CS 582 “Programming Languages II” is a four-credit course for graduate students that teaches advanced topics about the foundations of programming languages. CS 582 is the second part of a two-course sequence that starts with CS 581 in the Fall term. This class focuses on concepts found in programming languages (such as bindings, scope, recursion, or state) through the definition of a series of small toy languages. For each example language different language aspects (such as abstract syntax, semantics, and type systems) will be defined mathematically (using, for example, grammars or rule systems) as well as through implementations in metalanguages (specifically, Haskell and Idris).

Instructor: Dr. Martin Erwig
Email: erwig@oregonstate.edu

Office Hours (KEC 3045):
Monday 10am – 11am
Wednesday 2pm – 3pm
or by appointment

Resources:
- Type-Driven Development with Idris, by Edwin Brady. Manning, 2017
- Types and Programming Languages, by Benjamin C. Pierce, MIT Press 2002
- Free online book: Software Foundations (www.cis.upenn.edu/~bcpierce/sf/)
- Online resources for Idris: www.idris-lang.org/

Note: The book by Pierce is recommended as background reading material, and the Idris book provides a thorough introduction to Idris and programming with dependent types. However, the books are not required for this class.

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

1. Employ the Curry-Howard isomorphism to represent theorems as types and proofs as programs.
2. Define operational semantics using inference rules and a dependently typed programming language.
3. Translate between small-step/structural and big-step/natural operational semantics.
5. Explain and apply type checking, type inference, and unification.
6. Construct formal proofs of simple language properties as expressions of dependent types.
## Tentative Lecture Syllabus

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Thu Quiz</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction, Idris</td>
<td>–</td>
</tr>
<tr>
<td>2</td>
<td>Dependent Types, Proofs</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>Idris Practice</td>
<td>–</td>
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<tr>
<td>4</td>
<td>Inference Rules</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>Operational Semantics</td>
<td>–</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Midterm</td>
</tr>
<tr>
<td>7</td>
<td>Operational Semantics</td>
<td>✓</td>
</tr>
<tr>
<td>8</td>
<td>Language Properties</td>
<td>✓</td>
</tr>
<tr>
<td>9</td>
<td>Type Systems &amp; Polymorphism</td>
<td>–</td>
</tr>
<tr>
<td>10</td>
<td>Type Inference</td>
<td>–</td>
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### Important Dates and Times

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<tr>
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<tbody>
<tr>
<td>Quizzes</td>
<td>Jan 17</td>
<td>Thu, 10:00am – 10:20am</td>
</tr>
<tr>
<td></td>
<td>Jan 31</td>
<td></td>
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<tr>
<td>Midterm Exam</td>
<td>Feb 14</td>
<td>Thu, 10:00am – 11:00am</td>
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<tr>
<td>Quizzes</td>
<td>Feb 21</td>
<td>Thu, 10:00am – 10:20am</td>
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<td>Feb 28</td>
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<tr>
<td>Final Exam</td>
<td>Mar 20</td>
<td>Wed, 9:30am – 11:20am</td>
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### Grading

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<tr>
<td>10%</td>
<td>Class participation</td>
</tr>
<tr>
<td></td>
<td>(during class and on Piazza)</td>
</tr>
<tr>
<td>20%</td>
<td>Quizzes</td>
</tr>
<tr>
<td>30%</td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>40%</td>
<td>Final Exam</td>
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### Note on Quizzes and Exams:
You are allowed to use a one-page cheat sheet during each quiz or exam (single-sided, at least 10pt font size). No other supporting devices (books, cell phones, computers, etc.) are allowed.

### Note on Homework:
Homework is optional. Working through the homework problems is a good preparation for the midterm and final exams (the problems on the exams will be easier than the homework problems). Homework will not be graded. I may discuss selected exercises in class upon request.

Students with documented disabilities who may need accommodations, who have any emergency medical information the instructor should know, or who need special arrangements in the event of evacuation, should make an appointment with the instructor as early as possible, however, no later than the first week of the term. In order to arrange alternative testing the student should make the request at least one week in advance of the test. Students seeking accommodations should be registered with the Office of Services for Students with Disabilities.

This syllabus and other information can be found on the course home page:

[http://eecs.oregonstate.edu/~erwig/cs582/](http://eecs.oregonstate.edu/~erwig/cs582/)