CS 110 Computers

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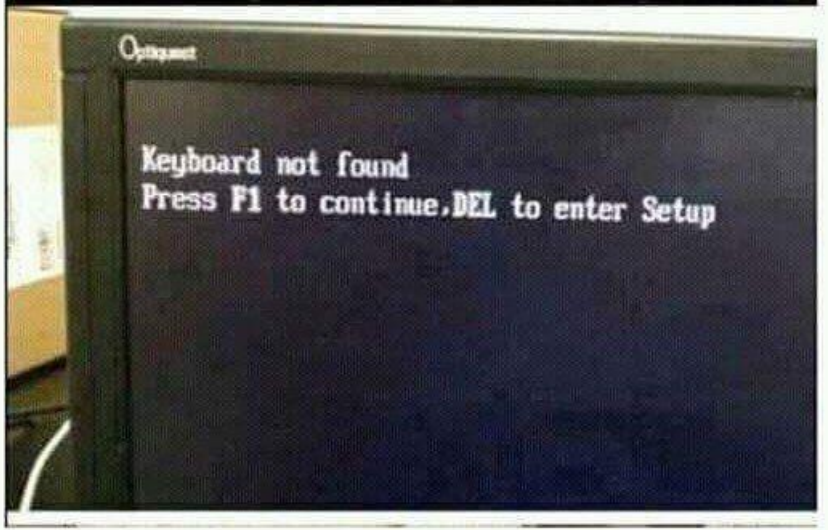


Computer

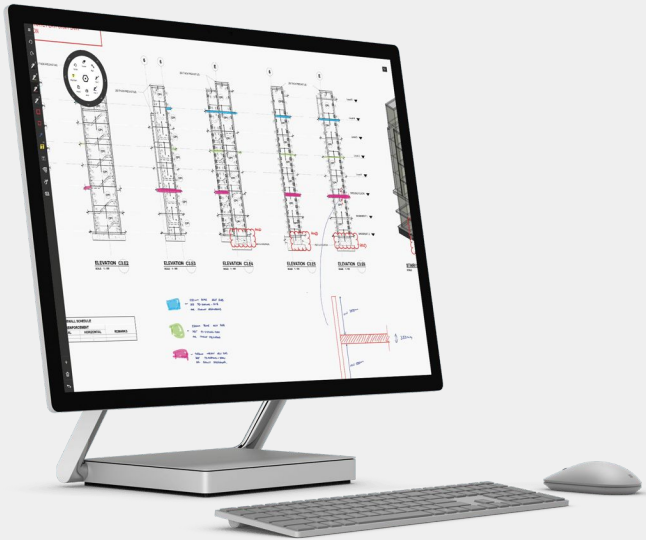
- What is a computer?
- Come up with a definition amongst your group, write on your whiteboard

Computer

A computer is a device that can be instructed to carry out sequences of arithmetic or logical operations automatically via computer programming.

(Wikipedia)

Types of Computers



Computer Dissection

- All of these are computers!
- The shape, size, and form-factor differ
- ***The core architecture and components inside of each of these devices is roughly the same***
- We will study the components and makeup of a standard desktop PC since it is the largest and easiest to “dissect”

Computer Dissection

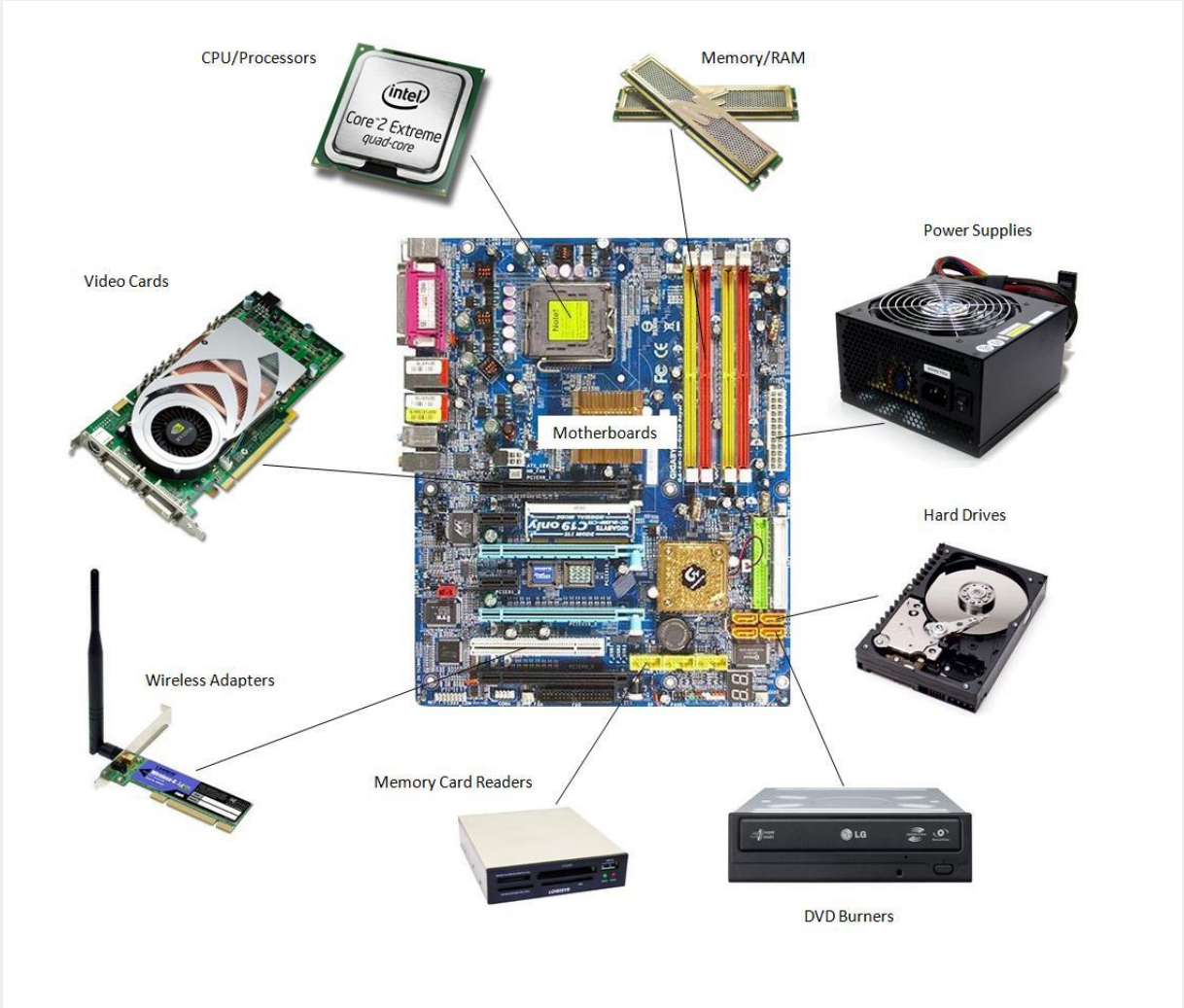
What does the ***inside*** of a computer look like?


CORSAIR
DIGI+ VRM
EPU
DARK POWER PRO
be quiet!

The components of a Computer

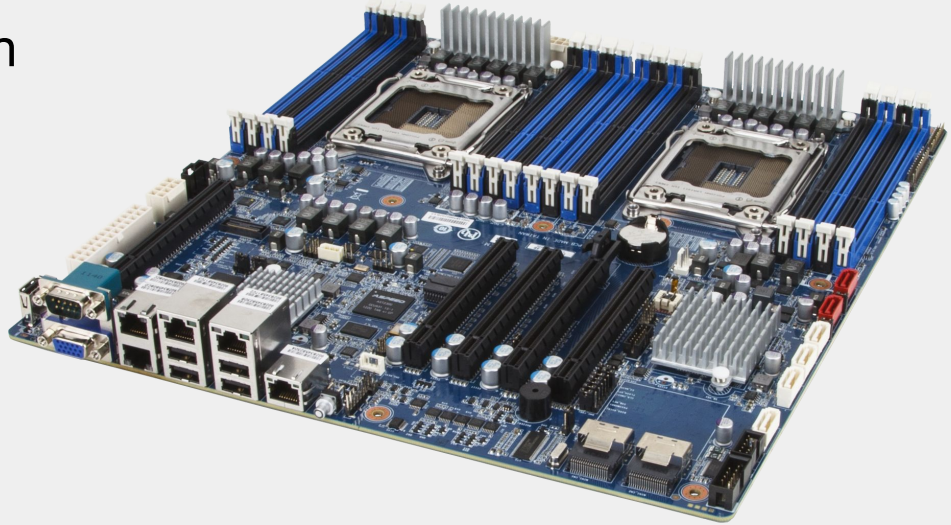
- Name three of the most important internal components of a computer
- What do each of these components do? What is their “job” ?

Main Computer Components



Motherboard

The ***Motherboard*** (mobo) is the main printed circuit board (PCB) found in general purpose computers. It holds and allows communication between the crucial electronic components of a system, such as the central processing unit (CPU) and memory, and provides connectors for other peripherals. (wp)



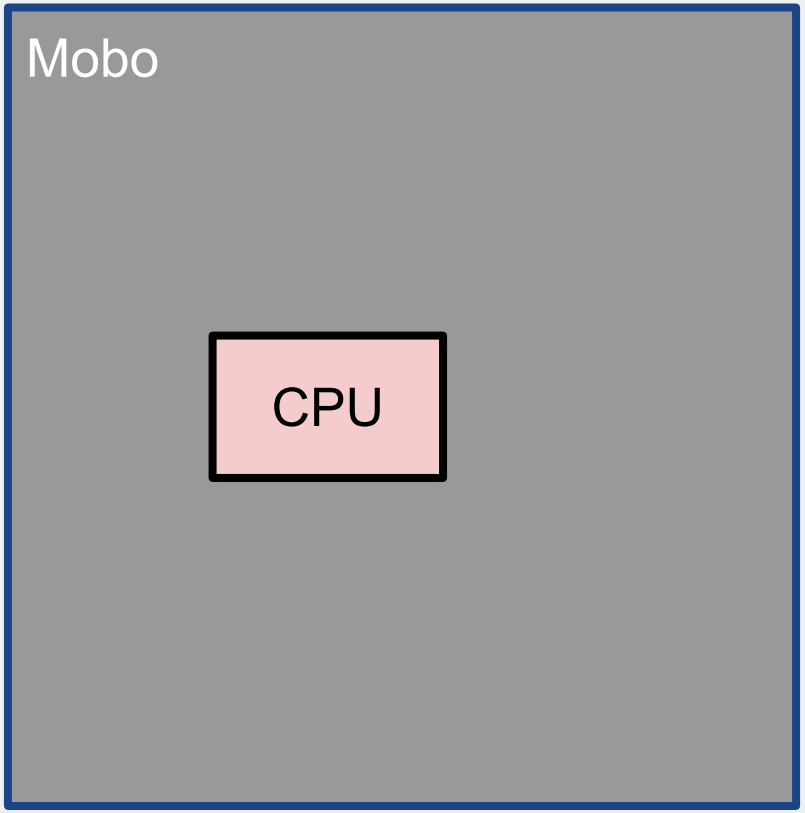
Central Processing Unit (CPU)

The ***central processing unit*** (CPU) is the electronic circuitry within a computer that carries out the instructions of a computer program by performing the basic arithmetic, logical, control and input/output (I/O) operations specified by the instructions.

Central Processing Unit (CPU)

Speed often measured in Gigahertz (GHz)

The Computer



Why Multiple Cores?

- What is the point of having multiple “cores” in a CPU?
- What kinds of programs do you think benefit from having multiple cores?
- Is it better to have 1 really fast core, or many slower cores?
- Would you rather have:
  - a 4-core CPU, and each core run at 1.5 GHz
  - a 1-core CPU that runs at 4GHz

Hard Disk Drive (HDD) and Solid State Drive (SSD)

- The ***hard disk drive*** (HDD) is a non-volatile data storage device that uses magnetic storage to store and retrieve digital information.

- A ***solid-state drive*** is a non-volatile, solid-state storage device that uses integrated circuit assemblies as memory to store data persistently.

Representing Information

- Computers store information (called ***files***) on Hard Drive Disk (HDD) and/or SSD (Solid State Drive)
- Both HDDs and SSDs are types of ***Hard Drives***

Representing Information

- Hard drives store information in ***Binary***
- This means that computers can only use ***1s*** and ***0s*** for storing every type of file!
- Before learning about how computer store text, images, and videos with binary, we need to learn how binary works

Representing Information

- A common type of hard drive today is the SSD (Solid State Drive).
- As solid state drive uses tiny electrical components called ***floating gate transistors (FGT)*** to store each 1 and zero
- A single SSD can have millions, billions, or even trillions of ***FGTs*** in them

Representing Information

- 1 Gigabyte = 8,000,000,000 (billion) bits of information
    - Meaning, a 1 GB hard drive can store 8 billion "1s and 0s"!
- A more common sized hard drive, like 256GB can store over 2 ***trillion*** "1s or 0s"!

HDD/SSD

- What are the pros and cons of an SSD?
- Pros and cons of HDD?

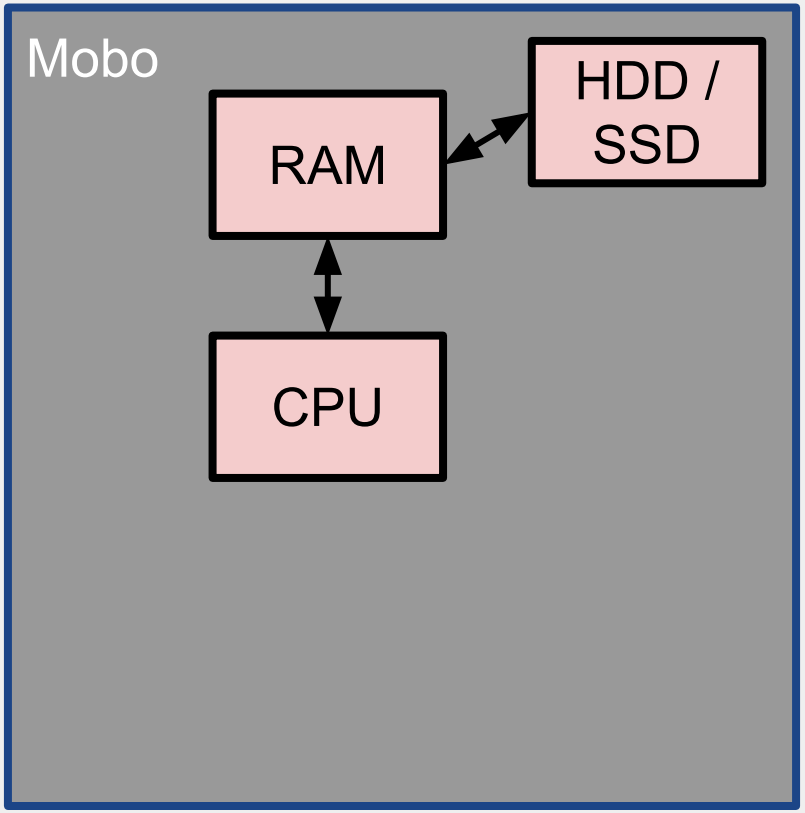
(Random Access) Memory (RAM)

Random-access memory (RAM) is volatile computer data storage which stores frequently used program instructions to increase the general speed of a system. A random-access memory device allows data items to be read or written in almost the same amount of time irrespective of the physical location of data inside the memory. (wp)

Volatile and Non-Volatile

- ***Volatile Memory (VM)*** is storage that only persists while power is on. Once shut down, all stored info is gone.
- ***Non-Volatile Memory (NVM)*** (persistent storage) is storage that remains regardless of the power state.

The Computer



HDD/SSD vs RAM

- Why do computers need both?
- What kinds of computer users could use a ***large amount*** of HDD/SSD capacity and a ***small amount*** of RAM?
  - 5000 gb of hard drive space, 4 gb RAM
- And vice-versa?
  - 256 gb hard drive space, 64 gb RAM

Volatile and Non-Volatile

- Typically, data can be stored to and retrieved from volatile memory much faster than non-volatile memory
- However, volatile storage is often much more expensive for comparable capacity
  - A 16 GB stick of DDR4 RAM (VM) costs ~ $75 on Amazon
  - A 1 TB (1000 GB) SSD (NVM) costs ~ $150 on Amazon
- VM and NVM are typically combined, to get the best of both worlds!

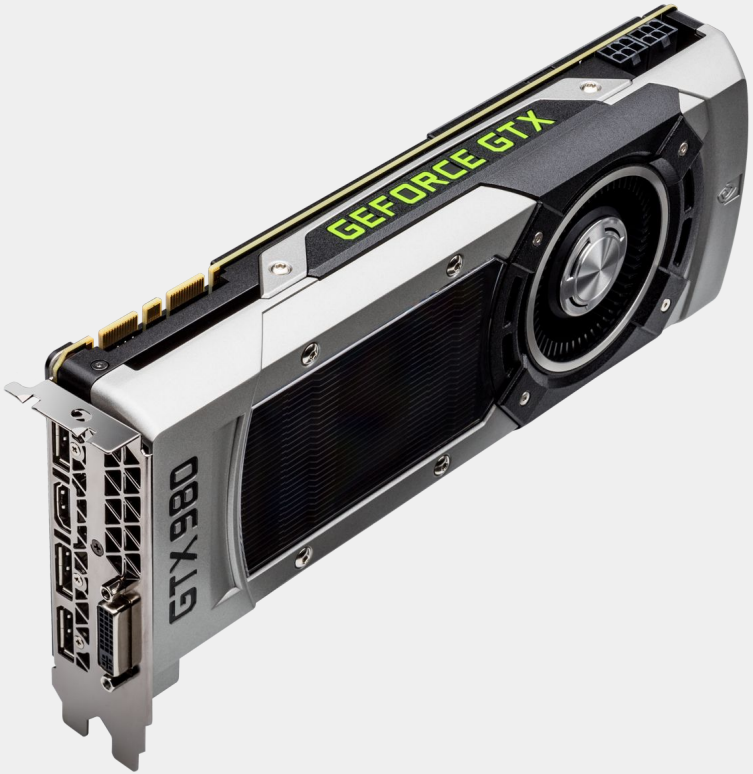
Wireless Network Interface Ctrl (WNIC)

A ***wireless network interface controller*** (WNIC) is a network interface controller which connects to a wireless radio-based computer network, rather than a wired network, such as Ethernet. This card uses an antenna to communicate via microwave radiation. These can connect via PCI, USB, and others. (wp)

Video Card

A ***video card*** (also called ***graphics card***) is an expansion card which generates a feed of output images to a display (such as a computer monitor). Frequently, these are advertised as discrete or dedicated graphics cards, emphasizing the distinction between these and integrated graphics. (wp)

Some CPUs have built-in video cards



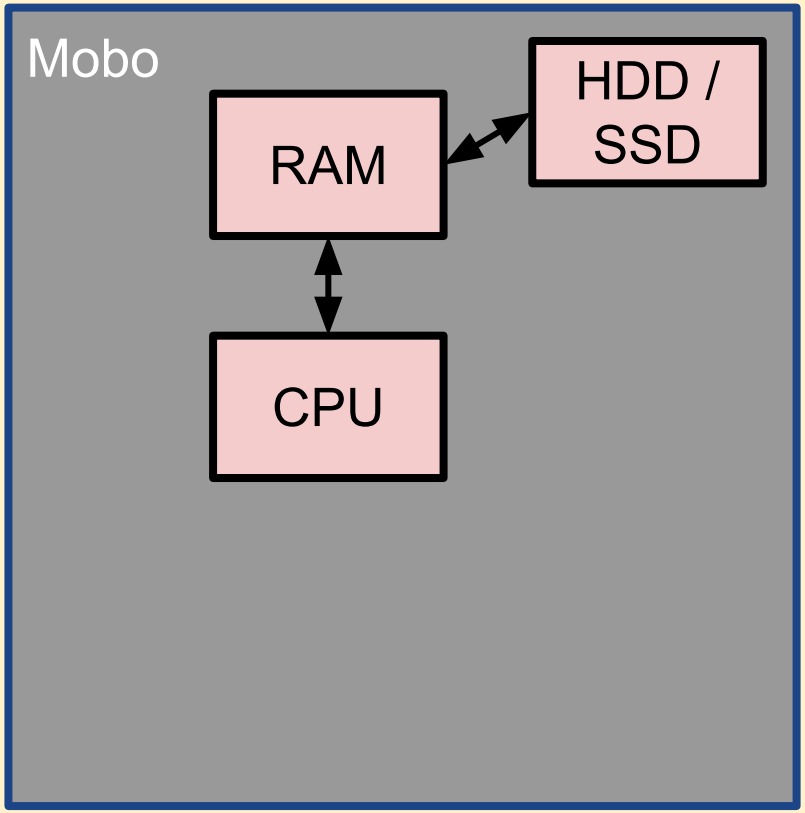
Power Supply Unit (PSU)

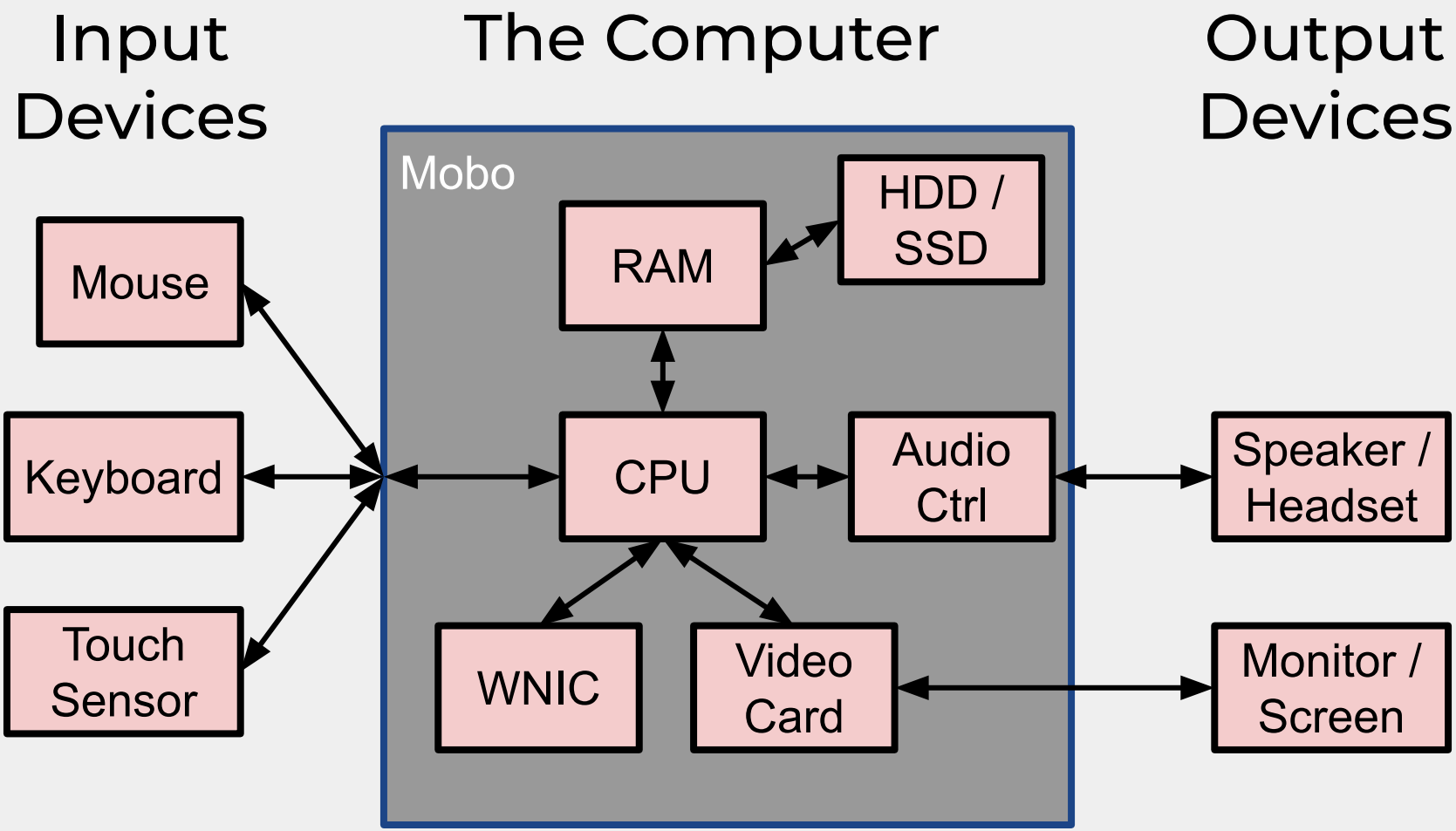
A ***power supply unit*** (or PSU) converts mains AC to low-voltage regulated DC power for the internal components of a computer. Modern personal computers universally use switched-mode power supplies. Some power supplies have a manual switch for selecting input voltage, while others automatically adapt to the mains voltage. (wp)

Where would you add?

- WNIC
- Video Card
- Mouse
- Keyboard
- Monitor
- Speakers

Create the full diagram




Input Devices
The Computer
Output Devices
Mobo
Mouse
Keyboard
Touch Sensor
RAM
HDD / SSD
CPU
Audio Ctrl
WNIC
Video Card
Speaker / Headset
Monitor / Screen

Computer Dissection

- Knowing how to build a computer, what each component does, and how each component functions ***does not make one a computer scientist***
- But it is important for a computer scientist to understand how it all works, because this is the primary tool of a computer scientist
- The physical computer is a ***tool*** of a computer scientist, so it is important to understand how it works

Materials

- Supplemental Materials
  - How to Build a Computer (17 mins)
  - Overheating CPUs (2 mins)
  - PC Build Guide (15 mins)
  - SOWP Chapter 1