# Computer Basics

CSE 100

Electronic computers have changed dramatically over their 50 history, but a few basic principles characterize all computers



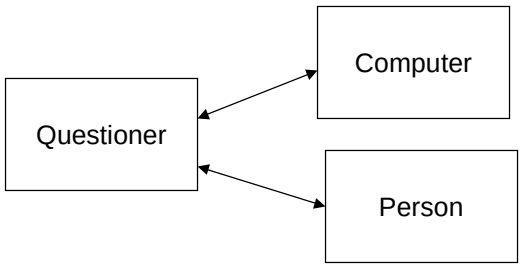
## CSE 100 Abstractly, A Computer Is ...

- Computers process information by deterministically following instructions
- You are sometimes a computer … when you fill out your income tax form, for example
- Unlike humans, computers follow instructions *exactly*
  - Computers have no imagination or creativity
  - Computers have no intuition
  - Computers are literal, with no sense of irony, subtlety, proportion, …
  - Computers don't joke, they're not vindictive or cruel
  - Computers are not purposeful
- … computers only execute instructions

If a computer has any useful characteristics, its because someone has programmed it -- given it the instructions -- to behave usefully

## CSE 100 A Long Standing Question ...

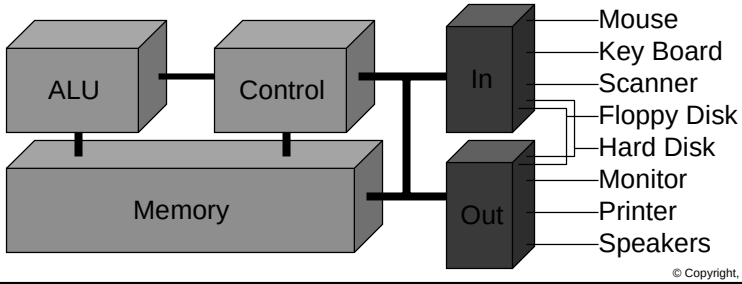
- Are computers intelligent?
- It depends on what you mean by intelligence
  - Computers do arithmetic
  - Computers win at chess
- Alan Turing, a computer pioneer, proposed a test, now called the “Turing Test”






## CSE 100 Anatomy Of A Computer

- A computer is composed five components …
  - Arithmetic/Logic Unit (ALU) -- the part that “computes”, e.g. +
  - Control -- the part that follows the instructions of the program and tells the ALU what to compute
  - Memory -- where data, programs are kept while computing
  - Input -- ports to peripheral devices from which data comes
  - Output -- ports to peripheral devices to which data goes



## CSE 100 Control Rules!

The control follows instructions, telling the other parts what to do

- The instructions come from the program stored in the memory

  Programmers write the instructions (programs) using languages (C, C++, Java, etc.) that are way too complicated for the control to follow … so the programs are translated into a simpler form called machine language that the control can understand. A typical machine instruction is

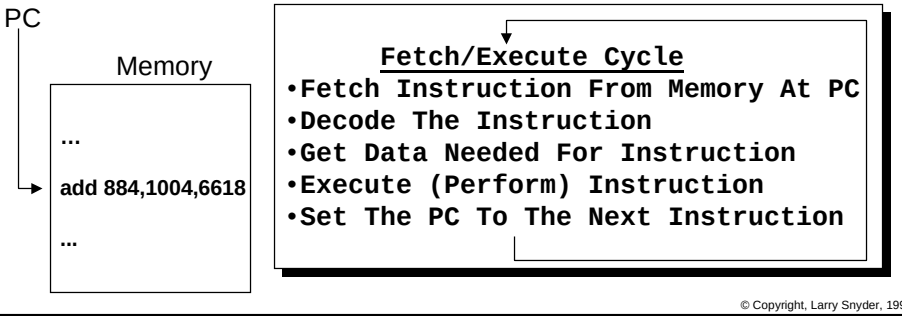
  add 884, 1004, 6618

  which means "*add the number in memory location 1004 to the number in memory location 6618, and put the result in memory location 884*"



## CSE 100 Following Instructions

- The control keeps track of where it is in the program using a program counter or PC … a better name would be "instruction pointer"
- The control follows instructions by using a simple process called the Fetch/Execute Cycle



## CSE 100 A Fundamental Idea

- The Fetch/Execute Cycle is a fundamental idea …
- Instructions can be deterministically executed by the F/E process …
  - Get the next task to do (Fetch, with PC specifying what's "next")
  - Figure out what to do (Decode)
  - Gather the necessary information to do the task (Operand fetch)
  - Perform the task (Execute)
  - Identify the next task (Increment the PC)
- Computer systems contain many instances of this idea:
  - Browsers use F/E cycle to interpret your HTML
  - Visual Basic 6.0 Interpreter … will see this next week
  - Java Byte Code Interpreter … makes the "motion" on web pages



## CSE 100 The Numbers, Please

- Think of the clock rate of a computer as the rate it executes instructions, that is, how many Fetch/Execute cycles it can complete in a second (modern computers are *very* complex and can complete more than one instruction per cycle)
- hertz measures "cycles per second"
- 100MHz, specifies "100 million cycles per second"

A higher clock rate may not result in a faster running program, because the speed may be limited by other parts of the computer besides instruction execution rate; the speed of getting an instruction's data is often a limitation that worsens with a faster clock

## CSE 100 Memory

- The memory is passive, storing programs and data
- Memory is called RAM for “random access memory” because the control can access any random location in the memory
- RAM is volatile, meaning it disappears when the power is turned off … how does the computer remember the date?
- Programs and data are also stored on floppy disks and hard disks, which are nonvolatile
- For the control to execute (run) a program, it must be stored in the RAM. So, one operating system duty is to move programs & data from the disk to the RAM



## CSE 100 The Numbers, Please

- A computer memory location can store a byte of information (8 bits), enough for a key board character
- A “normal” whole number (integer) uses 4 bytes
- Units of memory size are …
  - KB, kilobyte, 1024 bytes … just over a thousand bytes, a “K”
  - MB, megabyte, 1,048,576 bytes … just over a million bytes, a “meg”
  - GB, gigabyte, 1,073,741,824 bytes … just over a billion bytes, a “gig”
  - TB, terabyte, 1,099,511,627,776 bytes … just over a trillion bytes
- Why do computers use such strange numbers???
  - These numbers are powers of 2
    - $2^{10}$ = 1,024 call it a thousand
    - $2^{20}$ = 1,048,576 call it a million
    - $2^{30}$ = 1,073,741,824 call it a billion
    - $2^{40}$ = 1,099,511,627,776 call it a trillion

## CSE 100 Summary

- Computers deterministically execute instructions to process information
- Computers have five parts: ALU, Control, Memory, Input and Output
- The control implements a process called the Fetch/Execute Cycle
- The fetch/execute cycle is a fundamental method of deterministically performing operations, and the idea is used many places in a computer …
  - The computer is an electronic fetch/execute cycle, ie, hardware
  - All other F/E cycles are implemented as programs, ie, software