COURSE SYLLABUS

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YEAR COURSE OFFERED: 2024

SEMESTER COURSE OFFERED: Spring

DEPARTMENT: Computer Science

COURSE NUMBER: COSC4315 (COSC6345 grad section)

NAME OF COURSE: Programming Languages and Paradigms

NAME OF INSTRUCTOR: Carlos Ordonez

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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

Students will understand the theory and systems to design and evaluate programming languages. Students will learn it is necessary to develop multiple specialized programming languages and why one language cannot be a universal solution. The course will contrast imperative (traditional), procedural (old), functional (theory) and object-oriented (dominating) approaches, with an emphasis on functional programming, and how they can interoperate. From a systems perspective, this course will explain compiler and interpreter phases including lexical analysis, syntax analysis (parsing), data types and code generation. The course will make emphasis on which design and theory principles are essential on any language, but also which practical features have made some languages more successful than others (e.g. why C and C++ have survived, why Python leads AI).

Major Assignments and Exams

This is a course that gives more weight to programming homeworks. Grading is as follows:

- **70%**: 2 team programming assignments, each in a different language. HW1 has 30% weight and HW2 40%. HW1: functional programming in either JavaScript or Python using lists and recursion, HW2: in C++ (or plain C) parsing and evaluating Python source code (a short program 20-40 lines). If a program has errors, there will be an opportunity for resubmission within 3 days, with a 10%-20% penalty.
- **30%**: midterm exam. The exam will be closed-everything and written: 10 questions, short answers. Unfortunately, ChatGPT and Baird make an open-notes exam impossible.
- Extra points: Up to 5 points out of 100, towards final grade, based on answers to instructor questions in class or helpful participation in the messaging group. Simple

questions, minor clarifications, asking for extensions, complaining about test cases and so on do not count as participation. Students may jump one grade level (e.g. B- to B), or 2 levels in exceptional participation cases.

Required Reading

The following textbooks are recommended:

- Robert W. Sebesta, Concepts of Programm Languages, 11th Edition, 2016
- Daniel P. Friedman, Essentials of Programming Languages, MIT Press, 3rd edition
- John C. Mitchell, Concepts in Programming Languages, 2002
- Stroustroup, The C++ programming language, 4th edition, Addison-Wesley

List of lecture topics

1. Taxonomy of languages
2. Data types (simple, data structures, inference, dynamic vs static, ADTs, pattern matching)
3. Programming: OO vs functional decomposition, assignment vs function calls
4. Recursion (types, functions, tail, fixed points, stack manipulation)
5. Evaluation (translation, macros, lazy, memoization, promises, exceptions, garbage collection)
6. Functional aspects (lambda calculus, closures, higher order functions, currying, mutation avoidance)
7. Contrasting procedures/functions with object-oriented aspects (classes, polymorphism, containers, multiple inheritance, subtyping, extensibility, templates)
8. Optional: Concurrent vs parallel programming (shared memory, distributed memory)

General policies

- Teams with 2 students. Team members will be assigned by professor.
- Online lectures: a few lectures will be online, using MS Teams. These lectures will give the opportunity to learn development tools and interactive coding.
- 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.
- We will setup an agile message communication system (e.g. discord), instead of email. We will make an effort to answer within 24 hours.
- E-mail should not be used to ask HW or exam questions. E-mail should be used only to report personal problems, final grade complaints or academic dishonesty.
- Late submission of programs will incur a grade penalty; no extensions can be given. Late submissions beyond 3 days cannot be accepted.
- Source code quality: TAs and instructor will check code clarity, style, short but insightful comments and overall modularity.

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- Academic honesty: Source code will be automatically checked for plagiarism. Source code cannot be shared. Source code obtained from the Internet must be disclosed in documentation (to avoid misunderstandings, many students tend to copy source code from the a few web sites).
- Resubmission of programs with 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 the midterm exam on the assigned date, the makeup exam will be an oral exam (short questions) in the instructor office or lab.
- Attendance may be taken, if less than 30% students show up in the classroom. Face to face lectures will not be recorded, to encourage attendance and participation. Online lectures may be recorded, if students request it.
- Disruptive noises during class are unacceptable (whispering to next student, phone calls).
- Arriving late in the classroom is discouraged (i.e. more than 10 mins late).

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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.

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.

Syllabus Changes

Due to the changing nature of the COVID-19 pandemic, please note that the instructor may need to make modifications to the course syllabus and may do so at any time. Notice of such changes will be announced as quickly as possible through (*specify how students will be notified of changes*).

Video/Webcams

Video of student face is required for online lectures. Using MS Teams app is recommended.