COURSE SYLLABUS

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YEAR COURSE OFFERED: 2023

SEMESTER COURSE OFFERED: Spring

DEPARTMENT: Computer Science

COURSE NUMBER: COSC3320

NAME OF COURSE: Algorithms and Data Structures

NAME OF INSTRUCTOR: Carlos Ordonez

LECTURE MODE: Face to face (NEW: video streaming lectures, sporadic online)

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The information contained in this class syllabus is subject to change without notice. Students are expected to be aware of any additional course policies presented by the instructor during the course.
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Learning Objectives

Learning how to solve various problems that arise in a wide range of applications using algorithmic thinking and data structures. Understanding fundamental algorithmic design techniques. Designing efficient algorithms for a variety of problems, making emphasis on algorithmic thinking, solving computer resources limitations. Understanding and exploring how algorithms are applied. The course will provide intuition on the main ideas behind algorithms, justifying they work correctly as well as deriving their time complexity analyses. The course emphasizes theory, explaining mathematical techniques and patterns in algorithm design and analysis that are broadly applicable.

Grading: Major Assignments and Exams

This is a course that puts more emphasis on theory than programming. Grading is as follows:

- **40%**: two midterm exams, individual.
- **30%**: two written theory homeworks, solved in teams. Math notation and logical reasoning required. Script language: latex.
- **30%**: one programming homework, solved in teams. Language: C++.
- Participation points: Up to 5 points out of 100, towards final grade, based on answers to instructor questions in class.

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- Attendance points: Since lectures will be streamed it is necessary to check attendance. Attendance will be randomly taken during the lectures. Points towards final grade will be taken off if the student for each lecture is not present (points TBD).

Required Reading

The following textbooks are recommended (pdf available):

- Algorithms, Jeff Erickson
- Algorithms, Gopal Pandurangan
- Database Systems: The Complete Book, H. Garcia-Molina, J.D. Ullman, J. Widom

All course material comes from these books. Textbooks complement each other since some topics are covered on only one book, such as data structures. Not all chapters will be covered since some of them are graduate-level and some of them are too theoretical.

List of lecture topics

1. Algorithm notation
2. Time complexity, asymptotic notation, common functions
3. Correctness: P, Q, I
4. Techniques: iteration vs recursion, backtracking, smart recursion, greedy algorithms
5. Data structures in main memory (RAM): trees, hashing,search, sort
6. External memory (disk): search, hashing, B-trees, set ops, sort
7. P vs NP, NP-hardness, NP-completeness
8. Graph exploration and search: depth-first search, breadth-first search, triangles, cliques
9. Graph connectivity: minimum spanning trees, connected components, shortest paths, cycles, network flow
10. Advanced: Criptography, numerical methods

General policies and requirements

- All questions about grading, math background, program testing, Unix environment, exam difficulty will be answered during the 1st week of class.
- NEW: we will explore streaming the lectures live so that students can attend remotely. However, I am forced to take attendance. There will be sporadic lectures online (about 20%), in which attendance will also be taken. It is encouraged you install the MS Teams app.
- The exams are individual, in-class and written answer (10 questions, showing math reasoning and algorithms steps to solve a problem).
- Teams have 2 students. Team assigment will be done during 2nd and 3rd week. 1-team student teams are feasible, but discouraged.
- Homework submission and development: in a linux server. Login information will be provided during 2 week of class.

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- Written homeworks: Math notation required. Theory: correct notation, explain why an algorithm works correctly, derive O(). Latex strongly encouraged (sample code/lab will be given, Overleaf in the cloud, latex in our server), but a word processor (e.g Word, Write) is acceptable. Delivery format: PDF, letter size, plus source tex file.
- Programming: C++ (g++ in Linux). Programs developed in other compilers, or Windows or Mac will not be graded (very time-consuming for TAs). Program correctness: Programs will be carefully graded with 10 test cases, with varying degree of difficulty. Sample test cases will be posted before the due date. Source code quality: TAs and instructor will check code clarity, indentation, comments and modularity.
- Details about participation. For questions asked during class, the instructor will first randomly select students to give everyone an opportunity. Minor clarifications, asking for extensions, complaining about tests, posting many messages and so on do not count as participation. Students with in-class participation, giving accurate answers, generally jump one grade level (e.g. B- to B).
- We will setup an agile message communication system for smartphones (discord), instead of email or Microsoft Teams. We will make an effort to answer within 24 hours. Questions should be posted ASAP, after homework or programming assignments are posted, not 1 day before the due date.
- Late submission of homeworks and programs will incur a grade penalty each day. Late submissions beyond 3 days cannot be accepted.
- Academic honesty: Homework solutions and source code will be automatically checked for plagiarism. Documents and source code cannot be shared. Text and source code obtained from the Internet must be disclosed in documentation, to avoid misunderstandings.
- Resubmission: There will be a short window for resubmission of programs with minor I/O errors. Programs with major errors or incomplete requirements will incur a penalty between 10% and 20%, depending on the magnitude of changes.
- If for any reason a student cannot take some midterm exam on the assigned date, the makeup exam will be an oral exam in the instructor office or lab (typically 4 quick questions, 10 minutes total).
- Attendance will be randomly taken, counting as participation. Arriving late in the classroom is discouraged (i.e. more than 8 mins late). People arriving late are asked to wait until 16 minutes have passed to let everyone enter in batch (i.e. 11:46am).
- Face to face lectures will not be recorded. Some online lectures will be recorded.
- Disruptive noises or behavior during class are unacceptable (whispering to next student, having phone calls, messaging/typing on phone/laptop). Keeping mic on if connected remotely. Repeated disruption will result in 1-2 points off.

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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. No need to notify instructor since attendance will be randomly taken.

Recording of Class

Students cannot 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.

Smartphones and webcams

A smartphone with the MS Teams app is encouraged. Alternatively, access to a webcam on a laptop/desktop is also recommended.