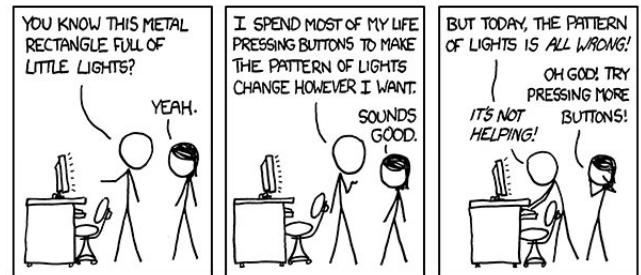


TOPIC 1 INTRODUCTION TO COMPUTER SCIENCE AND PROGRAMMING



Notes adapted from Introduction to Computing and Programming with Java: A Multimedia Approach by M. Guzdial and B. Ericson, and instructor materials prepared by B. Ericson.



Outline

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- What will you get out of this course?
- What is computation?
- What is computer science?
- Roles of Computer Science in our society
- What's in a computer
- What is a program
- What is programming
- What a compiler does
- Lets learn about Java

Why this course?

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- Learn how to think like a computer scientist
- Learn problem solving
- Read and write code
- Understand object oriented programming
- Be well prepared for CS1027
- Understand objects and classes
- Know a bit about the computing field

What is computation?

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- The tool is the computer – the action is computation
- Computers carry out actions
- Think of a recipe...
 - Place butter in pan
 - Add eggs
 - If you like them cooked all the way
 - Flip over
 - If not, keep cooking while they aren't done yet
 - Eat!!

What is computation?

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- A recipe is a set of steps
- A computer carries out a set of steps based on what the programmer tells it
- It can do any set of basic instructions

What is Computer Science?

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- The design, analysis, implementation, ...
- of algorithms (recipes),
- that **solve problems**.

Roles of Computer Science

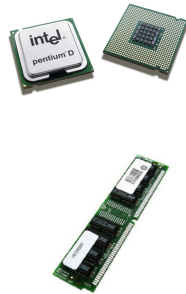
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- Maintaining the technical infrastructure
 - ▣ network, software
- But also many algorithmic challenges
 - ▣ Artificial Intelligence (AI) for games
 - ▣ search or auction algorithms (Google, Bing)
 - ▣ medical imaging
 - ▣ cryptology (RIM)
 - ▣ low-power chips

Whats in a computer?

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- Memory
- CPU – Central processing unit
 - ALU → arithmetic logic unit
 - Program Counter
- Peripherals
- I/O and secondary memory



Memory – Hard disk

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- Slow, cheap and huge
- Its a physical item, so it actually has to move to do anything
- Items here get loaded into RAM and then the cache if its being executed

Memory - RAM

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- Main memory – RAM
 - ▣ Random access memory
- **Faster, holds less**
- Disappears when you shut off the computer
- Made of switches that are either 0 or 1
- Holds programs currently executing

Memory - Cache

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- In the CPU
- Small
- Fast

Memory - Registers

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- Very few, nothing faster
- Called “working registers”
- Say you run a program... gets loaded to RAM, first part goes to cache, then current items go to registers

Peripherals

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Outside pieces of a computer that depend on it such as:

- Mouse
- Keyboard
- Speakers
- Printers
- Etc...

External memory and I/O

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- **Secondary Memory:** hard disks, CDs, DVDs, USB sticks
 - Provide long-term storage
 - Organized as files, each of which has a file name and a folder (directory) that contains it.
- **Input/Output (I/O) units:** keyboard, mouse, screen, printer, webcam, etc.
 - Used for communications with the user



What is a program?

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- **Programs** consist of:
 - Instructions to perform a task
 - Data values used in performing the task
- In CS, the general simplest program is “Hello World”, making a computer print “Hello World” to the screen
- For example, in Python it would be:
 - print "Hello, World!"

What is a program?

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- In Java, which we use, its a little more involved:

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



What is programming?

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- Programming is the process of creating detailed **instructions** that a computer can **execute** to accomplish some task
- Much like writing out a recipe for someone who only understands explicit instructions
- Take the recipe or instructions, boil them down to the key steps, and make the computer do these steps

How to Program

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- Computers don't just understand English
- We as programmers prefer languages that are similar to English
 - Called "**high level languages**"
- Computers prefer low level languages

High-level languages

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- **Java, C, C++, C#, Visual Basic, Turing, Python, Scheme, Lisp, Pascal, Fortran, etc.**
- **People-oriented:** We understand them easier than a computer does
- **Machine independent:** Not brand specific – can run on Windows, Mac, Linux, etc

What the computer understands

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- Computer is just electricity – either on or off
- If its on, it can be thought of as a 1
- If its off, it can be thought of as a 0
- Computers do not understand English, they understand on or off: 0 or 1
- At the basic level, all computers do is add, subtract or move what is stored in memory locations

Machine language

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- The **machine language** consists of the set of instructions that the CPU can execute **directly**
 - Instructions to the CPU are made up of **0's and 1's**

```
000100111000010100100110101111001
```

- **Machine dependent:** each type of computer has its own machine language

Binary

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- The numbers you are used to using are base 10
 - They go from 0 to 9 then start to repeat → there are only 9 options to make up all numbers
- Computers only have 2 options to make all numbers with – 0 and 1
 - Because they are limited to on or off

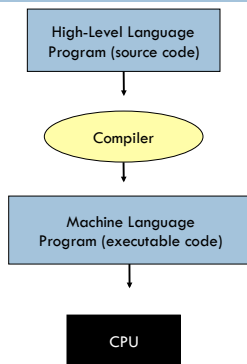
Bits and Bytes

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- A bit is a binary digit – a 0 or 1
- A string of 8 bits are a byte
- A kilobit is 1000 bits, a megabit is 1,000,000 and so on
- Computers can only do on or off, and a certain number of these at a time – hence a 64 bit processor a 32 bit processor, etc..

High-level to machine language

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Java

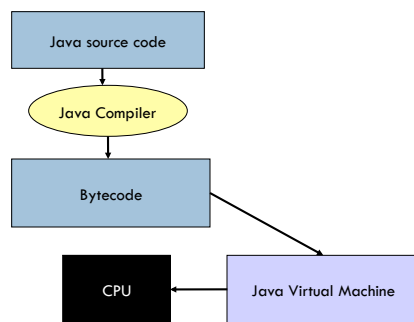
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- A high-level language developed by Sun Microsystems in the early 1990s
 - Cross-platform
 - Object-oriented (later)
- Widely used in business, science and education
- One of the fastest-adopted technologies of all time!
- Different from previous high-level languages



From program to execution

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Helpful Hints

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Pay attention to this little guy!
Work hard to understand concepts where he appears.



Summary

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- Terminology introduced:
 - CPU, RAM, ALU
 - Bit
 - Program
 - High-Level Language
 - Machine Language
 - Compiler
 - Bytecode
 - Java Virtual Machine
 - My exam buddy