SYLLABUS

CSCI 2270: DATA STRUCTURES

SPRING 2020, 4 CREDITS, JANUARY 13 – MAY 6

Instructor and Lectures Information

Section 100

Instructor: Maciej Zagrodzki

Lecture: Monday, Wednesday, Friday, 10:00-10:50am; Location: VAC 1B20

Email: Maciej.Zagrodzki@colorado.edu

Office Location: ECOT 736

Section 200

Instructor: Asa Ashraf

Lecture: Monday, Wednesday, Friday, 2:00-2:50pm; Location: ECCR 1B40

Email: Asa.Ashraf@colorado.edu

Office Location: ECOT 538

Section 300

Instructor: Ashutosh Trivedi

Lecture: Monday, Wednesday, Friday, 3:00-3:50pm; Location: MUEN E050

Email: Ashutosh.Trivedi@colorado.edu

Office Location: ECCE 1B11

Recitations are a mandatory part of the course. Please check buffportal.colorado.edu for times and locations.

TA Information

Zagrodzki TAs:

Sec	*TA*	*email*
101	Himanshu Gupta	Himanshu.Gupta@colorado.edu
102	Abhidip Bhattacharyya	abbh0278@colorado.edu
103	Archana Anand	archana.anand@colorado.edu
104	Tao Ruan	Tao.Ruan@colorado.edu

Ashraf TAs:

Sec	*TA*	*email*
201	Yoshinari Fujinuma	Yoshinari.Fujinuma@colorado.edu
202	Sanskar Katiyar	sanskar.katiyar@colorado.edu
203	Saumya Sinha	saumya.sinha@colorado.edu

Trivedi TAs:

Sec	*TA*	*email*
301	Guohui Ding	guohui.ding@colorado.edu
307	Yu-Ju Lee	Yuju.Lee@colorado.edu
303	Saiyma	saiyma.sarmin@colorado.edu
304	Elizabeth Spaulding	elizabeth.spaulding@colorado.edu
305	Varad Deshmukh	varad.deshmukh@colorado.edu
306	Sharat Nimmagadda	sharat.nimmagadda@colorado.edu

Course Tools

Moodle

This is the course website. Students are responsible for monitoring this site and **for any announcements made here**. Course content, such as lecture notes, assignments, quizzes, interview schedulers, will be accessed here. Students need to self enroll by going to http://moodle.cs.colorado.edu/ and finding CSCI 2270. The enrollment key is DataStructs.

Piazza

This is an online discussion forum where students can ask questions, answer questions, and explore the topics covered in class. The instructors will offer guidance and also moderate discussions. **The forum is anonymous to other students, but it is NOT anonymous to the instructors.** Any inappropriate or disrespectful content will result in users being removed and banned from the forum. Students are encouraged to answer the questions posed by their peers. Note that you should not depend on Piazza to get your questions answered, as it is merely a discussion forum. Please come to office hours for in-person help. The link to the Piazza forum will be made available on the Moodle course page.

Pre-requisites

Requires prerequisite courses of CSCI 1300 or CSCI 1310 or CSCI 1320 or ECEN 1030 or ECEN 1310 and APPM 1345 or APPM 1350 or MATH 1300 or MATH 1310 (all minimum grade C-).

Course Topics

Studies data abstractions (e.g., stacks, queues, lists, trees) and their representation techniques (e.g., linking, arrays). Introduces concepts used in algorithm design and analysis including criteria for selecting data structures to fit their applications.

Course Description

- Lectures 3 times a week (MWF)
- Weekly 75-minute recitation sections with course TAs
- Problem sets assigned weekly, due the following week
- Online lecture quizzes at the end of every week
- Two midterm exams
- One final project
- This will be a challenging course, please plan accordingly

Textbooks and Materials

Course materials, such as lecture notes and assignments, will be available in electronic form on the Moodle site for the course.

Required text: The textbook for this course is an ebook, which will be distributed on the course Moodle site. Hoenigman, R. 2015. Visualizing Data Structures. Lulu Press.

It is highly recommended that you often backup your files. We recommend using Github or Google Drive. Don't lose your hard-earned progress if your computer crashes!

Course Outcomes

In this course, students will:

1. Document code including precondition/postcondition contracts for functions and invariants for classes.

2. Create and recognize appropriate test data for simple problems, including testing boundary conditions and creating/running test cases.

3. Design and test new classes using the principle of information hiding for the following data structures: array-based collections (including dynamic arrays), list-based collections (singly-linked lists, doubly-linked lists, circular-linked lists), stacks, queues, binary search trees, hash tables, graphs, and at least one balanced search tree.

4. Identify features and applications of common data structures, including records/structs, lists, stacks, queues, trees, graphs, and maps.

5. Implement algorithms for standard operations on common data structures and discuss the complexity of the operations.

6. Comment on the features of different traversal methods for trees and graphs, including pre-, post-, and in-order traversal of trees.

7. Describe the implementation of hash tables, including algorithms for collision avoidance and resolution.

8. Describe the principles of recursion and iteration and implement recursive and iterative solutions for a problem.

9. Formulate and implement solutions to problems using fundamental graph algorithms, including depth-first search, breadth-first search, and Dijkstra's algorithm.

10. Explain the features of at least one tree balancing algorithm and how tree balancing affects the efficiency of various binary search tree operations.

11. Correctly use and manipulate pointer variables to change variables and build dynamic data structures.

12. Explain the differences between dynamic and static data structure implementations, and justify the use of static and dynamic implementations in different applications.

13. Practice explaining design choices and algorithm features in small-group settings.

GRADING

Recitation	15%
Homework	40%
Lecture quizzes	10%
Midterm exams	20%
Final project	15%

RECITATION

Recitation is required. Recitation activities must be submitted by the end of recitation. You can drop one recitation grade.

EXAM INFORMATION

The midterm exams for this class will be held as two-hour evening exams on Friday in Week 6 and Week 12 of the semester. Students with a scheduling conflict need to inform their course instructor **a week prior to the exam week**. There will be a third and optional Midterm. The grade from the 3rd midterm will be used to replace the lowest of the prior two midterms, **even if this grade is lower than the grades of both of the prior midterms.**

ADDITIONAL EXAM GRADE REQUIREMENTS TO PASS THE CLASS

You must get at least a 65% average on your midterms to receive better than a D+ in this class, regardless of your grades on other parts of the class. A grade of a C- in this class is required to take the next class in the computer science sequence.

FINAL COURSE GRADES

The grades for this class follow the standard percentage breakdown for the College of Engineering:

93%-100%	A
90%-92%	A-
87%-89%	B+
83%-86%	B
80%-82%	B-
77%-79%	C+
73%-76%	C
70%-72%	C-
67%-69%	D+
63%-66%	D
60%-62%	D-
0%-59%	F

TENTATIVE COURSE CALENDAR

Instructors reserve the right to change this calendar. Any changes will be announced either in lecture, on Moodle, or both. It is each student's responsibility to pay attention to announcements.

WEEK 1, JANUARY 13-JANUARY 19

Topics: Introduction, C++ Review (Arrays, Structs, File I/O)

Book chapters:

Chapter 1

Due:

Recitation 1

Assigned:

Assignment 1: C++ Review

WEEK 2, JANUARY 20-JANUARY 26

MARTIN LUTHER KING JR DAY -JANUARY 20 - NO CLASSES

Topics: Pointers, Dynamic memory

Book chapters:

Chapters 2, 3

Due:

Recitation 2

Assigned:

Assignment 2: Array doubling, structs

WEEK 3, JANUARY 27-FEBRUARY 2

Topics: C++ Classes review, Linked Lists

Book chapters:

Chapters 5.1, 5.2

Due:

Recitation 3

Assigned:

Assignment 3: Linked lists

Week 4, February 3-February 9

Topics: Linked Lists

Book chapters:

Chapter 5

Due:

Recitation 4

Assigned:

Assignment 4: Linked lists

Week 5, February 10-February 16

Topics: Stacks, queues

Book chapters:

Chapter 6

Due:

Recitation 5

Assigned:

Assignment 5: Stacks and queues

Week 6, February 17-February 23

Topics: Review, Binary trees, binary search trees

Book chapters:

Chapters 7, 8

Due:

Recitation 6

Assigned:

No assignment this week

Midterm 1 Exam. - Friday, Feb 21st, 5-7PM. Locations TBD.

Week 7, February 24-March 1

Topics: Binary search trees

Book chapters:

Chapters 9, 10

Due:

Recitation 7

Assigned:

Assignment 6: Binary search trees

Week 8, March 2-March 8

Topics: Tree-traversal algorithms, tree balancing

Book chapters:

Chapter 9, 10, 11

Due:

Recitation 8

Assigned:

Assignment 7: Binary search trees

Week 9, March 9- March 15

Topics: Graphs - breadth-first search, and depth-first search

Book chapters:

Chapter 12

Due:

Recitation 9

Assigned:

Assignment 8: Graphs

Week 10, March 16 - March 22

Topics: Graphs, Dijkstra's algorithm, Priority queues

Due:

Recitation 10

Assigned:

Assignment 9 – Graphs

Week 11, March 23 - March 29

No classes, Enjoy Spring Break! :)

Assigned:

No assignment this week

Week 12, March 30-April 5

Topics: Hash Tables

Book chapters:

Chapter 13

Due:

Recitation 11

Assigned:

No assignment - prepare for midterm

Week 13, April 6-April 12

Topics: Heaps, Exam review

Due:

Recitation 12

Assigned:

release project

Assignment 10: Hash Tables

Midterm 2 Exam – Friday, April 10, 5-7PM. Locations TBD.

Week 14, April 13-April 19

Topics: Heaps, Priority Queues

Due:

Recitation 13

Assigned:

Final project

Week 15, April 20 - April 26

Topics: special topics

Due:

Project due date, interview grading for project - **TBD**

Assigned:

No new

Week 16, April 27-May 3

Topics: Special Topics

May 1st - Reading Day - no lecture

Due:

Recitation 15 (TBD)

Assigned:

Nothing

Midterm 3 Exam – date TBD

Final Exam Week

Accommodation Statement

We are committed to providing everyone the support and services needed to participate in this course. If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Medical Conditions: Injuries, Surgeries, and Illnesses guidelines under Quick Links at Disability Services website and discuss your needs with your professor.

Religious Observances

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required assignments/attendance. If this applies to you, please speak with me directly as soon as possible at the beginning of the term.

Classroom Behavior

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, ability, and nationality. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the policies on class behavior and the student code.

It is my expectation that each of you will be respectful to your fellow classmates and instructors at all times. In order to create a professional atmosphere within the classroom, you are expected to:

* Arrive to class on time.
* Turn off your cell phone (talk and text).
* Bring your laptop to class if you have one to participate in classroom activities. Please restrict laptop use to these activities only, no email, Facebook, Youtube, etc.
* Put away newspapers and magazines.

* Refrain from having disruptive conversations during class.
* Remain for the whole class; if you must leave early, do so without disrupting others.
* Display professional courtesy and respect in all interactions related to this class.

Compliance with these expectations will assist all of us in creating a learning community and a high quality educational experience.

Though many of the above stated policies address academic climate within the classroom, these policies should also be upheld outside of the classroom. As a member of the CU community you are expected to consistently demonstrate integrity and honor through your everyday actions. Faculty, TAs, and staff members are very willing to assist with your academic and personal needs. However, multiple professional obligations make it necessary for us to schedule our availability. Suggestions specific to interactions with faculty and staff include:

* Respect posted office hours. Plan your weekly schedule to align with scheduled office hours.
* Avoid disrupting ongoing meetings within faculty and staff offices. Please wait until the meeting concludes before seeking assistance. Respect faculty and staff policies regarding use of email and note that staff and faculty are not expected to respond to email outside of business hours. Send email messages to faculty and staff using a professional format. Tips for a professional email include:
* Always fill in the subject line with a topic that indicates the reason for your email to your reader.
* Respectfully address the individual to whom you are sending the email (e.g., Dear Professor Smith).
* Avoid email or text message abbreviations.
* Be brief and polite.
* Add a signature block with appropriate contact information.
* Reply to email messages with the previously sent message. This will allow your reader to quickly recall the questions and previous conversation.

Discrimination and Harassment

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been discriminated against should

contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. The full policy on discrimination and harassment has more information.

No late submissions

Late work is not accepted in CSCI 2270. In the event of a documented personal, family, or medical emergency, consult your TA about receiving a penalty free extension. If you know you will be missing a weekly recitation, go to a recitation with the same TA being held at a different time. Recitation assignments are due by the end of recitation. Your lowest recitation grade will be dropped.

Attendance

Attendance at all class meetings and recitations is required. You are responsible for knowing the material presented during class and recitation, even if you were not in attendance when the material was presented.

Other information

Written work must be neat and readable, with adequate spacing and margins. Your name, the date, and your section number must be at the top right of the first page. Code files should have your name, date, and homework number included as comments at the top of the file.

A limited amount of printing may be required in this class. You need to ensure that your printing account has sufficient funds for this. Your initial allocation may deplete quickly, depending on your other printing activities. If this causes problems, please come see me.

Honor Code

All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu; 303-492-5550). Students who are found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the Honor Code website (https://www.colorado.edu/osccr/honor-code).

CSCI 2270 Spring 2020 Collaboration Policy

The Computer Science Department at the University of Colorado at Boulder encourages collaboration among students. Students are most successful when they are working with other students to

understand new concepts. The ultimate goal is that you fully understand the code you develop and be able to collaborate with others in a mutually beneficial way.

To support students in collaboration, the Department has created a Collaboration Policy that makes explicit when their collaborative behavior is within the bounds of collaboration and when it is actually academic dishonesty, and therefore a violation of the University of Colorado at Boulder's Honor Code.

Unless otherwise specified, you may make reasonable use of outside resources (internet, other books, people), but then you must give credit by citing your sources in the comments inside your code. **Reasonable use of outside resources does NOT include downloading complete, or almost complete, solutions to an assignment, or acquiring a complete, or almost complete, solution from any source, whether you cite the source of the solution or not. This is considered plagiarism and violates the University's Honor Code policy.**

Examples of citing sources include:

```
// Modified version from https://github.com/Phhere/MOSS-PHP
// Adapted from Program #7.2 in book "Accelerated C++" by Stroustrup
// Worked with Joe Smith from class to come up with algorithm for sorting
// Received suggestions from stackExchange website (see http://....)
```

A good rule of thumb: "If it did not come from your brain, then you need to attribute where you got it."

Collaboration Exceptions

Certain homework, quizzes, or exams may be required to be completed without outside resources. In this class, this includes the midterm exams. Use of outside resources in these cases violates the collaboration policy.

Examples of violating the Collaboration Policy

- Sharing a file with someone else.
- Submitting a file that someone else shared with you.
- Stealing a copy of someone else's work and submitting as your own (even with modification).
- Copying or using outside resources to solve a component of a larger problem and not citing your sources.
- Copying or using an entire solution that you didn't generate, regardless of whether you cite your sources.
- Downloading a solution from the Internet and modifying it to make it look like your own work.

Examples of collaborating correctly:

- Asking another student for a helpful suggestion.
- Reviewing another student's code for issues/bugs/errors.

- Working together on the whiteboard (or paper) to figure out how to approach and solve the problem. In this case you must include that person's name in your collaboration list at the top of your submission.

Autograder:

- An autograder tool will be used to grade most of the coding problems. Any attempts to hack or fool the autograder (e.g. by hardcoding the expected answers) will be treated as a form of cheating.

One way to know you are collaborating well is if everyone fully understands the solution that is developed. If you do not understand what is in the work you are submitting, you need to spend the time to learn the material before you submit your assignment. This collaboration policy requires that you be able to create the code (or solve the problem) on your own before you submit your assignment. If any member of the instructional team believes that you are submitting someone else's work, you might be called upon to explain your solution in a one-on-one meeting with the instructor to receive credit for the work.

Any discovered incidents of violation of this collaboration policy will be treated as violations of the University's Academic Integrity Policy and will lead to an automatic academic sanction in the course and a report to both the College of Engineering and Applied Science and the Honor Code Council. Students who are found to be in violation of the Academic Integrity Policy can be subject to non-academic sanctions as well, including but not limited to university probation, suspension, or expulsion.

Collaboration boundaries are hard to define crisply, and may differ from class to class. If you are in any doubt about where they lie for a particular course, it is your responsibility to ask the course instructor.