Computer Hardware

- What are the primary processes involved in a computer system?
- What typical hardware exists to facilitate entering data?
- What is a CPU?
- What are the different types of memory and how do they differ?
- What typical hardware exists to facilitate extracting information?
- How has the user interface evolved and what is its impact on you as a user?
- What is networking’s impact on schools?

A Computer System

Receive Input  Process Information  Produce Output

What Computers Do

Store Information

CPU-Process Information

- The processor, or central processing unit (CPU), processes information and performs all the necessary arithmetic calculations.
- The CPU is like the “brain” of the computer.

The computer you are using to read this page uses a microprocessor to do its work. The microprocessor is the heart of any normal computer, whether it is a desktop machine, a server or a laptop. The microprocessor you are using might be a Pentium, a PowerPC, or any of the many other brands and types of microprocessors, but they all do approximately the same thing in approximately the same way.

The Clock

- Huge quantities of data move around the computer
- This movement is synchronized by a clock
- It acts as the computer’s traffic cop
- Data and instructions are moved according to the pulse of the clock
The Computer’s Memory

- **RAM** (random access memory):
  - is used to store program instructions and data temporarily
  - unique addresses and data can be stored in any location
  - can quickly retrieve information
  - will not remain if power goes off (volatile)

**What RAM Holds**
- The operating system which is loaded at startup
- Application programs such as a word processor

Types of Memory

- While there are numerous types of memory chips such as SRAM, DRAM, EPROM, all memory can be classified as being either Read Only or Random Access Memory.

Save, save, save

- If there is a power failure, or a computer problem, all work that has not been saved will be lost.
- It is essential that work is saved frequently in order to prevent a disaster.
- Some applications such as Word have auto save facilities - it should be ensured that this is switched on.

Virtual memory

- Each application program that you have open will consume memory
- Modern computers will not run out of memory as they will start using part of the hard disc as virtual memory when all of the

**Virtual memory is slow**

- A hard drive is much slower to access than RAM
- When virtual memory is used, application programs have to be continually moved from disc to memory and the computer becomes sluggish

Memory Cards

- Flash Memory is used in such devices as digital cameras and computer games
**Memory sticks**
- A very important use of Flash Memory is in memory sticks which enable data to be moved easily from computer to computer.
  - Thumb Drives
  - USB Drives
  - Flash Drives

**The Computer’s Memory**
- **ROM** (read-only memory):
  - information is stored permanently on a chip.
  - contains startup instructions and other permanent data.

**Cache (pronounced CASH)**
- helps to overcome this difference in speed
- it is high speed memory in or close to the CPU
- it holds the most frequently used instructions and data
- CPU checks for them before going to main memory thus saving time

**BIOS**
- Windows machines hold their BIOS (Basic Input/Output System) in ROM
- In fact, this can be updated but a special program is required to do this

**Memory**
- **Memory**: This is very fast storage used to hold data. It has to be fast because it connects directly to the microprocessor. There are several specific types of memory in a computer:
  - Random Access Memory (RAM): Used to temporarily store information that the computer is currently working with.
  - Read only Memory (ROM): A permanent type of memory storage used by the computer for important data that does not change.
  - Basic Input/Output System (BIOS): A type of ROM that is used by the computer to establish basic communication when the computer is first turned on.
  - Cache: The storing of frequently used data in extremely fast RAM that connects directly to the CPU.
  - Virtual Memory: Space on a hard disk used to temporarily store data and swap it in and out of RAM as needed.

**Storage Devices: Input Meets Output**
- Secondary storage devices are computer peripherals capable of performing both input and output functions.
- Information is stored semi-permanently on tape and disk drives.
- Examples of storage devices:
  - Magnetic tapes and disks
  - Zip, Jaz and SuperDisks
  - Optical disks
Storage

Hard disks were invented in the 1950s. They started as large disks up to 20 inches in diameter holding just a few megabytes. They were originally called "fixed disks" or "Winchesters" (a code name used for a popular IBM product). They later became known as "hard disks" to distinguish them from "floppy disks." Hard disks have a hard platter that holds the magnetic medium, as opposed to the flexible plastic film found in tapes and floppies.

At the simplest level, a hard disk is not that different from a cassette tape. Both hard disks and cassette tapes use the same magnetic recording techniques.

Magnetic Media

- Magnetic drives
  - Random access
  - Floppy disks for inexpensive, portable storage
  - Hard disks are non-removable, rigid disks that spin continuously and rapidly thus providing much faster access than a floppy disk.
  - Removable media (Zip & Jaz disks) provide high-capacity portable storage.

Floppy Disks

The floppy disk drive (FDD) was invented at IBM by Alan Shugart in 1967. The first floppy drives used an 8-inch disk (later called a "diskette" as it got smaller), which evolved into the 5.25-inch disk that was used on the first IBM Personal Computer in August 1981. The 5.25-inch disk held 360 kilobytes compared to the 1.44 megabyte capacity of today's 3.5-inch diskette.

Optical Media

- CD-ROM drives are optical drives that read CD-ROMs. A CD can typically store 783,216,000 bytes (About 0.65 MB) of data
- CD-R are WORM media (write-once, read many).
- CD-RW can read CD-ROMs and write, erase and rewrite data onto CD-R & CD-RW disks.
- DVD (digital versatile disks) store & distribute all kinds of data. They hold between 3.8 and 17 gigabytes of information.

Optical disk use lasers to read and write bits of information on the disk surface.

- Not as fast as magnetic hard disks
- Massive storage capacity and reliability
* The platters, which typically spin at 3,600 or 7,200 rpm when the drive is operating. These platters are manufactured to amazing tolerances and are mirror-smooth (as you can see in this interesting self-portrait of the author... no easy way to avoid that!).

* The arm that holds the read/write heads is controlled by the mechanism in the upper-left corner, and is able to move the heads from the hub to the edge of the drive. The arm and its movement mechanism allow the arm on a typical hard drive to move the heads from the hub to the edge of the drive and back up to 50 times per second.

Expansion Made Easy

With the open architecture of the PC and the introduction of new interfaces, you can hot swap devices.

- **USB** (Universal Serial Bus) transmits a hundred times faster than a PC serial port
- **Firewire** (IEEE 1394) can move data between devices at 400 or more megabits per second
  - high speed makes it ideal for data-intensive work like digital video

FireWire Connection to a Digital Camera

Operating Systems & Software

THE COMPUTER CYCLE

Input Devices

Output Devices
What the Operating System Does

- The operating system controls:
  - Communication with peripherals
  - Coordination of concurrent processing
  - Memory management
  - Monitoring of resources and security
  - Management of programs and data
  - Coordinating network communications

Where the Operating System Lives

- Computer usually store part of the OS in ROM
  - The remaining system is loaded into memory (booting—the rom part tells how to begin loading OS)
- Most of the time it works behind the scenes
The User Interface: The Human-Machine Connection

The user interface is what the user sees on the screen.

Two major user interface types:
- **Character-based interface**
- **Graphical user interface (GUI)**

Graphical User Interface (GUI)

- In the early 80s, Steve Jobs from Apple visited the Xerox laboratories.
- He saw a graphical user interface controlled by a mouse that they had designed.
- He decided that this was the way that Apple should go and the Mac was born.
- Xerox decided that they were a copier and not a computer company and so their research was abandoned.

Software

- Both Windows and Mac OS use a Graphical User Interface (GUI).
- A GUI uses icons to represent objects and programs and a pointer to select and/or start them.
- Menus are also available in a GUI operating systems to give users lists of command options from which to choose.

A Character-Based Interface: MS-DOS

- This is a disk operating system in which the user interacts using characters
  - letters
  - numbers
  - symbols

Multiple User Operating Systems: UNIX and Linux

- **UNIX** was developed at Bell Labs before personal computers were available.
- **Linux** was created by Linus Torvalds and continues to be a work-in-progress.
  - Linux is free for anyone to use or improve.
A Character-Based Interface: Unix

Hardware & Software Platforms

- Windows Vista
- Windows 2000
- Windows CE
- Windows XP
- MS-DOS
- Mac OS/9
- Mac OS/X
- Jaguar, Darwin, Tiger, Leopard
- UNIX & Linux

Mouse-based GUI Won

Windows, Icons, Menus, and Pointing devices

- They're intuitive
- They're consistent
- They're forgiving
- They're protective
- They're flexible

Files

In data storage, the basic unit is the file
- Configuration files (.cfg)
- Text files (.txt)
- Graphics files (.jpeg .gif)
- Database files
- Sound files (.midi .mp3 .aiff)
- Document-specific files (.doc .xls .wpd, etc...)
- Executable files (compiled programs, e.g., .exe)
- Backup files
- Movie Files (.mov .swf .m4a)