CS415
INTRODUCTION TO COMPUTER SCIENCE
FALL 2017

2 - BACKGROUND
CHAPTER 0

- Read Chapter 0
  - Hardware
  - Software
  - Software development overview

HARDWARE ESSENTIALS

- Hardware
  - input/output devices
  - CPU - central processing unit
  - Primary memory (a.k.a. RAM, system memory)
  - Secondary memory (a.k.a. disk storage, hard drive)
  - Data stored in binary digits or bits (b)
    - bytes (B), KB, MB,GB,TB,...

MEMORY

- Primary memory (a.k.a. RAM, system memory)
  - volatile, short-term memory used while program is executing
  - fast and small capacity
  - stores both programs and data during execution
  - data stored as "variables"
- Secondary memory (a.k.a. disk storage, hard drive)
  - permanent, long-term memory
  - saves programs and data when they are not being executed
  - slow and large capacity
  - data stored in "files"

SOFTWARE IS KING!

- Software is what makes computers useful
  - *Applications* provide functionality desired by ordinary users
  - Operating system software provides an interface between applications (and their users) and the hardware
- Software is much *more complicated* than hardware
- Software is much *less reliable* than hardware

SOFTWARE IS KING!

- Software is much *less reliable* than hardware

We need to do something about that:

- Better design methodology
- Better testing methodology

CREATING SOFTWARE

- Software components
  - Data (values to be manipulated)
  - Algorithms (Instruction on how to manipulate them)

CREATING SOFTWARE

- Data
  - We'll represent data as *objects* belonging to *classes* of objects that have specific shared characteristics (*behavior*)
- Algorithm:
  - an unambiguous list of instructions for performing some task

An algorithm is something like a cooking *recipe*.

BLUEBERRY MUFFIN RECIPE

Ingredients (data)

1 cup flour

4 tsps baking powder

1/4 tsp salt

1 Tbsp sugar

1/3 cup cooking oil

1 egg

1 cup milk

1 cup blueberries

Directions (algorithm)

1. Preheat oven to 450°F.
2. Sift together flour, sugar, baking powder and salt.
3. Stir in egg, oil and milk.
4. Add blueberries.
5. Grease muffin tin or put in muffin liners.
6. Fill each liner about half full with mixture.
7. Bake 12-14 minutes.

BLUEBERRY MUFFINS AS CODE

- Need "variables" to represent "objects" in the recipe domain
  - amount of: flour, baking powder, salt, milk, mixing bowl, muffin tin, oven
- Need "actions" that we can apply to the objects
  - e.g.: turn the oven on, mix things into a bowl, etc.
- Need a notation for applying actions to objects:
  - oven.on(temperature)
  - bowl.mix(ingredients)

BLUEBERRY MUFFINS AS CODE (V. 2)

```
// data
Flour_C       flour = new Flour_C( 1 );
BPowder_t     bp = new BPowder_t( 4 );
Sugar_T       sugar = new Sugar_T( 1 );
Salt_t        salt = new Salt_t( 0.25 );
CookOil_C     oil = new CookOil_C( 0.33 );
Eggs          egg = new Eggs( 1 );
Milk_C        milk = new Milk_C( 1 );
Berry_C       berries = new Berry_C( 1 );
// Other variables

Oven           oven = new Oven();
MuffinPan     pan = new MuffinPan();
MixingBowl    bowl = new MixingBowl();
```

```
// algorithm
oven.on( 375 );
bowl.sift(flour,sugar,bp,salt );
bowl.add( eggs, oil, milk );
bowl.stir();
bowl.add( berries );
bowl.blend();
if ( haveLiners() )
    pan.addLiners();
else
    pan.grease();
foreach( muffinUnit, pan )
    muffinUnit.fill( bowl, 0.5 );
pan.putInOven( oven );
oven.wait( 13 );
pan.takeFromOven( oven );
```

ALGORITHMS AND PROGRAMS

- Algorithm:
  - Unambiguous, executable list of instructions for performing some task.
- Computer program:
  - An algorithm that can be executed by a computer.

PROGRAMMING LANGUAGES

- Each CPU has it own binary language called machine language
- A high level programming language is more human friendly than machine language
- A compiler translates a high level language into a machine language

LANGUAGE SYNTAX

- The formal structure of a language is called its syntax.
- Part of learning a language is learning the syntax.
- A mistake in using the syntax is called a syntax error.
- Even one syntax error prevents the language being compiled.

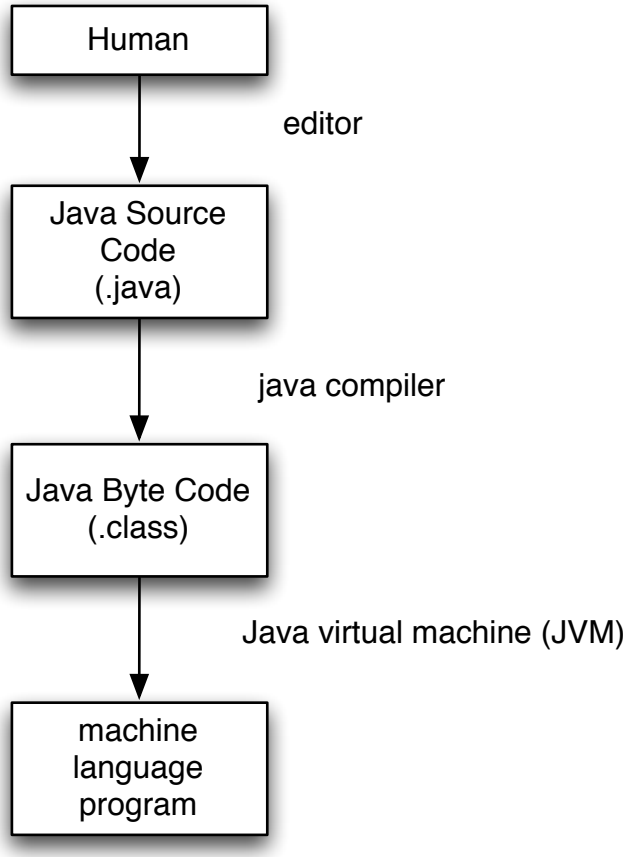
LANGUAGE SEMANTICS

- The meaning of a language construct is called semantics.
- Once you master the syntax then you must master the language semantics.
- Semantic errors allow the program to compile but the program does the wrong thing.
- Errors in a program are sometimes called software bugs.

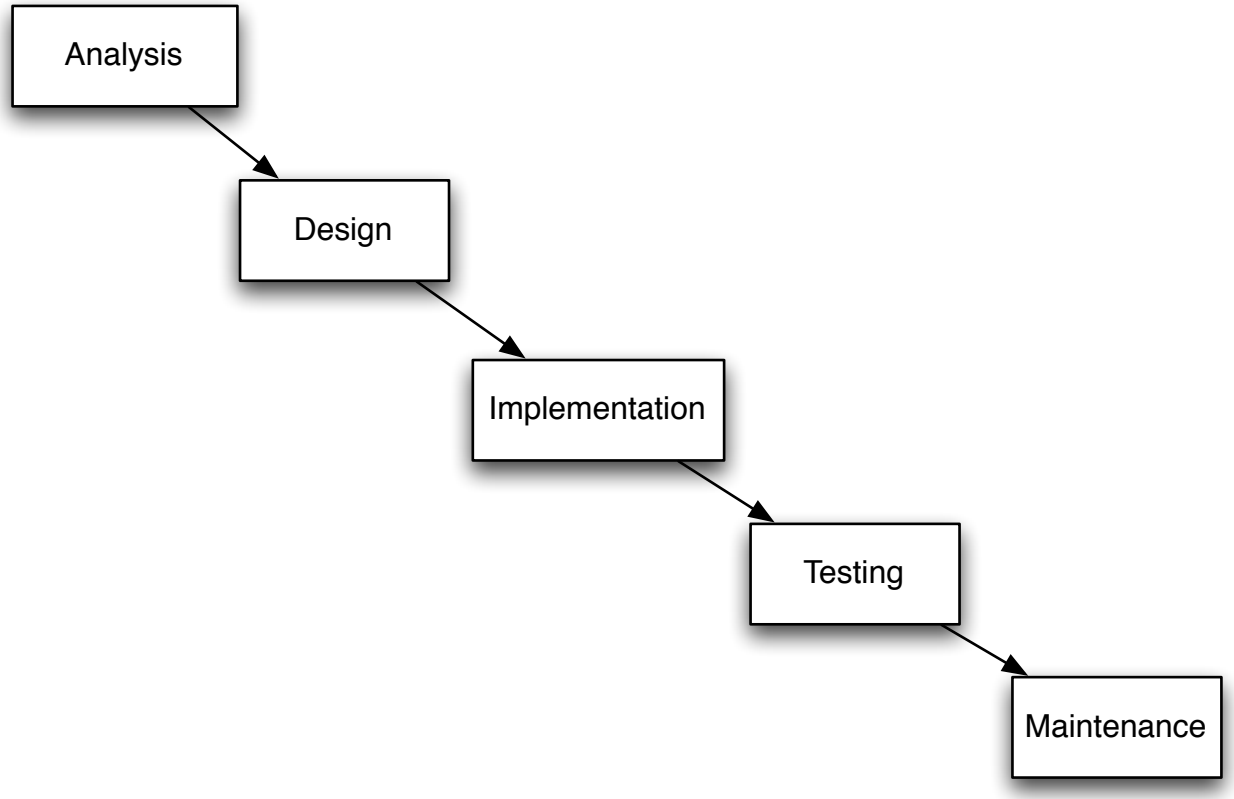
SOFTWARE DEVELOPMENT

- Most software is developed within an Integrated Development Environment (IDE) that supports
  - *editing* of the source program
  - *compiling* the program into a form that can be executed more efficiently than the high-level language
  - *executing* (or *running*) the compiled program with specified input
  - *testing* and *debugging* the program

COMPILING IN JAVA



SOFTWARE DESIGN PROCESS



WHAT WE JUST COVERED

- Hardware/Software blitz (for key terms)
- Software development overview

NEXT TIME, IN 415

- Chapter 1
  - Models
  - Programs as models.
  - Object Oriented Programming.
  - Objects: properties and capabilities.
- Read chapters 0 and 1.