# Course Syllabus

## 1. COURSE CONTENT

CS 581 *Programming Languages I* is a four-credit course for graduate students that teaches advanced topics about the foundations of programming languages. CS 581 is the first part of a two-course sequence. Here is the description from the official OSU course catalog.

> *Graduate-level introduction to functional programming and programming language theory. Strongly typed functional programming in Haskell, abstract syntax and grammars, interpreters, denotational semantics, domain theory, and lambda calculus.*

## Learning Objectives

On completion of the course, students must demonstrate the ability to:

- **Create** *functional programs* using *algebraic data types* and *recursive functions*
- **Produce** *abstract syntax* for a language given its concrete syntax
- **Create** *denotational semantics* for a language given its abstract syntax and an informal specification of its behavior
- **Analyze** *lambda expressions* and determine *free & bound variables*, *redexes*, and *normal forms*
- **Define** *relations* using inference rules
- **Create** *typing* rules for language constructs using inference rules

The class content is delivered by in-person lectures. The lectures will **not** be **recorded; no videos** will be available.

## Lecture Notes and Slides

I have lecture notes for some of the class content, which are available in the Files section on Canvas. For the other parts, I will make my slides available (see the table below).

## Background Reading

This course does not use an official textbook. All relevant information is contained on slides, in lecture notes, or in accompanying program examples. The lecture notes are closely related to my new undergraduate PL textbook, which contains some more background on basic programming language concepts:

> *Programming Language Fundamentals: A Metalanguage Approach in Elm*, Martin Erwig, Wiley 2024

I will also make a longer introduction to functional programming available.

If you want to read more about lambda calculus, operational semantics, and type systems (which are not covered by the lecture notes), I recommend the following textbook, which contains explanations of :

    *Types and Programming Languages*, Benjamin C. Pierce, MIT Press 2002

The OSU library has copies of both books.

## Haskell

We will use **Haskell** ⤷ **(http://haskell.org)** as a one metalanguage to explain concepts of programming languages. You basically have two options for how to use Haskell.

(1) Install the **GHC** ⤷ **(http://haskell.org/ghc)** interpreter on your machine, which is probably the most convenient option.

(2) Alternatively, you can use the installation on the ENGR machines, such as flip:

```
flip3> /usr/local/apps/ghc/current/bin/ghci
GHCi, version 9.8.1: https://www.haskell.org/ghc/  :? for help
>
```

**Note**: The exact version of GHC doesn't matter very much; the main differences will be in error messages. Within GHCi, enter `:?` for help on commands; enter `:q` to quit the interpreter.

## Tentative Schedule

| Week | Topic | Lecture Notes | Slides | Lecture Dates |
|------|-------|---------------|--------|---------------|
| 0 | Introduction, Haskell | Ch. 1, Ch. 2 | | Only 9/25 |
| 1 | Haskell | Ch. 2 | | 9/30  &  10/2 |
| 2 | Haskell | Ch. 2 | | 10/7  &  10/9 |
| 3 | Haskell & Abstract Syntax | Ch. 2, Ch. 3 | | 10/14  &  10/16 |
| 4 | Abstract Syntax | Ch. 3 | | 10/21  &  10/23 |
| 5 | Denotational Semantics | Ch. 4 | | 10/28  &  10/30 |
| 6 | *Review & Midterm Exam* | | | 11/4  &  11/6 |
| 7 | Inference Rules, Lambda Calculus | Sect. 5.1 | x | Only  11/13 |
| 8 | Lambda Calculus | | x | 11/18  &  11/20 |

| 9 | Lambda Calculus, Type Systems | Sect. 5.2-5.4 | x | 11/25 & 11/27 |
|---|---|---|---|---|
| 10 | Type Systems, Review | Sect. 5.2-5.4 | | 12/2 & 12/4 |

## 2. CLASS POLICIES

Please read the following rules carefully.

A. **No eating** is allowed in class.
B. The midterm and final **exams** can **only** be taken **at the time mentioned** (see below).
   Keep your graded midterm exam until the end of the term (e.g., in case your Canvas score needs to be fixed).
C. You are **allowed** to use a double-sided **note sheet** during the **exams**.
D. You must do all **homework assignments** and **exams** by yourself, **without the help of others** (except members of your group, see below)**.** Specifically, you are **not allowed** to use services such as Chegg or Course Hero. If you get stuck or need help with your homework, simply ask on Canvas, and you shall receive help!
E. Late homework will **not** be accepted.
F. A note on the use of ChatGPT and similar generative AI tools. You may use such tools for help in the same way you are allowed to ask another human for help. So, for example, it is **allowed** to **ask for explanations** of why some code works or doesn't work, but is it **not allowed** to have the tools **generate content/solutions** for you.

## 3. IMPORTANT DATES

- Midterm Exam: Wed, **Nov 6**, **8:30am - 9:30am**
- Final Exam: Thu, **Dec 12**, **6:00pm - 7:50pm**

## 4. HOMEWORK

***Homework 1 must be completed and submitted by every student individually.***

On all other homework, you can work in teams of up to three students to create and submit the assignments. Each group submits one solution, and all group members will receive the same grade for the homework.

**Note**: Working as a team on homework means that every team member solves (or at least tries to solve) every exercise. Only then can you learn. After every team member has worked on their solutions, the team should get together to compare and discuss the different solutions, integrating them into one submission. Teamwork should not be (ab)used to save effort by splitting the exercises among different people.

Homework is **graded leniently**, you should view it as an opportunity to get an honest assessment of your understanding to help you prepare for the exams.

**(mailto:madhwanb@oregonstate.edu)**

# 5. GRADING

Your final grade is roughly computed as follows.

20% Homework
35% Midterm Exam
45% Final Exam

**Grading Scale**

| Point Range | Letter Grade |
|---|---|
| 90 - 100 | A |
| 84 - 89 | A- |
| 78 - 83 | B+ |
| 72 - 77 | B |
| 66 - 71 | B- |
| 60 - 65 | C+ |
| 54 - 59 | C |
| 48 - 53 | C- |
| 42 - 47 | D+ |
| 36 - 41 | D |
| 30 - 35 | D- |
| 0 - 29 | F |

# 6. OFFICE HOURS

Instructor: Dr. Martin Erwig, **erwig@oregonstate.edu (mailto:erwig@oregonstate.edu)**

**Mon: 10am-11am  -  KEC 3045**

**Wed: 2pm-3pm  -  KEC 3045**

GTA: Zhengzhi Qi, **qizh@eecs.oregonstate.edu (mailto:qizh@eecs.oregonstate.edu)**

**Thu: 3pm-4pm  -  KEC Atrium**

## 7. MANDATORY UNIVERSITY-WIDE COURSE STATEMENTS

- **Academic Calendar**
  All students are subject to the registration and refund deadlines as stated in the Academic Calendar: **https://registrar.oregonstate.edu/osu-academic-calendar (https://registrar.oregonstate.edu/osu-academic-calendar)**

- **Statement Regarding Students with Disabilities**
  Accommodations for students with disabilities are determined and approved by Disability Access Services (DAS). If you, as a student, believe you are eligible for accommodations but have not obtained approval, please contact DAS immediately at 541-737-4098 or at **http://ds.oregonstate.edu (http://ds.oregonstate.edu/)** . DAS notifies students and faculty members of approved academic accommodations and coordinates implementation of those accommodations. While not required, students and faculty members are encouraged to discuss details of the implementation of individual accommodations.

- **Student Conduct Expectations link**:  **https://beav.es/codeofconduct (https://beav.es/codeofconduct)**

- **Student Bill of Rights**
  OSU has twelve established student rights. They include due process in all university disciplinary processes, an equal opportunity to learn, and grading in accordance with the course syllabus: **https://asosu.oregonstate.edu/advocacy/rights (https://asosu.oregonstate.edu/advocacy/rights)**

- **Reach Out for Success**
  University students encounter setbacks from time to time. If you encounter difficulties and need assistance, it's important to reach out. Consider discussing the situation with an instructor or academic advisor. Learn about resources that assist with wellness and academic success at **oregonstate.edu/ReachOut (https://counseling.oregonstate.edu/reach-out-success)** . If you are in immediate crisis, please contact the Crisis Text Line by texting OREGON to 741-741 or call the National Suicide Prevention Lifeline at 1-800-273-TALK (8255)