CS212

Java Practicum

Fall 2005
Lecture 1
Introduction

Announcements

- Three ways to get website:
  - Link from CS211
  - http://courses.cs.cornell.edu/cs212/
  - http://www.cs.cornell.edu/courses/cs212/2005fa/
- CMS:
  - sign sheet
  - TAs will add you if you're not on already
- Part 1 of project
  - posted today/early tomorrow
  - no partners
  - Due Mon Sep 5
  - See *Chapter 1* in notes

Overview

- **The course:**
  - course stuff
  - course overview
  - project overview
  - teams and CMS
- **Computer models:**
  - computer architecture
  - machine model
  - JVM model
  - SaM

Staff

- **Instructors:**
  - Prof. David I. Schwartz
  - also, "Director of GDIAC"!
- **Grad TA:**
  - Jon Kaldor
- **Ugrad TAs:**
  - Ivan Gyurdiev
  - David Levitan
  - Aaron Sidford
- **Consultants TBA**
- **Quest for TAs...**
- **See Staff on CS212 website**

Classes

- **Lecture:**
  - here!
  - Lecture notes? see **Notes & Examples** on website
- **Section:**
  - very sporadic—will hold based on demand
  - sometimes once before each homework

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Reading

- Usually just current CS211 and CS212 notes
  - The CS212 book?
- Optional:
  - *Programming for the Virtual Machine*, J. Engel, Reading, Mass: Addison-Wesley, 2003.
  - *The Java Virtual Machine Specification*, Second Edition, T. Lindholm & F. Yellin, Boston: Addison-Wesley, 1999

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Software

- **Java 5**! (also known as **jdk1.5**)
- *IDE is optional*
- See current CS211's website:
  - http://www.cs.cornell.edu/courses/cs211/2005fa
  - Click on **Help & Software** under **Java Resources**
  - Follow downloading directions for JDK
- Macs?
- **SaM**:
  - runs in Java 5
  - will be used for all CS212 assignments
  - will show up in CS211, too

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Why are you here?

- CS212: A project course that introduces students to the ways of ***software engineering*** using the Java programming language. The course requires the design and implementation of several large programs.
- So, you want to become better designers!

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Why are we here?

- We want and need you to do the following:
  - Improve your programming skills.
  - Implement principles of software engineering, which include top-down and bottom-up design, software reuse, abstraction, and testing.
  - Develop interpersonal and project management skills, which you need for later courses.
  - Learn about the field of computer science.

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When to Take CS212?

- **Take CS212 now?**
  - connection with CS211 very tight
  - concepts expanded upon in CS212
  - coordination of assignments and instructors
  - just-in-time learning
- **Take CS212 later?**
  - more experience under your belt
  - need to balance with CS312
  - less connection (possibly) with your CS211
- **Take CS212 before CS211?**
  - No!

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Groups and CMS

- **Partners allowed (Parts 2+):**
  - why? practice for later team-projects
  - learn about code integration
  - **teams of 1, 2, 3**
- **The gist:**
  - you choose team
  - once start for part must continue
  - can redo groups for each part
  - more detail in **Course Info**
- **CMS:**
  - all work submitted on CMS
  - form groups early!
  - usually follow CS211 format
    - CS211 website: see **Info** (under **CMS**)
    - we'll alert you to changes
  - regrades usually by meeting

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Grades and Coursework

- **Things to do:**
  - 3 "Parts"
  - programming, documentation, presentation
- **Breakdown:**
  - Part 1: 5%
  - Part 2: 35% (2 subparts)
  - Part 3: 59% (3 subparts)
  - see **Schedule** and **Course Info** on website

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The Project

- **Build a compiler:**
  - translate C-like language (***Bali***) to assembly-like code (***SaM***)
  - use techniques you are learning in CS211
- **SaM code:**
  - resembles ***JBC***
  - runs in simulation of ***JVM*** (SaM)
  - where's SaM? website (careful of versions!) currently http://www.csuglab.cornell.edu/~dbl24/sam/

Bits and Bytes

- ***Computer***:
  - "programming electronic device that can store, retrieve, and process data"
  - *digital*: stores limited number of digits
- Data:
  - ***bits***: use binary digits: 0 and 1
  - ***byte***: 8 bits
  - ***cells*** or words: groups of bytes

Storage of Bits

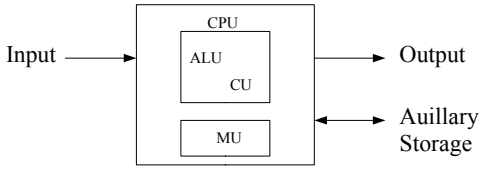
- Boolean operations:
  - `AND`, `OR`, `XOR`, …
  - e.g., `AND(1,0)→0`
- ***Gate***:
  - device that produces the output of Boolean operation
  - computers implement gates as small electronic circuits in which bits are represented as voltage values
- ***Circuits***:
  - gates provide building-blocks to create computers
  - can store bits, which means we can store info!
- ***Integrated circuit***:
  - embed multiple gates on chip
- need to discuss kinds of memory...

Computer Memory

- ***Memory***:
  - large collection of cells
  - has location (***address***)
  - can access cells in any order
- ***RAM*** (Random Access Memory)
  - storage for programs you run
  - programs fill cells with data
  - what about instructions...?

Von Neumann Model

- We have ability to store bits, which can be....
  - data
  - programs
- ***Von Neumann Model*** of computer architecture:



Components of Model

- **MU**:
  - ***memory unit***
  - hold data and programs
- **ALU**:
  - ***Arithmetic/Logic Unit***
  - handle arithmetic and logic calculations
- **CU**:
  - ***Control unit***
  - interprets instructions
  - controls ALU, Memory, I/O
- **I/O**:
  - ***input/output***
  - some storage

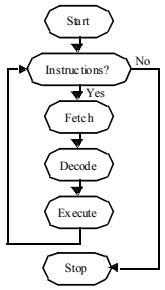
CPU

- ***CPU***:
  - central processing unit
  - CU, ALU, and registers
  - interact with memory
- ***Registers***:
  - writable memory cells
  - hold small amounts of data
  - various types:
    - **PC**: program counter
    - **IR**: instruction register (current instruction)
    - **SP**: stack pointer
    - more...

Assembly Language

- ***Instruction set***:
  - complete set of instructions for machine
  - has two parts:
    - ***opcode operand***
    - needs 2 bytes, or “binary strings”
- ***Assembly language***:
  - symbolic representation of machine language of specific processor
  - mnemonics:
    - write in human form
    - e.g., **`PUSHIMM 3`**

Fetch-and-Decode Cycle



- CU fetches next instruction from main memory at the address in the program counter (PC)
- CU places the instruction into the instruction register
- CU increments the PC to prepare for the next cycle
- CU decodes the instruction to see what to do
- CU activates the correct circuitry to carry out the instruction (such as getting the ALU to perform an operation)

Stack Machine Model

- **Main Memory Reminder:**
  - stack of cells that can hold information as bits
  - instructions and data can be translated as bit patterns
- **Java Bytecode (JBC):**
  - Java code gets compiled into class files which contain sequences of bits
  - not usually readable characters ("binary files")
  - a ***byte-code interpreter*** runs each instruction of byte-code in a similar fashion as machine code
- Use `javap -c classfile` to see JBC

Why Java?

- JVM is "average" of all computers
- JBC is "average" of all instruction sets to run on JVMs
- interpreter runs JBC for JVM to run on computer
- JVMs programmed for specific architectures, so Java can be compiled and run "everywhere"
- **"Write once, run everywhere!"**

JVM and SaM

- **JVM is only a specification!**
  - you can program your own!
  - certain features are prevalent, like stacks (see CS211: push and pop values onto stack)
- **SaM:**
  - approximate JVM with ***stack machine***
  - has areas for stack, heap
  - download from course website