Introduction and Course Organization

Principles of Programming Languages

CSE 526

1. Course Overview
2. Principles of PL
3. Course Organization
Course Information

Title: CSE 526: Principles of Programming Languages

Web Page: http://www.cs.stonybrook.edu/~cse526/

Class: Tue., Thu. 2:30pm – 3:50pm
      Old CS 2120

Instructor: C. R. Ramakrishnan
            e-mail: cram@cs.stonybrook.edu
            Office: NCS 233
            Office Hours: Mon., Wed. 11:00am – 12:30pm, or by
            appointment
            http://www.cs.stonybrook.edu/~cram
**Motivation**

*Rigorously* define the *meaning* of programs.

**Essential to:**
- Define implementation standards
  - High-assurance, high-performance compilers and implementation platforms
- Improve programmer understanding
- Enable software validation and verification
Fruit Flies Like a Banana
Fruit Flies Like a Banana
Time Flies Like an Arrow

Fruit Flies Like a Banana

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Time Flies Like an Arrow

Fruit Flies Like a Banana

Ambiguity may be fun for some . . .
Program Semantics: Description Techniques

- **Operational Semantics:** How does the program work?
  
  *Specifies program behavior with respect to an execution mechanism*

- **Denotational Semantics:** What does the program stand for?
  
  *Treats programs as mathematical objects, as functions mapping inputs to outputs*

- **Axiomatic Semantics:** What properties are true in the program?
  
  *Associates proof rules with programming constructs*

We will focus primarily on operational semantics in this course.
Types and Type Systems

A type system provides a way to reason about programs.

- Types are sets of values computed by phrases in a program.
- Type systems prove the absence of certain program behaviors by classifying program phrases based on types.

This classification may be done:

- *statically*, i.e. before a program runs, or
- *dynamically*, i.e. when the program runs.
The Use of Type Systems

- Programmer Support
  - Error Detection
  - Maintenance
- Abstraction (modules)
- Documentation
- Language Safety
  - Guarantee that abstractions in the language are protected
- Efficiency
See schedule linked from course web page

- Course contents will follow the text reasonably closely.
- Other sources may be used to explore concepts not covered in detail in the text book.
- Homeworks will reinforce material from lectures and textbook. Some may be programming homeworks.
- Grading scheme:
  - Homeworks: 20% of grade
  - Mid-Term Exam: 40% of grade
  - Final Exam: 40% of grade
Textbook

Benjamin Pierce

*Types in Programming Languages*

(MIT Press)
Course Content: Principles

CSE 526: **Principles** of Programming Languages

- Formally define the syntax and semantics of programming languages.
- Provide formal proofs for properties based on these definitions.

You are expected to be comfortable with mathematical logic and proofs, especially those based on induction.
Course Content: Programming

CSE 526: Principles of Programming Languages

- You are expected to be an experienced programmer in a procedural (e.g. C) or object-oriented (e.g. Java, C++) language.
- You will be expected to quickly pick up programming in
  - a functional programming language Objective Caml (aka OCaml). See https://ocaml.org for OCaml system, references and tutorials.
  - a logic programming language Prolog. See http://www.swi-prolog.org for a popular Prolog implementation, and this course’s web page for additional resources and tutorials.
- Programming homeworks will not be large, but will require prior preparation.
The Rules of the Game

All home work (and exams, too):

- Individual work.
- Limit discussion of homeworks to problems, not solutions.
- Cheating, illegal collaboration and plagiarism will be treated with maximum seriousness.
Course Support

Course web pages are split between CS web server, the Blackboard system, and Piazza.

- **Pages on CS Web Server** will have *Course Material*: handouts, homeworks, notes, etc. will be in the CS server (open access).

- **Pages on BlackBoard:**
  - *Homework submission forms*: all homework assignments will be submitted via the Blackboard system.
  - *Grades*: Homework and exam grades will be posted on Blackboard.

- **Piazza:**
  - *Discussion Forum*: for all course discussion
Course Discussion Board

- Use this to discuss any course-related material: lectures, homework problems, exams, etc.
- If you have any questions on the material, first check to see if any one else had the same question as you have, and whether the question has been answered already; otherwise post the question on the board.
- We’ll try to answer all questions on the board asap: within 24 hrs for normal days, and much quicker near exam/homework deadlines.
Questions

How to contact course staff:

- Staff contact information is on the web page/Blackboard.
- Post your question on the discussion board.
- Meet me during my office hours (or fix an appointment).
- Send me email. (Post on discussion board unless the question is personal.)