• You turn the computer on.
• The computer loads data from read-only memory (ROM) and performs a power-on self-test (POST) to make sure all the major components are functioning properly. As part of this test, the memory controller checks all of the memory addresses with a quick read/write operation to ensure that there are no errors in the memory chips. Read/write means that data is written to a bit and then read from that bit.
• The computer loads the basic input/output system (BIOS) from ROM. The BIOS provides the most basic information about storage devices, boot sequence, security, Plug and Play (auto device recognition) capability and a few other items.
• The computer loads the operating system (OS) from the hard drive into the system's RAM. Generally, the critical parts of the operating system are maintained in RAM as long as the computer is on. This allows the CPU to have immediate access to the operating system, which enhances the performance and functionality of the overall system.
• When you open an application, it is loaded into RAM. To conserve RAM usage, many applications load only the essential parts of the program initially and then load other pieces as needed.
• After an application is loaded, any files that are opened for use in that application are loaded into RAM.
• When you save a file and close the application, the file is written to the specified storage device, and then it and the application are purged from RAM.
"Why does a computer need so many memory systems?"

The bit size of a CPU tells you how many bytes of information it can access from RAM at the same time. For example, a 16-bit CPU can process 2 bytes at a time (1 byte = 8 bits, so 16 bits = 2 bytes), and a 64-bit CPU can process 8 bytes at a time.

Megahertz (MHz) is a measure of a CPU's processing speed, or clock cycle, in millions per second. So, a 32-bit 800-MHz Pentium III can potentially process 4 bytes simultaneously, 800 million times per second.

System RAM

System RAM speed is controlled by bus width and bus speed. Bus width refers to the number of bits that can be sent to the CPU simultaneously, and bus speed refers to the number of times a group of bits can be sent each second. A bus cycle occurs every time data travels from memory to the CPU. For example, a 100-MHz 32-bit bus is theoretically capable of sending 4 bytes (32 bits divided by 8 = 4 bytes) of data to the CPU 100 million times per second, while a 66-MHz 16-bit bus can send 2 bytes of data 66 million times per second. If you do the math, you'll find that simply changing the bus width from 16 bits to 32 bits and the speed from 66 MHz to 100 MHz in our example allows for three times as much data (400 million bytes versus 132 million bytes) to pass through to the CPU every second.

Even with a wide and fast bus, it still takes longer for data to get from the memory card to the CPU than it takes for the CPU to actually process the data. That's where caches come in.

A memory chip is an integrated circuit (IC) made of millions of transistors and capacitors. In the most common form of computer memory, dynamic random access memory (DRAM), a transistor and a capacitor are paired to create a memory cell, which represents a single bit of data. The capacitor holds the bit of information -- a 0 or a 1 (see How Bits and Bytes Work for information on bits). The transistor acts as a switch that lets the control circuitry on the memory chip read the
capacitor or change its state.

**Dynamic RAM**

A capacitor is like a small bucket that is able to store electrons. To store a 1 in the memory cell, the bucket is filled with electrons. To store a 0, it is emptied. The problem with the capacitor's bucket is that it has a leak. In a matter of a few milliseconds a full bucket becomes empty. Therefore, for dynamic memory to work, either the CPU or the memory controller has to come along and recharge all of the capacitors holding a 1 before they discharge. To do this, the memory controller reads the memory and then writes it right back. This refresh operation happens automatically thousands of times per second.

**Static RAM**

Static RAM uses a completely different technology. In static RAM, a form of flip-flop holds each bit of memory (see [How Boolean Logic Works](#) for details on flip-flops). A flip-flop for a memory cell takes four or six transistors along with some wiring, but never has to be refreshed. This makes static RAM significantly faster than dynamic RAM. However, because it has more parts, a static memory cell takes up a lot more space on a chip than a dynamic memory cell. Therefore, you get less memory per chip, and that makes static RAM a lot more expensive.

Static RAM is fast and expensive, and dynamic RAM is less expensive and slower. So static RAM is used to create the CPU's speed-sensitive cache, while dynamic RAM forms the larger system RAM space.

EDO DRAM: Extended data-out dynamic random access memory does not wait for all of the processing of the first bit before continuing to the next one. As soon as the address of the first bit is located, EDO DRAM begins looking for the next bit. It is about five percent faster than FPM. Maximum transfer rate to L2 cache is approximately 264 MBps.

- SDRAM: Synchronous dynamic random access memory takes advantage of the burst mode concept to greatly improve performance. It does this by staying on the row containing the requested bit and moving rapidly through the columns, reading each bit as it goes. The idea is that most of the time the data needed by the CPU will be in sequence. SDRAM is about five percent faster than EDO RAM and is the most common form in desktops today. Maximum transfer rate to L2 cache is approximately 528 MBps.
- DDR SDRAM: Double data rate synchronous dynamic RAM is just like SDRAM except that is has higher bandwidth, meaning greater speed. Maximum transfer rate to L2 cache is approximately 1,064 MBps (for DDR SDRAM 133 MHz).
- RDRAM: Rambus dynamic random access memory is a radical departure from the previous DRAM architecture. Designed by Rambus, RDRAM uses a Rambus in-line memory module (RIMM), which is similar in size and pin configuration to a standard DIMM. What makes RDRAM so different is its use of a special high-speed data bus called the Rambus channel. RDRAM memory chips work in parallel to achieve a data rate of 800 MHz, or 1,600 MBps.
How does hard disks work

http://www.youtube.com/watch?v=uDJk-ze_GMg

**Platters**: disks inside the drive.

5.25” or 3.5”, made of an aluminum alloy coated with a film of iron oxide.
The platters are mounted onto a spindle in the interior of the HDA.

**Read/write heads**: They read and write to the platters. **two read-write heads** for each platter, one to read the top surface and one to read the bottom.

The read/write heads float on a cushion of air only nanometers above the surface of the platters.

As the read/write heads pass over the spinning platters they magnetize the surface in a pattern which represents the data in digital form.

**SPINDLE**

The platters are mounted on the spindle which is turned by the drive motor. Most current hard disk drives spin at between 5,400 and 10,000 RPM.

Modern hard drives can transfer 80 megabytes of data per second.

**tracks**: concentric, circular paths

**sectors**: each sector will be able to store 512 bytes of data.

How does CD ROM works?
A CD has a single spiral track of data, circling from the inside of the disc to the outside.

The elongated bumps that make up the track are each 0.5 microns wide, a minimum of 0.83 microns long and 125 nanometers high. (A nanometer is a billionth of a meter.) Looking through the polycarbonate layer at the bumps, they look something like this:

A drive motor spins the disc. This drive motor is precisely controlled to rotate between 200 and 500 rpm depending on which track is being read.

- A laser and a lens system focus in on and read the bumps.
- A tracking mechanism moves the laser assembly so that the laser’s beam can follow the spiral track. The tracking system has to be able to move the laser at micron resolutions.

The laser beam passes through the polycarbonate layer, reflects off the aluminum layer and hits an opto-electronic device that detects changes in light. The bumps reflect light differently than the "lands" (the rest of the aluminum layer), and the opto-electronic sensor detects that change in reflectivity. The electronics in the drive interpret the changes in reflectivity in order to read the bits that make up the bytes.
**DVD Disks**

**DVD Fact**
The first DVD player hit the market in March 1997.

A DVD is very similar to a CD, but it has a much larger data capacity. A standard DVD holds about seven times more data than a CD does.

<table>
<thead>
<tr>
<th>Format</th>
<th>Capacity</th>
<th>Approx. Movie Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-sided/single-layer</td>
<td>4.38 GB</td>
<td>2 hours</td>
</tr>
<tr>
<td>Single-sided,double-layer</td>
<td>7.95 GB</td>
<td>4 hours</td>
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<tr>
<td>Double-sided/single-layer</td>
<td>8.75 GB</td>
<td>4.5 hours</td>
</tr>
<tr>
<td>Double-sided,double-layer</td>
<td>15.9 GB</td>
<td>Over 8 hours</td>
</tr>
</tbody>
</table>

**BLU- RAY DISCS**

**Blu-ray Disc** (official abbreviation BD, erroneously also known as BR or Blu-ray) is an optical disc storage medium designed to supersede the standard DVD format. Its main uses are for storing high-definition video, PlayStation 3 video games, and other data, with up to 25 GB per single-layered, and 50 GB per dual-layered disc. Although these numbers represent the standard storage for Blu-ray Disc drives, the specification is open-ended, with the upper theoretical storage limit left unclear. 200 GB discs are available, and 100 GB discs are readable without extra equipment or modified firmware.[citation needed] The discs have the same physical dimensions as standard DVDs and CDs.

The name *Blu-ray Disc* derives from the "blue laser" used to read the disc. While a standard DVD uses a 650 nanometer red laser, Blu-ray Disc uses a shorter wavelength 405 nm laser, and allows for almost ten times more data storage than a DVD.

SATISH MISHRA
PGT CS
KV TIRUMALAGIRI