Computer Fundamentals

CLARUSWAY©
WAY TO REINVENT YOURSELF

Agenda

- Introduction
- What is Computer
- How computers work
- Operating Systems

Introduction

1

Were you able to finish pre-class material?

Students choose an option

Pear Deck Interactive Slide
Do not remove this bar

Introduction

How long did it take to finish it?

Students choose an option

Pear Deck Interactive Slide
Do not remove this bar

What is Computer

Press Any Key
To Start.
WHERE IS THE
"ANY" KEY?!

What is Computer

Start
Wikipedia
De vrije encyclopedie
essential
internet
DELL
inspiron

What is Computer

Question:

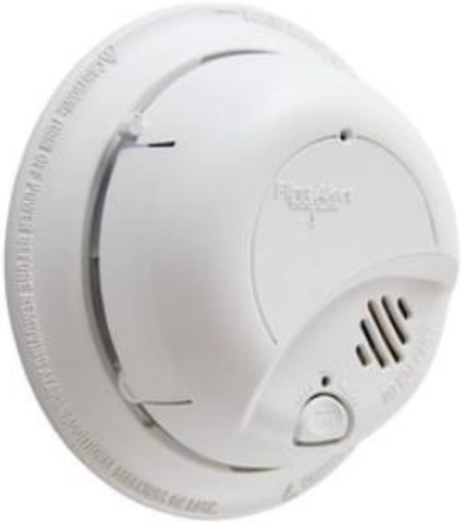
Think outside of the box and tell me a computer not in traditional sense.

Students, write your response!

Pear Deck Interactive Slide
Do not remove this bar

What is Computer

What is Computer



Students choose an option

What is Computer

- A computer is…

  a device that accepts data or **input** and **store** it to somewhere. Then **processes** this data in someway to automatically produce a **result or output**.

What is Computer

Galaxy Z Fold3
Samsung
Hey there!

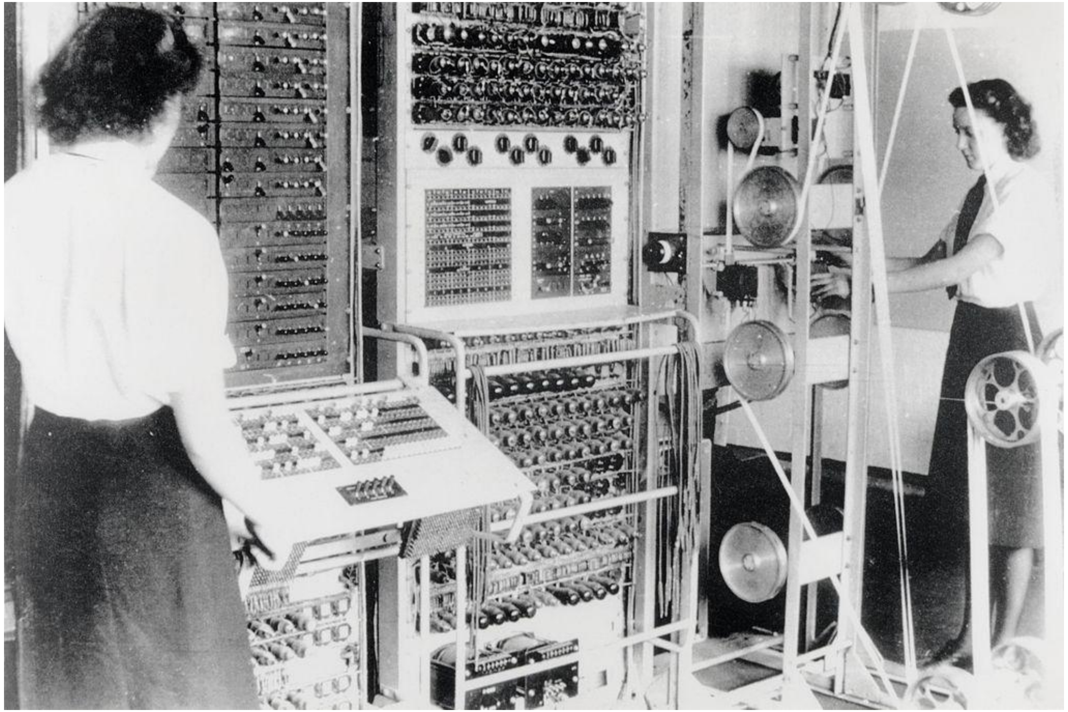
What is Computer

9:41
Tuesday, September 15

What is Computer

STÄUBLI
TX200
STÄUBLI

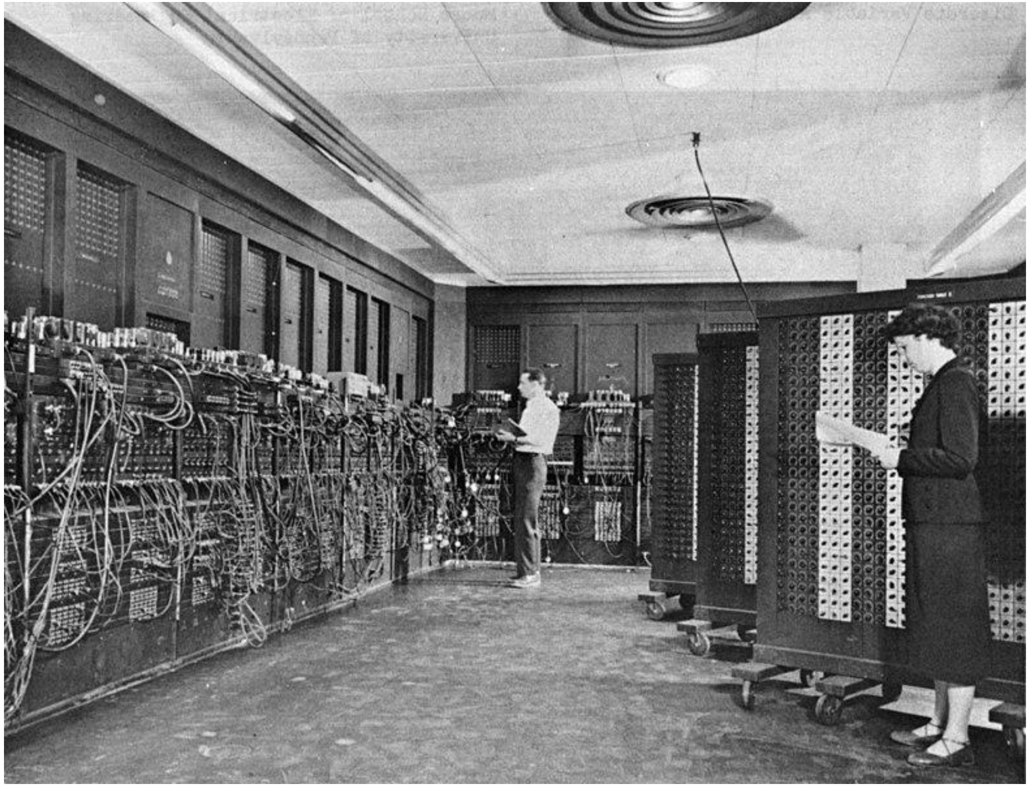
What is Computer



Colossus computer

1943 - 1945

What is Computer



ENIAC (Electronic Numerical Integrator And Computer)

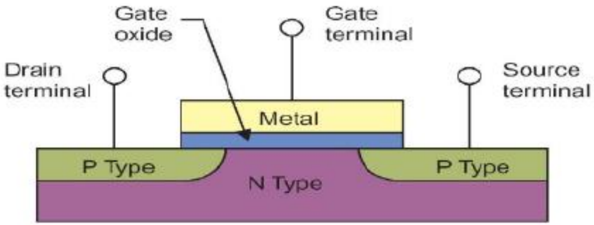
1955

2

How Computers Work

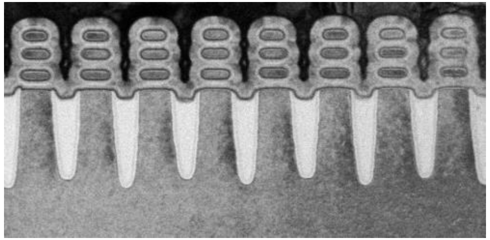
How Computers Work

- **TRANSISTORS**


Gate
oxide
Gate
terminal
Drain
terminal
Source
terminal
Metal
P Type
N Type
P Type

1956 Nobel Prize in Physics

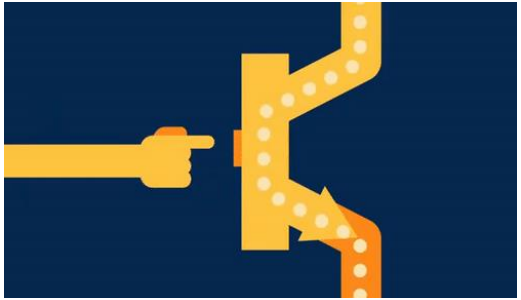
- Semi-conductor
- Cheap
- Small
- Very low energy consumption

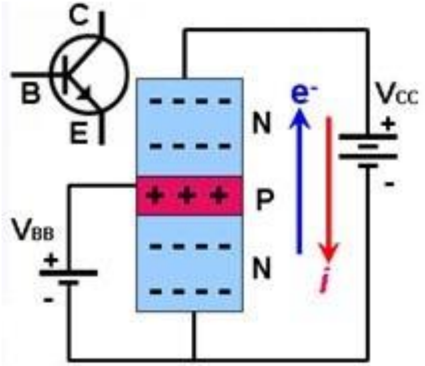


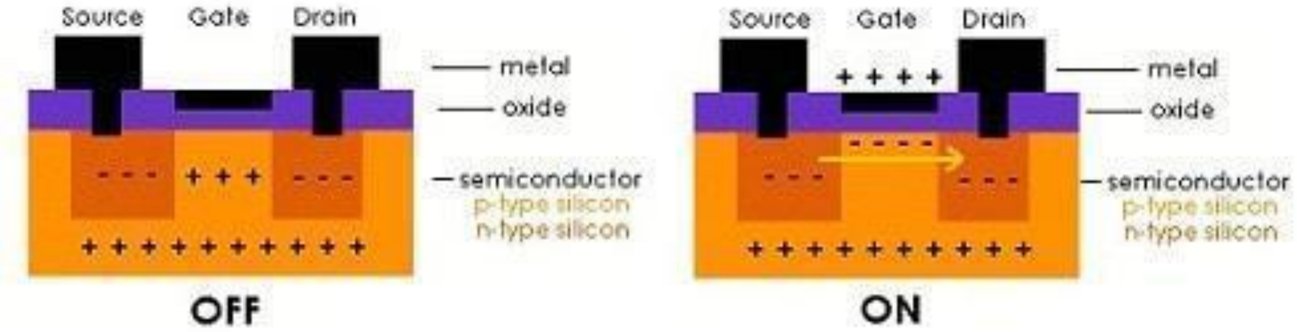
IBM’s 5nm transistors

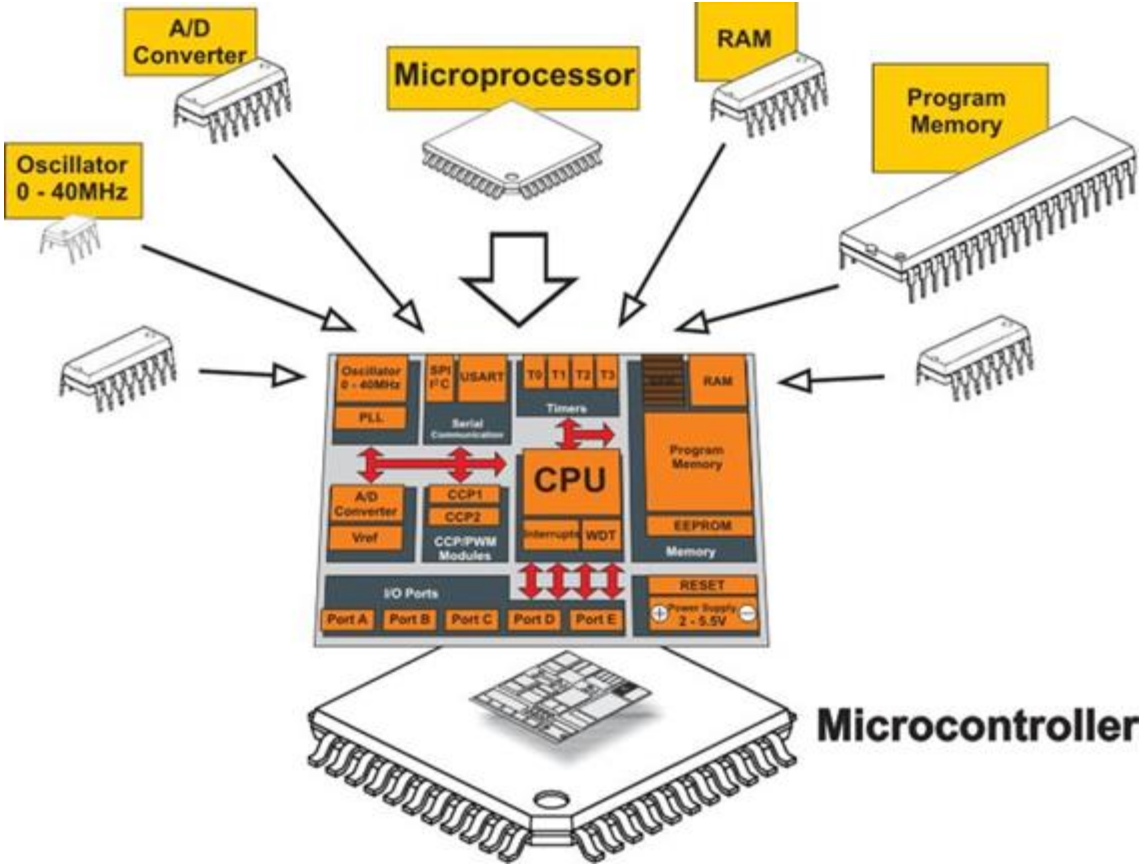
How Computers Work

- **TRANSISTORS**




C
B
E
N
P
N
e-
i
Vcc
VBB
+
-


Source
Gate
Drain
metal
oxide
semiconductor
p-type silicon
n-type silicon
OFF
ON

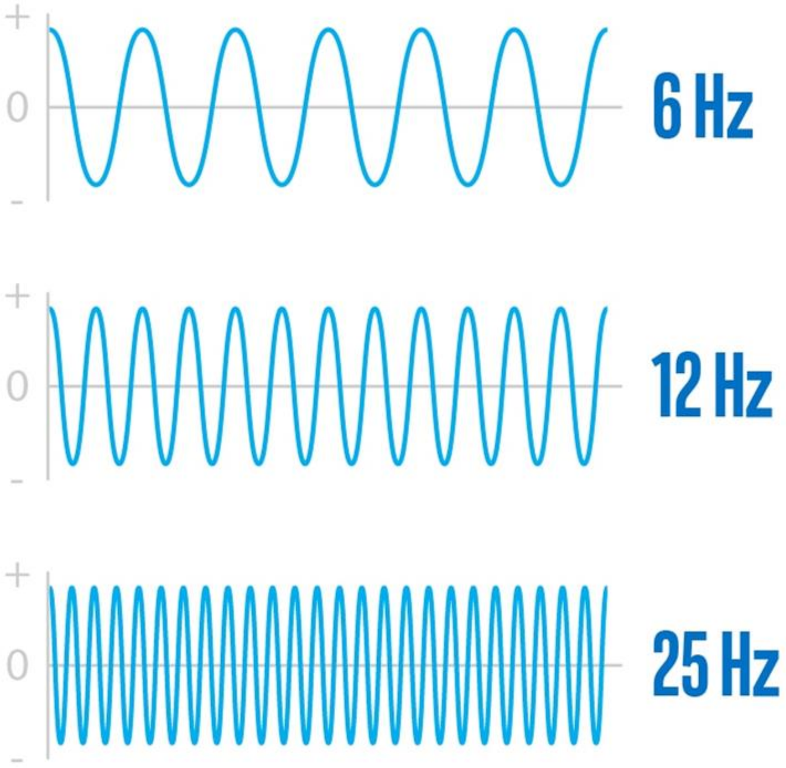

A/D Converter
Microprocessor
RAM
Program Memory
Oscillator 0 - 40MHz
Oscillator 0 - 40MHz
PLL
SPI
I²C
USART
Serial Communication
T0
T1
T2
T3
Timers
RAM
Program Memory
CPU
A/D Converter
Vref
CCP1
CCP2
CCP/PWM Modules
Interrupts
WDT
EEPROM
Memory
I/O Ports
Port A
Port B
Port C
Port D
Port E
RESET
Power Supply 2 - 5.5V
Microcontroller

How Computers Work

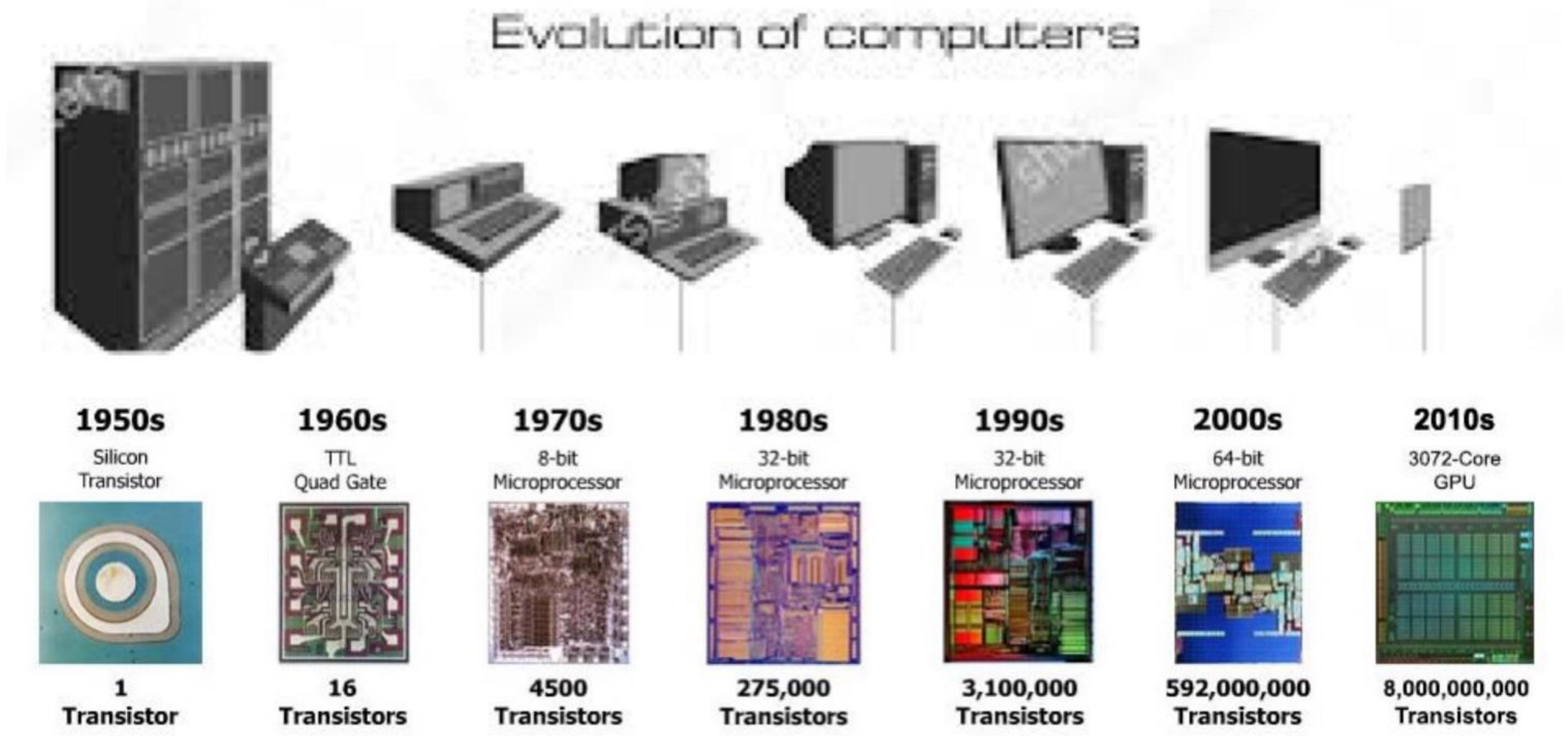
Central Processing Unit (Brain of the Computer)

4.6 GHz = 4.6 Billion cycles per second

How Computers Work



What is Computer

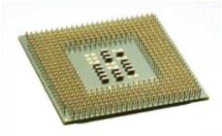

Evolution of computers
1950s
Silicon Transistor
1 Transistor
1960s
TTL Quad Gate
16 Transistors
1970s
8-bit Microprocessor
4500 Transistors
1980s
32-bit Microprocessor
275,000 Transistors
1990s
32-bit Microprocessor
3,100,000 Transistors
2000s
64-bit Microprocessor
592,000,000 Transistors
2010s
3072-Core GPU
8,000,000,000 Transistors

How Computers Work

DATE	CPU	# of transistors
1972	Intel 8008	3,500
1982	Intel 80286	134,000
1993	Pentium	3,100,000
2000	Pentium 4	42,000,000
2012	Quad-Core + GPU Core i7	1,400,000,000
2020	Apple M1 Chip	16,000,000,000
2022	Apple M2 Chip	20,000,000,000
2022	Apple M1 Ultra	114,000,000,000

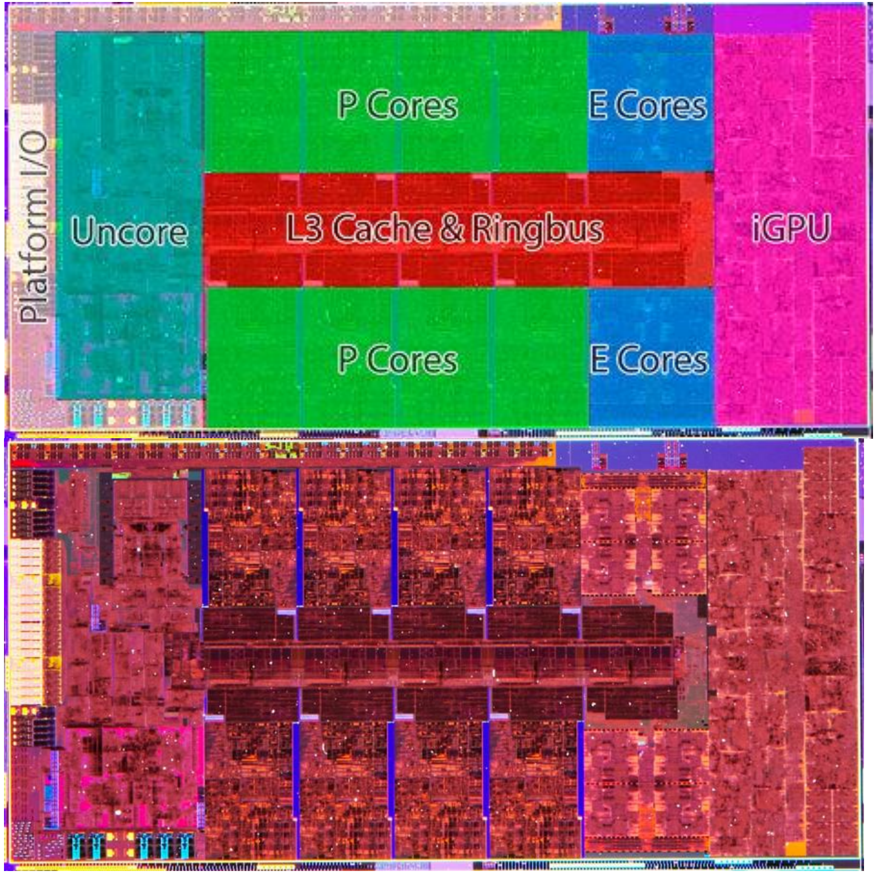
INTEL® CORE™ i9
i9-10900K
SRH91 3.70GHZ
V008D787
LGA12XX
DDR4

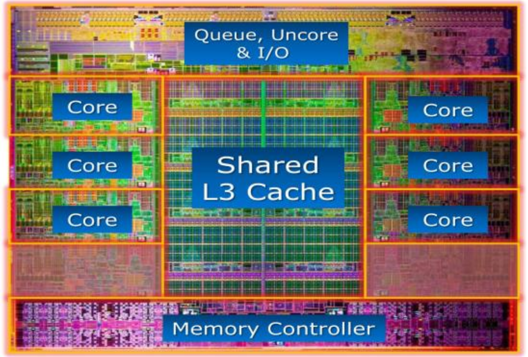
How Computers Work



Intel i9-12900K CPU die photo

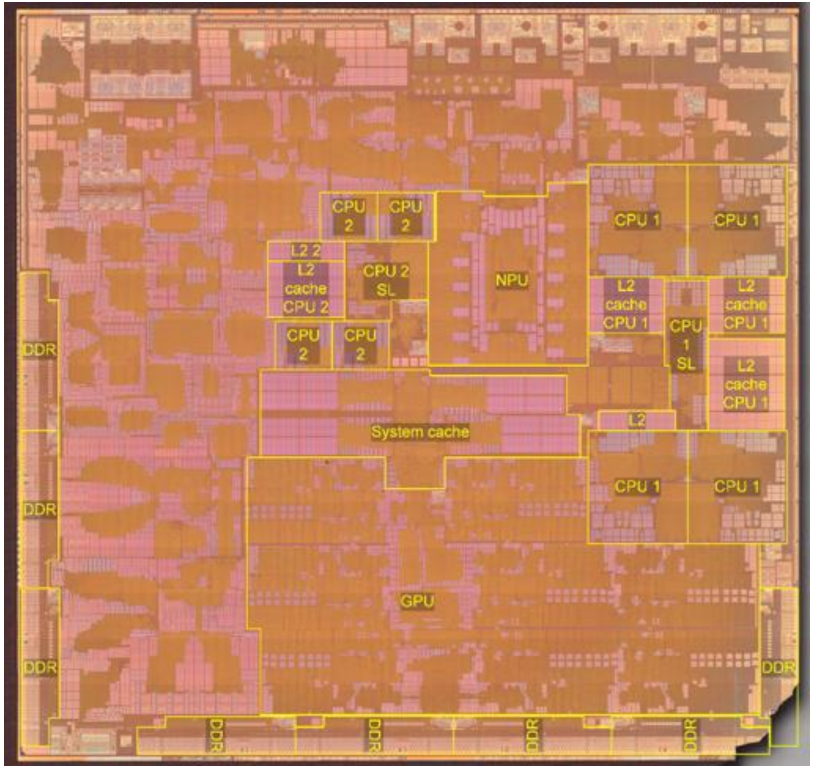
Total Cores :16
8 Performance-cores,
8 Efficient-cores
Cache : 30 MB


Platform I/O
Uncore
P Cores
E Cores
L3 Cache & Ringbus
iGPU
P Cores
E Cores


Queue, Uncore & I/O
Core
Core
Core
Shared L3 Cache
Core
Core
Core
Memory Controller

Intel i7-3960x CPU die

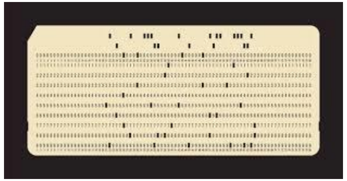
How Computers Work

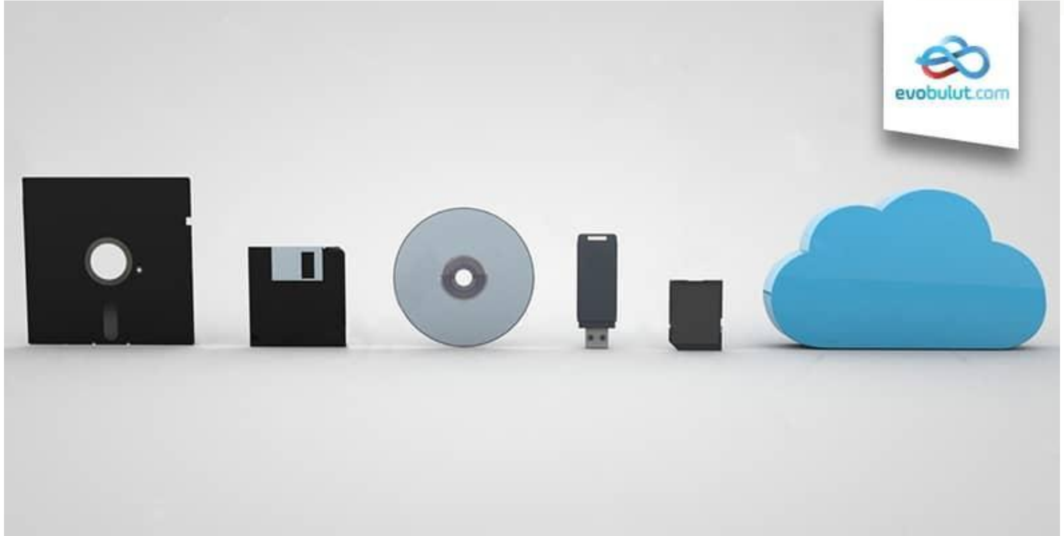

CPU 2
CPU 2
L2 2
L2 cache CPU 2
CPU 2 SL
CPU 2
CPU 2
NPU
CPU 1
CPU 1
L2 cache CPU 1
CPU 1 SL
L2 cache CPU 1
L2 cache CPU 1
L2
System cache
CPU 1
CPU 1
GPU
DDR
DDR
DDR
DDR
DDR
DDR
DDR
DDR

Apple M1 die photo

- System on a chip (SoC
- 5-nanometer process
- 16 billion transistors
- 8-core CPU
- 8-core GPU
- 16-core neural engine

How Computers Work





evobulut.com

How Computers Work

RAM (Random Access Memory)

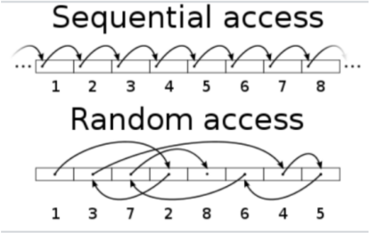
- Temporary
- Fast
- Expensive

crucial
DDR4 UDIMM
Product Origin

How Computers Work

Hard Drive

- Moving Parts
- Slow
- Cheap
- Vulnerable


Sequential access
...
1
2
3
4
5
6
7
8
...
Random access
1
3
7
2
8
6
4
5

How Computers Work

Hard Disk Drive (HDD) vs SSD vs NVMe

Magnetic- SATA3

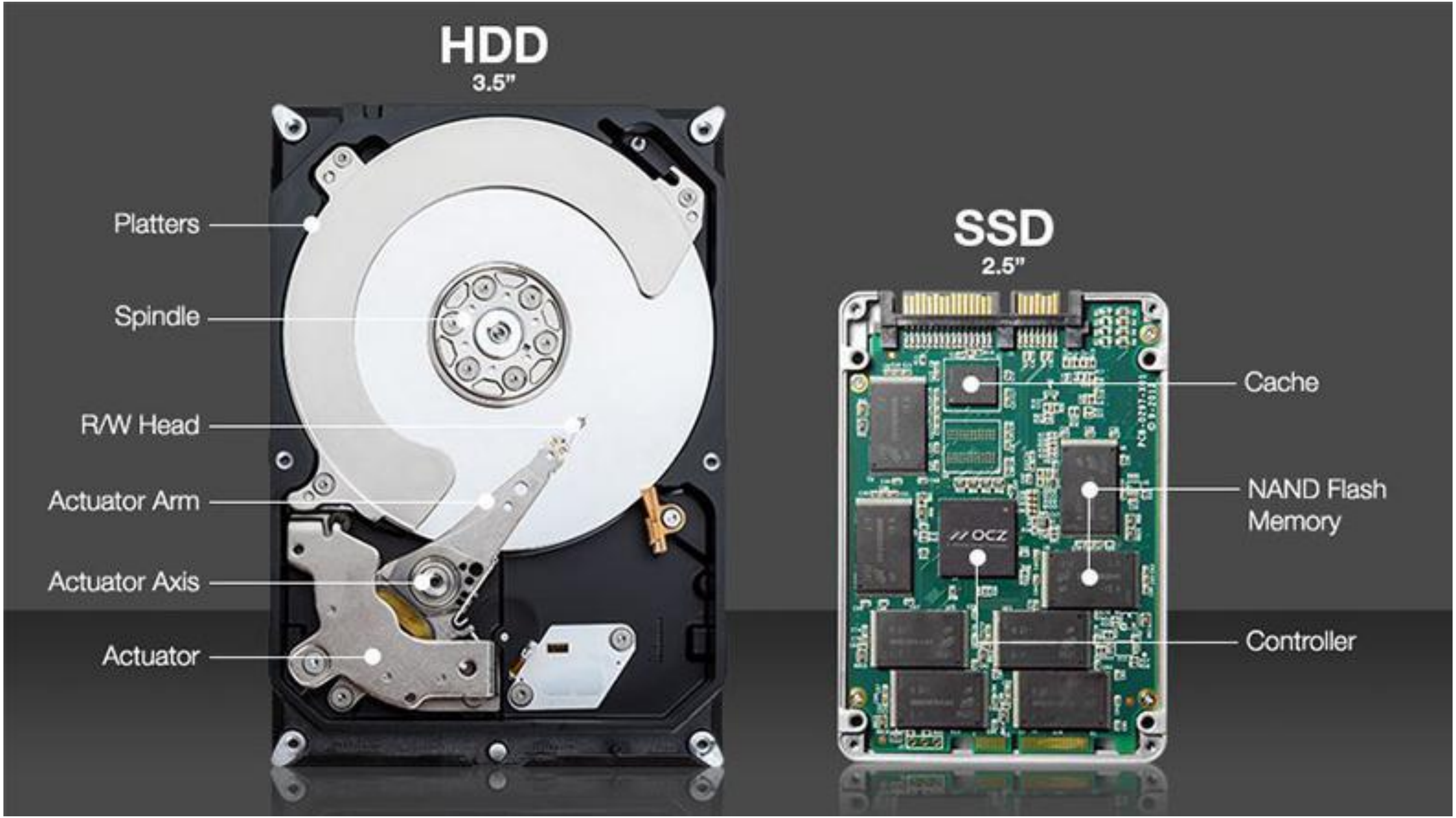
WD
2 TB
SATA / 64 MB Cache
WD20EZRX
WD Green
Desktop Hard Drive

SSD - SATA3

crucial
The Memory Experts

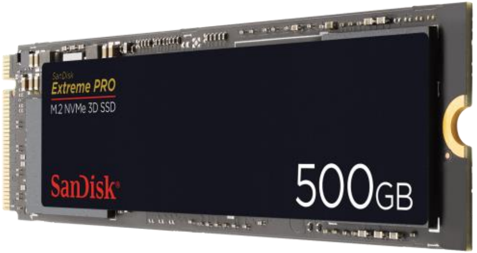
SSD - NVMe

V-NAND SSD
950 PRO M.2
512GB
SAMSUNG
nvm

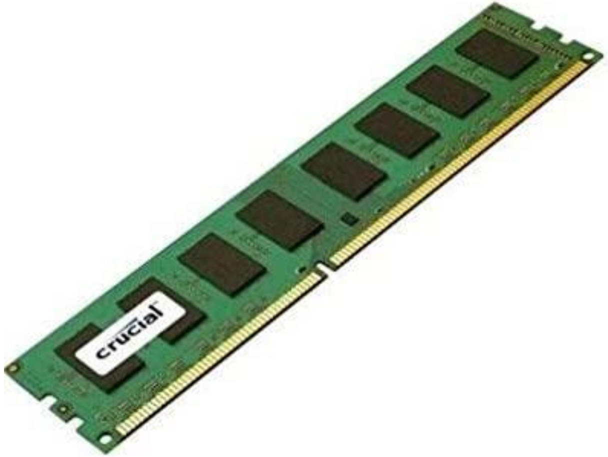

HDD
3.5"
Platters
Spindle
R/W Head
Actuator Arm
Actuator Axis
Actuator
SSD
2.5"
Cache
NAND Flash Memory
Controller

How Computers Work

Question: How about NVMe vs RAM?


SanDisk
Extreme PRO
M.2 NVMe 3D SSD
SanDisk
500GB

vs



Students choose an option

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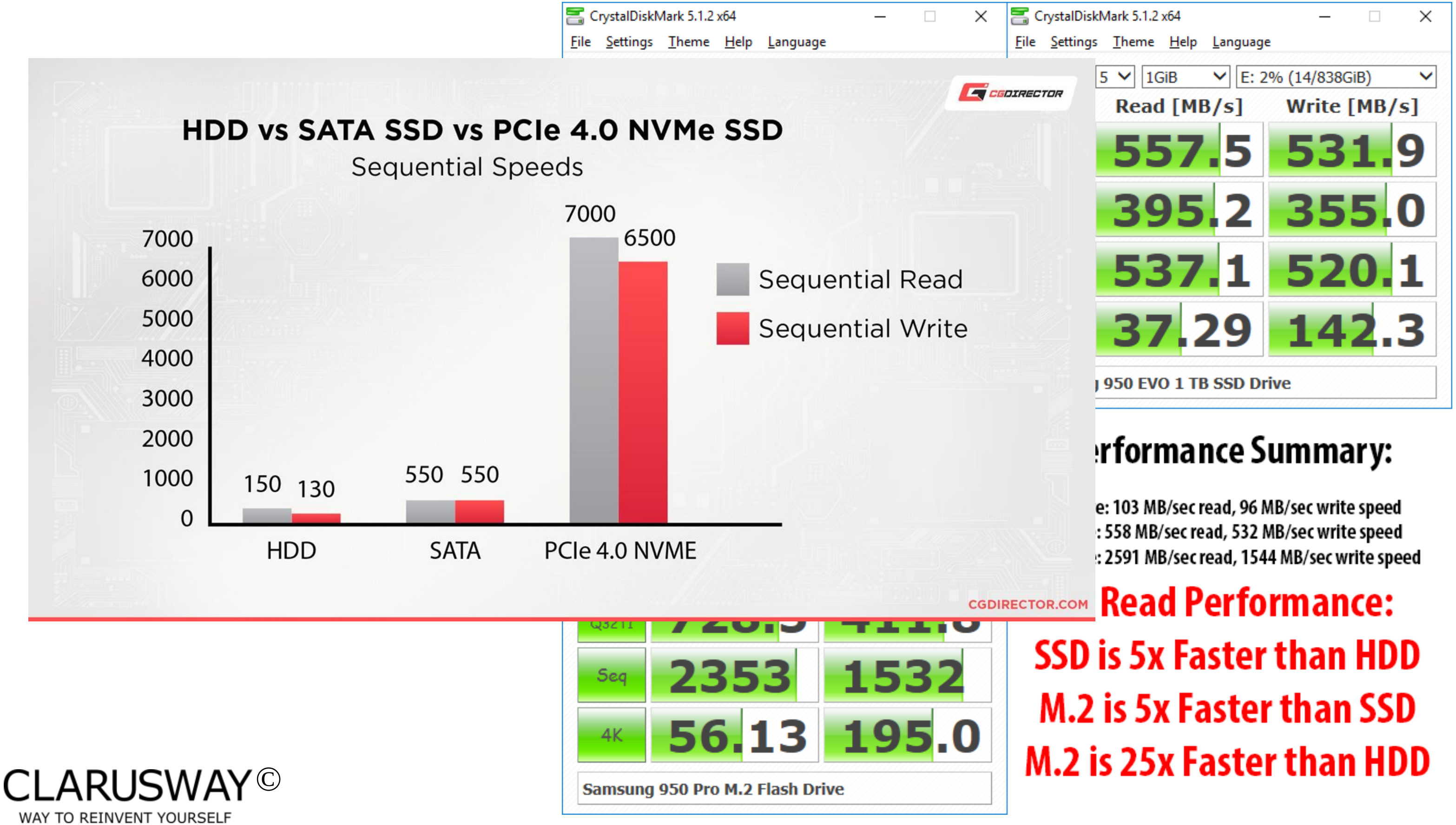
Do not remove this bar

How Computers Work



```
5   1GiB   E: 2% (14/838GiB)
Read [MB/s]   Write [MB/s]
557.5   531.9
395.2   355.0
537.1   520.1
37.29   142.3
950 EVO 1 TB SSD Drive
```

```
Seq   2353   1532
4K    56.13  195.0
Samsung 950 Pro M.2 Flash Drive
```

rformance Summary:

e: 103 MB/sec read, 96 MB/sec write speed
: 558 MB/sec read, 532 MB/sec write speed
: 2591 MB/sec read, 1544 MB/sec write speed

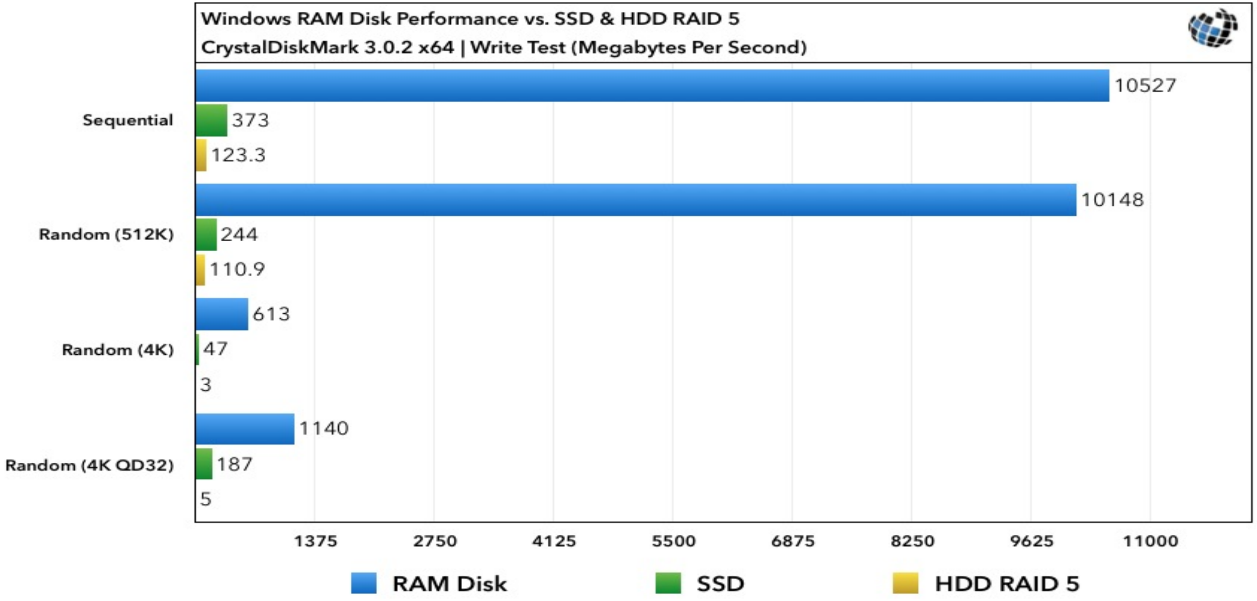
Read Performance:

SSD is 5x Faster than HDD

M.2 is 5x Faster than SSD

M.2 is 25x Faster than HDD

How Computers Work



Computer memory fundamentals
https://www.youtube.com/watch?v=p3q5zWCw8J4

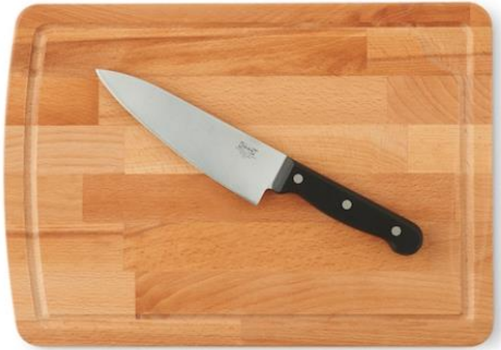
How Computers Work

Hard Drive vs RAM

Hard Drive

RAM

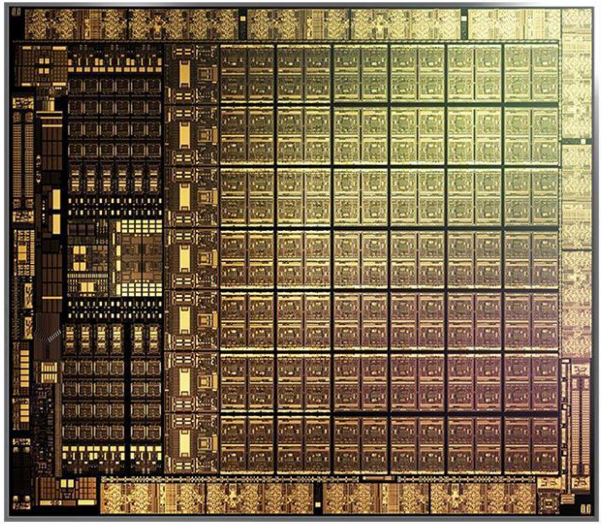
CPU



How Computers Work

GPU (Graphical Processing Unit)

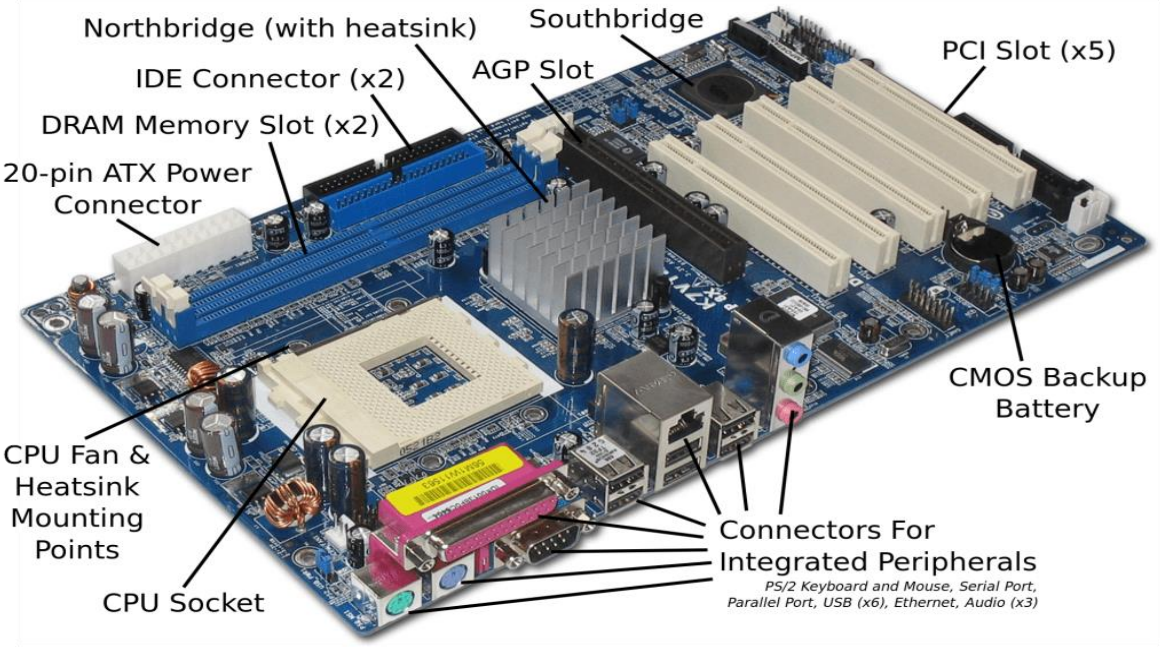
EVGA
GEFORCE RTX



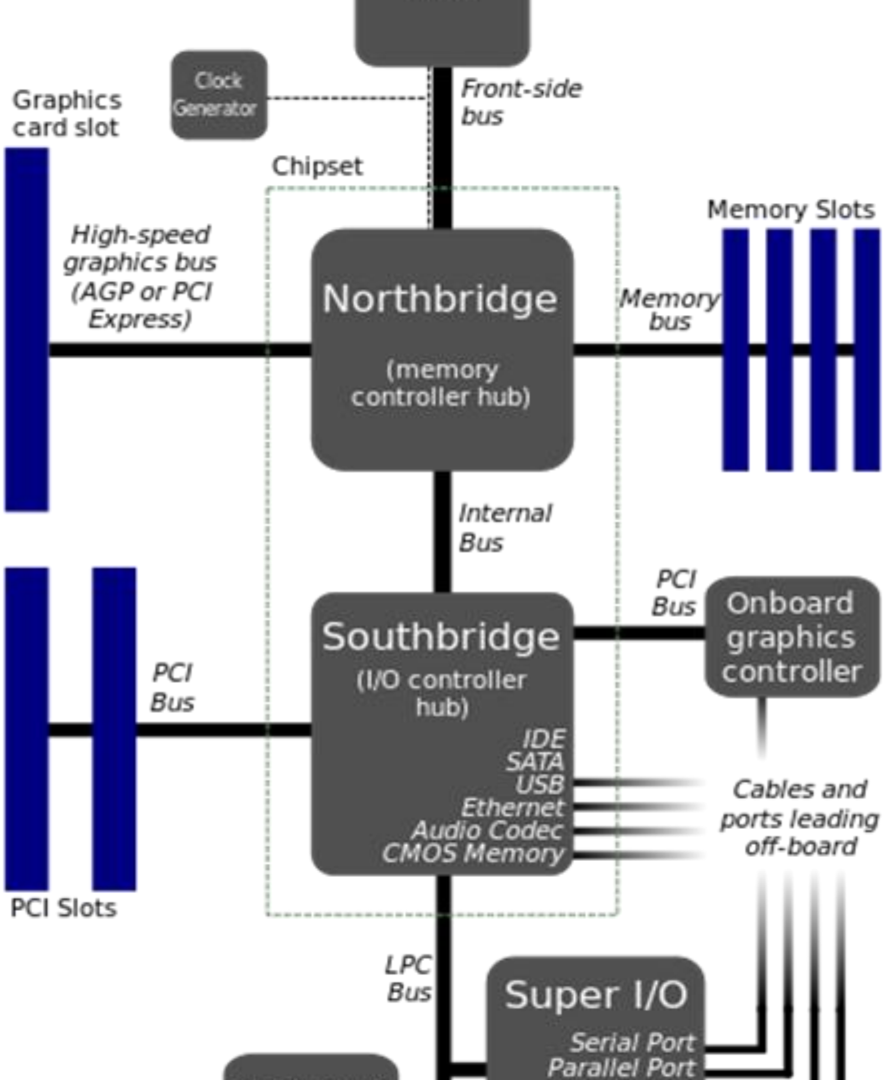
The GeForce RTX 3050’s GA106 GPU

How Computers Work

Mainboard or Logic Board


Northbridge (with heatsink)
Southbridge
IDE Connector (x2)
AGP Slot
PCI Slot (x5)
DRAM Memory Slot (x2)
20-pin ATX Power Connector
CMOS Backup Battery
CPU Fan & Heatsink Mounting Points
CPU Socket
Connectors For Integrated Peripherals
PS/2 Keyboard and Mouse, Serial Port, Parallel Port, USB (x6), Ethernet, Audio (x3)

New Generation motherboard (Intel i9)


Clock Generator
Front-side bus
Graphics card slot
Chipset
Memory Slots
High-speed graphics bus (AGP or PCI Express)
Northbridge
(memory controller hub)
Memory bus
Internal Bus
PCI Bus
Onboard graphics controller
Southbridge
(I/O controller hub)
PCI Bus
IDE
SATA
USB
Ethernet
Audio Codec
CMOS Memory
Cables and ports leading off-board
PCI Slots
LPC Bus
Super I/O
Serial Port
Parallel Port

How Computers Work

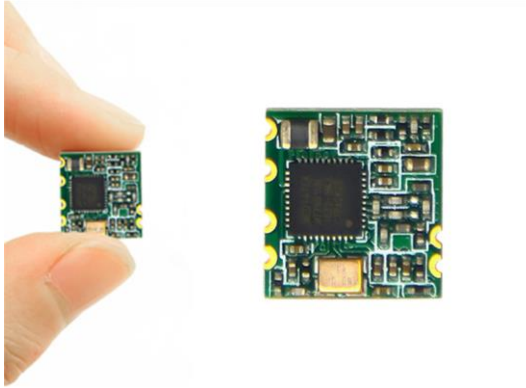
Input and Output Devices

Students, write your response!

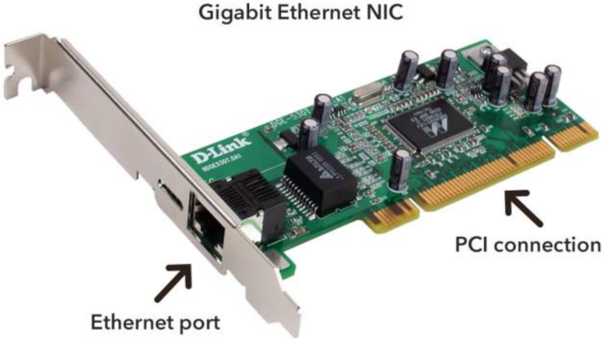
Pear Deck Interactive Slide
Do not remove this bar

How Computers Work

- **Communication Devices**



Wireless Adapter


Gigabit Ethernet NIC
PCI connection
Ethernet port

Network Interface Card

How Computers Work

- **Virtual Reality / Augmented Reality / Mixed Reality**

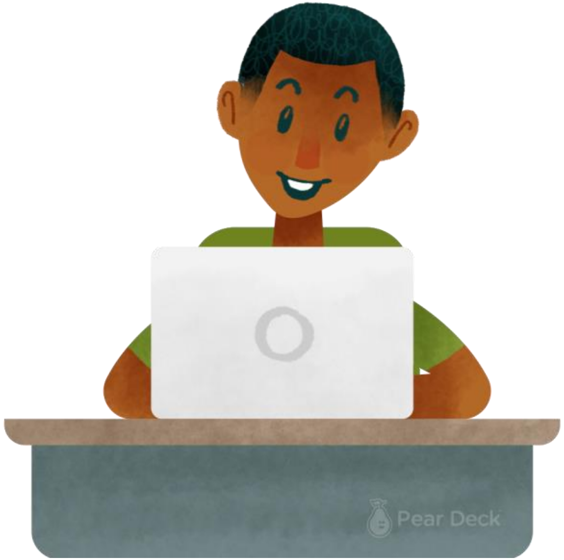
Students choose an option

How Computers Work

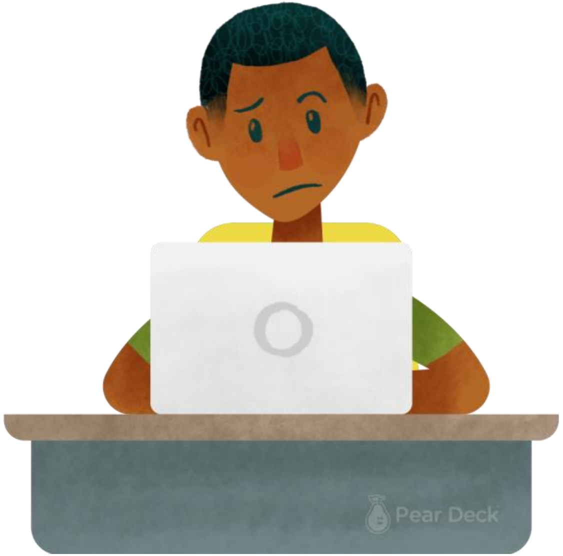
Hi. I'm Cortana.
Ask me a question!

???

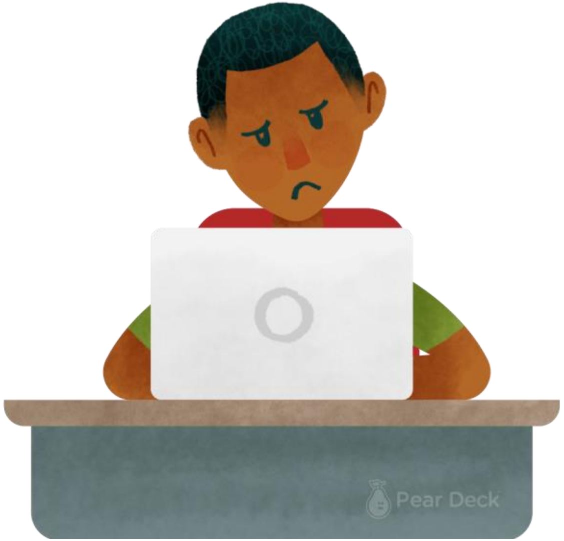
Drag your dot to how you are feeling:



Keep going, I understand



I’m a little confused



Stop, I need help!

Students, drag the icon! ●

Pear Deck Interactive Slide
Do not remove this bar

Operating Systems

LET'S PLAY
Kahoot!
Skip
10
0
Answers
That Family
e White Life
The Replacements
e Rejects

THANKS!

Any questions?