COMP 110-003
Introduction to Programming
Computer Basics

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THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

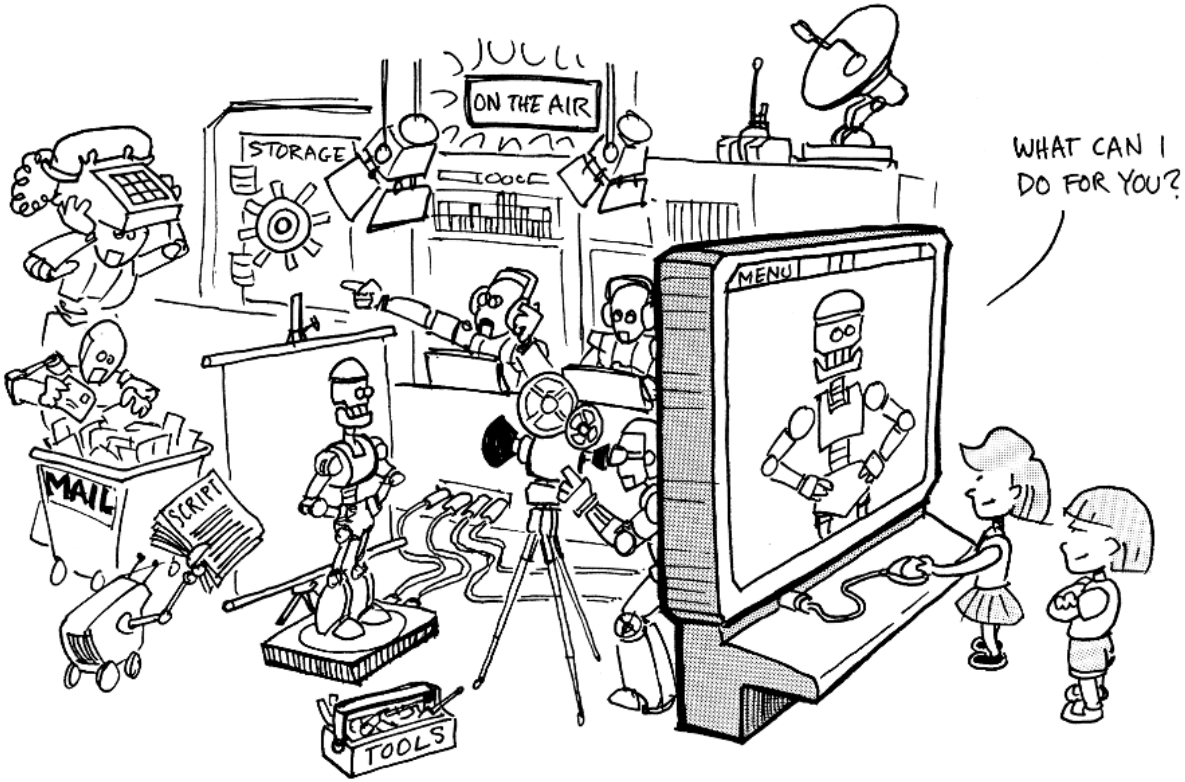
Today

- Hardware and Memory
- Programs and Compiling
- Your first program

Before Programming

- You need to know basics of a computer
  - Like learning driving, you should know that it has an engine that burns gasoline and deliver power to wheels
- Understand what your program is doing
- Talk intelligently about computers

Computer – It's not Magic



From: **Great Ideas in Computer Science by JAVA,**
by *A. W. Biermann and D. Ramm*,
The MIT Press 2002.

Hardware vs Software (Concretely)

- Hardware - physical machine
  - CPU, Memory
- Software - programs that give instructions to the computer
  - Windows 7, Google Chrome, Games, Eclipse

Hardware vs Software (Abstractly)

- Software
  - An organized collection of instructions
- Hardware
  - Circuits that execute, store and interact with instructions
    - Execution: CPU
    - Storage: Memory
    - Interaction: Peripherals, like keyboards, monitors, networks

Instructions

- An instruction is a sequences of 0's and 1's that represents a single operation on the computer
  - Example: 00000101 00000001 00000010
  - Means: ADD 1 2

    Instruction *Data*
  - The output will be 3
- These 0's and 1's are called **bits**
  - Why only 0 and 1?
    - Because it is easy to make an electrical device that has only two stable states

CPU (Central Processing Unit)

- It is the “brain” of the computer
  - CPU executes the instructions
  - CPU’s working routine
    - read instructions and data from memory
    - do calculation
    - write calculation results back to memory
- Intel Core i7 **3.4 GHz**
  - Executes *at most* 3,400,000,000 instructions per second

Memory

- Holds instructions and data for the computer
  - How much the “brain” can remember

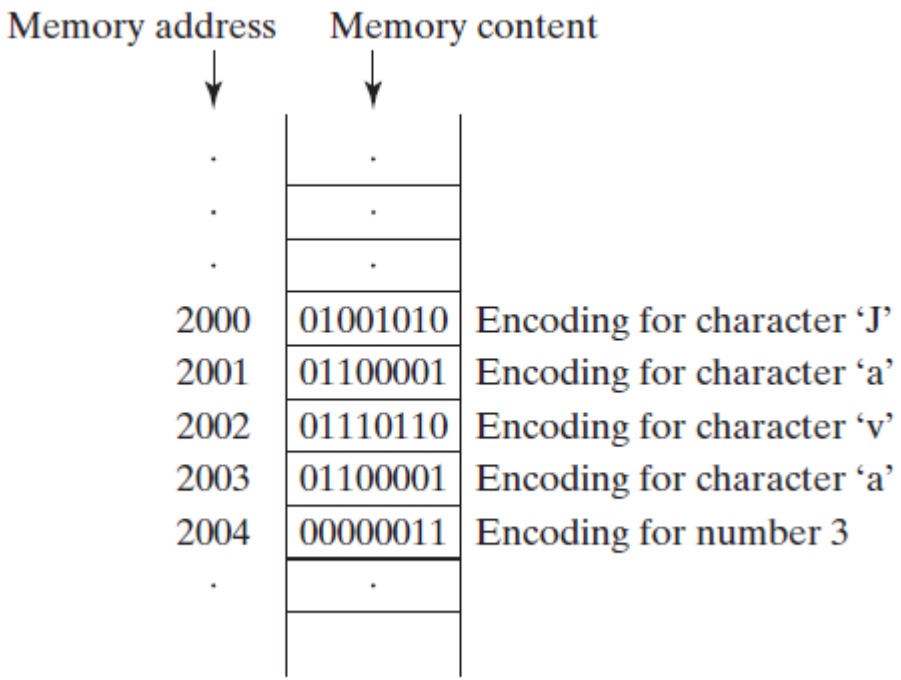
- Main Memory
  - For intermediate calculations (program you are running)
  - Disappears when you shut down your computer
- Secondary Memory
  - Hard drives, CDs, Flash drives
  - Exists until you delete it

GB? MB? KB?

- 1 bit = 0 or 1
- 1 byte = 8 bits
  - Smallest addressable unit of memory
- Kilo, Mega, Giga, Tera
  - 1 KB = 1,000 bytes (1 thousand bytes)
  - 1 MB = 1,000 KB = 1,000,000 bytes (1 million bytes)
  - 1 GB = 1,000 MB = 1,000,000,000 bytes (1 billion bytes)
    - The same for GHz (1 Giga Hertz)
  - 1 TB = 1,000 GB = 1,000,000,000,000 bytes!

Main Memory

- Memory address
  - To locate certain memory positions
  - CPU fetches data according to memory address
- *Another interesting fact: characters are also saved in bits, and so does everything*



Peripherals





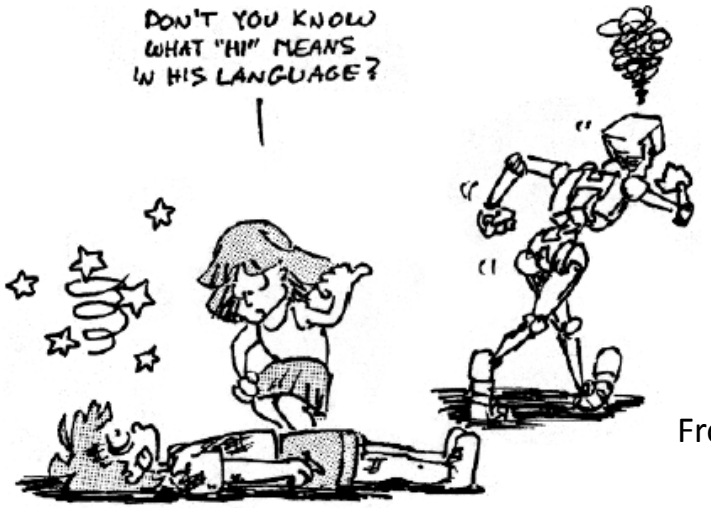

- Input devices
  - Keyboards, mouses, game controllers……
  - When they get inputs, they save them at certain memory addresses
- Output devices
  - Monitors, speakers, printers……
  - They are projected to certain memory addresses
  - When CPU wants to output, it writes to those addresses
- **CPU sees everything as memory**

Programs

- Set of instructions for a CPU to follow
  - Also known as software.
- You will be writing programs
  - We will look at one soon
- Our programs will be in **Java**

Programming Languages

- Why do we need languages when we have instructions?
  - Too hard for humans to write bits directly



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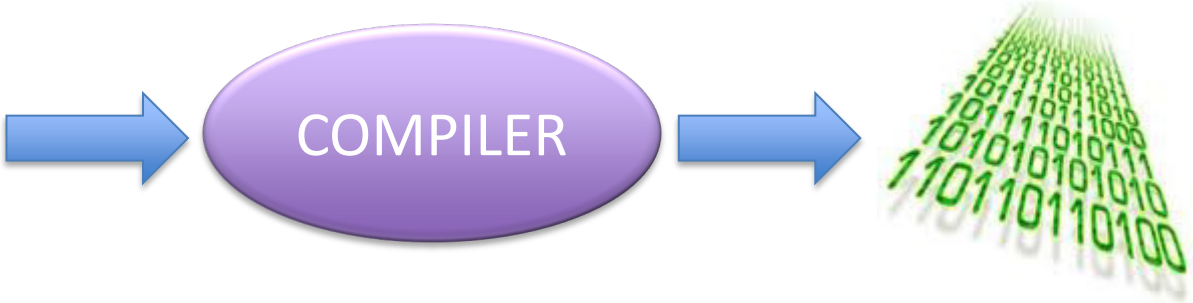
Programming Languages

- Different languages are good at different aspects
  - C/C++: close to instructions, runs fast
  - Matlab: good at scientific computation
  - Python: relatively easy, fast development
- We choose Java
  - Not because
    - Best Language (there is no such thing)
    - Easiest to learn ☹
  - Because
    - Widely used, incorporate (most) modern features

From Languages to Instructions

- The translator is called **compiler**
  - It is also a program
  - From human-readable to machine-readable

```
class Hello {
    public static void main(String[] arguments) {
        // Program execution begins here
        System.out.println("Hello world.");
    }
}
```



Self-test Questions

- What is a software?
- What are the two kinds of memories?
  - What's the difference?
- How many bits are there in 1 MB?
- When we enter something from the keyboard, what will happen inside the computer?