

Lesson 05: Computer Basics (W02D1)

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Do Now

For each of the following components of a computer, discuss with those around you what it does. No need to write down your agreed-upon answers, just be ready to share them if asked.

- CPU (or processor)
- RAM (or memory)
- Hard disk
- Graphics/video adapter
- Motherboard

Aim

Students will learn about computer architecture: internal components and their roles; the interaction between the BIOS, hard disk, and operating system to boot a computer; and the layering of BIOS, OS, and applications.

Under the covers

Let's look under the hood of a PC...

CPU



a



b

a source [here](#)

b source [here](#)

CPU

- Stands for **Central Processing Unit**
- Performs operations like arithmetic and simple instructions based on data from programs (which might come from hard disk, keystrokes, etc.)
- Over time: more transistors, smaller parts, higher speed (see [here](#))
- Transistors form *logic gates*

Logic Gates

- Perform logic operations you learned Math class:
 - AND
 - OR
 - NOT
 - the “combination” gates: NAND, NOR, & XOR

Logic Gates

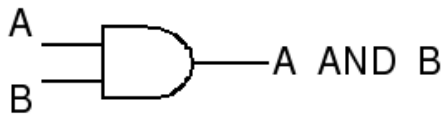
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- Linking of logic gates can perform more sophisticated functions; a topic covered in a Computer Engineering/Architecture course

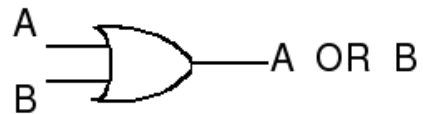
Gates

AND gate



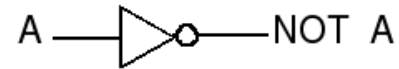
A	B	A AND B
T	T	T
T	F	F
F	T	F
F	F	F

OR gate



A	B	A OR B
T	T	T
T	F	T
F	T	T
F	F	F

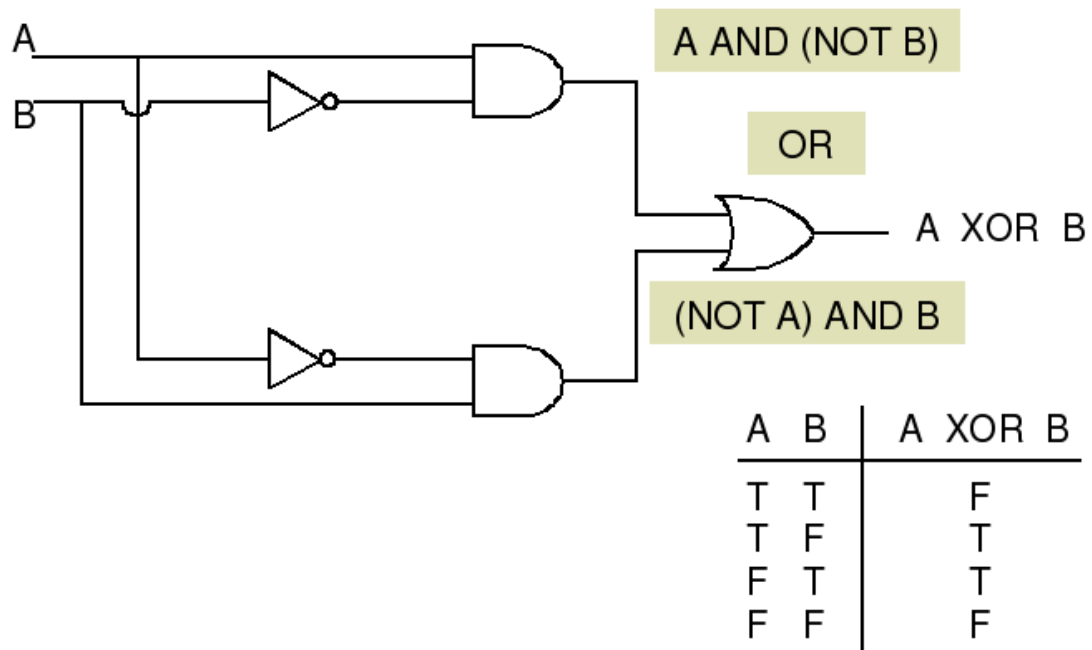
NOT gate



A	NOT A
T	F
F	T

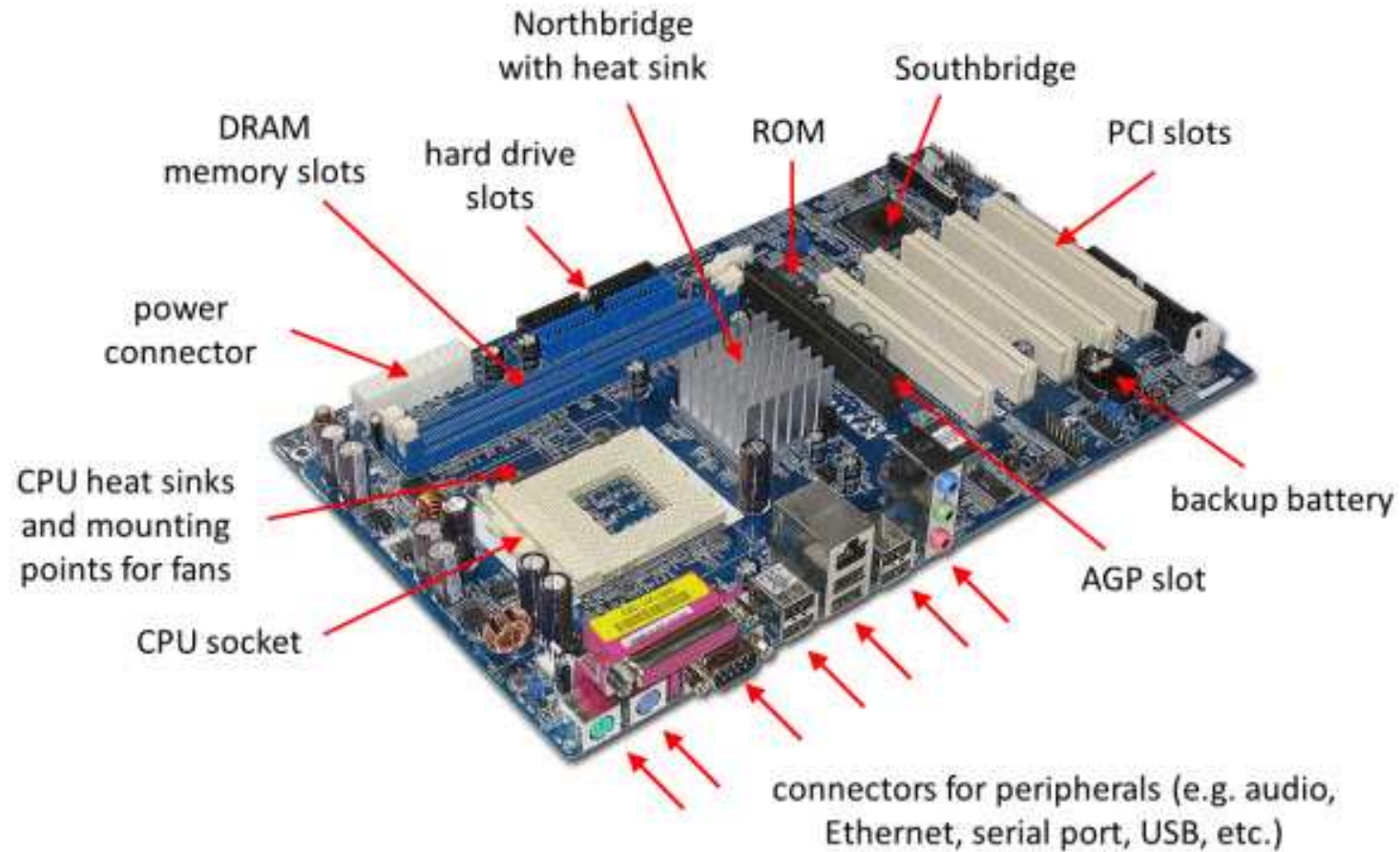
(taken from Litvin Ch01 PPT)

Example: XOR Circuit



(taken from Litvin Ch01 PPT)

Motherboard



a

^a source [here](#)

Motherboard

- Provides electrical pathways connecting core parts; sends & receives electrical pulses (0s and 1s) to/from other components.

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- Connects
 - CPU
 - RAM
 - Video adapter
 - PCI/AGP slots (to which other boards can be connected)
 - USB bus for connecting
 - mouse
 - keyboard
 - flash drive
 - etc.

Measurement Prefixes

- Used when measuring memory (e.g., 512KB), hard disk capacity (e.g., 250GB), and CPU clock speed (e.g., 2.8GHz)

Measurement Prefixes

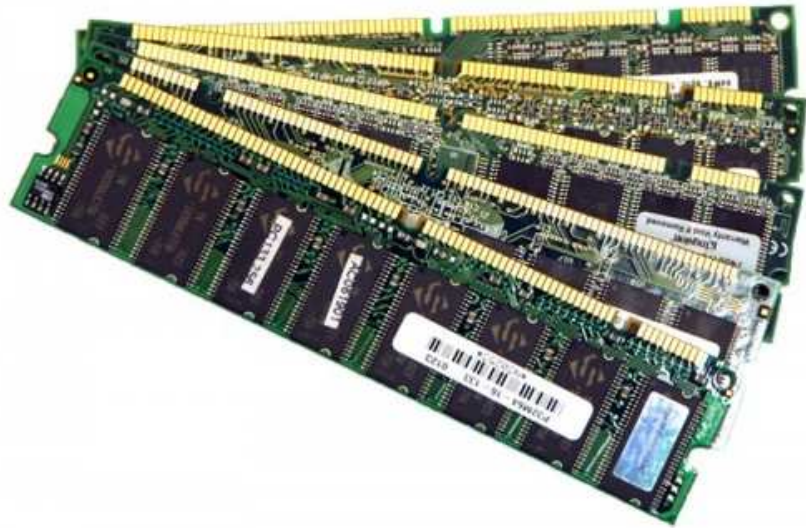
- Used when measuring memory (e.g., 512KB), hard disk capacity (e.g., 250GB), and CPU clock speed (e.g., 2.8GHz)
- Common prefixes: 10^x or 2^y ^a
 - K = kilo = 10^3 ($2^{10} = 1,024$)
 - M = mega = 10^6 ($2^{20} = 1,048,576$)
 - G = giga = 10^9 ($2^{30} = 1,073,741,824$)
 - Ex: 1TB (terabyte) = 1000GB; 1TiB = 2^{40} bytes

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 - Ex: 1TB (terabyte) = 1000GB; **1TiB = 2^{40} bytes**
- Depending on context — processor speed, RAM capacity, network bandwidth, etc. — either of the prefix types may be used.

^aSee [here](#) for an explanation of differences between powers of 10 & powers of 2 for prefixes.

Memory



a



b

a source [here](#)

b source [here](#)

Memory

- Data storage using binary representation
- Microchip-based, requires a voltage to read/write values
- Based on logic gates
- Various types and speeds; PCs nowadays commonly have DIMM modules

Memory, cont'd

- Some types are volatile (i.e., they lose **state** when voltage is no longer applied); Example: System RAM
- Other types are nonvolatile (e.g., **NVRAM** devices like USB flash drives)

Memory, cont'd

RAM [Random Access Memory] allows for non-sequential memory access; c.f. accessing data on a backup tape

Memory, cont'd

RAM [Random Access Memory] allows for non-sequential memory access; c.f. accessing data on a backup tape

(*Huh?! OK, consider the difference between finding a scene on a movie DVD vs. a VHS cassette)*

Memory: RAM or Hard Disk?

If software demands more physical memory (RAM) than is available, an operating system may take advantage of what is known as *virtual memory management*, and transparently begin using an area on a hard disk called a *paging file* (or, generically, *swap space*).

Hard Disk



a



b

a source [here](#)

b source [here](#)

Hard Disk

- Like RAM, it provides storage of data in binary form
- Not a “solid state” technology (i.e., there are moving parts, unlike RAM) → primary disadvantage(s)?
- Cheaper per unit of storage than RAM
- **Much** slower access time compared to RAM
- What about solid-state hard disks?

HW

- Make sure you've finished your home java setup (per Lesson # 4)
- Your first problem set will be assigned next class!