CS139

JAMES MADISON UNIVERSITY®

Algorithm Lab

- Let's take a look at some algorithms from the Lab...

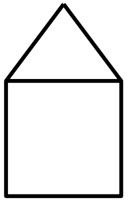
A Few Take-Home Messages

- “Natural” languages are:
  - Expressive – We can communicate a lot with just a few words
  - Ambiguous – We rely on the listener to apply their own understanding
  - We can present information/instructions at multiple levels of abstraction:

> In computer science, abstraction is a technique for managing complexity of computer systems. It works by establishing a level of complexity on which a person interacts with the system, suppressing the more complex details below the current level.

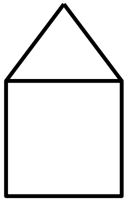
https://en.wikipedia.org/wiki/Abstraction_%28computer_science%29

Drawing Houses



- Drawing a House: (“high level” algorithm)
  1) Draw a 2” square.
  2) Add a roof by drawing two line segments that begin at the top two corners of the square and meet 1” above square's center.

Drawing Houses



- Drawing 2” A Square (less abstraction):

  1)Place the end of your pencil in the center of a sheet of paper.

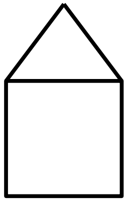
  2)Draw a 2” line from left to right, parallel with the top edge of the paper

  3)Without lifting your pencil, draw a 2” toward the bottom of the paper, parallel with the right edge of the paper.

  4)Without lifting your pencil, draw a 2” line from right to left, parallel with the top edge of the paper.

  5)Without lifting your pencil, draw a 2” line toward the top of the paper, parallel with the right edge of the paper.

Drawing Houses



- Placing a Pencil:

  1) Visually scan your surroundings for a pencil: a yellow cylindrical object, approximately six inches in length.

  2) If you see a pencil:

     - Position your hand so that the pencil is between your thumb and middle finger
     - Close your thumb and middle finger

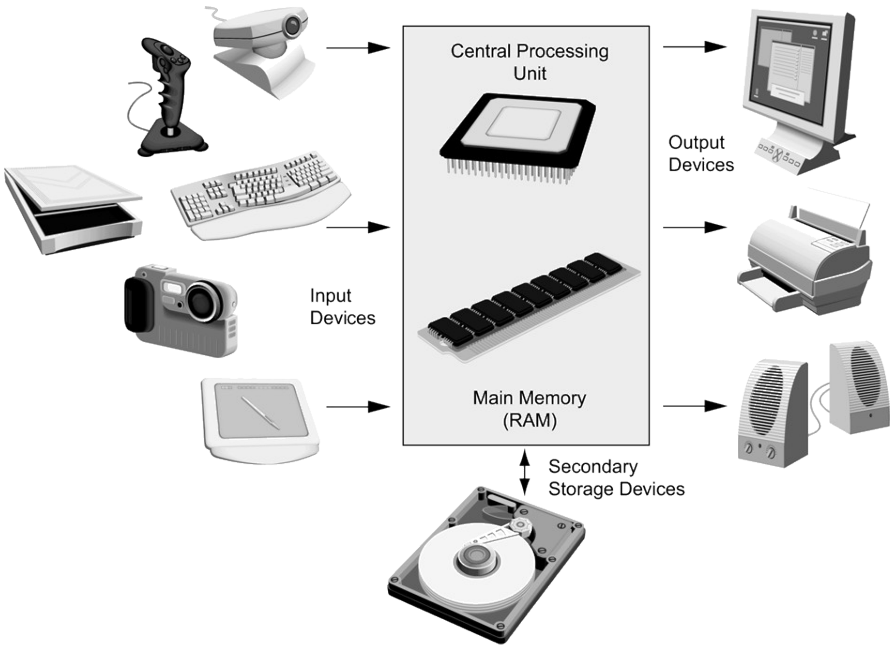
  3) If you don't see a pencil...

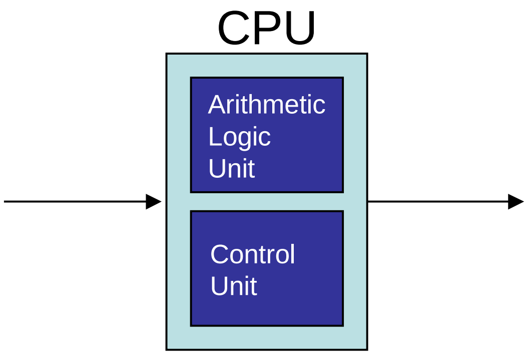
Machine Languages

- Computers have a lowest-level of abstraction (for our purposes)
- Machine language – The set of instructions that can be executed by the CPU of a particular computer
- Examples:
  - ARM – Probably running in your phone.
  - x86 – Probably running in your computer.

Computer Hardware

- Executing a program:
  - Machine instructions are loaded into RAM from secondary storage
  - Fetch/Decode/Execute
    - Fetch – instruction pulled from RAM to the CPU (Control Unit)
    - Decode – Based on the instruction, the appropriate switches are flipped to perform the desired operation (Control Unit)
    - Execute – The operation is performed (ALU)





Machine Language

- Individual Instructions May:
  - Perform an arithmetic operation
  - Change the contents of memory
  - Change the next instruction to fetch
    - Jump backwards → iteration
    - Jump forwards → conditional execution
  - Generate output
  - Obtain input

Machine Language

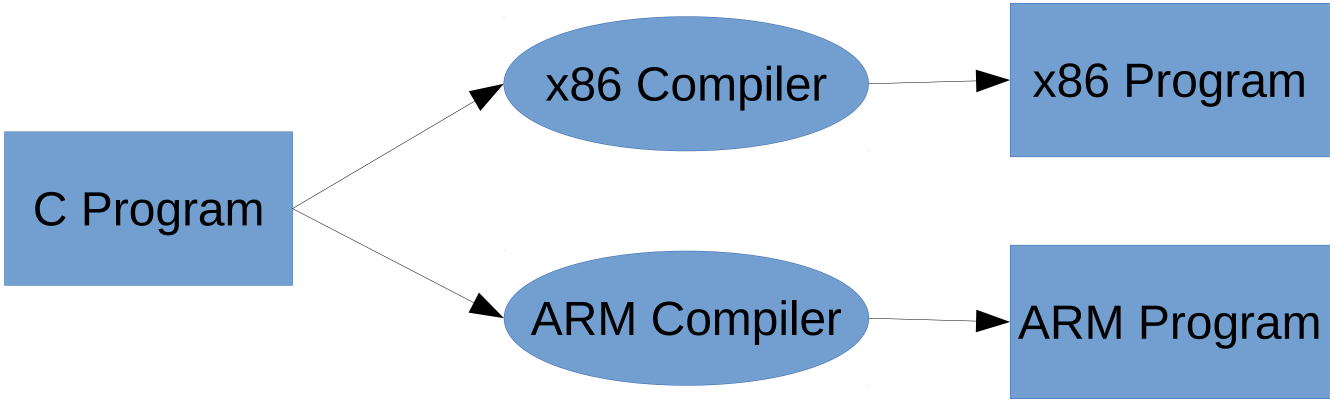
- The Bad News
  - Hard to work with
  - Not portable – differ from one machine to the next

Machine Language

- The Bad News
  - Hard to work with
  - Not portable – differ from one machine to the next
- The Good News
  - No one writes programs in machine language
  - We program in “high-level” languages like
    - Java, C, C++, Python, Ruby, Go, Perl, etc.

High Level Languages

- High-level languages exist to solve both problems:
  - Ease of use
    - Designed to be written and read by humans
    - Close enough to machine language to make translation possible
  - Portability:



Looking Forward

- Lab Tomorrow:
  - Unix command line interface
- Next week: Java!