Announcements

• HW 0 due by 11:55pm tonight via Moodle

What is a Computer?

A computer consists of a CPU, memory, hard disk, monitor, printer, and communication devices.

CPU

The central processing unit (CPU) is the brain of a computer.
• Retrieves instructions from memory and executes them.
• CPU speed is measured in megahertz (MHz), with 1 megahertz equaling 1 million pulses per second.
Memory

Memory is to store data and program instructions for CPU to execute.

Main memory: where computer stores a program while program is running, and data used by the program (also known as Random Access Memory or RAM)

Secondary storage: can hold data for long periods of time

Programs normally stored here and loaded to main memory when needed

How Computers Store Data

- All data in a computer is stored in sequences of 0s and 1s
- Byte: just enough memory to store letter or small number
  - Divided into eight bits
  - Bit: electrical component that can hold positive or negative charge, like on/off switch
  - The on/off pattern of bits in a byte represents data stored in the byte

Storage Devices

- Memory is volatile, because information is lost when the power is off.
- Programs and data are permanently stored on storage devices and are moved to memory when the computer actually uses them.
- 3 main types of storage devices:
  - Disk drives (hard disks and floppy disks)
  - CD drives (CD-R and CD-RW)
  - Tape drives.
Input Devices

- **Input**: data the computer collects from people and other devices
- **Input device**: component that collects the data
  - Examples: keyboard, mouse, scanner, camera
  - Disk drives can be considered input devices because they load programs into the main memory

Output Devices: Monitor

- **Output**: data produced by the computer for other people or devices
- **Output device**: formats and presents output
  - Examples: video display, printer
  - Disk drives and CD recorders can be considered output devices because data is sent to them to be saved
  - The monitor displays information (text and graphics).
  - Resolution and dot pitch determine the quality of the display.

Monitor Resolution and Dot Pitch

- **Resolution**: specifies the number of pixels per square inch.
  - The higher the resolution, the sharper and clearer the image is.
  - Image may be very small if you set high resolution on a small screen monitor.
  - For a 15-inch monitor, a comfortable resolution setting would be 640x480 (307,200 pixels).

- **Dot pitch**: the amount of space between pixels.
  - The smaller the dot pitch, the better the display.

Communication Devices

- A **regular modem** uses a phone line and can transfer data in a speed up to 56,000 bps (bits per second).
- A **DSL** (digital subscriber line) also uses a phone line and can transfer data in a speed 20 times faster than a regular modem.
- A **cable modem** uses the TV cable line maintained by the cable company. A cable modem is as fast as a DSL.
- A Network interface card (NIC) is a device to connect a computer to a local area network (LAN).
  - The LAN is commonly used in business, universities, and government organizations.
  - A typical type of NIC, called **10BaseT**, can transfer data at 10 mbps (million bits per second).
Programs

Computer programs, known as software, are instructions to the computer.

You tell a computer what to do through programs.

Computers do not understand human languages, so you need to use computer languages to communicate with them.

Programs are written using programming languages.

Self-Test Questions

• What is a program?

• What part of the computer actually runs programs?

Programming Languages

Machine Language  Assembly Language  High-Level Language

Machine language is a set of primitive instructions built into every computer. The instructions are in the form of binary code, so you have to enter binary codes for various instructions. Program with native machine language is a tedious process. Moreover the programs are highly difficult to read and modify. For example, to add two numbers, you might write an instruction in binary like this:

1101101010011010
Programming Languages

<table>
<thead>
<tr>
<th>Machine Language</th>
<th>Assembly Language</th>
<th>High-Level Language</th>
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**Assembly language**: uses short words (mnemonics) for instructions instead of binary numbers

**Assembler**: translates assembly language to machine language for execution by CPU

For example, to add two numbers, you might write an instruction in assembly code like this:

ADDF R1, R2, R3

Popular High-Level Languages

- COBOL (COmmon Business Oriented Language)
- FORTRAN (FORMula TRANslation)
- BASIC (Beginner All-purpose Symbolic Instructional Code)
- Pascal (named for Blaise Pascal)
- Ada (named for Ada Lovelace)
- C (whose developer designed B first)
- Visual Basic (Basic-like visual language developed by Microsoft)
- Delphi (Pascal-like visual language developed by Borland)
- C++ (an object-oriented language, based on C)
- C# (a Python-like language developed by Microsoft)
- Python (We use it in the book)

Compilers and Interpreters

- Programs written in high-level languages must be translated into machine language to be executed
- **Compiler**: translates high-level language program into separate machine language program
  - Machine language program can be executed at any time
Compilers and Interpreters (cont’d.)

- **Interpreter**: translates and executes instructions in high-level language program
  - Used by Python language
  - Interprets one instruction at a time
  - No separate machine language program
- **Source code**: statements written by programmer
  - **Syntax error**: prevents code from being translated

Compilers and Interpreters (cont’d.)

Executing a high-level program with an interpreter

What is Python?

- **General Purpose**: Python is a general purpose programming language. That means you can use Python to write code for any programming tasks. Python is now used in Google search engine, in mission critical projects in NASA, in processing financial transactions at New York Stock Exchange.
- **Interpreted**: Python is interpreted, which means that python code is translated and executed by an interpreter one statement at a time. In a compiled language, the entire source code is compiled and then executed altogether.
- **Object-Oriented**
What is Python?

Python is an object-oriented programming language. Data in Python are objects created from classes. A class is essentially a type that defines the objects of the same kind with properties and methods for manipulating objects. Object-oriented programming is a powerful tool for developing reusable software.

Python 2 vs. Python 3

Python 3 is a newer version, but it is not backward compatible with Python 2. That means if you write a program using Python 2, it may not work on Python 3.

Using Python

- **Python must be installed and configured prior to use**
  - One of the items installed is the Python interpreter
- **Python interpreter can be used in two modes:**
  - Interactive mode: enter statements on keyboard
  - Script mode: save statements in Python script

Interactive Mode

- **When you start Python in interactive mode, you will see a prompt**
  - Indicates the interpreter is waiting for a Python statement to be typed
  - Prompt reappears after previous statement is executed
  - Error message displayed if you incorrectly type a statement
- **Good way to learn new parts of Python**
Writing Python Programs and Running Them in Script Mode

• Statements entered in interactive mode are not saved as a program
• To have a program use script mode
  – Save a set of Python statements in a file
  – The filename should have the .py extension
  – To run the file, or script, type `python filename` at the operating system command line

The IDLE Programming Environment

• IDLE (Integrated Development Program): single program that provides tools to write, execute and test a program
  – Automatically installed when Python language is installed
  – Runs in interactive mode
  – Has built-in text editor with features designed to help write Python programs

Self-Test Questions

• A CPU understands instructions that are written only in what language?
• A program has to be copied into what type of memory each time the CPU executes it?
• Is Python a compiled or interpreted language?

Next Time

• No class on Monday
• Input/Processing/Output
• Read Sections 2.1-2.5