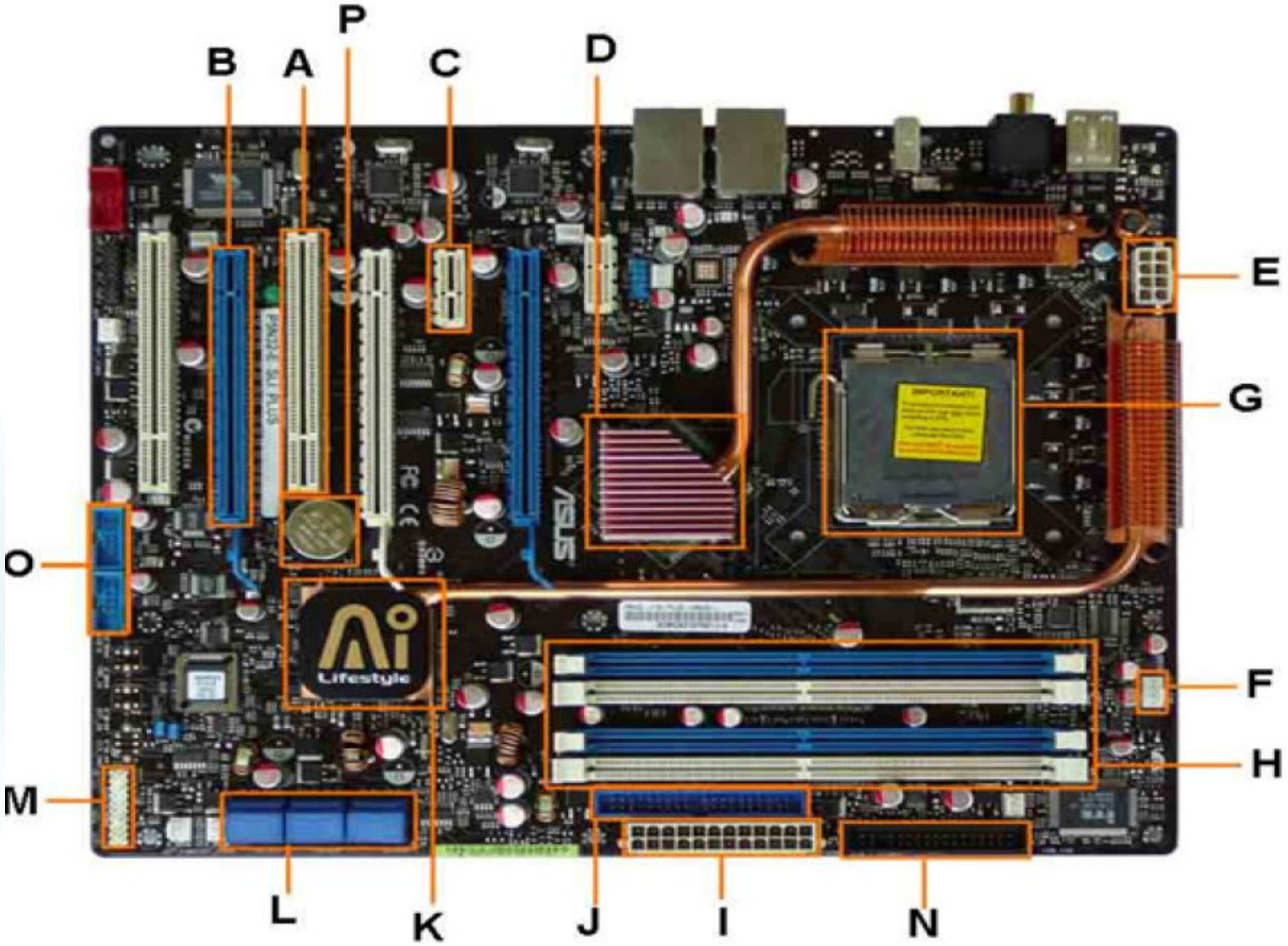
Unit 1 - Hardware

Data Storage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A. ***PCI Slot*** - This board has 2 PCI slots. These can be used for components such as Ethernet cards, sound cards, and modems.

B. ***PCI-E 16x Slot*** - There are 2 of them on this motherboard diagram, both are blue. These are used for your graphics card. With two of them onboard, you can run 2 graphics cards in SLI. You would only need this if you are a gamer, or working with high end video / graphics editing. These are the 16x speed versions, which are currently the fastest.

C. ***PCI-E 1x Slot*** - Single slot - In the PCIe 1.x generation, each lane (*1x*) carries 250 MB/s compared to 133 MB/s for the PCI slots. These can be used for expansion cards such as Sound Cards, or Ethernet Cards.

D. Northbridge - This is the Northbridge for this motherboard. This allows communication between the CPU and the system memory and PCI-E slots.

E. ***ATX 12V 2X and 4 Pin Power Connection*** Power Connection - This is one of two power connections that supply power to the motherboard. This connection will come from your Power Supply.

F. ***CPU-Fan*** Connection - This is where your CPU fan will connect. Using this connection over one from your power supply will allow the motherboard to control the speed of your fan, based on the CPU temperature.

G. Socket - This is where your CPU will plug in. The orange bracket that is surrounding it is used for high end heat sinks. It helps to support the weight of the heat sink.

H. Memory Slots - These are the slots for your RAM. Most boards will have 4 slots, but some will only have 2. The color coding you see on the motherboard diagram is used to match up RAM for Dual-Channel. Using them this way will give your memory a speed boost.

I. ***ATX Power Connector*** - This is the second of two power connections. This is the main power connection for the motherboard, and comes from the Power Supply.

J. ***IDE Connection*** - The IDE (Integrated Drive Electronics) is the connection for your hard drive or CD / DVD drive. Most drives today come with SATA connections, so you may not use this.

K. Southbridge - This is the controller for components such as the PCI slots, onboard audio, and USB connections.

L. ***SATA Connections*** - These are 4 of the 6 SATA connections on the motherboard. These will be used for hard drives, and CD / DVD drives.

M. ***Front Panel Connections*** - this is where you will hook in the connections from your case. These are mostly the different lights on your case, such as power on, hard drive activity etc.

N. ***FDD Connection*** - The FDD is the Floppy Disk controller. If you have a floppy disk drive in your computer, this is where you will hook it up.

O. ***External USB Connections*** - This is where you will plug in external USB connections for your case or USB bracket.

P. CMOS battery - This is the motherboard's battery. This is used to allow the CMOS to keep its settings.


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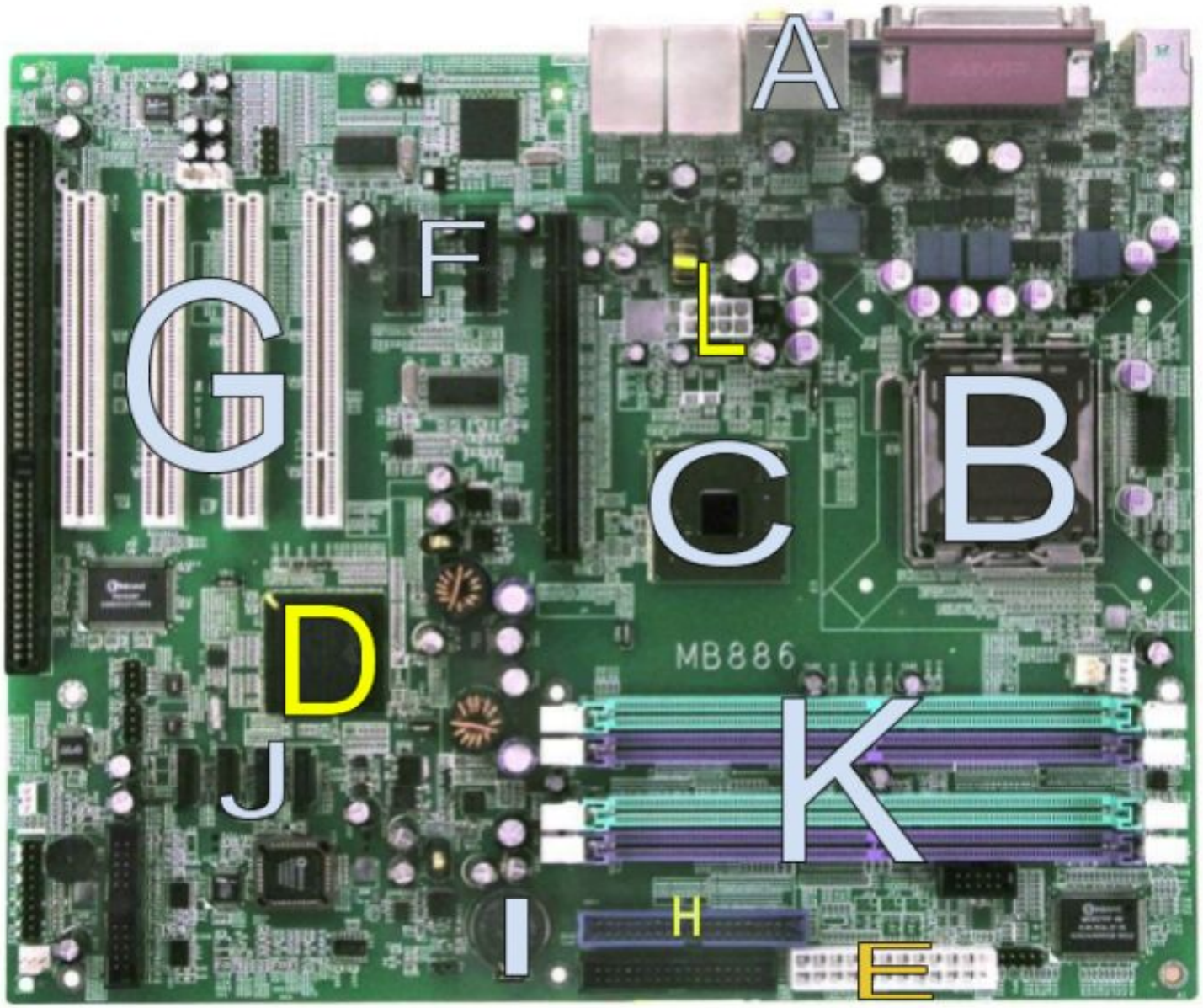
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Ultra Durable
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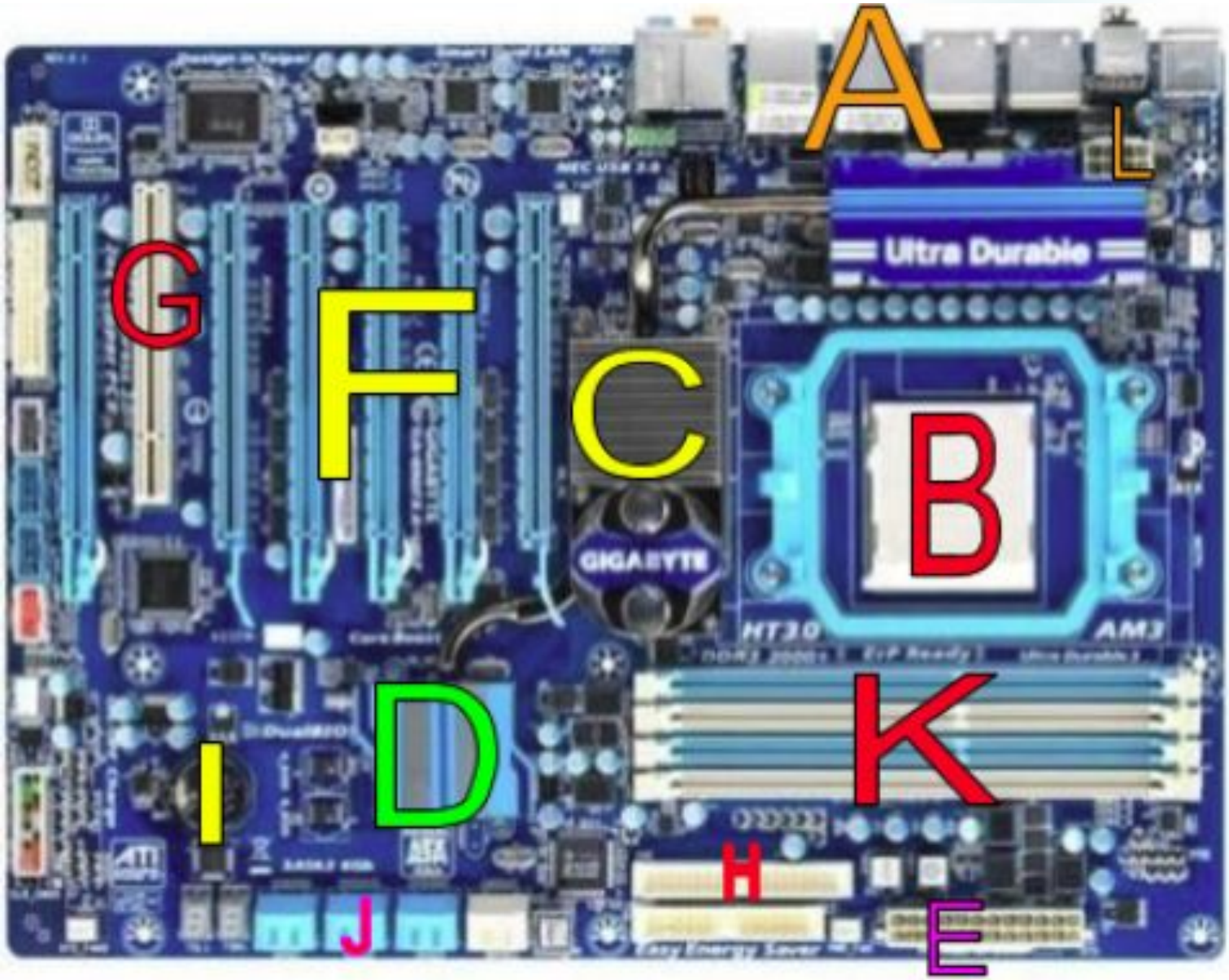
AM3
DDR3 2000+
ErP Ready
Ultra Durable 3
Core Boost
DualBIOS
SATA3 6Gb
Easy Energy Saver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How is data stored?

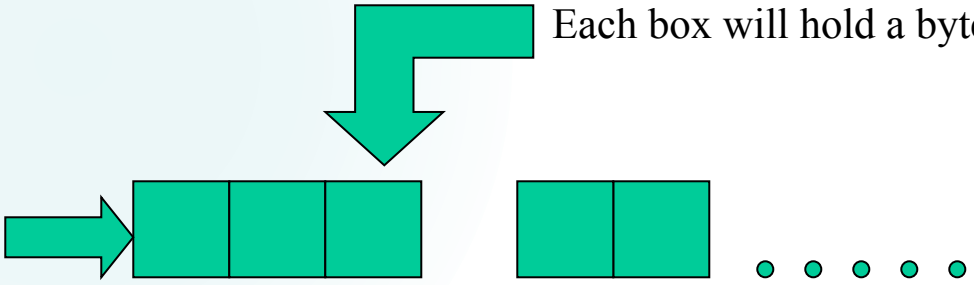
- Data is stored as a combination of 0's and 1's (bits). We will learn more about this later! 0's and 1's make up the binary numbering system.

- Bits are turned on and off using a small electromagnet. A bit that is turned on has a value of 1, and 0 when it's off.

- *We* don't necessarily understand what the series of 0's and 1's mean, but the program interprets these bits and presents us with meaningful output on the screen.

Memory

- Memory is data storage
- Memory size is measured in bytes.
- You can think of memory as an array of boxes that holds a single byte of information



Other units of computer storage

1 kilobyte = 1024^1 bytes

1 megabyte = 1024^2 bytes

1 gigabyte = 1024^3 bytes

1 terabyte = 1024^4 bytes

Hard Disk Drive (HDD)

- Non-volatile memory
  - Not erased when the computer powered down!

- Consists of:
  - one or more high-speed spinning disks (like a CD)
  - a read/write head on a moving arm that is used to access the data (like the arm on a record player)

- Youtube Video:

  http://www.youtube.com/watch?v=9eMWG3fwiEU

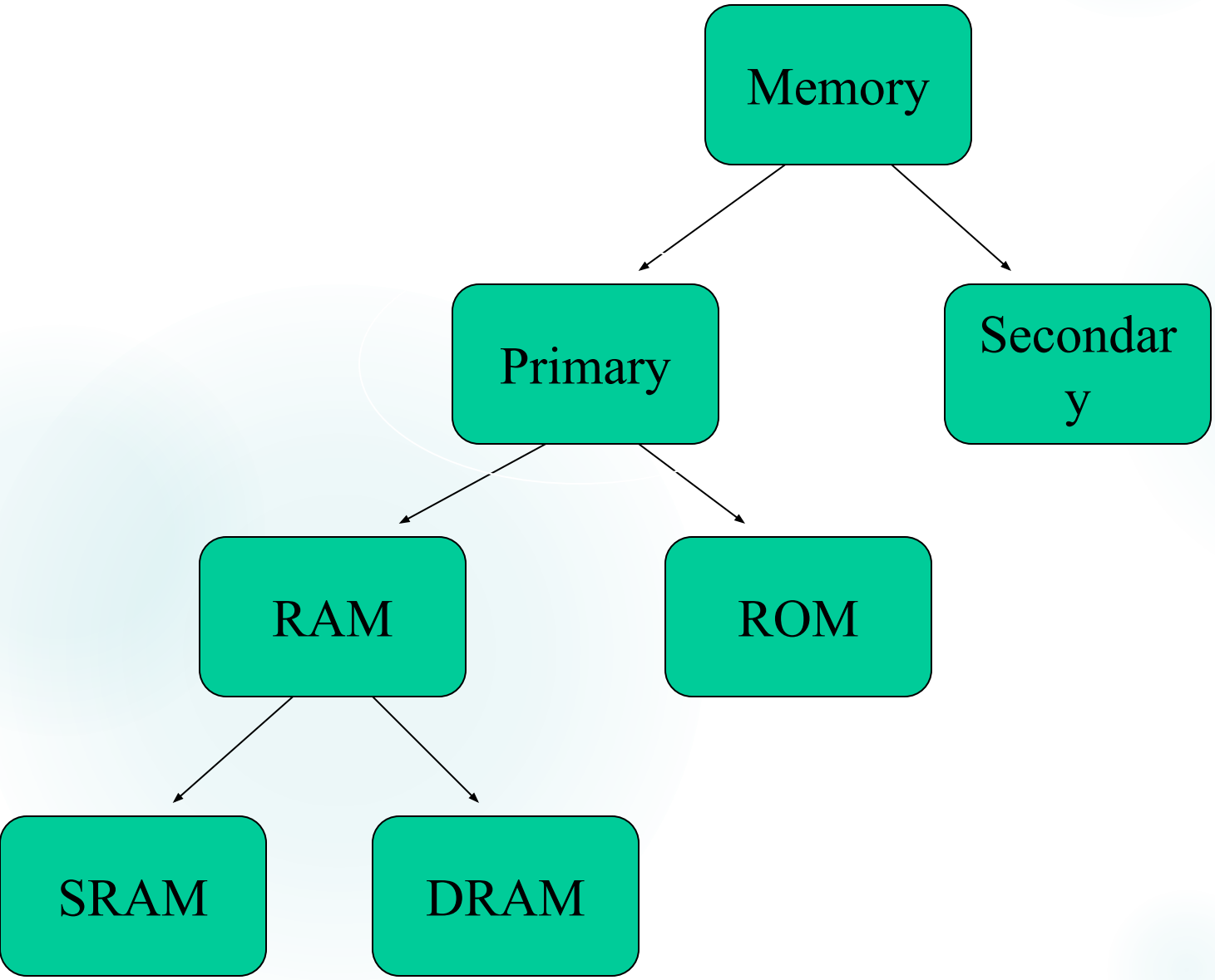
- How Stuff Works:

  http://www.howstuffworks.com/hard-disk.htm

Solid State Drive (SSD)

- **Problem**: Hard drives have a relatively low cost compared to other forms of memory (RAM, cache memory). However, they're *slow!*
- **Solution:** Solid state hard drives that use flash memory (the same memory in USB sticks).
- **Benefits:** No moving parts! And higher speed!
- **Downside:** Less capacity.

Memory Tree



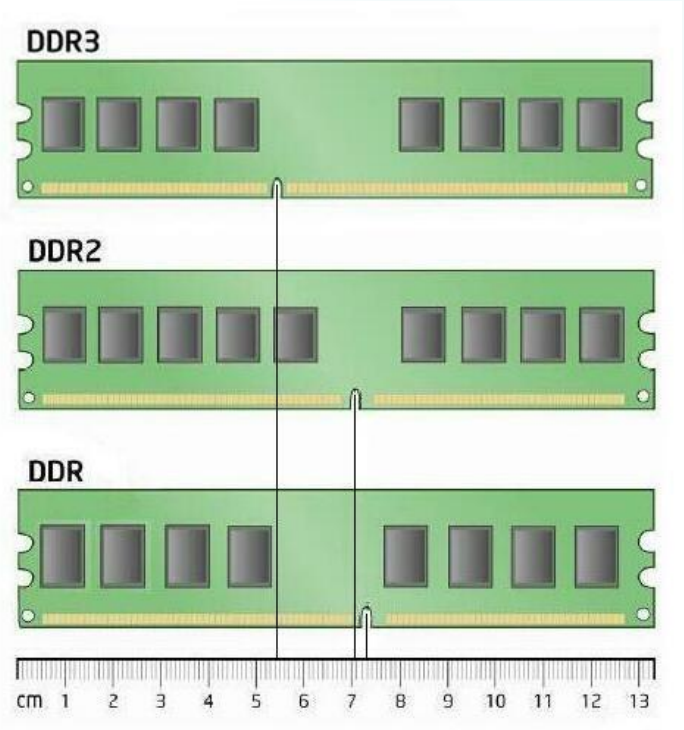
Random Access Memory (RAM)

- Volatile (erased once the computer is powered down)
- Working all of the time! The state of every running program is stored in RAM (or brought in to RAM) before being processed by the CPU.
- RAM is an integrated circuit (a chipset) with no moving parts. It is simply plugged in to the motherboard.
- Comes in different types (DDR3, DDR4, SD, etc.). Each type has different *read/write speeds* and *shapes*.

Types of RAM

- Different motherboards accept different types of RAM. For this reason, RAM is often sold in *kits* of two or four sticks so that the motherboard receives the same type for each of its slots.

- Note the shape differences:



Types of RAM

- **Dynamic RAM (DRAM)** The term *dynamic* indicates that the memory must be constantly *refreshed* (reenergized) or it will lose its contents.

- **DDR SDRAM –** double data rate synchronous dynamic random access memory (increased bandwidth)

Types of RAM

- **Static RAM (SRAM) - The term static is derived from the fact that it doesn't need to be refreshed like dynamic RAM.**
- **faster and more reliable than the more common DRAM**
- **much more expensive to produce than DRAM**
- **SRAM is used in personal computers, routers and peripheral equipment**

RAM in the news

- At one point, RAM was very expensive! In fact, there is now a class-action lawsuit because manufacturers *fixed prices* (made prices too high when they shouldn't have):

  http://www.cbc.ca/news/technology/themoneyismine-ca-refunds-electronics-buyers-after-dram-class-actions-1.2978279

Cache Memory

- Recall: Cache Memory is *fast* memory used by the CPU.
- Volatile: Erased when computer powers down.
- Originally, only microprocessors had cache. Now, other hardware have their own cache (video cards, hard drives) to speed up their work.
- How Stuff Works: Cache
  http://computer.howstuffworks.com/cache.htm

How do Cache, RAM, and the Hard Drive Interact?

Suppose you are a carpenter and you need to find your hammer.

- First, you check your tool belt. It's close by (fast to check), but doesn't hold much.
- Second, your check your toolbox. It's a little further away (slower to check), but holds more than the tool belt.
- Lastly, you check your work truck. It`s slow because it's so far away, but it holds *a lot.*

How do Cache, RAM, and the Hard Drive Interact?

Suppose you are a carpenter [CPU] and you need to find your hammer.

- First, you check your tool belt [cache]. It's close by (fast to check), but doesn't hold much.

- Second, your check your toolbox [RAM]. It's a little further away (slower to check), but holds more than the tool belt.

- Lastly, you check your work truck [hard drive]. It's slow because it's so far away, but it holds *a lot.*

Read-Only Memory (ROM)

- Non-volatile:
  - *Not* erased when computer powers down.
- Generally stores *firmware* – basic instructions for the system to boot up.
  - Computers use ROM to store the BIOS (bootup sequence)
  - Cellphones use ROM to store the operating system (Android, iOS, etc.) and special hardware instructions for the phone.
- How Stuff Works: ROM
  http://computer.howstuffworks.com/rom.htm

CD & DVD ROM

- Optical storage that uses lasers to read and write data.
- Data transfer on this type of ROM is *slow* – never used by the CPU!
- Cheap!