Week 2
Computer Hardware

Week2
Shih-Yi (James) Chien
Assistant Professor
Dept. of Management Information Systems
National Chengchi University, Taiwan
sychien@nccu.edu.tw

amazon

This item 2020 Newest ASUS VivoBook 15.6" FHD Thin Light Business Student Laptop, AMD Ryzen 5 3500U(Beat i7-7500U) 8GB RAM 128GB SSD+ 500GB HDD, Radeon Vega 8, Fingerprint, HDMI, USB-C, Win10, w/GM Accessories

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2020 Newest ASUS VivoBook 15.6" Full HD Laptop AMD Ryzen 7 3700U 12GB RAM 512GB SSD Radeon RX Vega HDMI WiFi Bluetooth 10 Windows 10 Home Silver

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2020 ASUS VivoBook 15 15.6 Inch FHD 1080P Laptop (AMD Ryzen 3 3200U up to 3.5GHz, 8GB DDR4 RAM, 256GB SSD, AMD Radeon Vega 3, Backlit Keyboard, FP Reader, WiFi, Bluetooth, HDMI, Windows 10) (Grey)

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2020 Newest Acer Aspire 5 Slim Laptop 15.6 FHD IPS Display, AMD Ryzen 3 3200u-Dual Core (up to 3.5GHz), Vega 3 Graphics, 8GB RAM, 128GB PCIe SSD + 500GB HDD, Windows 10 w/Ghost Manta Accessories

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Customer Rating	(32)	(55)	(111)	(122)
Price	$599.00	$729.00	$505.00	$539.00
Sold By	AMAZING WAREHOUSE DEAL(Record SN)	UltraGeek	Trusted eStore	AMAZING WAREHOUSE DEAL(Record SN)
Computer Memory Size	8 GB	12 GB	8 GB	8 GB
CPU Model Manufacturer	AMD	AMD	AMD	AMD
CPU Speed	2.10 GHz	2.3 GHz	2.6 GHz	2.60 GHz
Display Resolution Maximum	1920 x 1080 pixels	1920 x 1080 pixels	1920 x 1080	1920x1080 pixels
Screen Size	15.6 inches	15.6 inches	15.6 inches	15.6 inches
Display Technology	LED	LED	—	LED
Hard Disk Size	128 GB	512 GB	256 GB	128 GB
Item Dimensions	14.10 x 9.10 x 0.80 inches	14.10 x 9.10 x 0.80 inches	14.40 x 9.10 x 0.80 inches	14.31 x 9.74 x 0.71 inches
Item Weight	3.51 lbs	3.80 lbs	3.80 lbs	3.97 lbs
Operating System	Windows 10	Windows 10	Windows 10 Home	Windows 10
Processor Count	4	4	2	2
RAM Type	DDR4 SDRAM	DDR4 SDRAM	DDR4 SDRAM	DDR4 SDRAM
Wireless Communication Standard	Bluetooth	Bluetooth	802.11ac	802.11ac, Bluetooth

MacBook Air
From $999 or $83.25/mo. for 12 mo.**

- 13.3-inch Retina display[1]
- Up to 4-core Intel Core i7 processor
- Up to 16GB memory
- Up to 2TB storage[2]
- Up to 11 hours battery life[3]
- Touch ID
- Backlit Magic Keyboard

MacBook Pro 13″
From $1299 or $108.25/mo. for 12 mo.**

- 13.3-inch Retina display[1]
- Up to 4-core Intel Core i7 processor
- Up to 32GB memory
- Up to 4TB storage[2]
- Up to 10 hours battery life[3]
- Touch Bar and Touch ID
- Backlit Magic Keyboard

MacBook Pro 16″
From $2399 or $199.91/mo. for 12 mo.**

- 16-inch Retina display[1]
- Up to 8-core Intel Core i9 processor
- Up to 64GB memory
- Up to 8TB storage[2]
- Up to 11 hours battery life[3]
- Touch Bar and Touch ID
- Backlit Magic Keyboard

Factors to consider in buying a computer

1

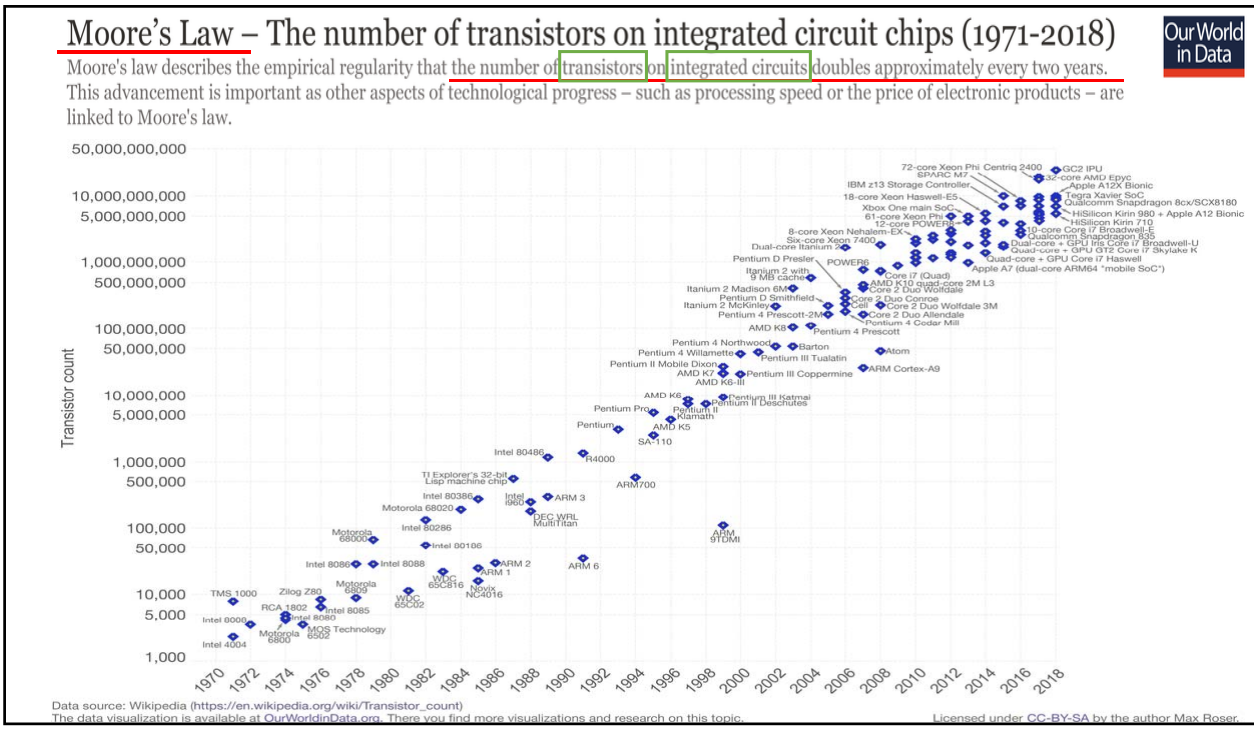
Computer component	Consideration
Platform	Does the software I need requires specific platform?
Hardware	Do I require specific hardware for my tasks? How much data di I plan to store?
Hardware specifications	Does the software I want to run require certain hardware specification?
Form factor	Where will I use the computer? Mobile or in one location?
Add-on devices	What additional devices will I need?

Storage Capacity

1

Capacity is the number of bytes that a storage medium can hold

Storage Term	Approximate Number of Bytes	Exact Number of Bytes
Kilobyte (KB)	1 thousand	2^{10} or 1,024
Megabyte (MB)	1 million	2^{20} or 1,048,576
Gigabyte (GB)	1 billion **1GB=1000MB**	2^{30} or 1,073,741,824
Terabyte (TB)	1 trillion **1TB=1000GB**	2^{40} or 1,099,511,627,776
Petabyte (PB)	1 quadrillion	2^{50} or 1,125,899,906,842,624
Exabyte (EB)	1 quintillion	2^{60} or 1,152,921,504,606,846,976
Zettabyte (ZB)	1 sextillion	2^{70} or 1,180,591,620,717,411,303,424
Yottabyte (YB)	1 septillion	2^{80} or 1,208,925,819,614,629,174,706,176



Transistor and Integrated Circuit

1

Transistor
A semiconductor device used to amplify or switch electronic signals and power

Image credit: https://en.wikipedia.org/wiki/Transistor

Integrated circuit (IC or chip)
A set of electronic circuits on one small flat piece (or chip) of semiconductor material

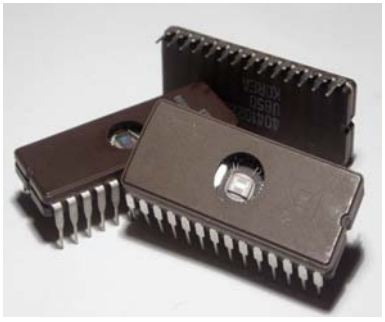


Image credit: https://en.wikipedia.org/wiki/Integrated_circuit

Transistor

Information is kept and manipulated in the binary formats (0 vs. 1)

- Transistor switches are used to manipulate binary numbers
  - Open transistor (i.e., there is no current) represents a **0**
  - Closed transistor (there is a current) represents a **1**
- Operations can be completed by connecting multiple transistors

Image credit: https://en.wikipedia.org/wiki/Transistor

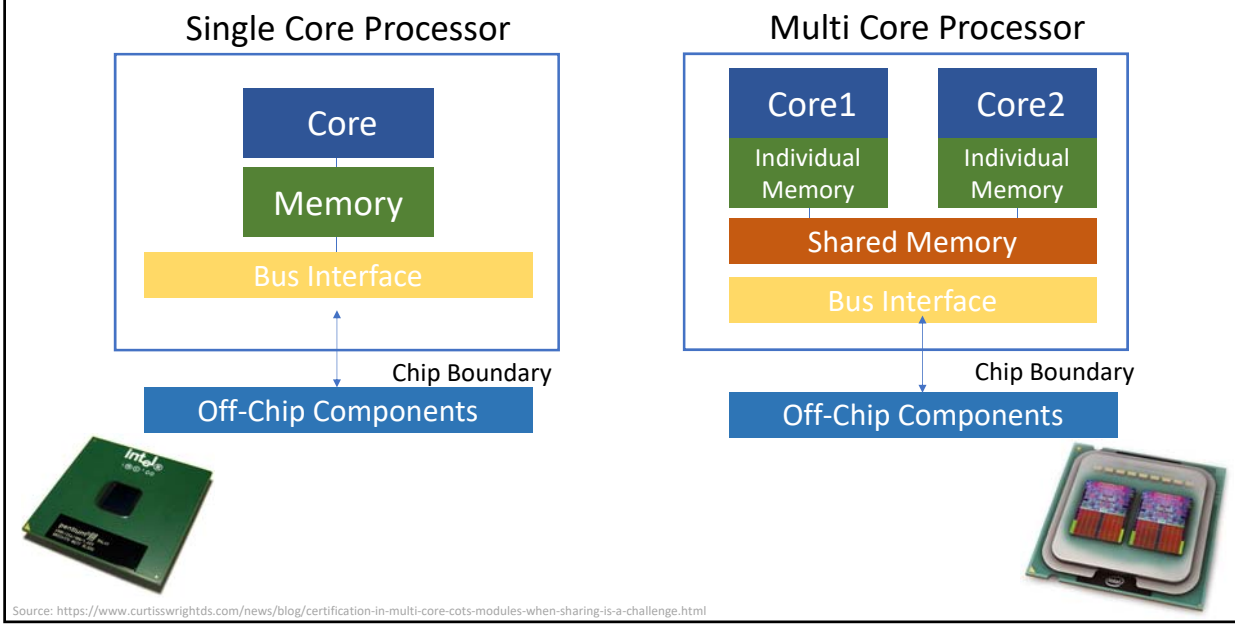
What is CPU

1

- **CPU**: central processing unit, also called central processor
  - Interpret and carry out the basic instructions
  - Converting input into meaningful output
- **Bus:** what data travels in and out of the CPU
- **Single vs. multi-core processors**
  - A multi-core processor is a single chip with two or more separate processor cores
  - Multi-core processor can do parallel computing
    - Single: 5x4x3x2 (one by one)
    - Multi: 5x4=20, 3x2=6, then 20x6=120

Multi-core processor

1



Source: https://www.curtisswrightds.com/news/blog/certification-in-multi-core-cots-modules-when-sharing-is-a-challenge.html

Control Unit and ALU

When running an application:
Instructions are transferred from storage device to memory

Control unit directs and coordinates the instruction flow in the computer

- Control unit interprets and executes the instructions in the memory

ALU performs arithmetic and comparison operations

- ALU performs calculations on data in memory

The results (info) are stored in memory

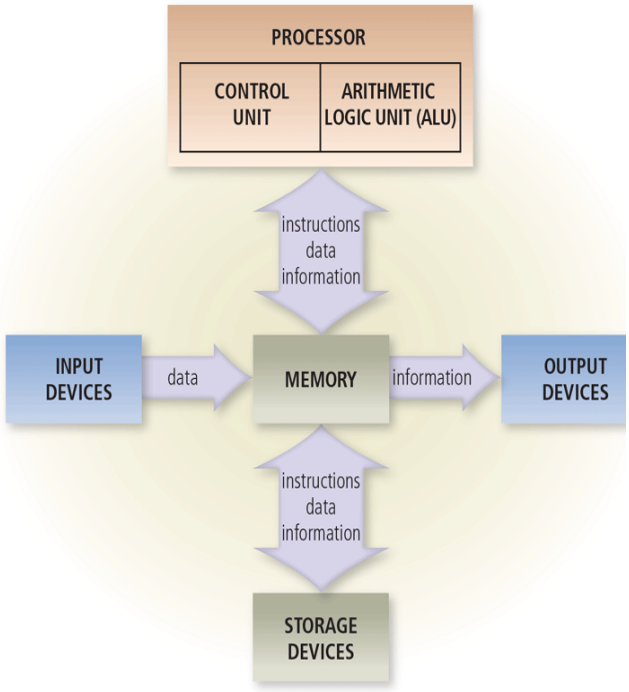


Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

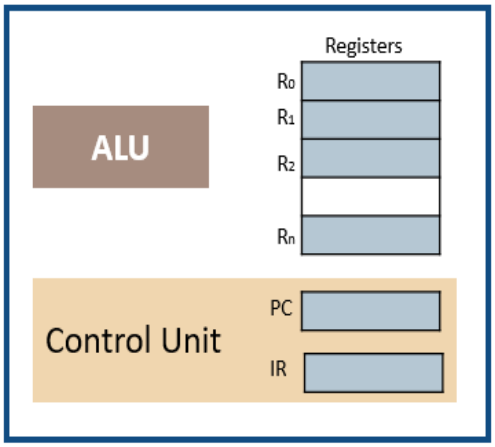
CPU Components- ALU & CU

ALU performs operations

- *Logic* operations
- *Shift* operations
- *Arithmetic* operations

Control Unit tells ALU what operation to perform on that data

- Moves the data between the registers, ALU, and memory
- Controlling is achieved through signals sent from CU to other subsystems



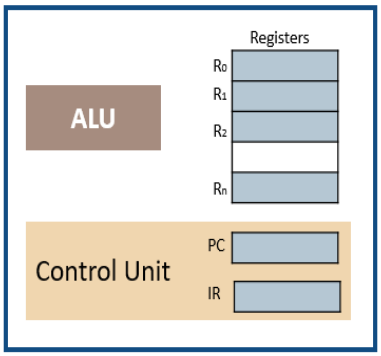
Central Processing Unit

CPU Components- Register

Register is a storage available as part of CPU, which can hold data temporarily

Multiple registers are needed to facilitate CPU operation

- *Data* register: keep the input data and the (intermediate) result of operations
  - Numerous registers may be used to speed up the operation
- *Instruction* register: keep the instructions (one by one from memory)
- Program counter: keep track of the instruction that is being executed
  - Fetch the instruction whose address is indicated by PC from the memory and load the data into instruction register



Central Processing Unit (CPU)

Machine Cycle

For each instruction, the processor repeats a set of four basic operations

- **Fetch**: Control unit fetches instructions or data from memory
- **Decoding**: Control unit decodes instructions and send data and instructions to ALU
- **Execute**: ALU executes command (perform calculation)
- **Storage**: The results are stored in memory

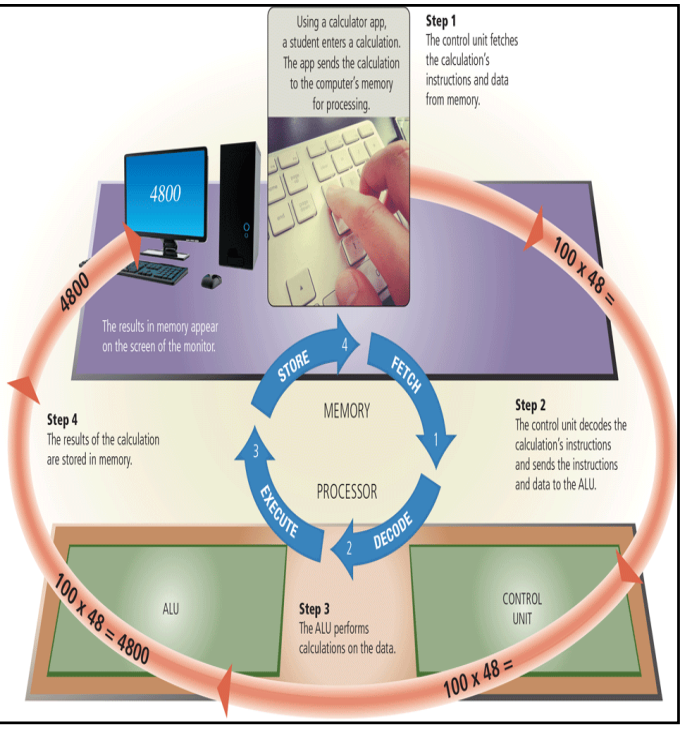
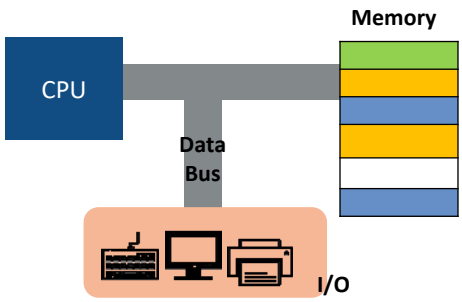


Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

How CPU Executes Instructions?

1. Input instructions (x= i*j and z= x*y)
2. Store the instructions in instruction register
3. CU fetches instructions from instruction register
4. Decode the instructions (machine language)
5. Check cache, ram, external memory
6. Once all the required data ready, send it to ALU
7. CU informs ALU about the required operations
8. Once finished, send the result to data register
   - Task: x= i*j and z= x*y
   1. Fetch i and j from memory and store the values in data register
   2. Compute (i*j) and store x in data register
   3. Fetch y from memory and store the value in data register
   4. Compute (x*y) and store z in data register or output the result



ALU- Logic Operations

ALU perform operations

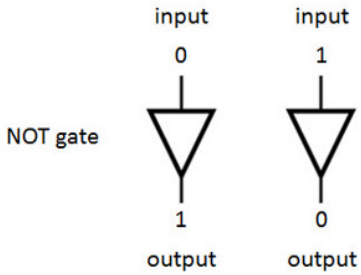
- *Logic* operations
- *Shift* operations
- *Arithmetic* operations

Bitwise logical operations

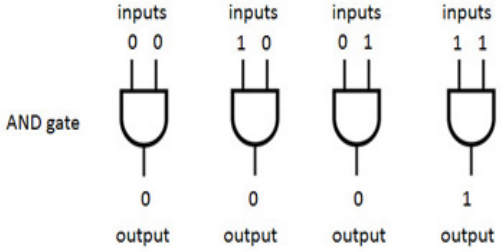
- Test if a logical expression is either true (1) of false (0)
- NOT, AND, OR, and XOR

Logic Operations at Bit Level- NOT & AND

NOT operator uses a single input and produces a single output The output bit is always the opposite of the input



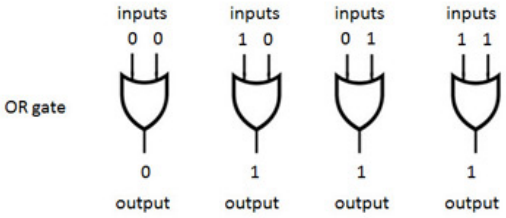
AND operator uses two inputs; the output bit is 1 if both the first and second input are 1s



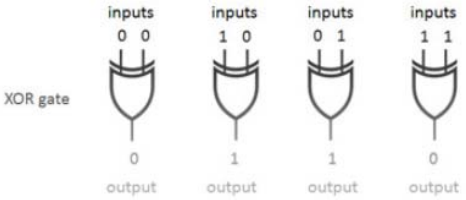
Source: https://study.com/academy/lesson/arithmetic-logic-unit-alu-definition-design-function.html#:~:text=An%20arithmetic%20logic%20unit%20(ALU)%20is%20a%20digital%20circuit%20used,(CPU)%20of%20a%20computer.&text=Most%20of%20the%20operations%20of,load%20data%20from%20input%20registers

Logic Operations at Bit Level- OR & XOR

OR operator uses two inputs; the output bit is 1 if either the first or the second input is a 1 (the output bit is 0 if both inputs are 0)

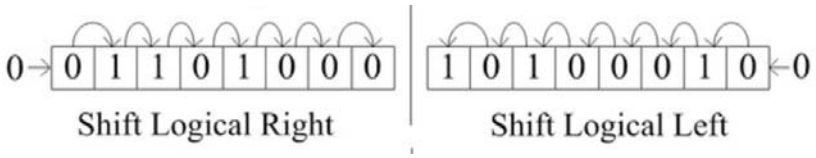


XOR operator uses two inputs; the output bit is 0 if both the inputs are 0 or if both are 1 (otherwise, the result is a 1)



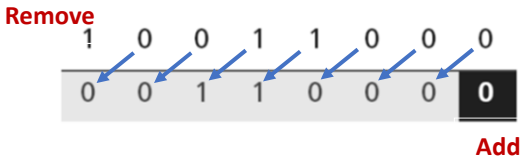
Source: https://study.com/academy/lesson/arithmetic-logic-unit-alu-definition-design-function.html#:~:text=An%20arithmetic%20logic%20unit%20(ALU)%20is%20a%20digital%20circuit%20used,(CPU)%20of%20a%20computer.&text=Most%20of%20the%20operations%20of,load%20data%20from%20input%20registers

Logical Shift Operations



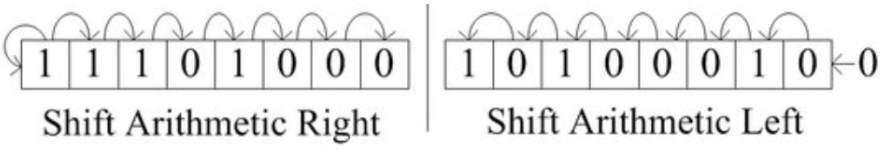
Use a logical left shift operation on the bit pattern 10011000

The leftmost bit is lost and a 0 is inserted as the rightmost bit



Source: Mitra and Chowdhury (2015). Optimized Logarithmic Barrel Shifter in Reversible Logic Synthesis.

Arithmetic shift operations



Arithmetic right shift is used to divide an integer by two

- Do **shift arithmetic right** to the binary number *01110101* (117 in decimal)
- The result is the binary number *00111010* (58 in decimal)
- We divided the original number by 2

Arithmetic left shift is used to multiply an integer by two

- Do **shift arithmetic left** to the decimal number 2 represented as 4 bit binary number *0010*
- By shifting to the left with one position, the result is *0100* (4 in decimal)

Arithmetic operations

All arithmetic operations such as addition, subtraction, multiplication, and division can be applied to integers

A + B

A − B → A + ($\overline{B}$ + 1)

5 – 3 → 5 + (-3)

(a) 3: 0011

(b) Transfer to two's complement: 1100 → 1101

(c) 5: 0101

-3: 1101

2: 0010

Example A+B

A=17, B=22; A+B= ?

A = $(00010001)_2$ **B = $(00010110)_2$**

	0	0	0	1	0	0	0	1	A
+	0	0	0	1	0	1	1	0	B
	0	0	1	0	0	1	1	1	

Example A+(-B)

A=24, B=-17; A+(-B)= ?

A = $(00011000)_2$ **B = $(11101111)_2$**

	0	0	0	1	1	0	0	0	A
+	1	1	1	0	1	1	1	1	B
	0	0	0	0	0	1	1	1	

Measure CPU Performance

1

[Clock speed](): measures the num of cycles your CPU can execute per second

- Higher clock speed → faster CPU
- Cycle: the smallest unit of time that a process can measure
  - Megahertz (MHz): millions of cycles per second
  - Gigahertz (GHz): billions of cycles per second

Bus: an electronic channel that allows the CPU and various devices to communicate with each other

- Bus *speed*: num of times a group of bits can be sent each second
- Bus *width* (word size): num of bits that can be sent to the CPU simultaneously
  - Wider bus → more data can be transferred
  - 32-bit vs. 64-bit system

[Benchmark test](): test run by a laboratory to determine processor speed

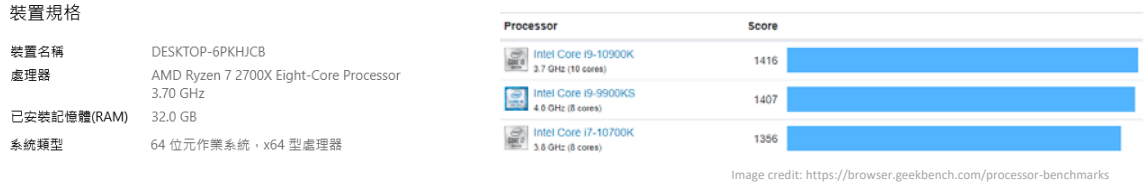


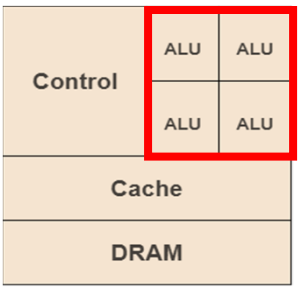
Image credit: https://browser.geekbench.com/processor-benchmarks

CPU vs. GPU (Graphics Processing Unit)

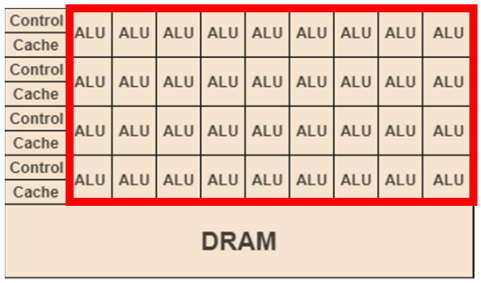
1

CPU can act alone to process complex logical operations and different data types
- Good at handling a wide-range of tasks quickly
- Limited in the concurrency of running tasks

GPU cannot work alone and must be called by the CPU to work
- Good at repetitive and highly-parallel computing tasks
- Parallel computing: deal with a large amount of data with similar processing type



CPU



GPU

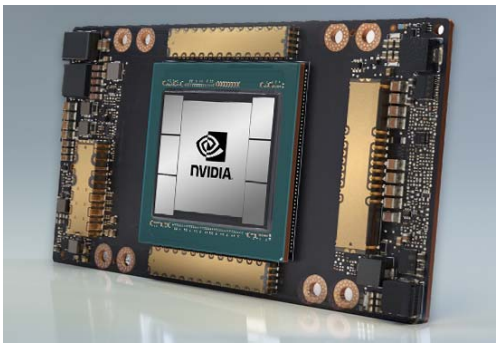
What is a CPU

- Constructed from millions of transistors, the CPU can have multiple processing cores
- It executes the commands and processes needed for your computer and operating system
- The CPU is also important in determining how fast programs can run, from surfing the web to building spreadsheets

Source: https://www.4gamers.com.tw/news/detail/38388/intel-readies-new-stepping-of-9th-gen-core-processors

What is a GPU

- The GPU is a processor that is made up of many smaller and more specialized cores
- By working together, the cores deliver massive performance when a processing task can be divided up and processed across many cores



Source: https://www.ithome.com.tw/review/137818

27

What Is the Difference Between a CPU and GPU?

- CPU can be seen as the taskmaster of the entire system, coordinating a wide range of general-purpose computing tasks, with the GPU performing a narrower range of more specialized tasks (usually mathematical)
- Both handle and compute data; different architectures for different purposes

CPU	GPU
• Can work alone without a GPU • Big portion of CU and storage units • Powerful in processing a wide-range of tasks • Large and broad instruction sets, managing every input and output of a computer • Individual CPU cores are faster and smarter than individual GPU cores • Complex logical tasks (serial process) • CPUs have large and broad instruction sets, managing every input and output of a computer, which a GPU cannot do	• Cannot work alone (must have a CPU) • Big portion of ALU units • Parallel operations on multiple sets of data, graphical tasks, machine learning and scientific computation • Repetitive and highly-parallel computing tasks • Designed with thousands of processor cores running simultaneously • Enable massive parallelism where each core is focused on making efficient calculations • GPUs can process data several orders of magnitude faster than a CPU due to massive parallelism, but GPUs are not as versatile as CPUs

28

Reading and Writing Processes

1

A **storage device** is the hardware that used to record and/or retrieve items to and from storage media

Reading is the process that transferring items from a storage medium into memory

Writing is the process of transferring items from memory to a storage medium

Storage

1

- A storage medium is the physical material on which a computer stores data, information, programs, and applications
- Cloud storage keeps information on servers on the Internet, and the actual media on which the files are kept are transparent to the user

Internal hard drive for a laptop

Photo by Vincent Botta on Unsplash

USB flash drive

Image by FlitsArt from Pixabay

Memory cards

Image by Photo Mix from Pixabay

External hard drive

Photo by : Jessica Lewis , from : Pexels

Access Time

Access time measures:

- The amount of time that a storage device takes to locate an item on a storage medium
- The time required to deliver an item from memory to the processor
- Memory is faster but more expensive
- Storage is cheaper but slower

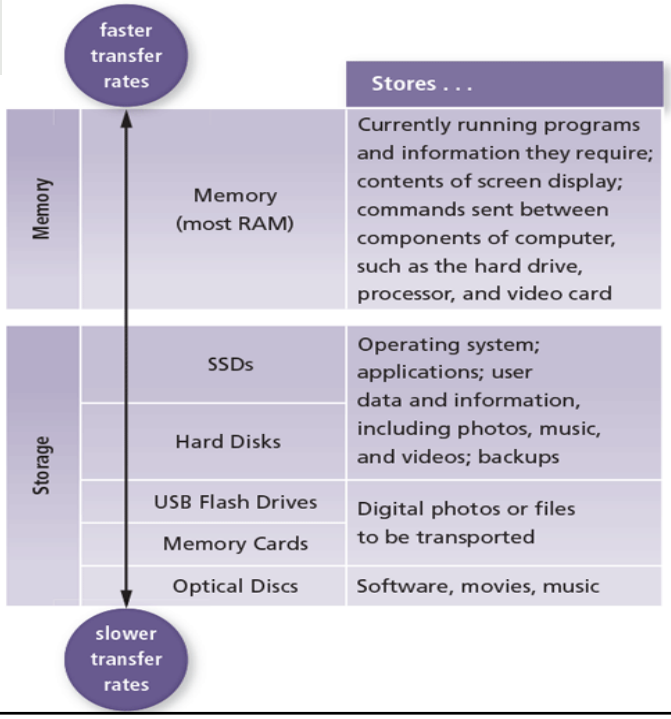


Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

Types of Memory

1

Memory consists of electronic components that store instructions waiting to be executed by the processor

- Volatile vs. nonvolatile memory

RAM (random access memory)

- Contents of RAM are lost when power is off (volatile)
- Temporarily store data required by the operating system and applications
- When the application is launched, the instructions of the application are transferred from the hard drive to the RAM

ROM (read-only memory)

- Contents of ROM are NOT lost when power is removed (nonvolatile)
- The ROM chip contains the BIOS (instructions to start a computer)
  - Power-on self test: Test whether all computer components are ready
- ROM provides means to communicate b/t operating system and hardware devices

Types of Memory

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- The ROM chip contains the BIOS (instructions to start a computer)
  - Power-on self test: Test whether all computer components are ready
- ROM provides means to communicate b/t operating system and hardware devices
  - Firmware: low-level control for a device's specific hardware
  - Updated firmware version allows you to fine-tune the communication with other devices
    - Programmable ROM is used in smartphones and other mobile devices

Common Types of RAM

1

Type of RAM	Description	Volatile or nonvolatile
Dynamic RAM (DRAM)	The memory needs to be constantly charged or the contents will be deleted	Volatile
Static RAM (SRAM)	The memory charge frequency may be less than DRAM, but can be more expensive than DRAM	Volatile
Magnetoresistive RAM (MRAM)	Memory uses magnetic charges to store contents, and can retain its content without power	Nonvolatile
Flash memory	The fast type of RAM is generally cheaper than some other types of RAM and can retain its contents without power	Nonvolatile

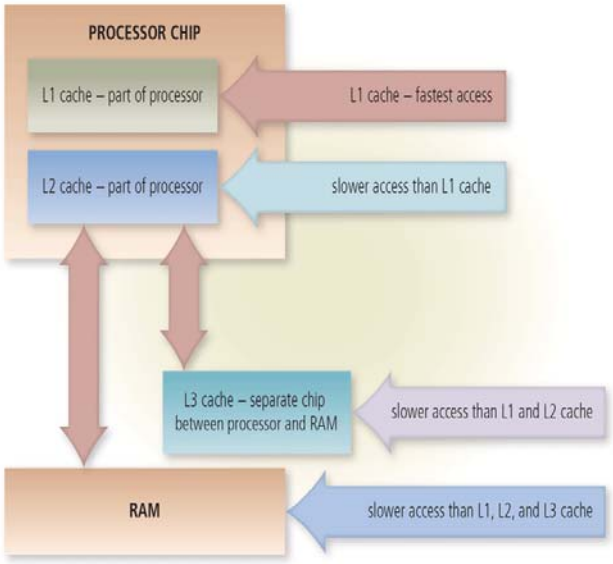
Memory Cache

1

Memory cache stores frequently used instructions and data

- Data might be needed again soon (to speed processing times)

- L1 and L2 cache built directly on the processor chip
- L3 cache is on the motherboard
  - L1: fastest but smallest; L3: largest but slowest



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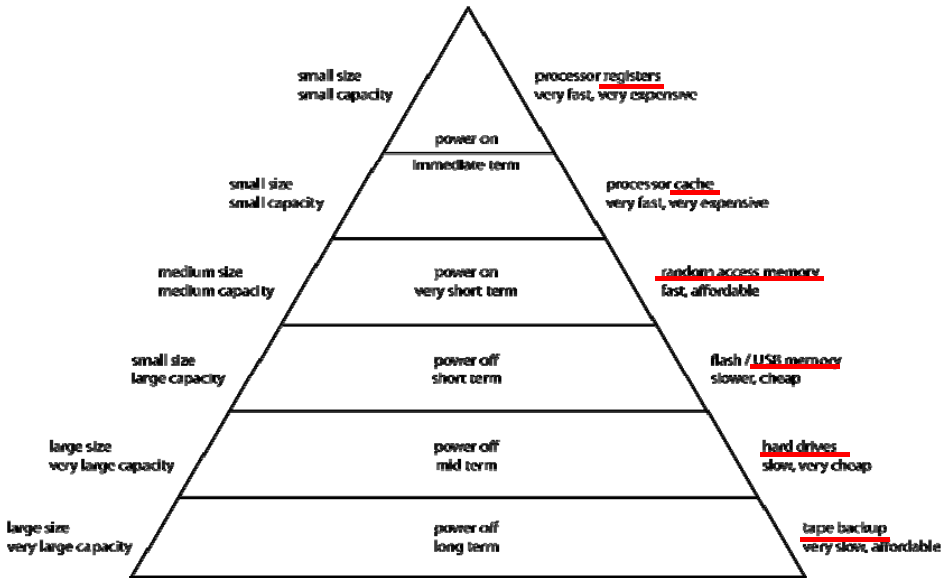
Computer Memory Hierarchy

1



Virtual Memory

1

Running more applications at the same time will require more RAM

- Exchange the content b/t RAM and hard drive
- **Virtual memory** is a *part of a storage medium that acts as additional RAM*
- The area of the hard drive used for virtual memory is called a swap file
  - **Swap** (exchange) data b/t memory and storage
- Page is the **amount of data** that can be exchanged at a given time
  - Swapping items b/t memory and storage is called paging
- Thrashing operating system spends lots of time paging instead of executing the application

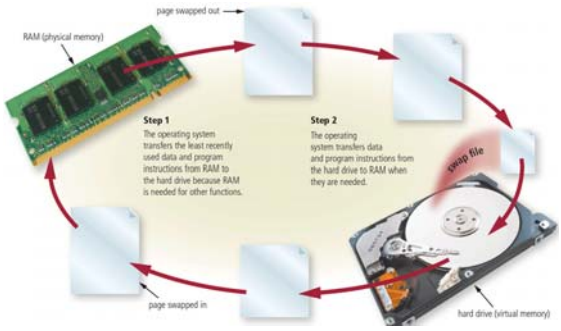
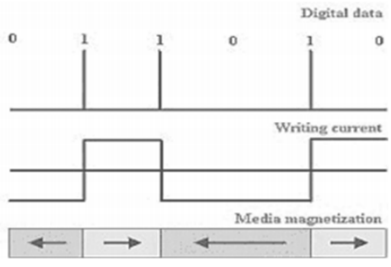


Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

Hard Drives

1

- **Hard disk** or hard disk drive (HDD) contains one or more non-fixed, circular platters which use magnetic particles to store data, instructions, and information



https://www.youtube.com/watch?v=wteUW2sL7bc

Step1. The circuit board controls the movement of the head actuator and a small motor

Step2. A small motor spins the platters while the computer is running

Step3. When software requests disk access, the read/write heads determine the current or new location of the data

Step4. The head actuator positions the read/write head arms over the correct location on the platters to read or write data

Photo by Frank R on Unsplash

Binary System- 0 & 1

1

How computers represent data

- 0 (false: absence) vs. 1 (true: presence)
  - Bit (binary digit): the smallest unit of data a computer can process
  - Byte: 8 bits form a byte, representing a single character in the computer
- Coding scheme: transfer a char into bits and bytes
  - ASCII: 8-bit coding scheme, 8 bits are used to represent letters, mathematical operators, etc.
  - Unicode: 16-bit coding scheme, extension of ASCII, support more than 65000 symbols and characters, including Chinese, Japanese, Arabic, etc.

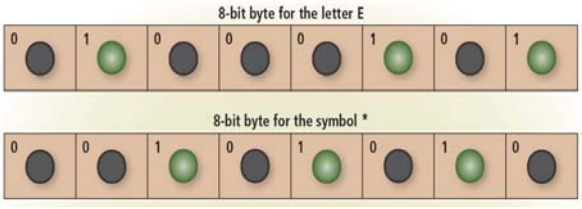
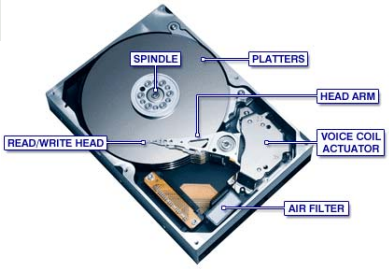


Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

Characteristics of Hard Disk

1

- Before reading from or writing on a hard disk, the disk must be formatted
  - Formatting: the process that dividing the disk into tracks and sectors
- **Track** is a narrow recording band that forms a full circle on the surface of a disk
  - **Cylinder**: tracks that line up on each platter from top to bottom and can be read at the same time
- Breaking the tracks into small arcs called sector
  - A sector stores up to 512 bytes of data
  - Several sectors (n>1) form a **cluster**
- When a computer is running, the platters in the HD rotate at high speed; this rotational speed is called **revolutions per minute** (RPM)
  - 5400 rpm to 15000 rpm



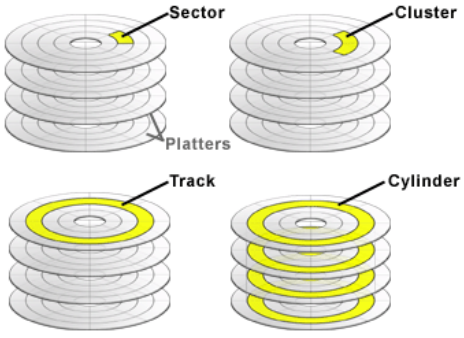


Photo credit: https://goo.gl/images/3vyj6n
Phot credit: https://goo.gl/images/hyM5A1

Solid State Drive (SSD)

1

SSD (**solid state drive**) is a flash memory storage device that contains its own processor to manage its storage

- An SSD has several advantages over traditional (magnetic) hard disks:
  - Faster access times
  - Faster transfer rates
  - Quieter operation
  - More durable
  - Lighter weight
  - Less power consumption
  - Less heat generation
  - Longer life
  - Defragmentation not required

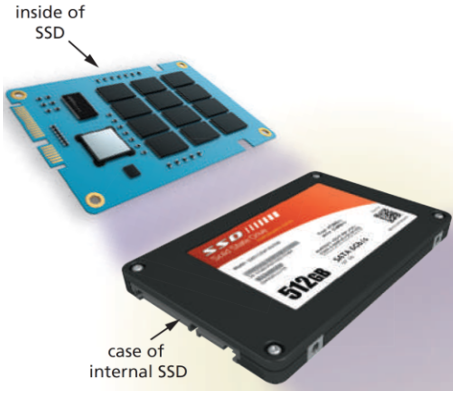


Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

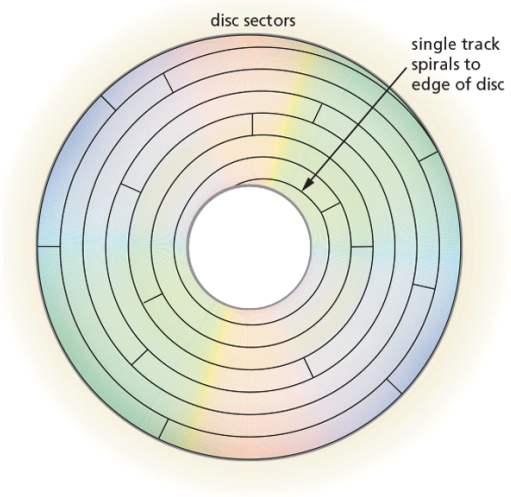
Cloud Storage

Cloud storage : An Internet service that provides storage to computer or mobile device users

iStockphoto.com / Aaltazar

Optical Discs – Track and Sector

- Optical discs commonly keep items in a single track that spirals from the center of the disc to the edge of the disc
- Track is divided into equaly sized sectors



Types of Optical Discs

CD-ROM: can be read from but not written to

- Single-session disc

A **DVD-ROM**: a high-capacity optical disc on which users can read but not write on or delete

CD-R : an optical disc that users can write once, but not erase

A **DVD-R** or **DVD+R**: competing DVD-recordable WORM (write once, read many) formats, on which users can write once but not erase

CD-RW: an erasable multisession disc

DVD-RW, DVD+RW, DVD+RAM: competing DVD-rewritable formats that users can write on multiple times

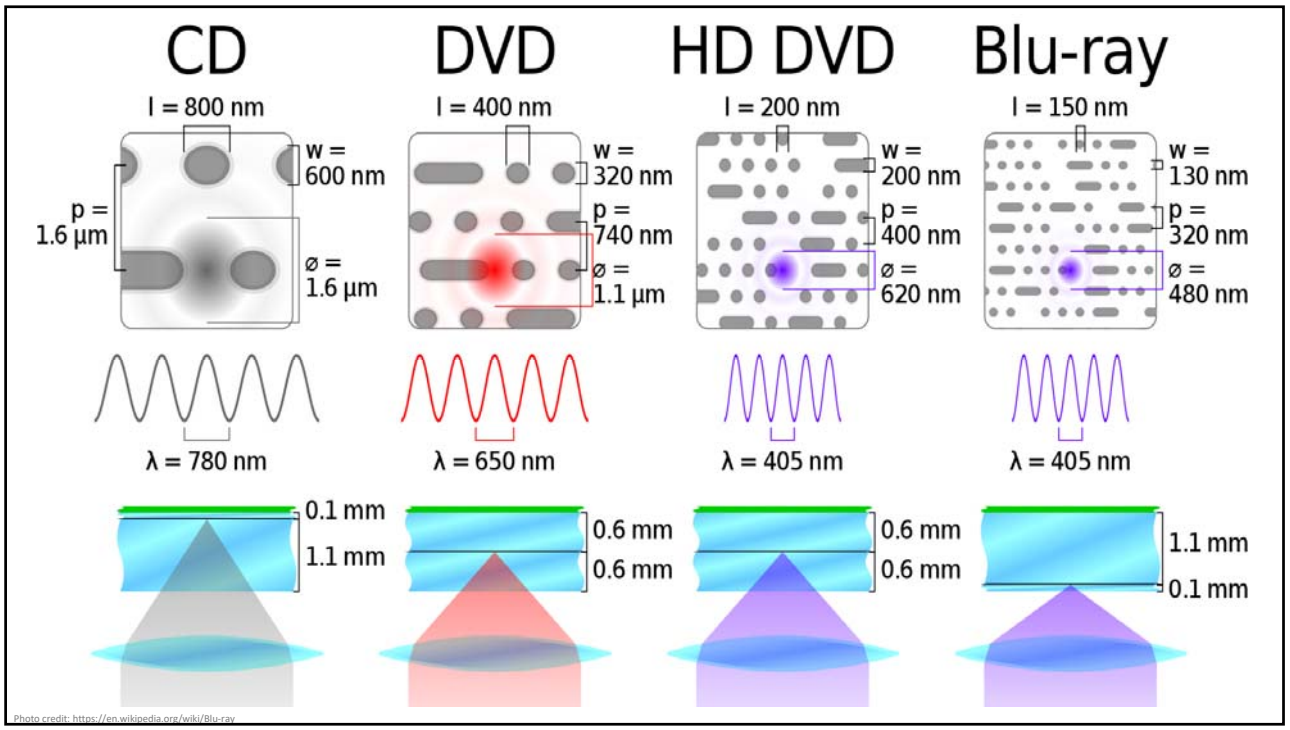


Photo credit: https://en.wikipedia.org/wiki/Blu-ray

Parameter	CD	DVD	BD
Disk diameter	120 mm	120 mm	120 mm
Disk thickness	1.2 mm	1.2 mm	1.2 mm
Laser wavelength	780 nm	650 nm	405 nm
Numerical aperture	0.45	0.60	0.85
Minimum pit length	0.83 um	0.4 um	0.138 um
Data rate	1.2 Mb/sec	11 Mb/sec	36 Mb/sec
Number of data layers	One	One or two	One or two
Data capacity	~680 MB	4.7 GB 8.5 GB	25-27 GB 50-54GB

Source: https://www.slideshare.net/apurvapatilpatil/blu-ray-disc-61719679

What Is Input?

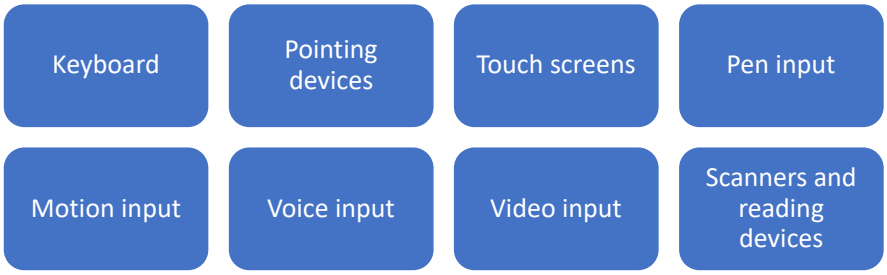
- **Input** : any data and instructions that entered into the memory of a computer
  - Keyboard
  - Pointing device
    - Mouse
    - Touchpad
    - Trackball
  - Touchscreen/multitouch screens
  - Pen Input
    - Digital pen
  - Microphone
  - Cameras/webcams
  - Scanner

Image by Free-Photos from Pixabay

Image by Karolina Grabowska from Pixabay

Input Devices

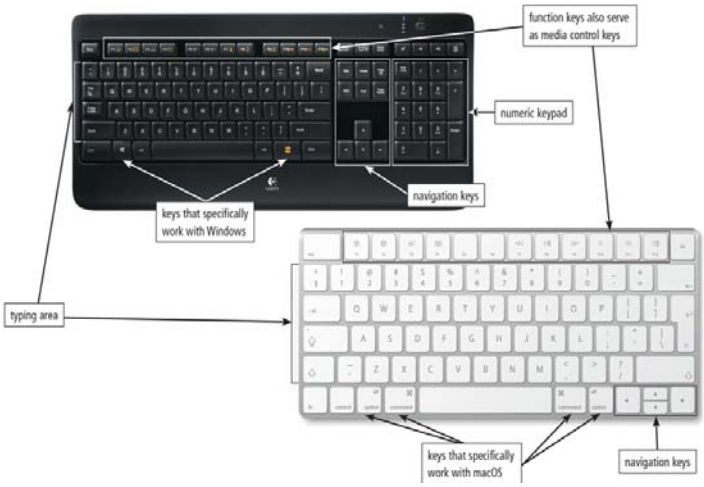
- Input methods that are commonly used :



Keyboards

Keyboard: an input device that contains keys which you can press to enter data and instructions into a computer or mobile device

- Toggle key: switch between two states (Caps Lock, Num Lock, etc.)



Pointing Devices I

- **Pointer**: a small symbol on the screen whose location and shape change while a user moving a pointing device
- **Mouse** : A pointing device which fits under the palm of your hand comfortably
  - Optical mouse, laser mouse, and touch mouse

Anton Derevschuk / Shutterstock.com; Courtesy of Apple, Inc.

Pointing Devices II

Touchpad: small, rectangular pointing device which is sensitive to pressure and motion

https://www.logitech.com/zh-tw/product/mx-ergo-wireless-trackball-mouse

Trackball: stationary pointing device with a ball on the top or side

Pen Input

- With **pen input**, you can use a **stylus** or **digital pen** on a flat surface to write, draw, or make selections

iStockphoto.com / pixelfit; iStockphoto.com / pictafolio; iStockphoto.com / tirc83

Graphics Tablet

- A **graphics tablet**, named a digitizer as well, is an electronic plastic board that detects and exchanges movements of a style or digital pen into signals that are sent to the computer

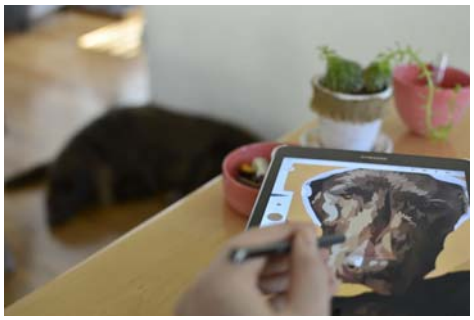


Photo by CHARLI on Unsplash

Motion Input

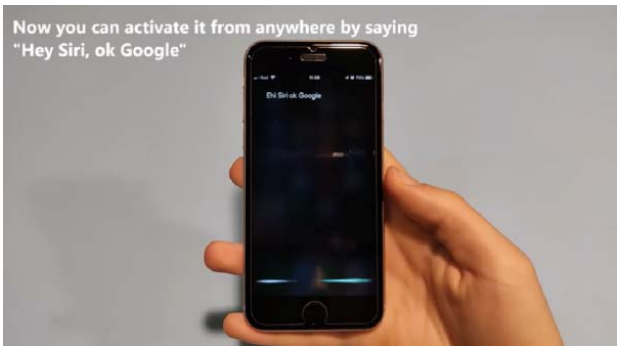
Motion input

- Gesture recognition
- Users can guide on-screen elements using air gestures

Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

Voice Input

- Voice input : the process of entering input by speaking into a microphone
- **Voice recognition** (speech recognition) : The computer or mobile device's capability of distinguishing spoken words



https://3edition.com/brands/apple/5901

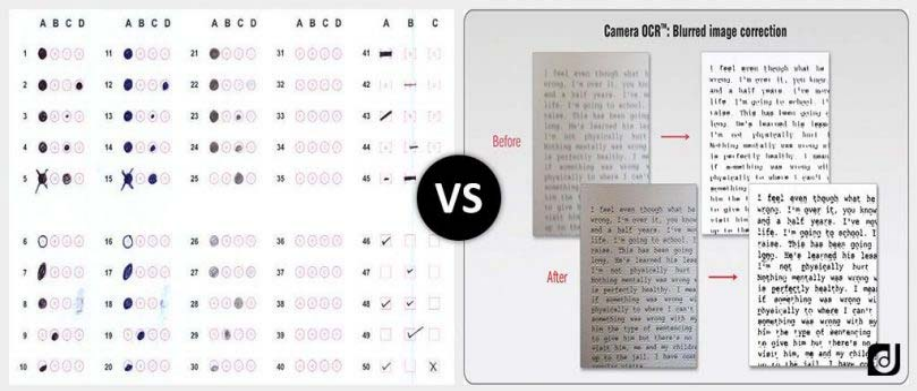
Scanners and Reading Devices

- A **scanner**: a **light-sensing** input device that converts printed text and graphics into a form the computer can process
  - The flatbed scanner works as a copy copier, except that it creates document files in memory instead of paper copies

Optical Readers

- An optical reader : a device that uses a light source to read characters, marks, and codes and then changes them into digital data that a computer can process

Optical mark recognition (OMR) Optical character recognition (OCR)

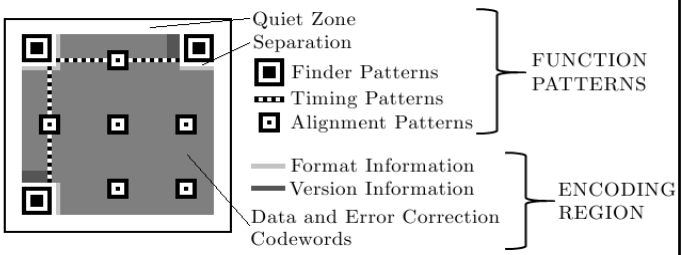


Bar Code Readers

- **Bar code reader(**bar code scanner) : uses laser beams to read **bar codes**
- **QR (quick response) code** : keeps information in <u>both a vertical and horizontal</u> direction
  - Error correction level
  - Recovery capacity (%)

recovery capacity 7%

recovery capacity 30%



Video: https://www.youtube.com/watch?v=L4YNWUJD8Do
Photo: https://www.researchgate.net/figure/QR-code-version-7-structure_fig1_304614728

QR code generator: http://qr.calm9.com/tw/

RFID

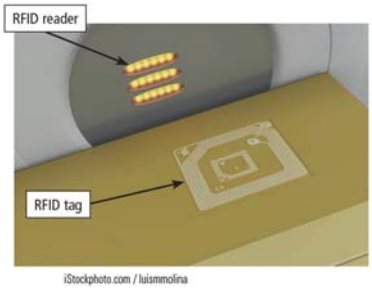
RFID (radio frequency identification) : uses radio signals to communicate with a tag placed in or attached to an object

RFID reader : reads information on the tag via radio waves

- Tracking times of runners in a marathon
- Tracking location of people and other items
- Checking lift tickets of skiers
- Gauging temperature and pressure of tires on a vehicle
- Checking out library books
- Managing purchases
- Tracking payment as vehicles pass through booths on tollway systems

RFID

- **RFID tag** : consists of an antenna and a memory chip that contains the information to be transmitted via radio waves
- RFID reader reads radio signals and transmits the information to a computer or computing device



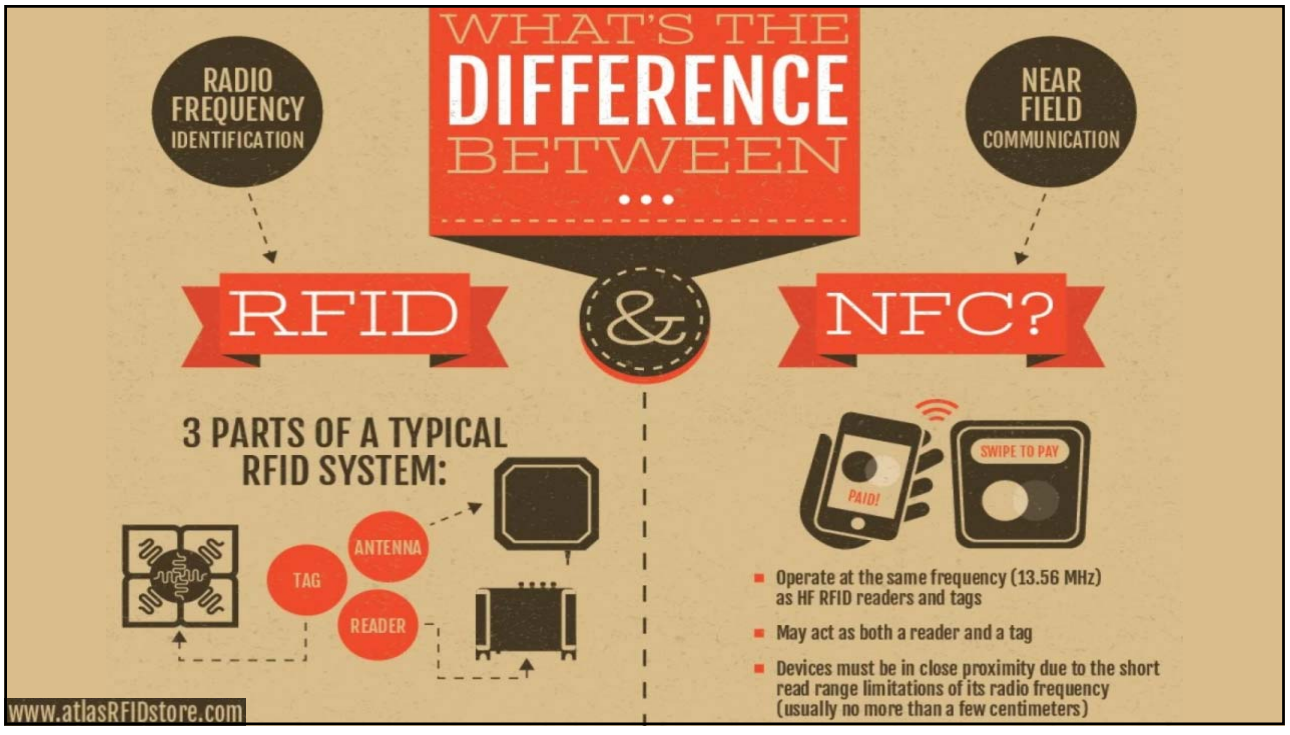
iStockphoto.com / luismmolina

NFC

An NFC-enabled device contains an NFC chip

- An NFC tag contains a chip and an antenna that contains information to be transmitted

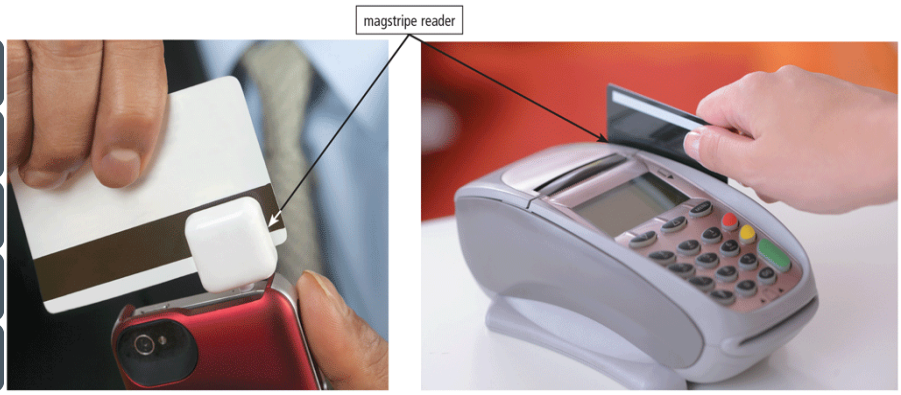
iStockphoto.com / scyther5



Magstripe Devices

Read the magnetic stripe on the back of cards such as:

- Credit cards
- Entertainment cards
- Bank cards
- Identification cards
- Other similar cards



EdBockStock / Shutterstock.com; iStockphoto.com / hocus-focus

Card

- A **magnetic stripe card** has a magnetic stripe that contains information
- A **smart card** keeps data on an integrated circuit embedded in the card

iStockphoto.com / rwarnick

iStockphoto.com / oytun karadayi; iStockphoto.com / audioundwerbung

What Is Output?

Data that processed into a useful form

- Speakers
- Headphones
  - Earbuds
  - Headsets
- Projectors
- Voice synthesizer
- Printers
  - Ink-jet
  - Laser
  - Multifunction device (MFD)
  - Mobile
  - Plotter
  - 3-D

Image by Michal Jarmoluk from Pixabay

Displays

- **Display**: visually conveys text, graphics, and video information
- **Monitor**: a display that is packaged as a separate peripheral device
  - **LCD** monitor

laptop display

Photo by Kari Shea on Unsplash

Digital camera display

Photo by ShareGrid on Unsplash

Digital camera display

Photo by Oskar Kadaksoo on Unsplash

handheld game device display

Photo by Ben on Unsplash

Smartphone display

Photo by Jonathan Kemper on Unsplash

Monitor display

Photo by Kitai Jogia on Unsplash

Display Ports

- The monitors today use a digital signal to produce a picture
- The monitor should plug in display ports to display the highest quality images:
  - VGA port
  - DVI port
  - HDMI port
  - DisplayPort

More details: https://www.youtube.com/watch?v=3LoGJZmyfpA

http://www.brucebnews.com/2014/08/the-confusing-world-of-videovga-dvi-hdmi-displayport/

Digital Television

- Home users sometimes use a digital television (DTV) as a display
- **HDTV** (High-definition TV) is the most advanced form of digital television
  - Provide higher resolution images
- Smart TV is a high-definition TV that supports the Internet

Photo by Glenn Carstens-Peters on Unsplash

Quality of Displays

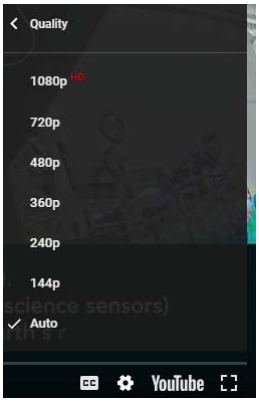
- The quality of a display depends primarily on its:
  - **Resolution**: number of horizontal and vertical pixels in a display
  - **Response time**: the time required to turn the pixel on or off (in milliseconds)
  - **Brightness**: measured in nits (nits: a unit of visible light intensity, equal to one candle per square meter)
  - **Dot pitch**: also called pixel pitch, the distance between pixels on the display, in millimeters
  - **Contrast ratio**: difference in light intensity between the brightest white and the darkest black that can be produced on the display
  - **Frame rate**: Frames per second (fps), expressed in Hertz, the frequency at which successive images called frames appear on the display
    - The human visual system can process 10 to 12 images per second and perceive them separately, while higher rates are considered motion

How Computers Represent Images

Pixel: the smallest picture elements

- Each color is assigned to a binary number: white: 11, black: 00

- The resolution of the video file is width x height; the higher the resolution, the clearer the video
  - Standard definition (SD): 640 x 320 and 720 x 480
  - High definition (HD): 1280 x 720 (720p) and 1920 x 1080 (1080p or Full HD)
  - 4K: 3840 x 2160 (2160p)
  - 8K: 7840 x 4320 (4320p)
  - Not all devices can play 4k/8k files. Play 4k video on 720p display, your computer will convert 4k video to 720p, because this is the best video the screen can provide



Common graphics file formats

Graphic file format	File extension	Best use / Notes
Bitmap graphics		
GIF	.gif (Graphics Interchange Format)	Simple web graphics and short web animations Format is limited to 256 colors; supports transparency; small file size makes it good for websites
JPEG	.jpeg or .jpg (Joint Photographic Experts Group)	Photos on the web Images have rich colors, but discard some data to reduce file size, which can affect quality
PNG	.png (Portable Network Graphics)	Logos, icons, and illustrations Images have good quality even when highly compressed; supports 16 million colors; better quality and smaller file size than GIF
TIF	.tif or .tiff (Tagged Image File Format)	High-quality photos and printed graphics Large file size is better suited for print than web use
Vector graphics		
EPS	.eps (Encapsulated PostScript)	Logos and other illustrations that are frequently resized A standard format for exporting vector graphics without data loss
SVG	.svg (Scalable Vector Graphics)	Illustrations on the web Developed by the World Wide Web Consortium (W3C); allows interactivity and animation

Printers

- A printer is an output device that generates text and graphics on physical media
- Before buying a printer, ask yourself a series of questions

攝影師：cottonbro，連結：Pexels

Printers

Nonimpact printer: forms characters and graphics on a piece of paper without actually contacting the paper

Type of printer	Description
Ink-jet printer	Prints by spraying small dots of colored ink onto paper
Laser printer	Uses a laser beam and toner to print on paper
Multifunction device (MFD)	Also called an all-in-one printer; can serve as an input device by copying and scanning, as well as an output device by faxing and printing
Mobile printer	Small, lightweight printer that is built into or attached to a mobile device for mobile printing
Plotter	Large-format printer that uses charged wires to produce high-quality drawings for professional applications such as architectural blueprints; plotters draw continuous lines on large rolls of paper
3-D printer	Creates objects based on computer models using special plastics and other materials

Ink-jet Printer

- An **ink-jet printer** forms characters and graphics by ejecting tiny liquid ink drops onto a sheet of paper
  - Color or black-and-white
  - Speed is measured by the number of pages per minute (ppm) it can print

攝影師：cottonbro，連結：Pexels

Laser Printer

Laser printer
- High speed
- Black-and-white/color
- High quality

Courtesy of Xerox Corporation

All-in-one Printers

- An **all-in-one printer** ：a single device which can *print, scan, copy*, fax(multifunction printer)

Mobile Printer

- The **mobile printer :**

a small, lightweight, battery-powered printer that allows mobile users to print from mobile devices

Courtesy of Brother International Corporation

Thermal Printer

- **thermal printers** : generates images by pushing electrically heated pins against the heat-sensitive paper
  - Dye-sublimation printer

Plotter

- **Plotters** : produce high-quality drawings
- **Large-format printers** :
  create photo-realistic quality color prints

3-D Printer

- **3-D printer :** use a process called additive manufacturing to create objects by adding materials to a three-dimensional object, one horizontal layer at a time

Photo by Tom Claes on Unsplash

Projector

- A **data projector** is a device that projects text and images displayed on a computer or mobile device screen onto a larger screen so that the audience can see the image clearly

Image by Michal Jarmoluk from Pixabay

Interactive Whiteboard

- An **interactive whiteboard** is a touch-sensitive device similar to a dry-erase board that can display images on a connected computer screen

QOMO 107" 16:9 IR Interactive Whiteboard

Assistive Technology Input and Output

Figure 7-44 A camera/receiver mounted on the monitor tracks the position of the head-mounted pointer, which is the reflective material on the brim of the hat. As the user moves her head, the pointer on the screen also moves.
Courtesy of NaturalPoint, Inc.

Figure 7-45 A Braille printer.
Courtesy of Enabling Technologies; Don Farrall / Getty Images

Image credit: Discovering Computers 2018: Digital Technology, Data, and Devices

Tentative Syllabus

Week	Topic	Lab	Assignment
1 (9/18)	Impact of digital technology	Brief Intro	
2 (9/25)	Computer Hardware and Digital Media		
3 (10/2)	**Holiday**		
4 (10/9)	**Holiday**		
5 (10/16)	Operating Systems and Internet *Online Session: Intro to Social Technology by Prof. Hsiao	MS Excel Advanced Functions	
6 (10/23)	Software Development *Online Session: Fake News in Social Media by Prof. Su	MS Word Advanced	
7 (10/30)	Networking Standard *Online Session: Data Visualization by Prof. Hsiao		
8 (11/6)	Digital Security and Privacy *Online Session: Introduction to AI by Prof. Ku		
9 (11/13)	AI and Big Data *Online Session: Algorithmic Governance by Prof. Chen	Personal Website II	HW-1.2 (5%) Personal Website
10 (11/20)	**Midterm (30%)**		Final Project Topic & Team Members

1. learn history, conceptual structure and computer organizations
2. study the state-of-the-art information technology

1. understand the innovative features of intelligent systems and computer applications
2. study the principles and learn from practical cases

Topic: Data Viz by Prof. Hsiao @ ASU
Link: https://ppt.cc/f4bZOx
Passcode: **n4#O1=q+**

85

科目代號(Course #)：306005011
科目名稱：計算機概論
Course Name：Introduction to Computer Science
授課教師：簡士鎰
Instructor：CHIEN SHIH-YI
系所：資管一甲、資管一乙
上課時間 (Session)：五D5 (fri13-15)