

AP CSP

SouthLake Christian Academy
2022-2023

Hardware Layer

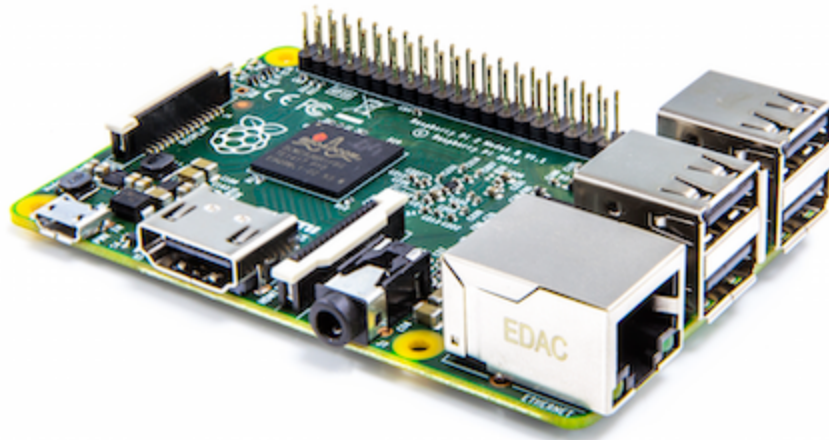
CPU

If you have heard that your computer has “Intel Inside,” it has an Intel processor in it



- The backside of the processor has pins that connect into the motherboard
- The motherboard is a circuit board made of silicon
- The CPU is the brain of the computer
 - Does all the thinking
 - Performs math in numbers fed to it
 - Helps display numbers on a screen
 - Adds or deletes numbers
- CPUs now can have multiple cores
- Cores are the devices inside the CPU that can perform mathematical operations, load info from memory, save info to memory, etc.
 - The more cores, the more tasks a CPU can do at once
- Systems on a Chip (SoC) are when a CPU and more are all interconnected at once rather than attached to a motherboard
 - Popular in phones, tablets, and game consoles

- Raspberry Pi

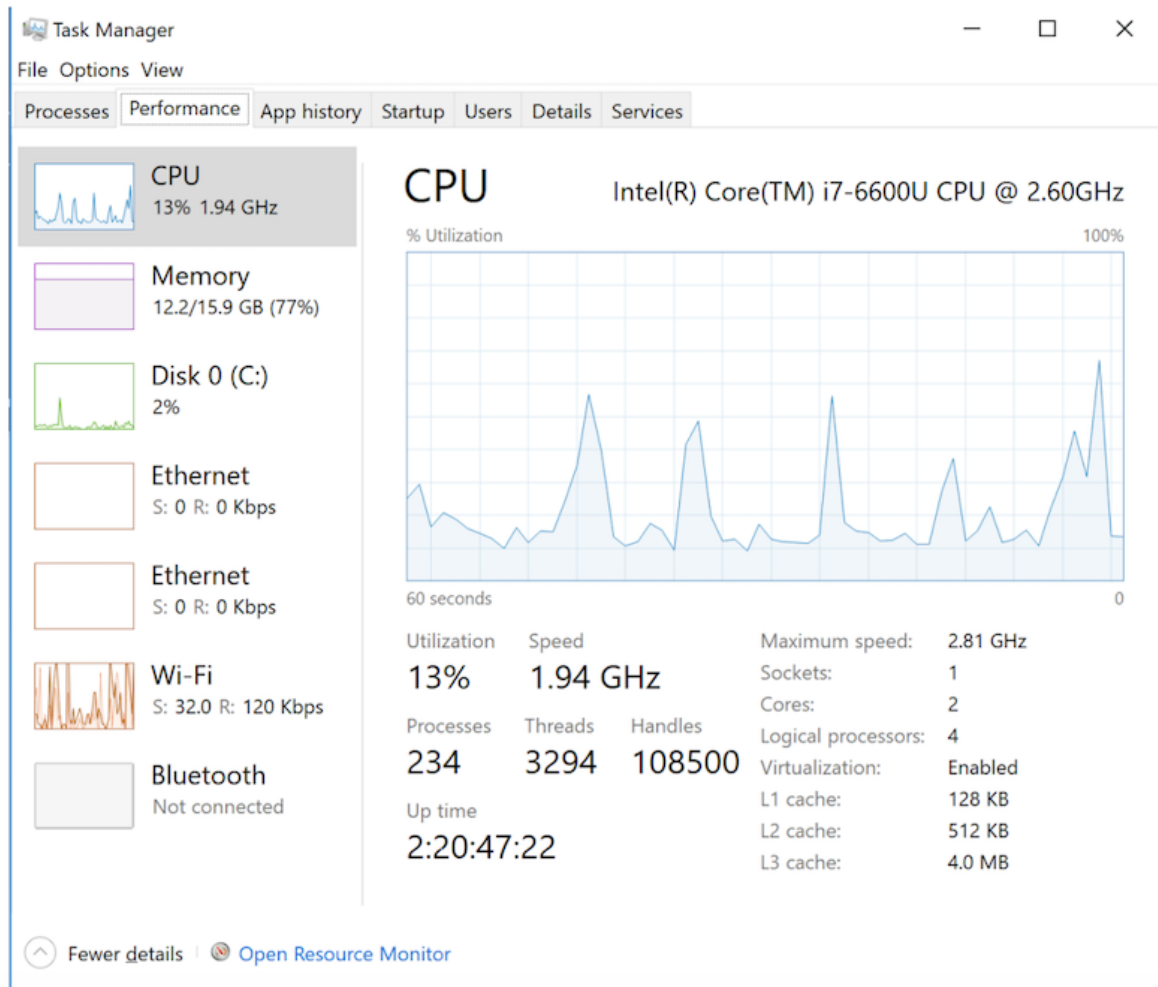


RAM (Random Access Memory)

- Circuit board with chips that slides into a slot on the motherboard



- The chips store data
 - Only stores data when the power is on
- Files and programs are loaded onto these chips when ran
- Fast memory
- You can check your RAM and other specs:
 - Windows Task Manager



- CPU chart shows when peak usage occurs
- GHz is the number of operations a CPU can perform per second (in billions)
 - 1.94 GHz = 1.94 billion operations per second
- Logical processors in this case is 4, which means both cores support hyper-threading
 - Each core will do two things at once as if 4 cores exist
- Mac System Profiler

Hardware Overview:

Model Name:	MacBook Pro
Model Identifier:	MacBookPro12,1
Processor Name:	Intel Core i7
Processor Speed:	3.1 GHz
Number of Processors:	1
Total Number of Cores:	2
L2 Cache (per Core):	256 KB
L3 Cache:	4 MB
Memory:	16 GB

Hard Drives

- When you turn a computer off, you need a place to store data
 - A hard disk drive (HDD) stores this information



- RAM may store 1 GB, 2 GB, 4 GB, through 16 GB or so
- HDD stores 256 GB, 1024 GB (AKA terabyte or TB), 2 TB
- Inside a HDD, metal platters physically spin around



- Data is stored on these disks
- The reading heads move back and forth reading data from the device
- Uses tiny magnetic particles where north pole orientation represents 1 and south pole orientation represents 0
 - Power is only needed to read or change the data
 - Data is preserved when power is off
 - David shows a video of a HDD running in slowmo
- To store data in a hard drive, RAM sends data and instructions to the HDD
 - The hard drive translates that data into voltage fluctuations
 - Some signals spin the platters, others move the read/write heads
 - Pulses sent to the read/write head turn on a magnet which creates a field that changes the polarity of a tiny portion of the metal platter's surface
 - Power is sent in different directions as to change polarity
 - To read, the particles on the disk use their charge to move the read/write head.
 - Pieces of a file can be spread out around the platters
 - A special file keeps track of data's location
 - Anytime you have a physical device that moves over a period of time, things go wrong
 - Dropping a HDD can corrupt files

- Platters spin slower than how fast electrons move

Flash Memory

- Solid state disk (SSD)



- Smaller (3.5 inch width for HDD vs 2.5 inch width for SSD)
 - Still fits where old HDDs are
- No moving particles
- Inside, it looks a lot like RAM

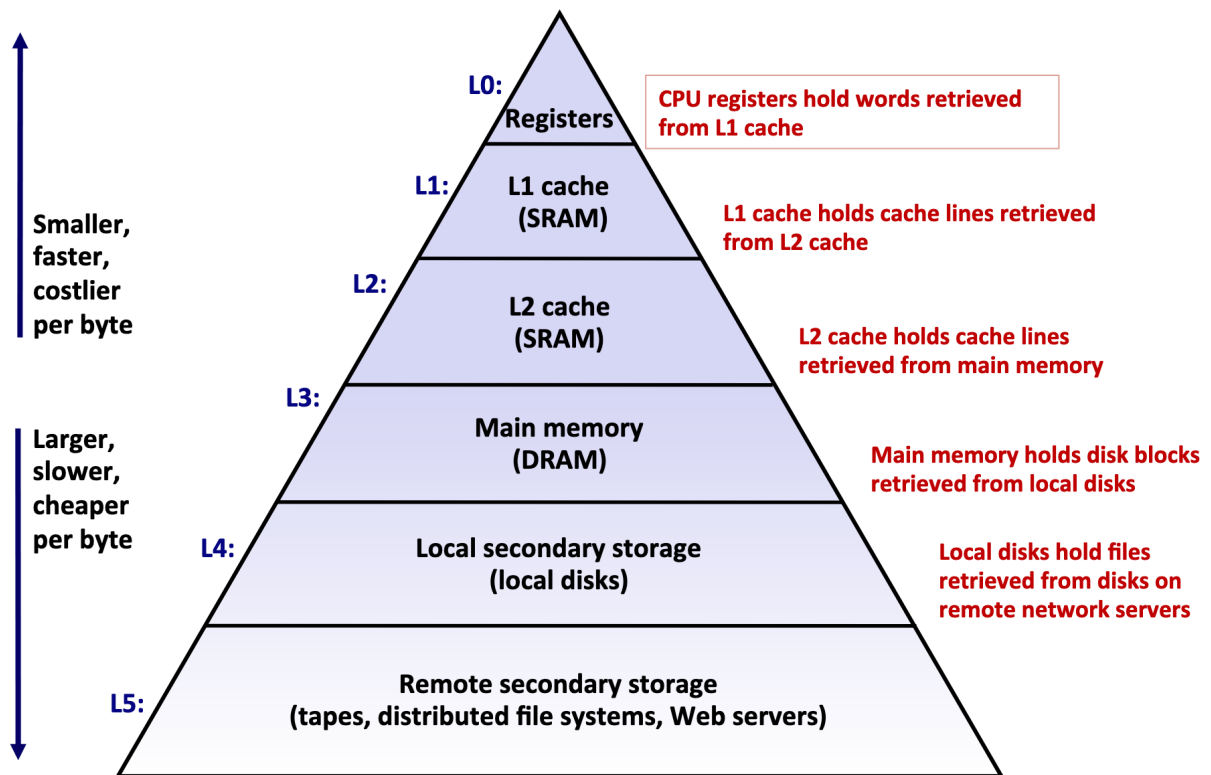


- Much faster than HDD
 - Programs/files load and save more quickly
- SSD theoretically don't last as long as HDD

- Finite number of writes
- Hybrid Drives
 - Some GB of solid state memory and more GB or TB of HDD space
 - Stores as much of frequently-needed data on the SSD
 - Stores less frequently-needed data on HDD
- Flash memory also exists in the form of USB sticks
 - Might store 1 GB, 16 GB, or more
 - Portable
- External SSDs exist for more storage
 - Might store 256 GB or more
 - Can be used to share data with others without network usage
- Can also have external HDD

The Memory Hierarchy

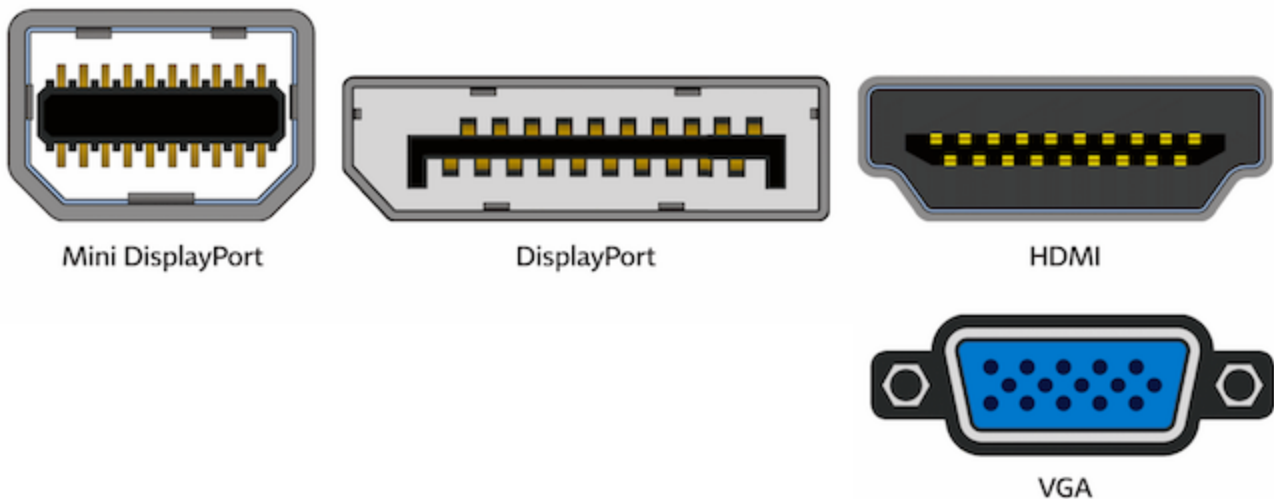
- There is a tradeoff between space, money, and speed of data transfer



- Theoretically, the CPU never has to wait for data to crunch
- There is a tiny amount of memory (bytes) called registers where numbers are stored for operations.
- Memory at the bottom is more expensive

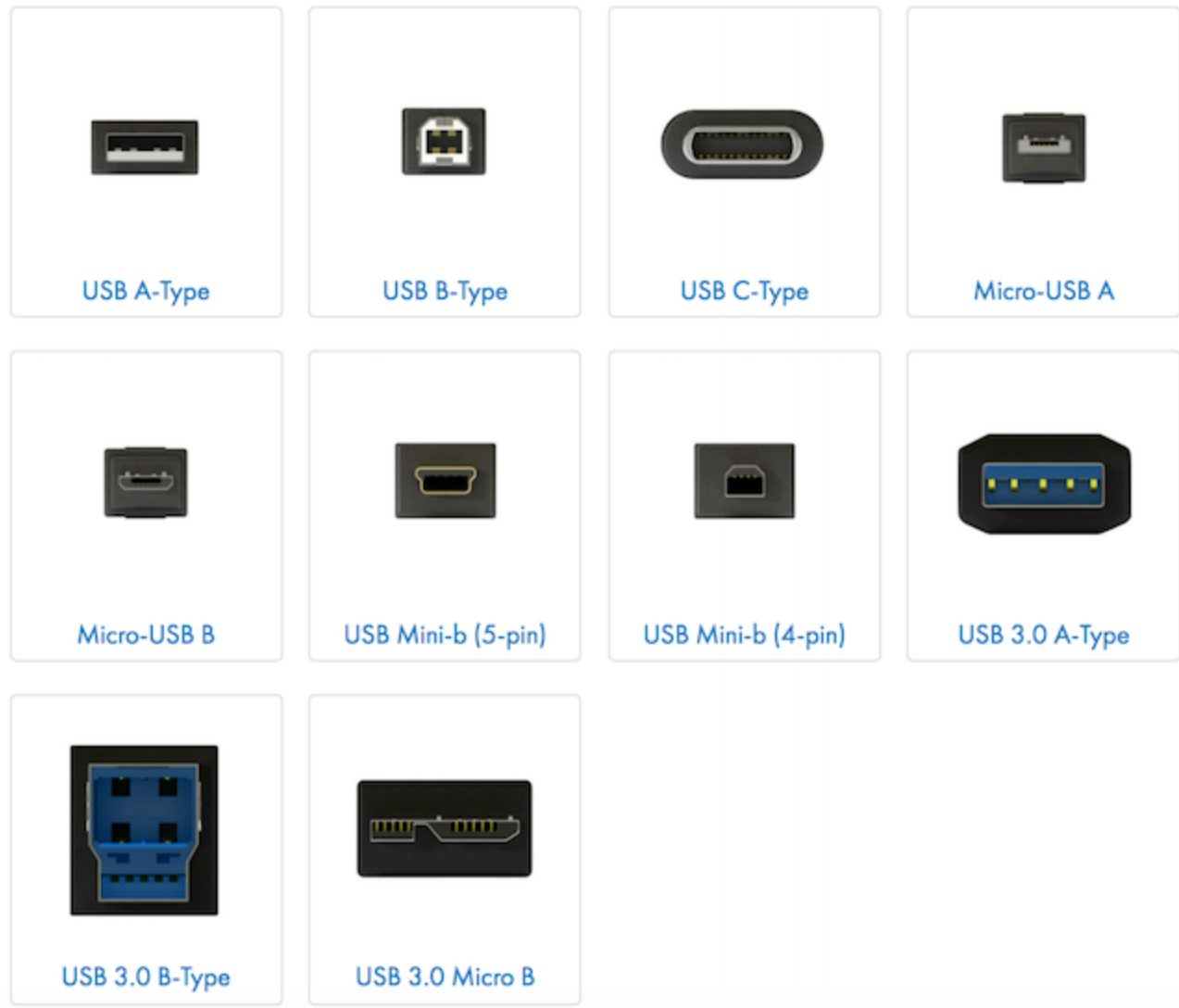
- Disk is important for the long-term storage
- RAM is important as it stores programs you use simultaneously
- As an analogy for memory, picture a candy store
 - A customer approaches the counter and requests candy
 - The shop owner then leaves the counter to grab the candy before returning moments later
 - Not super efficient to walk all the way to the store room to grab candy
 - Better to have a cache of memory
 - Instead, the shop owner leaves the counter to ready a cache of candy before the customers arrive
 - When a customer comes, the candy can be distributed quickly

Display Connectors



- These sockets all connect to monitors or displays
- Mini DisplayPort are used form monitors
- HDMI is not only on laptops and computers but also TVs
- VGA is older, but still commonly uses on projectors

USB (Universal Serial Bus)



- Can plug in a whole range of peripheral devices including printers, keyboards, mice, scanners, etc.
- USB-A most common
- USB-B is often used for printers and scanners
- USB-C is newer and can be plugged in coming from different directions
- Other variants often exist for phones
- Older USB connections are slower when transferring data
 - Hard drives can connect via USB
 - Even if a hard drive is fast, if the USB is slow, the transfer of data will be slow

Wireless

- Wifi is wireless internet
- Bluetooth allows devices such as wireless keyboards and headphones to connect to your

computer

- Limited range
 - This is ok as it is used for you to connect to your own device

Extra Resources

- [Slides \(https://docs.google.com/viewer?url=https://github.com/APCSP-SLCA/slides/raw/main/hardware/slides.pdf\)](https://docs.google.com/viewer?url=https://github.com/APCSP-SLCA/slides/raw/main/hardware/slides.pdf)