CSPB 3155 - Principles of Programming Languages Syllabus

Course Information

Instructor Information

Instructor: Eric Reckwerdt (he/him)

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Preferred Method of Contact:

For all course-related inquiries, please use the Piazza platform to contact me. This ensures that all communication is centralized and accessible to all class members, which may provide answers to questions that others might also have. For private matters, you can message me directly on Piazza.

Course Description

Study fundamental concepts on which programming of languages are based, and execution models supporting them. Topics include values, variables, bindings, type systems, control structures, exceptions, concurrency and modularity. Learn how to select a language and to adapt to a new language.

Learning Goals

This course is about principles, concepts, and ideas that underlie programming languages. But what does this statement mean?

As a student of computer science, it is completely reasonable to think and ask, "Why bother? I'm proficient and like programming in Ruby. Isn't that enough? Isn't language choice just a matter of taste? If not, should I be using another language?''

Certainly, there are social factors and an aspect of personal preference that affect the programming languages that we use. But there is also a body of principles and mathematical theories that allow us to discuss and think about languages in a rigorous manner. We study these underpinnings because a language affects the way one approaches problems working in that language and affects the way one implements that language. At the end of this course, we hope that you will have grown in the following ways:

- You will be able to learn new languages quickly and select a suitable one for your task.
- You will gain new ways of viewing computation and approaching algorithmic problems.
- You will gain new ways of viewing programs.

- You will gain insight into avoiding mistakes for when you design languages.
- We will dissect programming languages by constructing interpreters. The semester project is to construct an interpreter for a toy language called Lettuce (a language based on a family of programming languages called ML). We will see that interpreters are the basis for realizing computation, and we will study the programming language theory that enables us to reason carefully about a language's design and implementation.

Incoming students often expect this course to be what we will call a trip to the Zoo of Programming Languages. While it is certainly interesting to go to the zoo, we seek a more informative and scientific study of the underlying principles. A more apt analogy is an anatomy course where we will study the "guts" and inner-workings of programming languages. After this course, such an anatomical study will enable us to compare and contrast programming languages in a substantive manner and address the learning goals outlined above.

The course covers many aspects of using, understanding, and reasoning about programming languages (e.g., syntax, scoping, induction, data types, and typing). We will build up a set of mathematical tools for careful discourse. A significant part is devoted to abstraction, that is, how languages help programming in the large (e.g., subtyping polymorphism, parametric polymorphism, modules, and objects).

Prerequisites

- CSPB 2270 - Computer Science 2: Data Structures
- CSCI 2824 - Discrete Structures

Required Texts

The primary reading for the course are the Jupyter notebooks that will be distributed each week

Recommended Textbooks:

- *Programming in Scala, third edition* by Martin Odersky, Lex Spoon, and Bill Venners
- *Essentials of Programming Languages, 3rd edition* by Daniel P. Friedman and Mitchell Wand

Useful Scala Textbooks:

- *Atomic Scala* by Bruce Eckel and Dianne Marsh
- F*unctional Programming in Scala* by Paul Chiusano and Runar Bjarnason

Grading Categories

Assessment	% of Grade	Description
Quizzes	10%	Weekly quizzes
Problem Sets	35%	Weekly problem sets
Mini Projects	5%	Three mini projects
Spot Exams	30%	Five spot exams
Final Exam	20%	Required to pass class

Quizzes

Weekly online quizzes will account for 10% of the grade. These will be posted as "quizzes" on moodle. You will have two attempts for each quiz. You can also check your answers for each question but a wrong answer will involve a small penalty to your grade

Problem Sets

Each week you will receive a problem set that will include concept-based problems and programming assignments in scala. These assignments will be posted as jupyter notebooks that need to be filled out. These will be posted on moodle and instructions for submission will be provided. These have to be followed precisely.

Mini Projects

We will have three mini projects that will involve building interesting applications using the skills you have learned in class. One of the mini-projects will implement a language from scratch. Another mini project will explore building a domain specific language.

Spot Exams and Final Exam

We will have five spot exams. These exams will last 20 minutes and consist of material covered in class or through your assignments

The final is compulsory to get a passing grade in this class.

Piazza

- You are expected to participate in Piazza in this course.
- All course communications will be via Moodle announcements and Piazza posts.
- Please set your communication preferences in the Piazza application.

- Instructors will post starter threads on Monday, use these to keep Piazza organized.
- Use the weekly folders to check in with class activities.
- Instructors may not immediately answer Piazza questions. Please help out your fellow students. We will endorse your posts when they contain good advice.
- Instructors are active on Piazza Monday through Friday during business hours.
- Instructors will try to immediately respond to Piazza posts if they are emergencies (Moodle not working, exam not working, etc.).

Method of Instruction

This is a live course and participation is essential. While there is flexibility in when you access the materials, there are strict weekly due dates - no late work is accepted. You may have access to future assignments if you wish to move faster, however, weekly discussion and instructor support will be focused on the current week.

A variety of materials and approaches will be used including: videos, readings, discussions, quizzes, and writing assignments.

As this is an online course, it requires a good deal of self-discipline and time management skills in order to be completed successfully. It is up to you, the student, to understand the schedule and keep up with the assignments. Make sure you know your deadlines and due dates.

Student Responsibilities and Class Expectations

Each week you should watch all the lectures and read the weekly notes. After you complete these, try taking the quiz. This is enough to get started on the homework, which is usually implementing some form of language feature discussed that week.

Grading Policies

Submission Policies

Fill out and upload the Jupyter Notebook for each week..

Grading will be done before the subsequent assignment is due or within 6 days of the due date (whichever is first).

Large one time projects may take two weeks to grade.

Individual Check-In

If you have a unique situation that may be affecting your work or class experience or you need clarification of an email, Piazza, or ZOOM exchange, please email your instructor with the subject line

"Individual Check-In". Your instructor will email you back to set up a Zoom call to discuss the specific situation and work with you to develop a solution and/or strategy to move forward.

Grading Reviews

Deadline to ask for a grade review is within a week of an assignment being returned.

Any grade review may include a review of all work submitted and your grade may go up or down

All grades are final on the last day of classes. No grade changes will be made after the last days of classes.

Late Work Policy

No late work and no extra credit. The lowest quiz, assignment, programming project, and exam scores are dropped.

Grading Scale

All coursework grades are final and will not be changed after the last day of classes. Please review your scores during the semester.

93 - 100   A
90 - 93   A-
87 - 90   B+
83 - 87   B
80 - 83   B-
77 - 80   C+
73 - 77   C
70 - 73   C-
67 - 70   D+
63 - 67   D
60 - 63   D-
0 - 59.9   F

Course Topics

- Introduction to Programming in Scala
- Inductive Definitions
- Operating on Inductive Definitions
- Interpreter for a Basic Language

- Interpreter with Function Calls: Variable Scoping and Recursion
- Dealing with Mutable Data/State
- Type System: Type Checking and Type Inference
- Objects and Inheritance, Abstract Classes and Traits
- Advanced Topics: Concurrency

Program Policies and University Policies

Service Interruptions and Support

Due to the online nature of this program, there is always the possibility of service interruptions. If you are unable to access the course materials (Moodle, Piazza, etc.), we encourage you to visit https://www.isitdownrightnow.com/applied.cs.colorado.edu.html.

For non-urgent issues related to platform support, please contact cscihelp@colorado.edu.

Classroom Behavior

Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure 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 race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation, or political philosophy.

For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

Collaboration Policy

We welcome collaboration! Sharing insights, asking questions, learning by doing, and learning by helping others are essential skills in learning computer science.

Collaboration is discussing ideas of the course with others, sharing insights and extra resources, working through similar questions to an assignment, sharing resources, and helping others. The Piazza forum in your class is an ideal place to share ideas, lead a discussion or be the hero that asks the "dumb question" everyone else is afraid to ask. And Piazza is often a source for content for instructors to include in letters of recommendations. Your leadership, courage, and determination will not go unnoticed.

Collaboration is not:

- "Having a partner." In particular, Group Projects, or projects that specify "working with a partner" will have individual guidelines.
- One student solving problems 1-4, and another solving 6-10.
- An identical group solution submitted by multiple students.

Unless specified in the assignment, all coursework is individual.

In general:

- You must document resources and collaboration on any assignment. This should be in the form of comments at the start of code and/or within solution notes.
- Cite Your Sources: If you collaborated with someone on an assignment, or if your submission includes quotes from a book, a paper, or a web site, you must clearly acknowledge the source.
- Plagiarism is forbidden. Copying answers directly or indirectly from solution manuals, web pages, or your peers is a violation of honor code. The assignments and code that you turn in should be written entirely on your own
- Copying/soliciting a solution to a problem from the internet or another classmate constitutes a violation of the course's collaboration policy and the honor code and may have serious consequences.
- You may not actively search for a solution to the problem from the internet. This includes posting to sources like StackOverflow, Reddit, Chegg, CourseHero, etc.
- StackExchange Clarification: Searching for basic techniques in Python/C++ is totally fine.
- If you have taken this course prior to this semester and have done some/all of homeworks previous code or previous homework solutions may not be reused. You must start each homework from scratch.
- When in doubt, ask. If something doesn't seem right - you are not sure if you can use a resource or if you are feeling pressure to share a specific solution - please reach out to your instructor.

Note: Other information on the Honor Code can be found at www.colorado.edu/policies/honor.html and https://www.colorado.edu/sccr/honor-code.

Requirements for Infectious Diseases

Members of the CU Boulder community and visitors to campus must follow university, department, and building health and safety requirements and all applicable campus policies and public health guidelines to reduce the risk of spreading infectious diseases. If public health conditions require, the university may also invoke related requirements for student conduct and disability accommodation that will apply to this class.

If you feel ill and think you might have COVID-19 or if you have tested positive for COVID-19, please stay home and follow the guidance of the Centers for Disease Control and Prevention (CDC) for isolation and testing. If you have been in close contact with someone who has COVID-19 but do not have any symptoms and have not tested positive for COVID-19, you do not need to stay home but should follow the guidance of the CDC for masking and testing.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation

If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.

If you have a required medical isolation for which you require adjustment, please contact your instructor.

Preferred Student Names and Pronouns

CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

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 Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), 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 Student Conduct & Conflict Resolution: honor@colorado.edu, 303-492-5550. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, reporting options, and support resources can be found on the OIEC website.

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of incidents related to these policies regardless of when or where something occurred. This is to ensure that individuals impacted receive an outreach from OIEC about their options for addressing a concern and the support resources available. To learn more about reporting and support resources for a variety of issues, visit Don't Ignore It

Religious Holidays

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 attendance. In this class, please contact me directly. See the campus policy regarding religious observances for full details.

Mental Health and Wellness

The University of Colorado Boulder is committed to the well-being of all students. If you are struggling with personal stressors, mental health or substance use concerns that are impacting academic or daily life, please contact Counseling and Psychiatric Services (CAPS) located in C4C or call (303) 492-2277, 24/7.

Free and unlimited telehealth is also available through Academic Live Care. The Academic Live Care site also provides information about additional wellness services on campus that are available to students.