COURSE SYLLABUS

****

YEAR COURSE OFFERED: 2025

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 (some lectures online via MSTeams)

****

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.

****

Learning Objectives

Understanding fundamental algorithmic design techniques and advanced data structures. Designing efficient algorithms for a variety of problems, making emphasis on algorithmic thinking, managing computer resources limitations. Understanding and exploring how algorithms are applied by learning how to solve various problems in science. 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:

- **50%**: two midterm exams, individual, in-class, closed-everything.
- **30%**: two written theory homeworks, solved in teams (number of team members TBA). Math notation and logical reasoning required. Script language: latex. Submission format: PDF.
- **20%**: 2 programming homeworks, solved in teams. Language: Pascal.
- Participation points: 1-5 points out of 100, towards final grade, based on answers to instructor questions in class. 1-3 points in general, 4-5 points in exceptional cases.
- Attendance points: Attendance will be randomly taken during lectures (points TBD). Absent students will be reported to undergrad director, but no points off.

COURSE SYLLABUS

Required Reading

The following textbooks are recommended (pdf available):

- Algorithms, Gopal Pandurangan (main textbook)
- Algorithms, Jeff Erickson
- 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. Time complexity, asymptotic notation, common functions
2. Pascal programming language
3. Algorithm notation
4. Correctness: P, Q, I
5. Search, sort, set operations
6. Design techniques: iteration vs recursion, backtracking, smart recursion (dp), greedy algorithms
7. Data structures in main memory (RAM): arrays, trees, hashing,
8. Data structures in secondary storage (disk, ext. mem): hashing, B-trees
9. Graphs: exploration and search: depth-first search, breadth-first search, triangles, clique detection. Graph connectivity: minimum spanning trees, connected components, shortest paths, detecting cycles, network flow
10. P vs NP, NP-hardness, NP-completeness
11. Criptography,
12. Algorithms vs numerical methods

General policies and requirements

- The exams are individual, closed-everything, in-class and written answer (10 questions, showing math reasoning, algorithms steps to solve a problem and correct code).
- Teams have 4 students. Team assignment will be done during 3rd week, after the DROP date. 1-team student teams are feasible, but discouraged.
- It is acceptable to use AI websites to solve homeworks, but an explanation must be given explaining which aspects were solve by AI and which by students. AI websites cannot be used to solve exams.
- All questions about grading, math background, program testing, Unix environment, exam difficulty will be answered during the 1st week of class.
- We may stream some 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.

COURSE SYLLABUS

- Homework submission and testing: in a linux server. Login information will be provided during 2nd week of class.
- 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 (or doc) file.
- Programming: Pascal. Testing/submission: our linux server. Programs developed in other programming languages 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 use an agile message communication system for smartphones (discord), instead of email or Microsoft Teams. TAs will answer soon, within 8 hours. Questions should be posted ASAP, after homework or programming assignments are posted, not 1-2 days before the due date. Due to the volume of questions, questions posted close to the submission date their response time is not guaranteed.
- Late submission of homeworks and programs will incur a grade penalty of 10 points per day. Late submissions beyond 3 days cannot be accepted.
- Academic honesty: A the top of your report or readme file, you need to disclose which AI tool you used (chatgpt, meta ai, hugging face, baird, etc). Homework solutions and source code will be automatically checked for plagiarism and compared with answers provided by AI. 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 without penaly. Programs that require more than 2 hours of work, 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. 1:16pm).
- Face to face lectures may be streamed and recorded, subject to TA availability. Online lectures will be recorded.
- It is encouraged you turn off your laptop and phone during class. 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.

COURSE SYLLABUS

COURSE SYLLABUS

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.