Focus of the course

- Program development
  - problem solving
  - program design and implementation
  - object-oriented concepts
  - steps in the development process
  - program design and implementation
  - problem solving

- Specific programming concepts and techniques
  - arrays, vectors, strings
  - objects and classes
  - decisions and loops
  - data and operations
  - graphical user interfaces
  - graphics
  - sorting and searching
  - the Java programming language

Java Software Solutions
Lewis and Loftus
Before we can dive into programming, we need to understand the fundamentals of computers in general.
Hardware and Software

- Hardware – the physical, tangible parts of a computer
  - keyboard, monitor, wires, chips, disks

- Software – programs and data
  - a program is a series of instructions

Each is essentially useless without the other.

A computer requires both hardware and software

Hardware and Software
Hardware Components

- Central Processing Unit (CPU)
- Input/Output devices
  - Keyboard, monitor, mouse
  - Allow interaction with the user

- Central Processing Unit (CPU)
- Input/Output devices
  - Intel Pentium processor, Sun Sparc processor
  - The chip that executes program commands
Hardware Components

- Main memory
  - the primary storage area for programs and data in active use

- Secondary memory devices
  - long-term storage
    - floppy disks, hard disks, tapes

- Main memory
  - the primary storage area for programs and data in active use
Hardware Interaction

- Monitor
- CPU
- Main Memory
- Hard Disk
- Floppy Disk
- Keyboard
Software Categories

• Operating system
  - controls all machine activities
  - manages resources such as the CPU and memory
  - provides the user interface to the computer
  - controls all machine activities
  - Windows 95, Solaris, Mac OS

• Application program
  - word processors, missile control systems, games
  - generic term for any other kind of software
  - Windows 95, Solaris, Mac OS
Analog vs. Digital

- There are two basic ways to store and manage data

Digital

- The information is broken down into pieces, and each piece is represented separately

Analog

- Example: music on a CD

  - continuous, in direct proportion to the temperature

  - Example: a mercury thermometer - the mercury rises in direct proportion to the data represented
In some way, all information is digitized - broken down into pieces and represented as numbers, including:

- program instructions
- video
- audio
- graphics and pictures
- text
- numbers

Modern computers store all information digitally.
Representing text digitally

• Each character, including spaces, digits, and punctuation,
is stored as a number.

• Corresponding upper and lower case letters are separate.

Hi, Heather.
Once information is digitized, it is represented and stored in memory using the binary number system. A single binary digit (0 or 1) is called a bit. Devices that store and move information are cheaper and more reliable if they only have to represent two states.

A single bit can represent two possible states, like a light bulb that is either on (1) or off (0). Combinations of bits are used to store larger values.

Binary Numbers
### Bit Permutations

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<th>2 bits</th>
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</tbody>
</table>
Bit Permutations

- Each bit that is added to the string doubles the number of states or items that can be represented.
- N bits can represent $2^N$ unique items.

<table>
<thead>
<tr>
<th>Bits</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
<td>4</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>5</td>
<td>32</td>
</tr>
</tbody>
</table>

5 bits = $2^5 = 32$ items
4 bits = $2^4 = 16$ items
3 bits = $2^3 = 8$ items
2 bits = $2^2 = 4$ items
1 bit = $2^1 = 2$ items
Now we can examine the hardware components of a computer in more detail.

- Binary information moves between devices across a group of wires called a **bus**.
- All other devices can be considered **peripherals**.
- Controllers coordinate the activities of specific peripherals.
- The CPU and main memory are the two key hardware components.
- Now we can examine the hardware components of a computer architecture.
Memory

- Main memory is divided into many memory locations.
- Each memory location has an address which uniquely identifies it.
- Data is stored in one or more consecutive memory locations.
- On most computers, each memory location holds 8 bits.
- Or 1 byte
Large values are stored in consecutive memory locations.
Storage Capacity

- Each memory device has a storage capacity, indicating the number of bytes it can hold.
- Capacities are expressed in various units of binary:
  - Kilobyte (KB) = $2^{10}$ bytes = 1024 bytes
  - Megabyte (MB) = $2^{20}$ bytes
  - Gigabyte (GB) = $2^{30}$ bytes
  - Terabyte (TB) = $2^{40}$ bytes
  - Petabyte (PB) = $2^{50}$ bytes
  - Exabyte (EB) = $2^{60}$ bytes
  - Zettabyte (ZB) = $2^{70}$ bytes
  - Yottabyte (YB) = $2^{80}$ bytes

Each memory device has a storage capacity, indicating the number of bytes it can hold.
Memory

- Main memory is volatile - stored information is lost if the electric power is removed.
- Secondary memory devices are nonvolatile.

A magnetic tape is a sequential access device since its data is arranged in a linear order; you must get by the intervening data in order to access other information. Which means that information can be reached directly.

Main memory and disks are random access devices.
RAM should probably be called Read-Write Memory.

Both RAM and ROM are random access devices!

ROM could be a set of memory chips, or a separate device, such as a CD ROM.

Interchangeable

The terms RAM and main memory are basically

ROM - Read-Only Memory

RAM - Random Access Memory

RAM vs. ROM
The Central Processing Unit (CPU)

- A CPU is also called a microprocessor.
- It performs calculations and decisions.
- This process is called the fetch-decode-execute cycle.
- It retrieves, interprets, and executes instructions, one after another, continuously.
- A CPU is also called a microprocessor.

The CPU contains:

- Control unit - coordinates processing steps.
- Arithmetic / logic unit - performs calculations and decisions.
- Registers - small storage areas.
The Central Processing Unit

CPU

Main memory

Arithmetic / Logic unit

Control unit

Registers
The Central Processing Unit

- The speed of a CPU is controlled by the system clock.
- The system clock generates an electronic pulse at regular intervals.
- The speed of a CPU is controlled by the system clock.
- The speed is measured in megahertz (MHz).
- The pulses coordinate the activities of the CPU.
Consider the following specification for a personal computer:

- 200 MHz Pentium Processor
- 32 MB RAM
- 2.3 GB Hard Disk
- 12x speed CD ROM Drive
- 17" Multimedia Video Display with 1280 x 1024 resolution
- 33,600 bps Data / Fax Modem
- 200 MHz Pentium Processor

A Computer Specification
Monitor

- The primary output device listed in the specification is a 17" monitor.
- The size is measured diagonally, like a television screen.

- It has multimedia capabilities: text, graphics, video, etc.
- It has a resolution of 1280 by 1024 pixels.
- High resolution (more pixels) produces sharper pictures.

- The size is measured diagonally, like a television screen.
- It has multimedia capabilities: text, graphics, video, etc.
- It has a resolution of 1280 by 1024 pixels.
- High resolution (more pixels) produces sharper pictures.
Data transfer devices allow information to be sent and received between computers. The computer specification includes a modem, which transfers information at a rate of 33,600 bits per second (bps). A modem allows information to be moved across a telephone line. It can send and receive fax documents as well as basic data. It transfers information at a rate of 33,600 bits per second (bps).
Networks

- A *network* is two or more computers connected together so that information and resources can be shared
- Most computers are connected to some kind of network
- Each computer has its own *network address*, which uniquely identifies it among the others
- A *file server* is a network computer dedicated to storing programs and data that are shared among network users
- A file server often has a large amount of secondary memory
Network Connections

• There are many techniques for connecting computers.

  • Point-to-point connections - each computer is directly connected to each other.

  • Adding a new computer requires a new communication line for each machine.

This technique is not feasible for more than a few close machines.

• There are many techniques for connecting computers.

  • There are many techniques for connecting computers.
Network Connections

- Most modern networks share a single communication line.
- Adding a new computer to the network is relatively easy.
- The shared communication line must be managed carefully.
- Network users must take turns using the line, which introduces delays.
- Often information is broken down into parts, sent to the receiving machine, and reassembled.
Network Connections

Shared Line

Point-to-Point

Java Software Solutions  Lewis and Loftus

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Different groups in many different countries organize a LAN, but WANs often connect LANs from many organizations. Individual LANs are usually owned by a single building. A wide-area network (WAN) connects two or more buildings. A LAN often connects the machines in a single room or distances and a small number of computers is designed to cover small LANs and WANs.
LANs and WANs

Long-distance connection

LAN to LAN
The Internet

- The Internet is a WAN which spans the entire planet.
- It started as a United States government project, which implies a network of networks.
- The word Internet comes from the term internetworking.
- Less than 600 computers were connected to the Internet.
- The Internet grew quickly throughout the 1980s and 90s.
- It was originally called the ARPANET (ARPA), and was sponsored by the Advanced Research Projects Agency.
- In 1983, there were over 10 million computers connected to the Internet.

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Chapter 1
The Internet

• The software which manages Internet communication is called TCP/IP.

• The programs in the Transmission Control Protocol (TCP) reassembles messages and handles lost information for transfer.

• The programs in the Internet Protocol (IP) formats the information.

• Each computer on the Internet has a unique IP address, such as: 204.192.116.2.
Most computers also have a unique Internet name, which is also referred to as an Internet address.

The Internet

- The Internet
- Most computers also have a unique Internet name, which
- The first part indicates a particular computer (renoir)
- The rest is the domain name, indicating the organization (vill.edu)
New suffix categories are being considered.

- uk - United Kingdom

Sometimes the suffix indicates the country:

- org - non-profit organization
- com - commercial business
- edu - educational institution

the type of organization:

The last section of each domain name usually indicates:

The Internet
Internet address sections of an IP address and the sections of an Internet address are not one-to-one correspondence between the DNS (Domain Name System) address by software called the Domain Name System. When used, an Internet address is translated to an IP address.

- Unique domain names mean that multiple sites can have the same local name.
- A domain name can have several parts:
- There is not a one-to-one correspondence between the Internet address and the sections of an Internet address.
The World-Wide Web

not organized in a linear fashion

The term Web comes from the fact that information is

creating a hypermedia environment

A Web document usually contains links to other Web

A browser is a program which accesses and presents

information to be accessed using a common interface

The World-Wide Web allows many different types of

information: text, graphics, sound, audio, and programs
A URL may indicate an HTML document, or some other kind of information.

http://www.lycos.com

Resource Locator (URL):

Information on the Web is found using a Uniform Resource Locator (URL).

Language (HTML):

Web documents are defined by the HyperText Markup Language (HTML).

The World Wide Web