Introduction to Programming

with Java, for Beginners

Intro

Computing

- Formal Definition:
  - The use of a computer to process data or perform calculations

- Penn Legacy - ENIAC (Electronic Numerical Integrator And Computer)
  - Build to calculate artillery firing tables
  - Reprogrammable

- Advancement in electronics enabled computing devices that were faster than man
  - A computer no longer tied to the desk anymore!!
  - E.g. PDA, Smart phones, EduBot

Computing Examples

- Mars Rover

Source: http://www.physics.arizona.edu/~thews/reu/granados.html

Digital Computer

- Modern day computers are made out of electronic device called transistors
  - Transistor is made from a semi-conductor

- The devices react to presence or absence of voltage

- Symbolically we represent
  - Presence of voltage as “1”
  - Absence of voltage as “0”

Other Sources: http://coweb.cc.gatech.edu/ice-gt/374
An electronic device can represent uniquely only one of two things:
- Each “0” and Each “1” is referred to as a **Binary Digit** or **Bit**
- Fundamental unit of information storage

To represent more things we need more bits:
- E.g. 2 bits can represent four unique things: 00, 01, 10, 11
- k bits can distinguish \(2^k\) distinct items

Combination binary bits together can represent some information or data. E.g. 00101001 can be:
- 1. Decimal value 41
- 2. Alphabet (or character) ‘A’ in ASCII notation
- 3. Command to be performed e.g. Performing Add operation

Programming to Machine Language

- Computers understand only 0s and 1s
  - a.k.a machine language
  - Tedium for humans to work in

- The compiler (special system software) translates the programming language into a **specific machine** language
  - Specific Machine: Electronic Hardware + Operating System
  - e.g. Intel Process + Windows XP vs. Intel processor + Mac OS

- Once translated (Programming -> Machine)
  - The same program **cannot run** on different machine
  - Java avoids the above problem
  - Code is portable - Write one run anywhere!
  - One of the features for popularity of Java

Programming Language Syntax

- Syntax is the **grammar** of the language
  - The Listener a.k.a Compiler will point out every syntax error
    - Analogous to rules in English Language:
      - Missing a period after sentence
      - Rules using verbs, nouns etc..

- Error messages may be helpful
  - Often, they are not
  - You gain experience with error messages after a while
Program

- A written set of instructions in particular language
- The first step in writing any program is to analyze the work/job to be done
  - Think Algorithmically
- Algorithm
  - Step-by-step procedure that is guaranteed to terminate, such that each step is precisely stated and can be carried out.

Algorithm Example

Algorithm or Not?

“IF NUCLEAR WARPHEADS ARE FALLING LIKE HAILSTONES, I WILL LIE DOWN AND TRY TO ENJOY IT. OTHERWISE, I WILL GO TO WORK AS USUAL.”

Programming Language Semantics

- When the computer carries out your instructions
  - Running or Executing a program
- Semantics is the meaning of the program
  - We learn the semantics after we run or execute the program
  - Basically we observe the output
- After the executing program, the semantics of the program may or may be correct
- Semantic errors cause your answers to be wrong
  - You may or may not get error messages
    - E.g. Error Message – Dividing a number by zero
  - If your program is not doing what you want it to do, though it runs, the error is semantic

Algorithm Example

1. Input a number \( x \)
2. Multiply \( x \) times itself
3. Multiply \( x \) times 2
4. Add the results of (2) and (3)
5. Add 10 to the result of (4)
Programming - The Craft

- People have different tastes in programming, but many values are held in common
  - Programming is an art as well as a craft

- Craft
  - Learn concepts fundamental to all programming languages
  - Learn about Object Oriented Programming (OOP) model using Java
  - Learn some basic data structures and algorithms

Programming Recurring Themes

- Modularity
  - Break big problem into sub problems and compose

- Algorithm Thinking
  - A well defined procedure

- Abstraction
  - Look for and encode common features

Java Books (Optional)

- Non Required!
  - Learn from Course Notes
  - Online Resources (see course website)

- Optional
  - Java Backpack Reference Guide (Java 5 edition) by DePasquale, Addison-Wesley
  - Murach’s Beginning SE 6 by Doug Lowe, Joel Murach, Andrea Steelman
  - Java 6 Illuminated: An Active Learning Approach (Jones and Barlett Illuminated) (Paperback)

Software

- Java Development Kit (JDK)
  - Compiler Software (for analyzing syntax)
  - Java Runtime Environment (JRE) software that allows you to run Java programs on your computer

- Dr Java
  - Free Development Environment
    - Create, edit, compile and run programs written in Java with help of JDK

- Both are Multiplatform (Windows, Mac, Linux)

- Installation guide can be found on Resources page