CS 538

Introduction to the Theory and Design of Programming Languages

Charles N. Fischer

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http://www.cs.wisc.edu/~fischer/cs538.html

Class Meets

Mondays, Wednesdays & Fridays,
9:55 — 10:45
1325 Computer Sciences

Instructor

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Key Dates

- Feb 25: Homework #1 (tentative)
- March 24: Programming Assignment #1 - Scheme (tentative)
- April 2: Midterm Exam (tentative)
- April 16: Programming Assignment #2 - Standard ML (tentative)
- May 2: Programming Assignment #3 - Prolog (tentative)
- May 9: Programming Assignment #4 - Java, C#, Pizza and Python
- May 15: Final Exam 2:45pm-4:45pm

Class Text

- Required text:

  "Modern Programming Languages," Adam Webber, Franklin, Beedle & Associates, 2003.

- Handouts and Web-based reading will also be used.

Reading Assignment

- Webber: Chapters 1, 10, 18 (as background)

Class Notes

- Each lecture will be made available prior to that lecture on the class Web page (under the "Lecture Nodes" link).

Instructional Computers

Departmental Linux Machines (king01- king12, emperor01- emperor40) have been assigned to CS 538. All necessary compiler, interpreters and tools will be loaded onto these machines.

You may also use your own PC or laptop. It will be *your* responsibility to load needed software (instructions on where to find needed software are included on the class web page).

The Systems Lab teaches brief tutorials on Linux if you are unfamiliar with that OS.

Academic Misconduct Policy

- You must do your own assignments — *no* copying or sharing of solutions.
- You may discuss general concepts and Ideas.
- All cases of misconduct *must* be reported to the Dean's office.
- Penalties may be severe.

Program & Homework Late Policy

- An assignment may be handed in up to 7 days late, but no later.
- Each day late will be debited 4%, up to a maximum of 28%.
- All students are given 10 "free" late days. That is, the first 40% in late debits will be automatically forgiven.
- Your 10 free late days my be used at any time, and in any combination.

Approximate Grade Weights

Homework 1	10%
Program 1 - Scheme	16%
Program 2 - ML	16%
Program 3 - Prolog	12%
Program 4 - Java, C#, Pizza and Python (optional extra credit)	10%
Midterm Exam	23%
Final Exam (non-cumulative)	23%

Programming Languages to be Considered in Detail

1. Scheme

   A modern variant of Lisp.

   A *Functional Language*: Functions are "first class" data values.

   Dynamically Typed: A variable's type may change during execution; no type declarations are needed.

   All memory allocation and deallocation is *automatic*.

   Primary data structures, lists and numbers, are *unlimited* in size and may grow without bound.

Continuations provide a novel way to suspend and "re-execute" computations.

2. ML ("*M*eta *L*anguage")

Strong, compile-time type checking.

Types are determined by *inference* rather than declaration.

Naturally polymorphic (one function declaration can be used with many different types).

Pattern-directed programming (you define patterns that are automatically matched during a call).

Typed exceptions are provided.

Abstract data types, with constructors, are included.

3. Prolog (*Pro*gramming in *Log*ic)

Programs are Facts and Rules.

Programmers are concerned with definition, not execution.

Execution order is automatically determined.

4. Pizza

Extends a popular Object-oriented language, Java, to include

- Parametric polymorphism (similar to C++'s templates).
- First-class functional objects.
- Algebraic data types, including patterns.

5. C#

Microsoft's answer to Java. In most ways it is very similar to Java, with some C++ concepts reintroduced and some useful additions.

- Events and delegates are included to handle asynchronous actions (like keyboard or mouse actions).
- Properties allow user-defined read and write actions for fields.
- Indexers allow objects other than arrays to be indexed.
- Collection classes may be directly enumerated:
  `foreach (int i in array)` ...
- Structs and classes co-exist and may be inter-converted (boxed and unboxed).
- Enumerations, operator overloading and rectangular arrays are provided.
- Reference, out and variable-length parameter lists are allowed.

6. Java 1.5 (Tiger Java, Java 5.0)

Extends current definition of Java to include:

- Parametric polymorphism (collection types may be parameterized).
- Enhanced loop iterators.
- Automatic boxing and unboxing of wrapper classes.
- Typesafe enumerations.
- Static imports (**`out.println`** rather than **`System.out.println`**).
- Variable argument methods.
- Formatted output using **`printf`**:
  `out.printf("Ans = %3d",a+b);`

7. Python

A simple, efficient scripting language that quickly builds new programs out of existing applications and libraries.

It cleanly includes objects.

It scales nicely into larger applications.