

Component 4: Introduction to Information and Computer Science

Unit 3: Computer Hardware & Architecture

BMI540/640
Week 1

Unit Objectives

- List the major elements of a computer (motherboard, CPU, I/O devices, memory, secondary storage, buses, expansion cards, ports, etc.).
- Describe how data is stored in memory and in secondary storage.
- Describe how data is represented in binary.
- Describe the function of the CPU.
- Describe how data is input/output from the computer.
- Describe how a computer system works together.
- Introduce specialized architectures and embedded systems used in healthcare settings.

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What is a Computer?

- An electronic device that receives input and produces output that is useful to people or devices.
- Made up of hardware and software.
- Executes instructions found in software programs.

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What is a Computer? (cont'd)

- Computers understand only binary numbers.
- All input is translated into a binary value.
- Output is generally translated from a binary value to a code understood by users (people).
 - Output is sent from one computer to another in binary format.

Computer Hardware Components

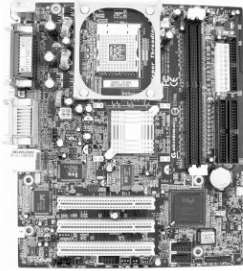
- Computer hardware consists of
 - System components
 - Storage devices
 - Input devices
 - Output devices

System Components

- Motherboard
 - Made up of circuitry, chips, and thousands of thin copper wires.
- Central Processing Unit (CPU)
 - The “brain” of the computer that is responsible for all operations.
 - Has its own memory which serves as a ‘work area’.
 - Modern computers have multiple processors (or cores).

System Components (cont'd)

- A modern motherboard:



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Motherboard Ports are...

- Expansion ports on motherboard rear panel:
 - Interface between the computer and an external device.
 - An example is a mouse (PS/2) port, usually colored green.
 - Some expansion ports permit device connection while the computer is running ("hot swappable").

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Motherboard Ports are also...

- Expansion cards that plug into motherboard:
 - PCI (peripheral component interface) slots hold expansion cards.
 - An example is a network interface card.
 - PCI standards and architecture provide functionality.
 - Standards needed for interoperability between hardware manufactured by various vendors.
 - PCI Express (PCIe) replaces PCI-X and AGP and is found in modern computer systems.

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Motherboard Buses

- Buses
 - Copper wires on a motherboard that connect motherboard devices for communications purposes.
 - A motherboard has a number of buses, but we will focus on its main three buses:
 - Address bus - Destination address for this communication.
 - Control bus – Timing and specific commands.
 - Data bus – Actual data to be acted upon.

Motherboard Buses

- For example, if a device requests data be saved to the hard disk:
 - The “save” command is placed on the **control** bus .
 - The actual data to be saved is placed on the **data** bus.
 - The physical address on the HD is placed on the **address** bus.

What is a Device?

- A computer device is hardware that is not part of the computer case or installed inside the computer.
 - Input devices provide data and control settings to a computer:
 - Key presses (keyboard)
 - Sound (microphone)
 - Movement (mouse)
 - Output devices communicate data processing done by a computer to the world outside the computer:
 - Monitor
 - Printer
 - Headphone
 - Speakers

What is a Device? (cont'd)

- Some devices are standalone pieces of hardware:
 - Computers are devices!
 - Routers manage access to networks
 - Digital cameras
 - Cell phones
 - Handheld equipment
 - Can you think of others?

Device Functionality

- Devices usually connect to the computer via ports but can connect wirelessly as well.
 - Devices can also connect to the computer via expansion cards.
- Devices communicate by sending/receiving electronic signals that are translated to binary (machine language instructions).

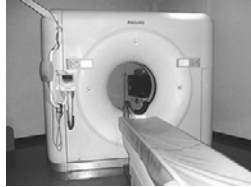
Input Devices

- Keyboard
 - Device whose key strokes are usually interpreted by software into some type of symbol or symbols.
 - For example, the capital letter "A," typed into a word processing document, is sent electronically in binary code to the motherboard (as "01000001") and output on the monitor in alphabetic format.
- Mouse
 - Pointing device that functions by detecting motion using an X and Y coordinates system, relative to its point of origin on some type of surface.
- Sound
 - Devices include CD/DVD players, microphones.

Input Devices (cont'd)

- Computerized Tomography (CT) Scans
 - "... a diagnostic procedure that uses special x-ray equipment to obtain cross-sectional pictures of the body." [X-ray computed tomography. From Wikipedia, the free encyclopedia. Online: http://en.wikipedia.org/wiki/Computed_tomography, 2010.]

The image displays a Philips 64 slice 'Brilliance' Scanner.



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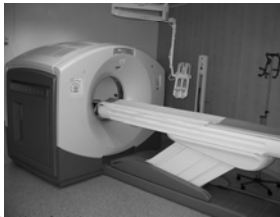
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Input Devices (cont'd)

- Positron Emission Tomography (PET) Scans
 - "...a nuclear medicine imaging technique which produces a three-dimensional image or picture of functional processes in the body." [Positron emission tomography. From Wikipedia, the free encyclopedia. Online: http://en.wikipedia.org/wiki/Positron_emission_tomography, 2010]

The image displays the GE Discovery D600 PET/CT System, with 16 slice CT System, built in 2009.



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Input Devices (cont'd)

- Ultrasonography
 - Sound waves are utilized to produce an image. The echoes are received as input from a sonographic probe and translated into pixels.



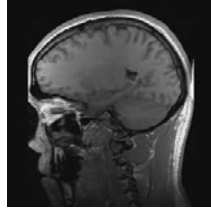
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Input Devices (cont'd)

- Magnetic Resonance Imaging (MRI) – a body is placed in a magnetic field and flooded with a radio frequency pulse that produces an image of the body's interior structure.



The image represents the output of an MRI scan of the human head.

Input Devices (cont'd)

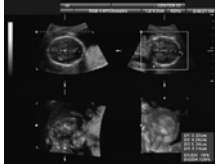
- Touchpads – found on most modern laptops. The surface is pressure sensitive and is able to detect (finger) movement and translate this as mouse movement.
- Other common input devices include game joysticks, fingerprint readers, cameras, and bar code readers used in stores.

Output Devices

- Monitor
 - Display device that can show computer input and output on screen.
- Printer
 - Device that usually produces a paper copy based on an electronic document.
 - Connects to the motherboard via USB, parallel, or other ports, depending on device.
- Flash drive
 - Secondary storage device that connects to the computer via a USB port.

Output Devices (cont'd)

- Speakers
 - Hardware devices connected to a sound card which is installed on the motherboard.
 - ✓ An onboard speaker does not connect to a 'sound card' since sound card functionality is part of the motherboard's circuitry.
- Sonographic equipment
 - Produces images based on sound waves received.



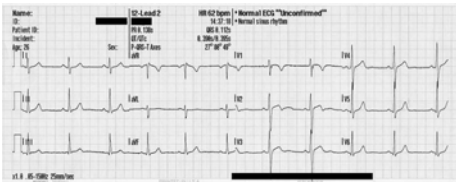
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Output Devices (cont'd)

- Electrocardiography (ECG or EKG)
 - An interpretation of the electrical activity of the heart over time captured and externally recorded by skin electrodes.
 - A noninvasive recording produced by an electrocardiographic device.



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Output Devices (cont'd)

- Voice synthesizer
 - Produces sound based on text input.
 - Physicist *Stephen Hawking's* synthesized 'voice' is known throughout the world although he lost his ability to speak in 1985.
- Other common output devices
 - Projectors, scanners and fax machines.

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