [Exchange email account](#) which each University of Houston student receives. The Exchange mail server can be accessed via Outlook, which provides a single location for organizing and managing day-to-day information, from email and calendars to contacts and task lists. Exchange email accounts can be accessed by logging into Office 365 with your CougarNet credentials or through Access UH. Additional assistance can be found at the [Get Help](#) page.

## Helpful Information

**Coogs Care:** <https://www.uh.edu/dsaes/coogscare/>

**Laptop Checkout Requests:** <https://www.uh.edu/infotech/about/planning/off-campus/index.php#do-you-need-a-laptop>

**Health FAQs:** <https://uh.edu/covid-19/faq/health-wellness-prevention-faqs/>

**Student Health Center:** <https://uh.edu/class/english/lcc/current-students/student-health-center/index.php>

Week	Date	Topic	WDS	ODS	Goodrich	Suggested Extra from Goodrich
Part 0 - Introduction & Review						
1	21 August, 2023	<ul style="list-style-type: none"><li>• Introduction</li></ul>	Chapters <a href="#">1, 2,4</a>	Chapter <a href="#">1, 4</a>	Chapters 1, 2	Extra_1_4_1: C1.7 Extra_1_4_2: R2.12 Extra_1_4_3: C 2.4
		<ul style="list-style-type: none"><li>• C++ Review</li></ul>				
2	28 August, 2023	<ul style="list-style-type: none"><li>· Recursion</li></ul>				
Part 1 - <a href="#">Linear Data Structures</a>						
		<ul style="list-style-type: none"><li>• Arrays</li></ul>			Chapters 3	Extra_1_5_1 : C3.7 Extra_1_5_2: C3.8 Extra_1_5_3:S3.14
3	Labor day Monday september 4th					
		<ul style="list-style-type: none"><li>◦ Static &amp; dynamically sized implementations</li></ul>				
	4 September, 2023	<ul style="list-style-type: none"><li>◦ Complexity analysis</li></ul>				
		<ul style="list-style-type: none"><li>• Lists</li></ul>	Chapters <a href="#">1, 3, 4, 11</a>	§ <a href="#">2.1</a>	Chapter 4	Extra_2_1_1: C4.5 Extra_2_1_2:C4,23 Extra_2_1_3:C4.26
		<ul style="list-style-type: none"><li>◦ ADT, Concept &amp; Interface</li></ul>		§ <a href="#">3, 3.1,</a>		
4		<ul style="list-style-type: none"><li>◦ Singly linked list</li></ul>				
	11 September, 2023	<ul style="list-style-type: none"><li>◦ Doubly linked list</li></ul>		<a href="#">3.2</a>		
					Chapter 5,6	Extra_2_3_1:C6.12 Extra_2_3_2:C6.17 Extra_2_3_3:C6.20
5	9/18/20233	◦ Quadratic Sorting				
Exam 1 - <a href="#">Tuesday September 26</a>						
Part 2 - <a href="#">Linear Data Structures.....Continue</a>						
		<ul style="list-style-type: none"><li>· Stacks</li></ul>				
		<ul style="list-style-type: none"><li>◦ ADT, Stacks</li></ul>				
6	25 September, 2023	<ul style="list-style-type: none"><li>◦ Complexity analysis</li></ul>	Chapter 5		Chapter 5	Extra_2_2_1:C5.2 Extra_2_2_2:C5.5 Extra_2_2_3:C5.6
		<ul style="list-style-type: none"><li>◦ Post fix notation</li></ul>				
Part 3 - <a href="#">Queues and Priority Queues</a>						
		<ul style="list-style-type: none"><li>• Queues</li></ul>				Extra_2_5_1:C7.4 Extra_2_5_2:C7.5 Extra_2_5_3:C7.34
		<ul style="list-style-type: none"><li>◦ ADT, Concept &amp; Interface</li></ul>				
7		<ul style="list-style-type: none"><li>◦ Array, Vector, List</li></ul>				
	2 October, 2023	implementations		§ <a href="#">1.2.1</a>		
		<ul style="list-style-type: none"><li>◦ Complexity analysis</li></ul>	Chapter 7	§ <a href="#">2.3</a>	Chapter 7,8	Extra_3_1_1: C8.4 Extra_3_1_2:C8.5 Extra_3_1_3:C8.17
		<ul style="list-style-type: none"><li>◦ Priority Queues : Heaps</li></ul>		§ <a href="#">3.1.1</a>		
		<ul style="list-style-type: none"><li>• Hash Tables (<i>Unordered Set/Multi Set, Unordered Map/Multi Map</i>)</li></ul>				



		o Concept & Interface	Chapter 9,11	Chapter 5	Chapter 9	Extra_3_2_1 :C9.12 Extra_3_2_2:C9.13 Extra_3_2_3:C9.14
8	9 October, 2023	o Hash Codes, Compression functions				
		o Collisions / Collision handling				
		o Complexity analysis				
9	16 October, 2023	· Binary Trees				Extra_3_4_1:C10.2
		o Binary search trees (BST)	Chapter 6,11	Chapter 6	Chapter 10	Extra_3_4_2:C10.9 Extra_3_4_3:C10.10
		o Complexity analysis				
10	23 October, 2023	· Sorting				Extra_3_4_1:C10.2
		o Merge				Extra_3_4_2:C10.9 Extra_3_4_3:C10.10
		o Quick				
Exam 2 - <b><u>Tuesday October 31st</u></b>						
Part 4 - <b><u>Trees, BST, AVL</u></b>						
		• <b>Binary Trees</b>	<b><u>Chapters 6, 11 +</u></b>		<b><u>Chapters 6, 11 +</u></b>	<b><u>Chapters 6, 11 +</u></b>
11			<b><u>AVL</u></b> link	<b><u>Chapter 6</u></b>	<b><u>AVL link</u></b>	<b><u>AVL link</u></b>
		o AVL Trees				
	30 October, 2023	o Traversal techniques	Skip §6.7,		Skip §6.7,	Skip §6.7,
		o Complexity analysis				
		· Sorting				
		o Complexity analysis	§6.8, §6.9		§6.8, §6.9	§6.8, §6.9
		o AVL trees				
12	6 November, 2023	B-trees				
		o Complexity analysis				
Part 5 - <b><u>Unordered data structure</u></b>						
<b>Deadline to drop - Wednesday November 15</b>						
		• <b>Graphs</b>				
		o Concept & Interface				Extra_4_3_1:C13.5 Extra_4_3_2:C13.8 Extra_4_3_3:C13.26
13	13 November, 2023	o Adjacency list, adjacency matrix	<b><u>Chapter 8</u></b>	<b><u>Chapter 12</u></b>	<b><u>Chapter 13</u></b>	
		o Traversals				
		o Searching				
		o Complexity analysis				

		<ul style="list-style-type: none"> <li><i>Graphs (continued)</i></li> </ul>				
14						
	20 November, 2023					
	Thanksgiving Holiday	November 22-25, 2023 Wednesday-Saturday				
		<ul style="list-style-type: none"> <li><i>Huffman code and Review</i></li> </ul>				
15						
	27 November, 2023					
	Last Day of Class	December 2, 2023 Saturday				
Final Exam for 10-11:30 (section 15428) - <b><u>Tuesday December 12 from 11-2</u></b>						
Final Exam for 11:30-1:00 (section 15430) - <b><u>Thursday December 7 from 11-2</u></b>						

*Wishing you a pleasant and a fruitful semester*