CS5000: Foundations of Programming

Mingon Kang, PhD
Computer Science, Kennesaw State University
Self Introduction

- Mingon Kang
- http://ksuweb.kennesaw.edu/~mkang9
  - Or Google “Mingon Kang” and the top one.
- Research interests:
  - Bioinformatics, Machine Learning, Data Mining, and Big Data Analytics
Course Information

- Instructor: Dr. Mingon Kang
- Office: J-339
- Email: mkang9@kennesaw.edu
- Office Hours:
  - T: 2-4pm
  - W: 10am-12pm
  - By appointment
Textbook (Not required)

Evaluation (tentative)

- Homework Assignment (30%)
- Exam 1: 15%
- Exam 2: 15%
- Final: 20%
- Project: 20%

If the grade received on your final exam is greater than one of the earlier exams, then I will replace the lowest of the earlier two exam grades with the grade received on the final exam.
Academic Integrity

- Academic dishonesty
  - Cheating
  - Plagiarism
  - Collusion
  - The submission for credit of any work or materials that are attributable in whole or in part to another person
  - Taking an examination for another person
  - Any act designed to give unfair advantage to a student or the attempt to commit
How to succeed this class

- Be honest (homework, exam, ...)
- Enjoy homework assignments
- Make your own challenging homework
- THINK hard, not WORK hard
Looks like building a house

Timeline to build a house
- Layout: Floor plan
- Excavation
- Footing/Foundation
- Framing
- Mechanicals
- Insulation
- Drywall
- Paint
- …
House!!
Work of art like Antoni Gaudi’s?
Programming Languages

- Programming languages
  - What is a programming language?
    - Formal constructed language to communicate to a machine.
  - A glance at the history of the computer programming
    - Punched Cards for computer programs
      - [http://homepage.cs.uiowa.edu/~jones/cards/collection/i-program.html](http://homepage.cs.uiowa.edu/~jones/cards/collection/i-program.html)
  - What kinds of programming languages?
Punched Cards (early 1900s)

- Write program codes on a paper
- Submit the codes to the computation center
- A staff moves the codes to a punched-card.
- A computer regularly runs a batch of programs, and outputs the results.
Top Programming Languages

- The 15 most popular programming languages, according to the 'Facebook for programmers

- Programming Language for Interviews
Why Java?

- Platform independence
- Object-Oriented Languages
- The Java Memory Model
- The Core API
- Intelligent IDEs
Origins of the Java Language

- Created by Sun Microsystems team led by James Gosling (1991)
- C in 1969 at AT&T Bell Labs
- Originally designed for programming home appliances
  - Difficult task because appliances are controlled by a wide variety of computer processors
  - Team developed a two-step translation process to simplify the task of compiler writing for each class of appliances
Computer Language Levels

- **High-level language**: A language that people can read, write, and understand
  - A program written in a high-level language must be translated into a language that can be understood by a computer before it can be run

- **Machine language**: A language that a computer can understand

- **Low-level language**: Machine language or any language similar to machine language

- **Compiler**: A program that translates a high-level language program into an equivalent low-level language program
  - This translation process is called compiling
Compiler

- A computer program that converts source codes to object code which a computer can execute.

- The compilers for most programming languages translate high-level programs directly into the machine language for a particular computer.

- Different computers have different machine languages, a different compiler is needed for each one.
Compiler and Run

C/C++

Source File ➔ Compilation ➔ Linking ➔ Executable File

Hello.c ➔ Hello.o ➔ Hello.exe

Java

Source File ➔ Compilation ➔ Output ➔ Virtual Machine

Hello.java ➔ Hello.class
Byte-Code and the Java Virtual Machine

- The Java compiler translates Java programs into byte-code, instead of Low-level language.
- The machine language for a fictitious computer called the Java Virtual Machine (JVM).
- Once compiled to byte-code, a Java program can be used on any computer, making it very portable.
Compiled vs Interpreted

- **Compiled languages**
  - Codes are optimized to a set of machine-specific instructions (such as assembly) before being saved as an executable program
  - Fast
  - Source can be hidden

- **Interpreted languages**
  - The interpreter translates each statement into machine language and executes it before processing the next statement.
  - Slow, but easy to handle or maintain
Byte-Code and the Java Virtual Machine

- **Interpreter**: The program that translates a program written in Java byte-code into the machine language for a particular computer when a Java program is executed
  - The interpreter translates and immediately executes each byte-code instruction, one after another
  - Translating byte-code into machine code is relatively easy compared to the initial compilation step
IDE (Integrated development environment)

- NetBeans (Open Source, https://netbeans.org/)
- Eclipse (Freeware, https://eclipse.org/)
Hello, World!

- First Java program

```java
public class HelloWorld {
    public static void main(String[] args) {
        System.out.print("Hello World");
    }
}
```

- Compile: `javac HelloWorld.java`
- Run: `java HelloWorld`
Compiling a Java Program or Class

- Each class definition must be in a file whose name is the same as the class name followed by `.java`
  - The class `HelloWorld` must be in a file named `HelloWorld.java`

- Each class is compiled with the command `javac` followed by the name of the file in which the class resides
  - `javac HelloWorld.java`

- The result is a byte-code program whose filename is the same as the class name followed by `.class`
  - `HelloWorld.class`
Running a Java Program

- A Java program can be given the run command (java) after all its classes have been compiled.
  - Only run the class that contains the main method (the system will automatically load and run the other classes, if any).
  - The main method begins with the line:
    ```java
    public static void main(String[] args)
    ```
  - Follow the run command by the name of the class only (no .java or .class extension).
    ```shell
    java HelloWorld
    ```
**Errors**

- **Bug:** A mistake in a program
  - The process of eliminating bugs is called *debugging*
- **Syntax error:** A grammatical mistake in a program
  - The compiler can detect these errors, and will output an error message saying what it thinks the error is, and where it thinks the error is
Errors

- **Run-time error**: An error that is not detected until a program is run
  - The compiler cannot detect these errors: an error message is not generated after compilation, but after execution

- **Logic error**: A mistake in the underlying algorithm for a program
  - The compiler cannot detect these errors, and no error message is generated after compilation or execution, but the program does not do what it is supposed to do