What is a computer system? A “system” that does “computation.”

So … what is required of such a system?

Consider the following simple problem. We want this clever fellow to solve the problem on the paper.

What capabilities are required to solve it? Where are they “located?”
Where are the equivalent “capabilities” on a computer?

Front view:

Rear view:

Answer:
Lets look at the **hardware** of a typical computer system. It consists of:

1. **input devices:**

2. **output devices:**

3. **memory:** (“short term” and “long term”)

**a. primary memory** = **RAM** = Random Access Memory (for short term storage)

**b. Hard drives, diskettes, CD ROM** = Compact Disk Read Only Memory, **USB** (Universal Serial Bus) flash drives, **DVD** = Digital Versatile Disc or Digital Video Disc

**Important Aside**

The following units are used to measure various “capacities.” What do they mean and what are they usually used to measure?

Bit (b)

Byte (B)

KB

MB

GB

TB

PB
The anatomy of a floppy disk – ever see one?? Similar in some ways to a hard drive.

What happens when we format a diskette or the hard drive? (Remember formatting is a “destructive” operation)
….. but sometimes, not destructive enough. When? …

The anatomy of a hard drive.
Q: Why does a hard drive or “disk” need to be formatted?
A:

This document: [http://www.seas.upenn.edu/~cse381/Disks_Directories_and_Files.pdf](http://www.seas.upenn.edu/~cse381/Disks_Directories_and_Files.pdf) while dated, gives a readable (but technical) overview of disks and how they are organized.

**Remember:** Information on disks is stored magnetically so we need to be careful not to subject it to powerful magnets.

Q: What about these flash drives?
History

Flash memory (both NOR and NAND types) was invented by Dr. Fujio Masuoka while working for Toshiba circa 1980. According to Toshiba, the name "flash" was suggested by Dr. Masuoka's colleague, Mr. Shoji Ariizumi, because the erasure process of the memory contents reminded him of a flash of a camera. It happened “all at once”, or “in a flash!”

Flash memory stores information in an array of memory cells made from floating-gate transistors.

Advantages

Flash memory is non-volatile, which means that no power is needed to maintain the information stored in the chip. In addition, flash memory offers fast read access times (although not as fast as volatile DRAM memory used for main memory in PCs) and better kinetic shock resistance than hard disks. These characteristics explain the popularity of flash memory in portable devices. Another feature of flash memory is that when packaged
in a "memory card," it is enormously durable, being able to withstand intense pressure, extremes of temperature, and even immersion in water.

Limitations

1. One limitation of flash memory is that although it can be read or program a byte or a word at a time in a random access fashion, it must be erased/written a "block" at a time. **So read speed is higher than write speed on these devices.**

2. Another limitation is that flash memory **has a finite number of erase-write cycles. Most commercially available flash products are guaranteed to withstand around 100,000 write-erase-cycles,** before the wear begins to deteriorate the integrity of the storage.

Transfer rates

Commonly advertised is the maximum read speed, NAND flash memory cards are much faster at reading than writing. As a chip gets worn out, its erase/program operations slow down considerably, requiring more retries and bad block "remapping."

Transferring multiple small files, smaller than the chip specific block size, could lead to much lower rate. Access latency has an influence on performance but is less of an issue than with hard drives.

The **speed** is sometimes denoted in MB/s (megabyte per second), or in number of "X" like 60x 100x or 150x.

**What does “X” refer to?**

"X" speed rating makes reference to the speed at which a legacy audio CD drive would deliver data, 1x is equal to 150 kilobytes per second.

For example, a 100x memory card goes to 150 KB x 100 = 15000 KB per second = 14.65 MB per second.

Note that the exact speed depends on whether the marketer means 106 bytes or 220 bytes (1,000,000 bytes or 1,048,576 bytes) by "megabyte".

c. ROM = **Read Only Memory**

4. system unit: (Arithmetic Ability and Control)

\[
\text{CPU} = \text{Central Processing Unit}
\]

\[
\text{ALU} = \text{Arithmetic and Logic Unit}
\]

Registers, etc. ....

Control unit

All connected by the **BUS**. In the diagram below the BUS is represented by the double arrows.

What about a modem? Does it represent …

Input?

Output?

Communication?
Modem = MO+ DEM

**MO**=Modulate / **DEM**=DEModulate

AM radio = Amplitude **Modulation**
FM radio = Frequency **Modulation**

So the modem **Modulates** the carrier signal when it **sends it out**:

- it “adds” the binary information onto the analog carrier signal

and

**DeModulates** the signal when it is received

- It “subtracts out” the carrier signal when input is received and is left with the “bits”, i.e. binary digits (information) that hitched a ride on the carrier wave.