Introduction to Compilers

Programming Language Design and Implementation

Introduction

Spring 2016
Why take this course?

• Programming languages matter
  ▪ In theory, almost all languages are equivalent (Turing complete)
  ▪ In practice, languages make it easier/harder to do different things

• At some point in your career, the language you are working in may not be good enough

• (Name some languages you know or have heard of, and describe what they’re good for)
Course goals

• At the end of this course, you should be able to
  ▪ Understand the design and implementation of existing languages
  ▪ Design and implement a small programming language
  ▪ Extend an existing language
Warning

• A little knowledge is a dangerous thing

  Domain-specific languages tend to evolve into badly designed general purpose languages

  — (paraphrased) Paul Hudak

  ▪ Examples?

• Moral:

  ▪ Don’t design a new language when an existing one will do
  ▪ Some languages let you create new domain-specific languages internally, to a greater or lesser extent
Topics

• Lexing and parsing
• Operational semantics and Interpreters
• Intermediate representations
• Code generation
• Type systems
• Dataflow analysis
• Register allocation and optimization
• Advanced topics
Course overview

• Project 1: OCaml warmup
• Project 2: Unit calculator
  ▪ “42 furlongs per fortnight in m/s” → 0.006985 m/s
• Project 3: Interpret a small language
• Project 4: Compile a small language
• Project 5: Compile a small language (part 2)
• Project 6: Build a type checker

• Meet your professor!
Grading

• 5-6 programming projects (40%)
• 2 Midterms (35%)
• Final (24%)
• Meet your professor (1%)
Textbook

• None

• There is simply no book available that covers the right set of topics
  - Use these lecture notes as a reference
  - Take your own notes
Other administrivia

• Will use submit and grade server
  ▪ Programs *must* work on the submit server

• Announcements and discussions on Piazza
  ▪ Do not post code or test cases on Piazza
  ▪ Do not give away answers on Piazza

• GRACE accounts

• Projects due at midnight on due date

• Homework due at *start* of class on due date
  ▪ Unless otherwise specified

• Let me know as soon as possible if you have an excused absence

• Avoid academic dishonesty