Computer Science
North University of China

CS101

Introduction to
Computer Science

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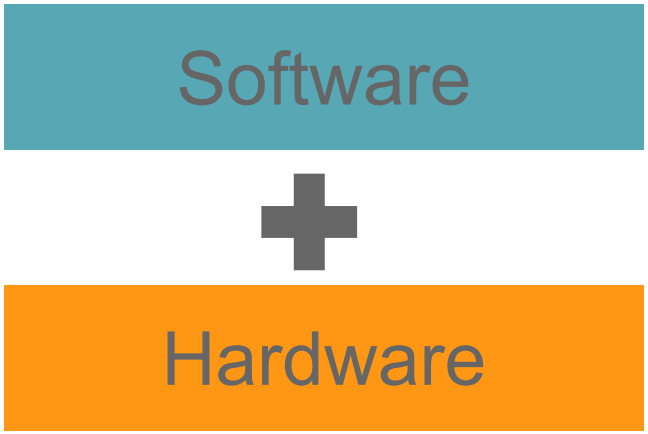
School of Computer Science & Technology

Fall 2017

Recognize Computer Hardware

Computer System

A computer is a device that can be instructed to carry out arbitrary sequences of arithmetic or logical operations automatically. The ability of computers to follow generalized sets of operations, called programs, enables them to perform an extremely wide range of tasks.



Computer System

Analogies:

- **Piano and music**
- **Cooking utensil and meal**
- **...**

Types of Computer

Desktop

Laptop

Supercomputer

Smart Phone

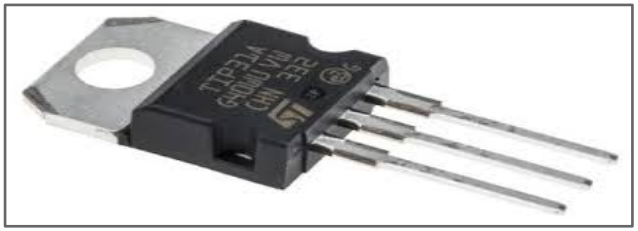
Smart Watch

Smart TV

Chips and Transistors

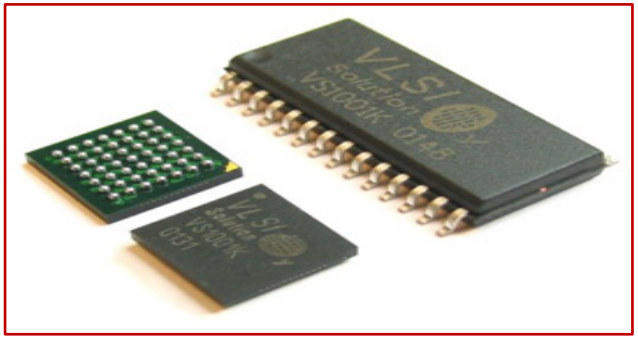
Transistor – building block

- A **transistor** is a semiconductor device used to amplify or switch electronic signals and electrical power.
- It is composed of semiconductor material usually with at least three terminals for connection to an external circuit.



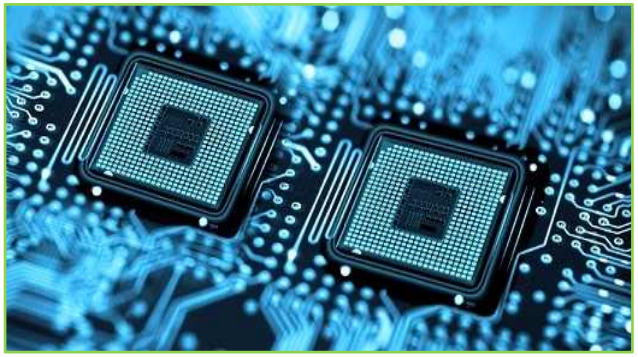
Chip – fingernail sized silicon

- Chip can contain billions of transistors
- E.g. CPU chips, memory chips, flash chips



VLSI - Very-large-scale Integration

- Integrated Circuit - IC, 集成电路
- **VLSI** is the process of creating an **integrated** circuit (IC) by combining thousands of transistors into a single chip.



Moore's Law

Gordon Moore (Intel co-founder)

- states that the density of transistors on a chip doubles about every 2 years or so (sometimes listed as every 18 months).
- Integration level: density of transistors

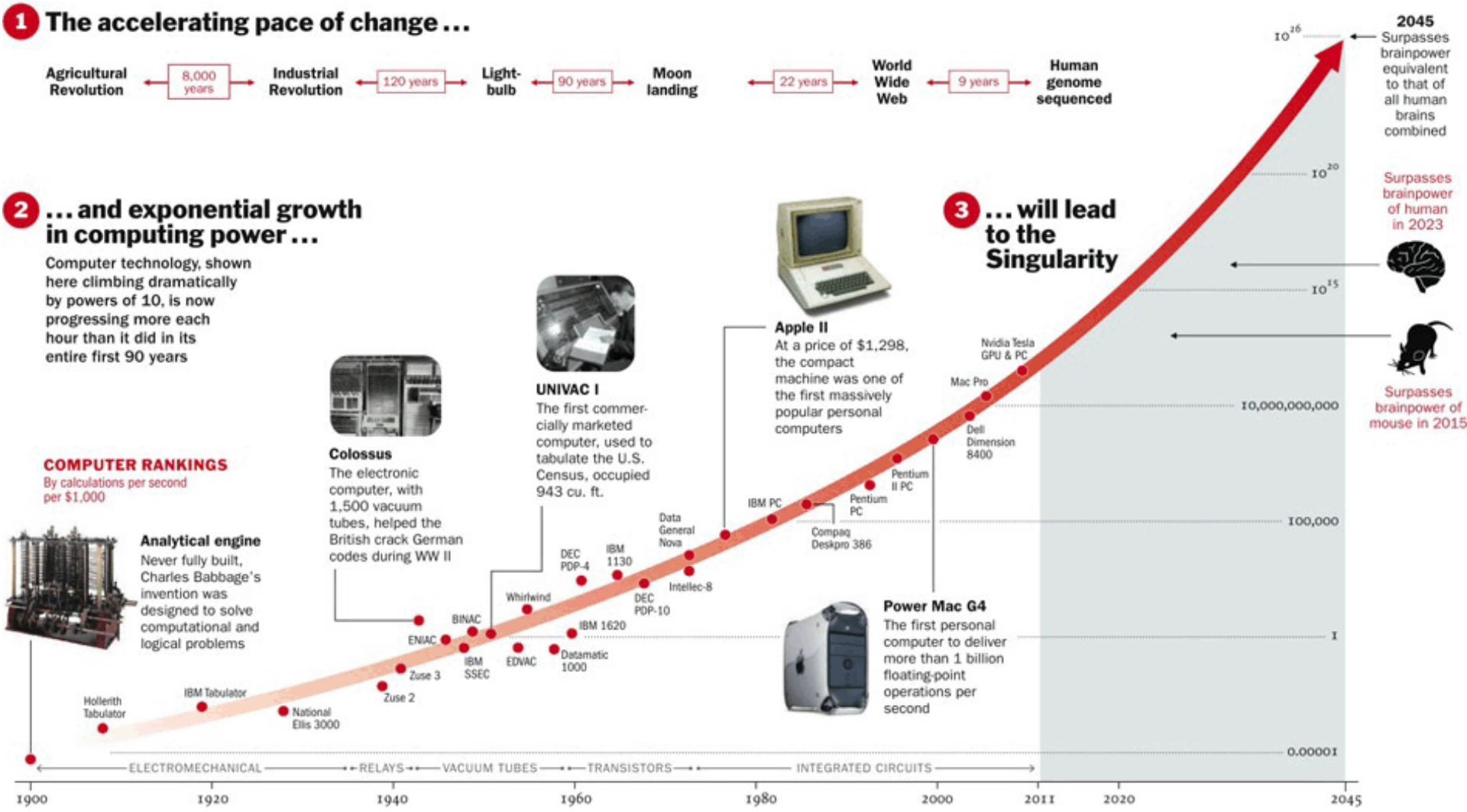
Observation vs. "law"

- In effect, transistors/computers get cheaper (powerful)
- Why computers are now in cars, TVs, and even watches
- Memory of your smart phone get bigger every couple years:16GB, 32GB,64GB, 128GB, 256GB, …

Exponential Growth

- 10 doublings, about 1000 x

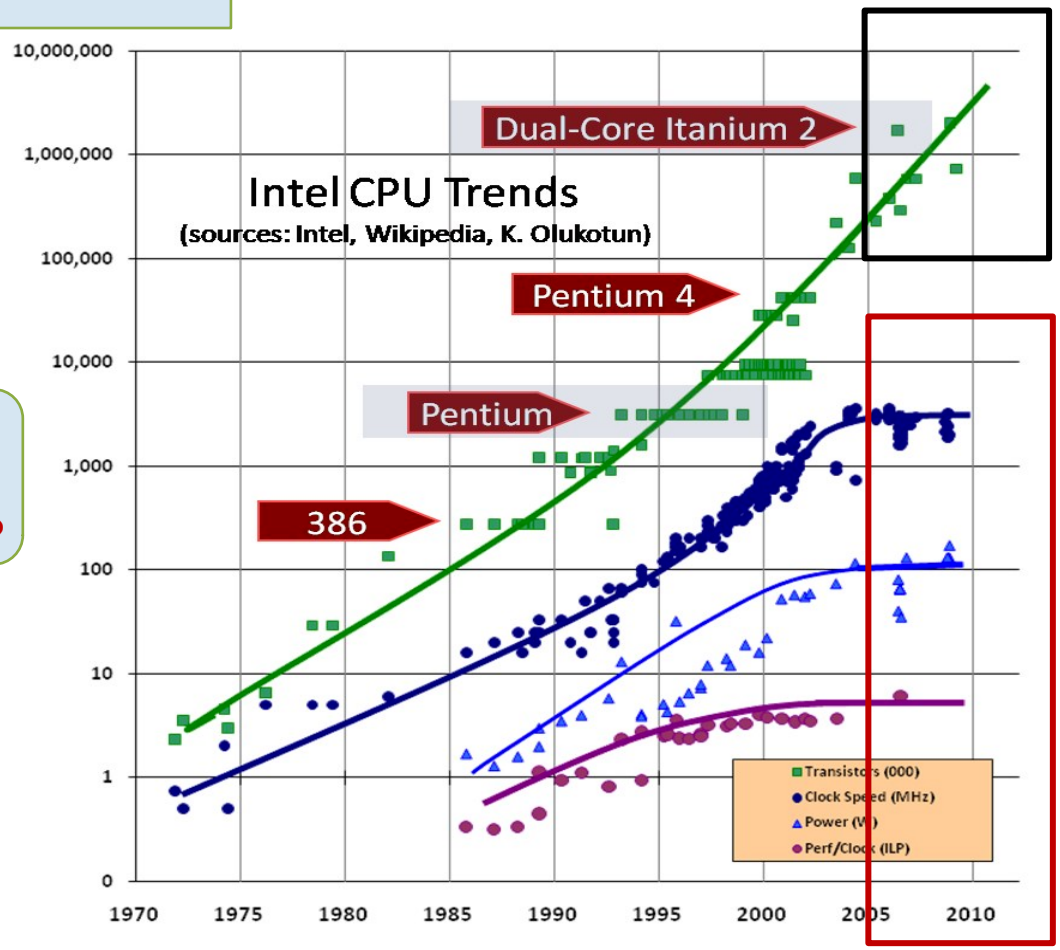
Moore's Law


1 The accelerating pace of change ...
Agricultural Revolution
8,000 years
Industrial Revolution
120 years
Light-bulb
90 years
Moon landing
22 years
World Wide Web
9 years
Human genome sequenced
2 ... and exponential growth in computing power ...
Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years
3 ... will lead to the Singularity
2045
Surpasses brainpower equivalent to that of all human brains combined
Surpasses brainpower of human in 2023
Surpasses brainpower of mouse in 2015
COMPUTER RANKINGS
By calculations per second per $1,000
Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems
Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II
UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.
Apple II
At a price of $1,298, the compact machine was one of the first massively popular personal computers
Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second
Hollerith Tabulator
IBM Tabulator
National Ellis 3000
Zuse 2
Zuse 3
ENIAC
BINAC
IBM SSEC
EDVAC
Whirlwind
Datamatic 1000
IBM 1620
DEC PDP-10
DEC PDP-4
IBM 1130
Intellec-8
Data General Nova
IBM PC
Compaq Deskpro 386
Pentium PC
Pentium II PC
Dell Dimension 8400
Mac Pro
Nvidia Tesla GPU & PC
10^26
10^20
10^15
10,000,000,000
100,000
1
0.00001
ELECTROMECHANICAL
RELAYS
VACUUM TUBES
TRANSISTORS
INTEGRATED CIRCUITS
1900
1920
1940
1960
1980
2000
2011
2020
2045

The Free Lunch Is Over

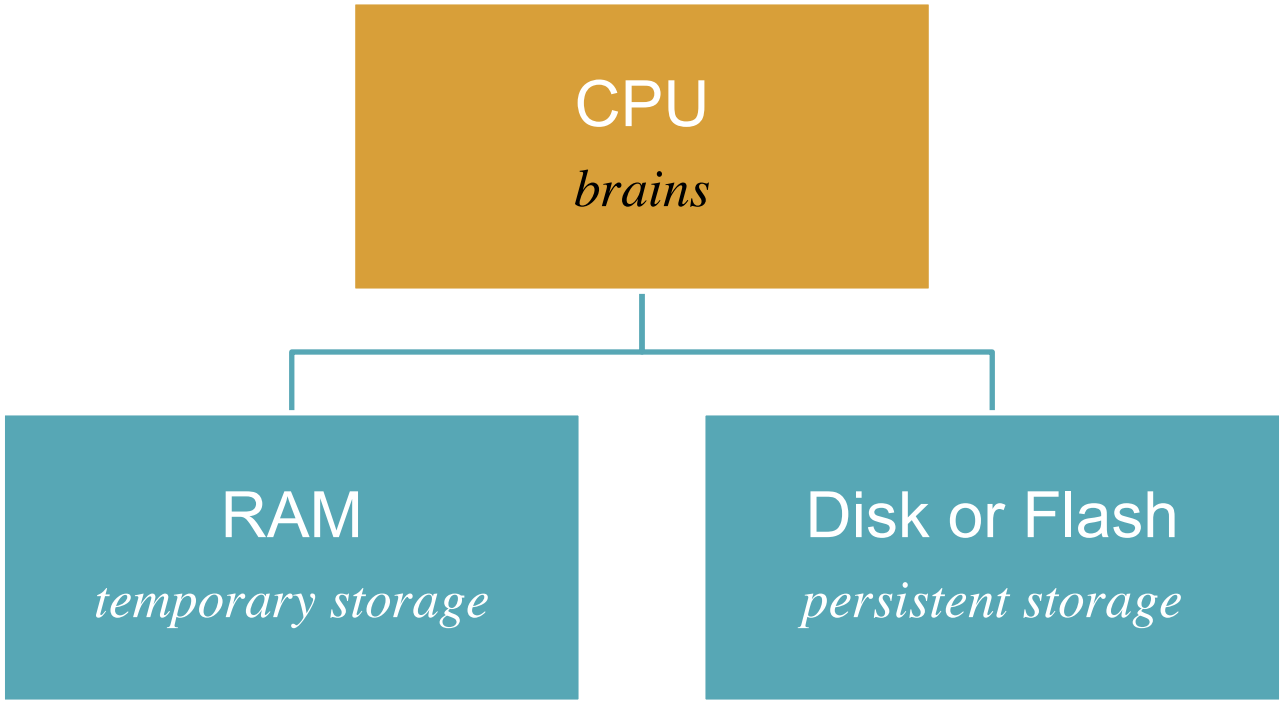
Physical Limits

Speed of light 300 000 km/s
Size of an atom



Why Moore's Law continues even when integration increase stops?

Computer Hardware



CPU

CPU - Central Processing Unit

- The brain of a computer
- Performs simple operations
- e.g. Add two numbers

Intel® Core™ i7-7820X	Performance
Number of Cores	8
Number of Threads	16
Processor Base Frequency	3.60 GHz

Types of CPU

Number of Kernels

- Duo: 2 Kernels
- Quad: 4 Kernels
- Kernels work in parallel

What is Duo and Quad?

Storage Devices - Bytes

Storage devices RAM, hard drives, flash drives

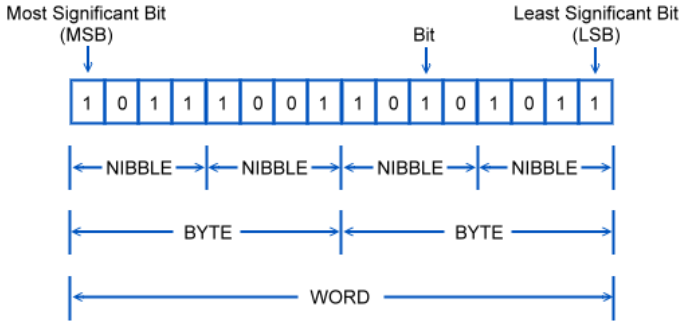
- All of them rely on the concept "Bytes"
- Their capacities are measured in bytes, despite being very different hardware

Byte

- is the unit of information storage
- 1 byte comprises of 8 bit
- It is enough to hold 1 letter, e.g. 'b' or 'X'

Megabyte, MB, about 1 million bytes

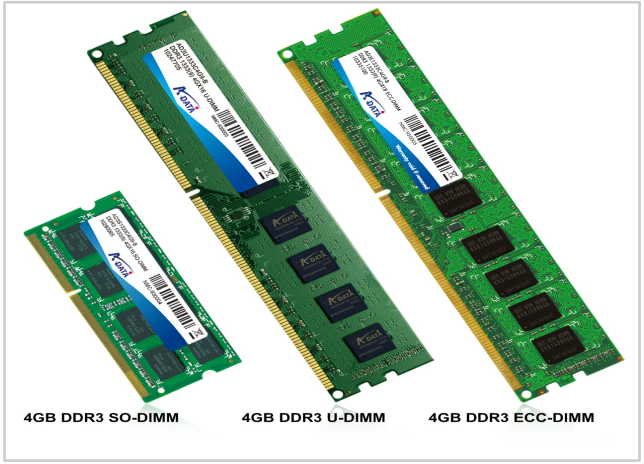
Gigabyte, GB, about 1 billion bytes

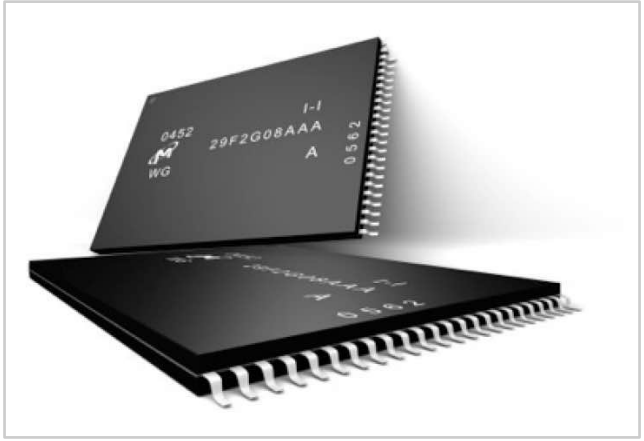


RAM

RAM - Memory, Random Access Memory

- Temporary, working storage bytes
- e.g. new Simple Image("flowers.jpg") --bytes of image loaded into RAM
- e.g. pixel.setRed(0) ... manipulating bytes in RAM
- RAM is "volatile", not "persistent", .. gone when power goes out
- e.g. You're working on a doc, then power goes out (vs. "Save")





Persistent Storage

Persistent storage

- “Non volatile” – preserve data even lose power

Types

- Hard Drive, Flash Drive

Hard drive - stores bytes as a magnetic pattern on a spinning disk

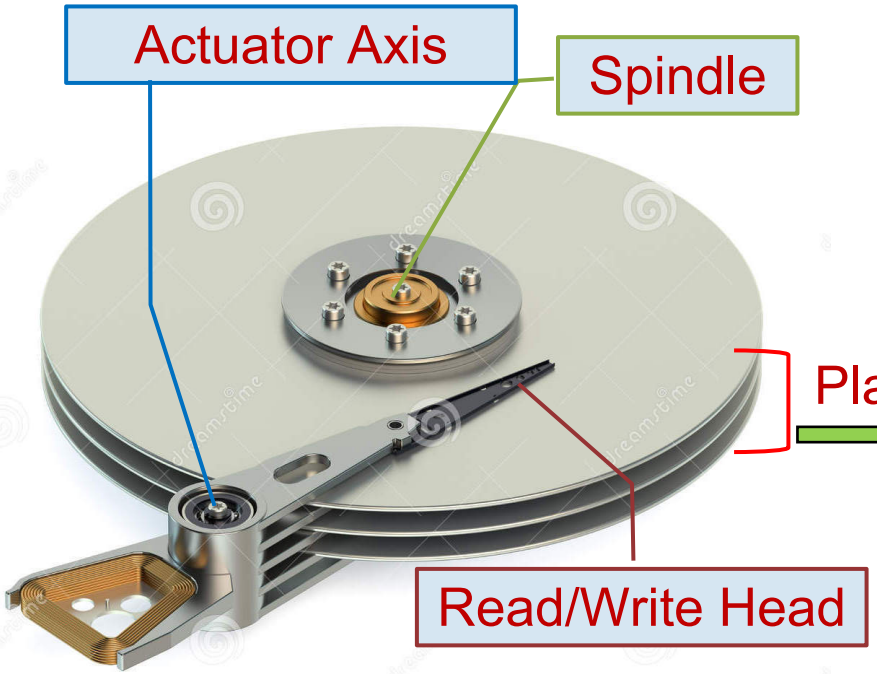
- aka "hard disk"
- High pitch spinning sound you may have heard

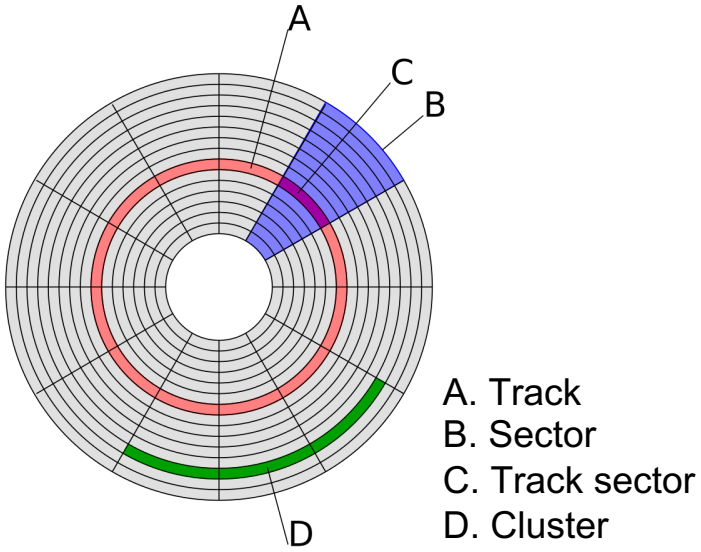
Flash drive - stores bytes as electrons in a chip

- aka "Flash memory"
- "Solid state", no moving parts approach

Hard Disk

160 GB hard drive
Connects to motherboard with SATA cable





Flash Chips

- USB thumb drive
- Contains a flash chip, solid state
- SD Card, similar idea
- SSD
- Flash storage forms: usb key, SD card in camera, flash chips built into a tablet
- Flash
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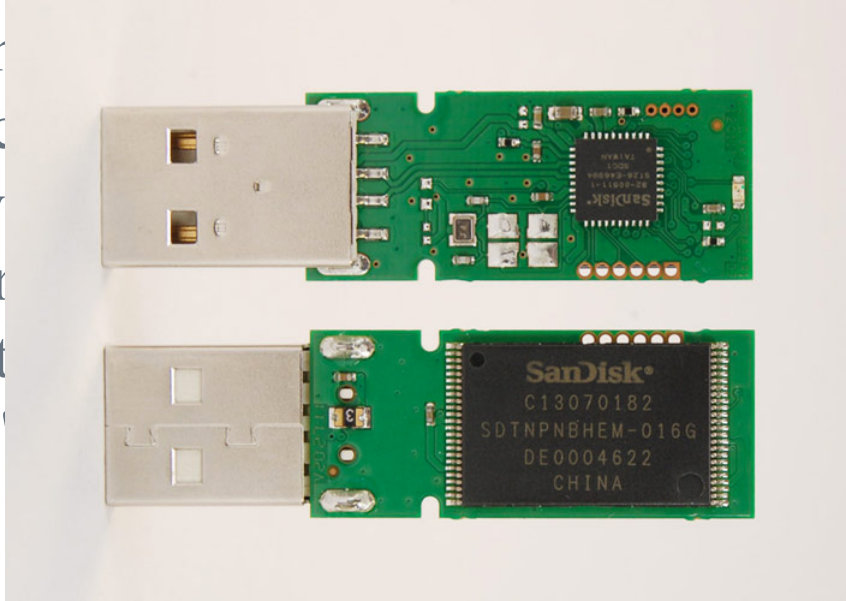
- How
(Moor
- Not t
Flash"



USB thumb drive

SD Card

SSD

SSD – Solid State Disk/Drive

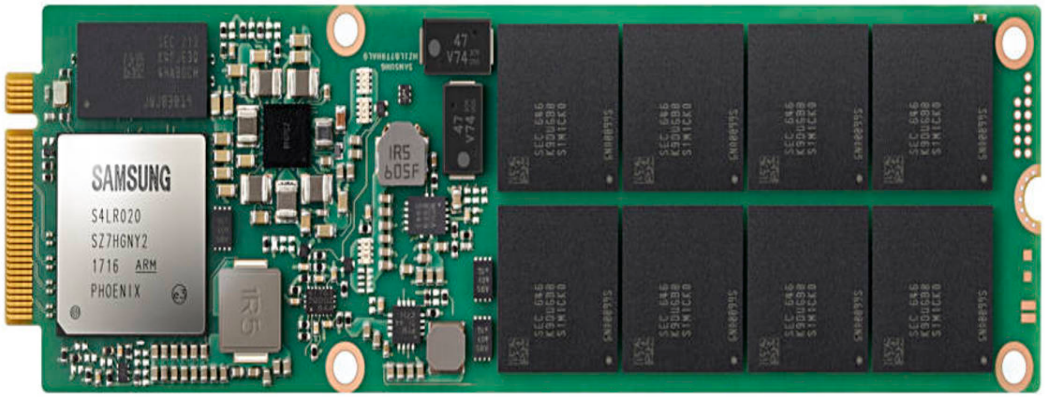
- SSD is a solid-state storage device that uses integrated circuit assemblies as memory to store data persistently.

SAMSUNG 128GB SSD

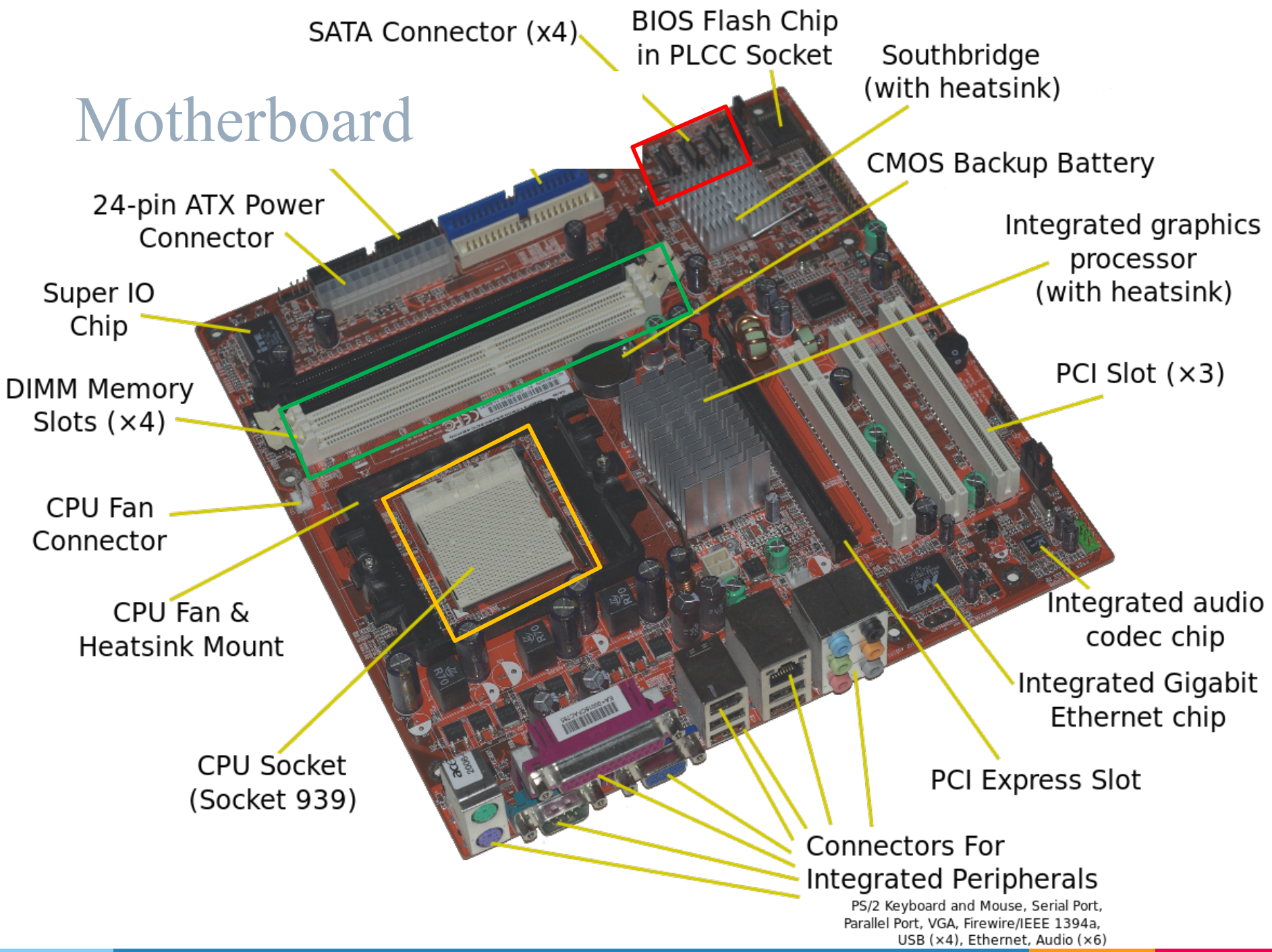
Types

- USB thumb drive
- Contains a flash chip, solid state
- SD Card, similar idea
- SSD

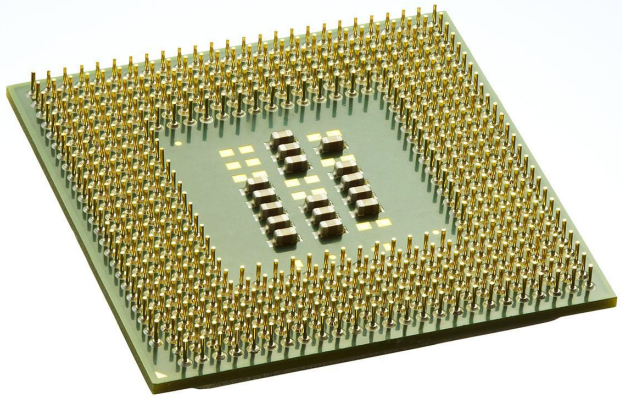
SSD Inside

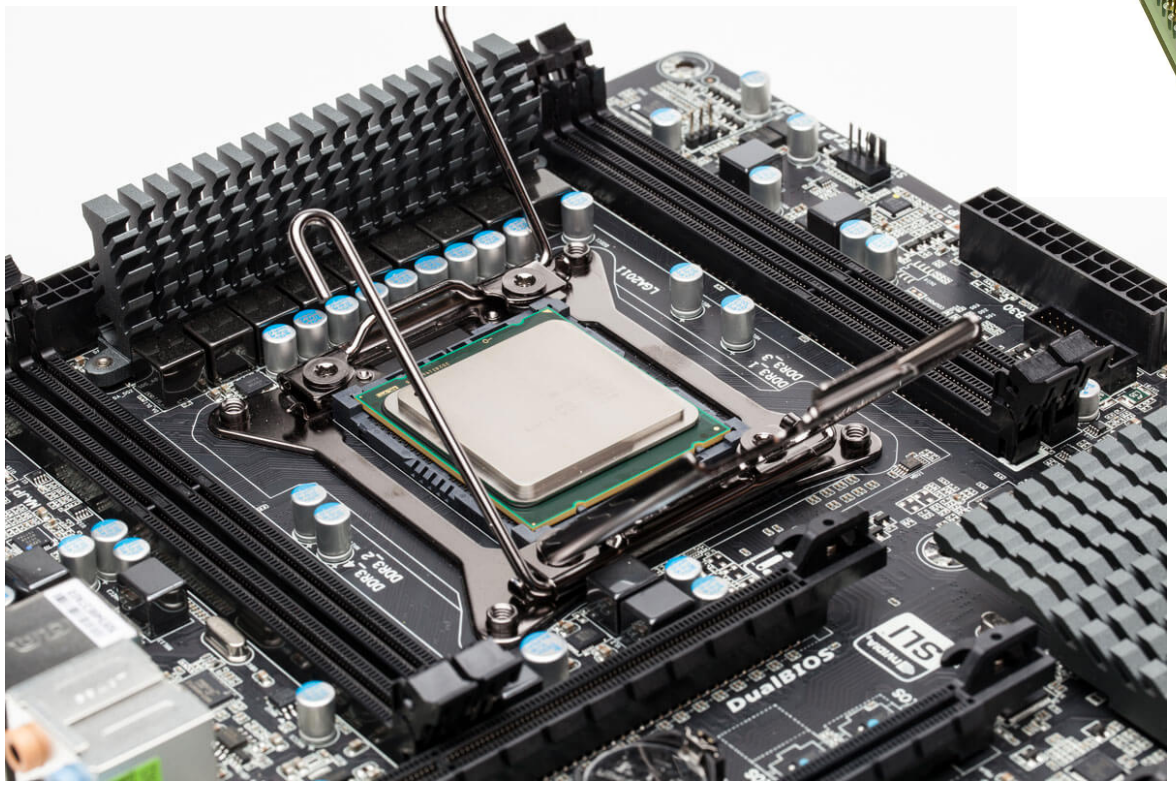


Motherboard



CPU Socket & CPU Pins





Buses(总线)

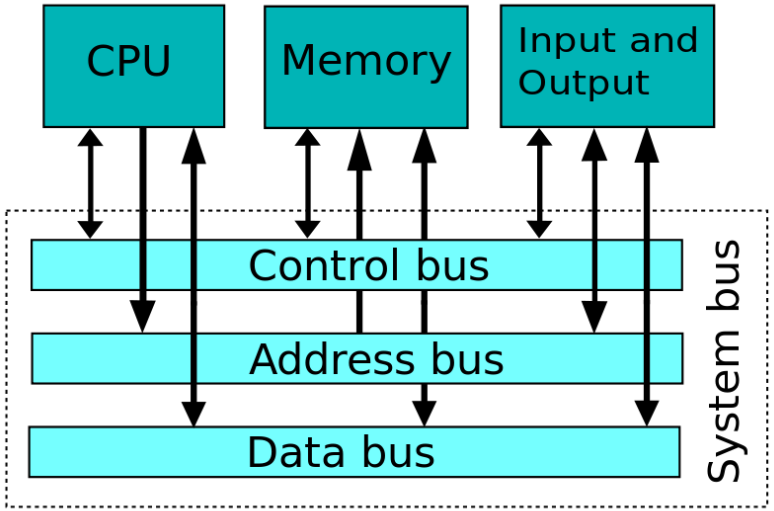
In computer system, a bus is a communication system that transfers data between components inside a computer, or between computers. This expression covers all related hardware components (wire, optical fiber, etc.) and software, including communication protocols.

Internal buses – internal data bus

- Memory bus connects the internal components of a computer, such as CPU and memory, to the motherboard

External buses – expansion bus

- Pathways connect the external devices, such as hard disk, printer etc., to the computer
- SATA, Serial Advanced Technology Attachment
- PCI - Peripheral Component Interconnect



THANKS!

Q&A

Questions