

COMP 150-AVS

Fall 2018

Introduction

Why Take This Course?

- “Software” is an amazing idea
 - One of the core drivers of computer science
- Software is not just something humans write
 - Intended to be *read* and *manipulated* by a machine
- Design intention: Compilers
 - Compiler = *translator* from one programming language into another
 - Typically, source code to assembly code
 - Then, assembler translates into machine code
- But compiling code is not the only possibility...

Three Related Topics

- Program Analysis
 - Prove facts about programs' behavior
 - Grew out of optimizing compilers
 - Most popular use today: static bug detection
- Program Verification
 - How to argue that a program is correct?
 - State of the art: machine checked proofs of correctness
- Program Synthesis
 - Writing code is hard!
 - Good for employment of software engineers, but maybe bad overall
 - Develop ways to *search* for code satisfying a specification
 - Key difference from machine learning: resulting program should *always* work, not just probabilistically

Prerequisites

- COMP 105 or graduate standing
 - Ideas we will use in this class:
 - Functional programming
 - Operational semantics
 - Type systems
 - Lambda calculus
 - Talk to me if you're not sure

(Possible) Topics

- Lambda calculus and operational semantics review
- Dataflow analysis
- Abstract interpretation
- Symbolic execution
- SMT solvers
- Model checking and LTL
- Type inference and points-to analysis
- Axiomatic semantics and Hoare Logic
- Verification with Dafny
- Separation logic
- Proofs in Coq
- Inductive synthesis and programming by example
- Enumerative and stochastic search
- Constraint-based synthesis

Grading

- Programming projects (50%)
 - Equally weighted
 - Will cover major topics:
 - Tentative list: OCaml warmup; (constraint-based analysis?); dataflow analysis; symbolic execution; program verification; program synthesis
 - I reserve the right to add graded homework if needed
- Midterms (24%)
- Final (25%)
 - Take home exam
- 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

- We will try to use gradescope
 - Use entry code to add yourself to the class
- OCaml version 4.07
- Announcements and discussions on Piazza
 - Do not post code or test cases on Piazza
 - Do not give away answers on Piazza
- Projects due at 11:59 on due date
- Homework (if any) 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**