Chapter1: Computer System

Asst.Prof.Dr.Supakit Nootyaskool

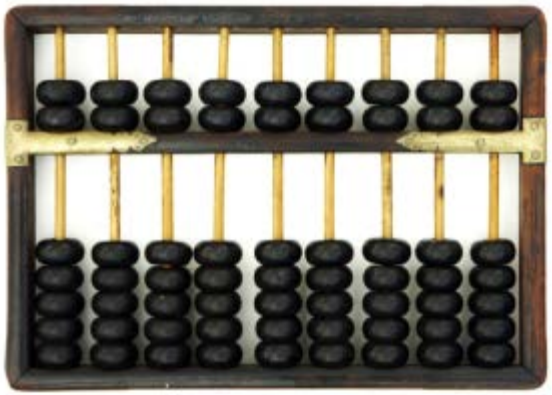
Learning Outcome

- Express computer evolution from the mechanical to semiconductor.

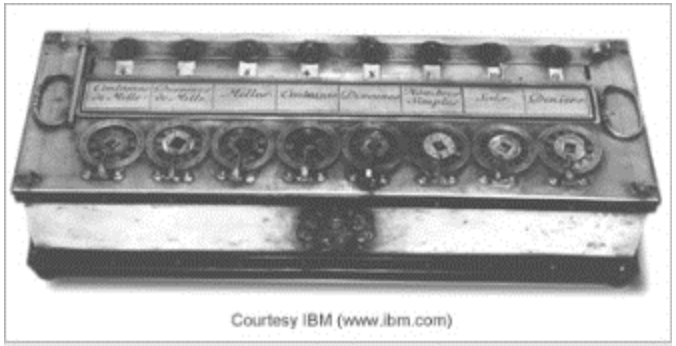
- Describe the difference between the microprocessor and microcontroller.

FIRST COMPUTING DEVICE

Mechanical computer



- Abacus
  - Used in China, Europa and Russia



Courtesy IBM (www.ibm.com)

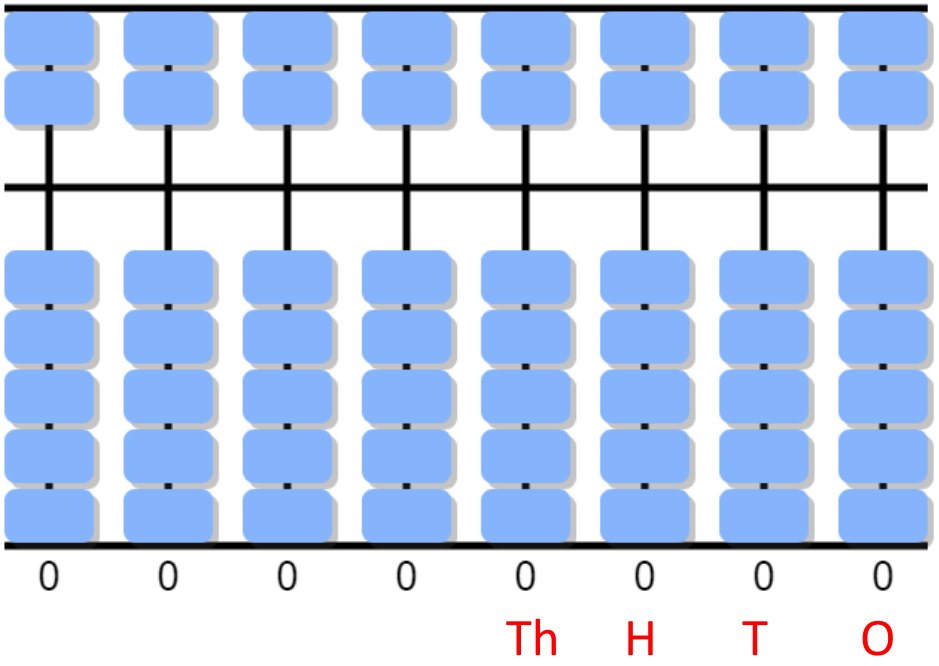
The Pascaline

- Mechanical calculator
  - Blaise Pascal (1642) developed a machine to help his father working in the shop.
  - Working only function of the addition and subtraction.

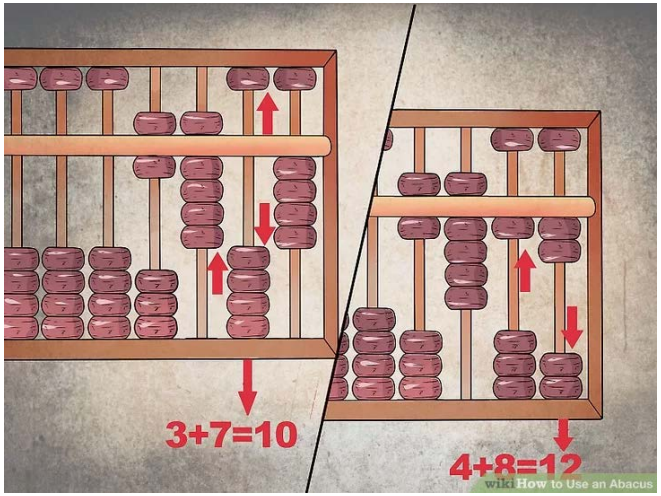
Activity 1.1 Play abacus

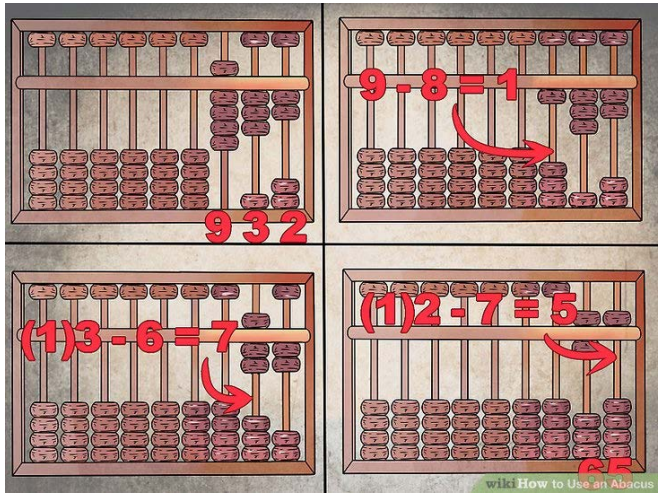
- Click on https://www.mathematik.uni-marburg.de/~thormae/lectures/ti1/code/abacus/sanpan.html

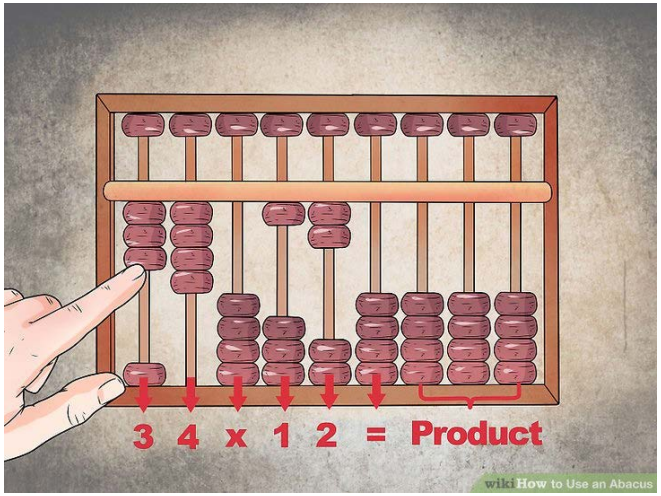
- Calculate
  - 83 + 12 = ?
  - 112 + 12 = ?

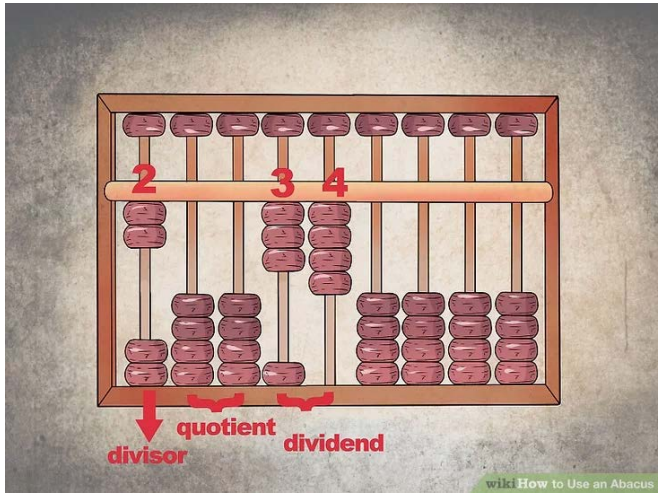


More functions in Abacus



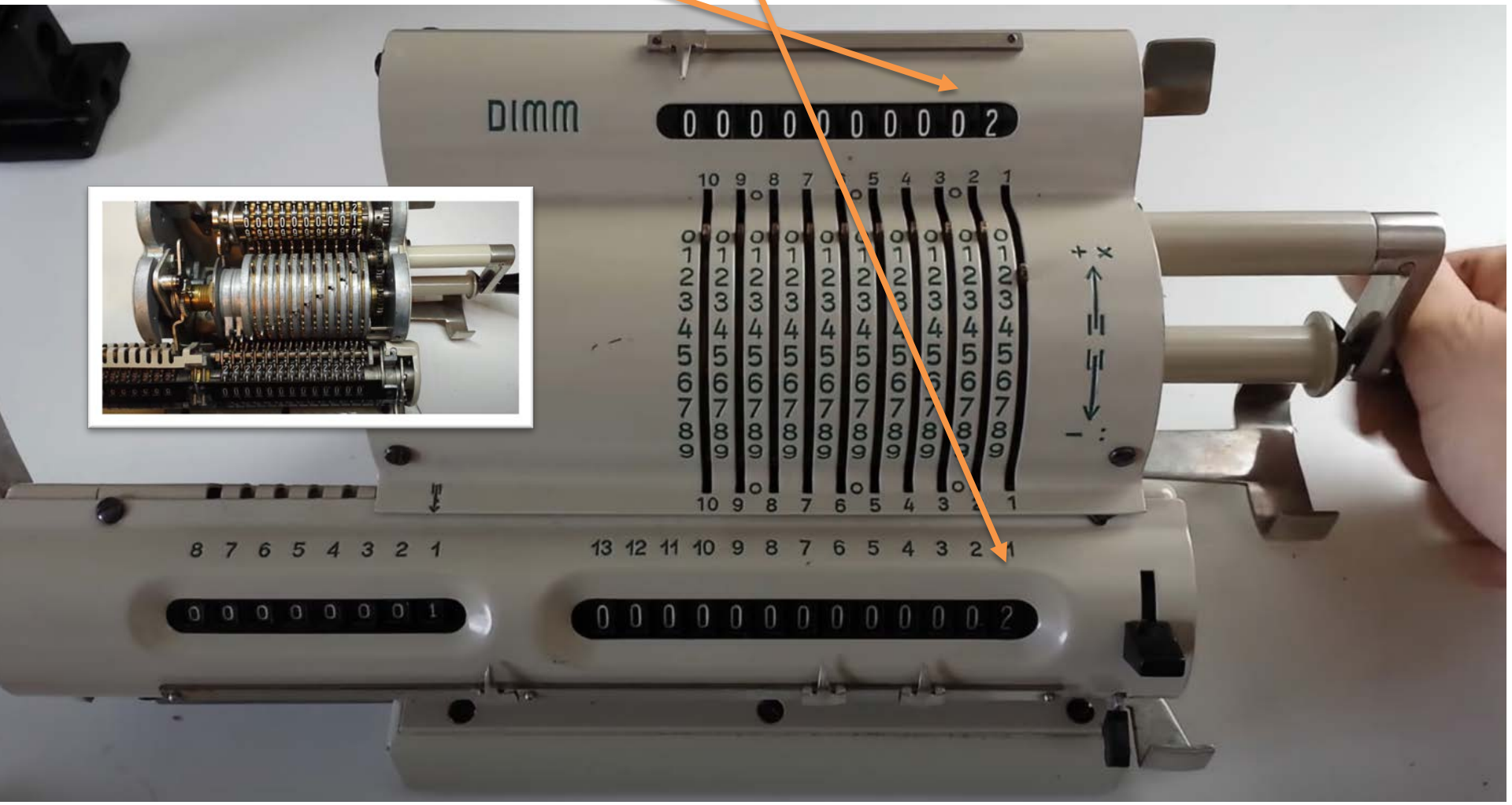






https://www.wikihow.com/Use-an-Abacus

2+2 = 4

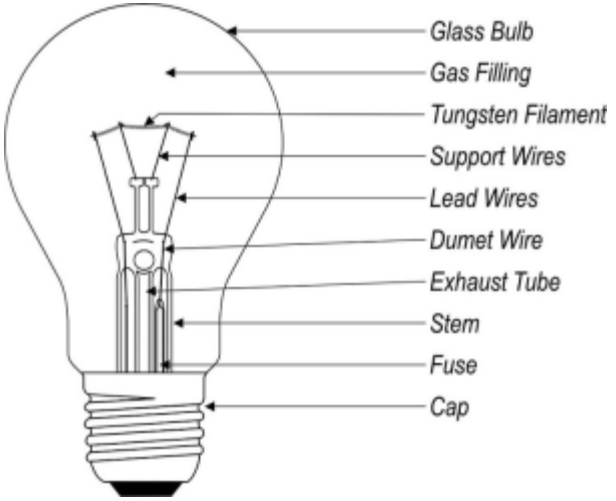


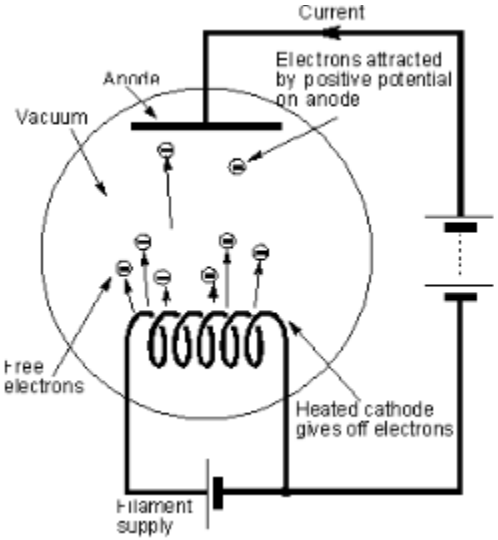
https://youtu.be/aDN4s8ElxqE?t=144

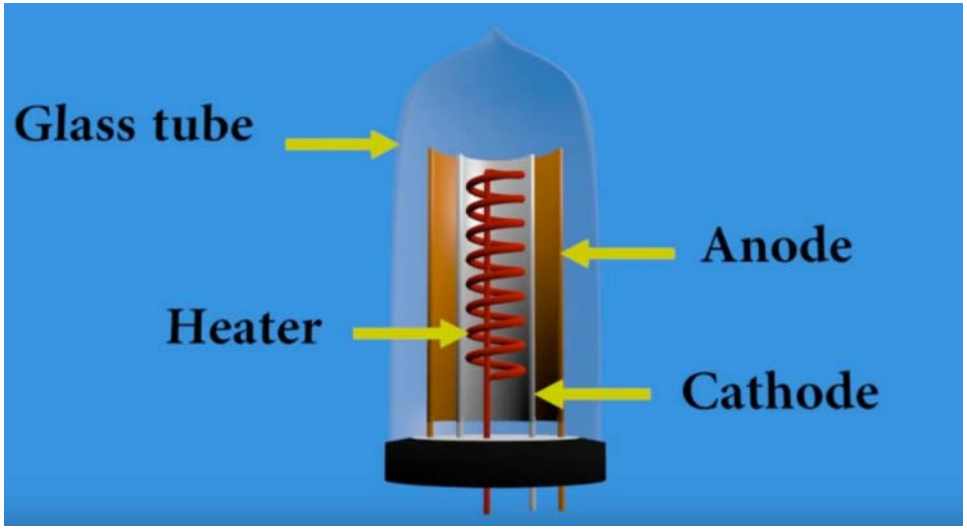
ELECTRIC AND ELECTRON

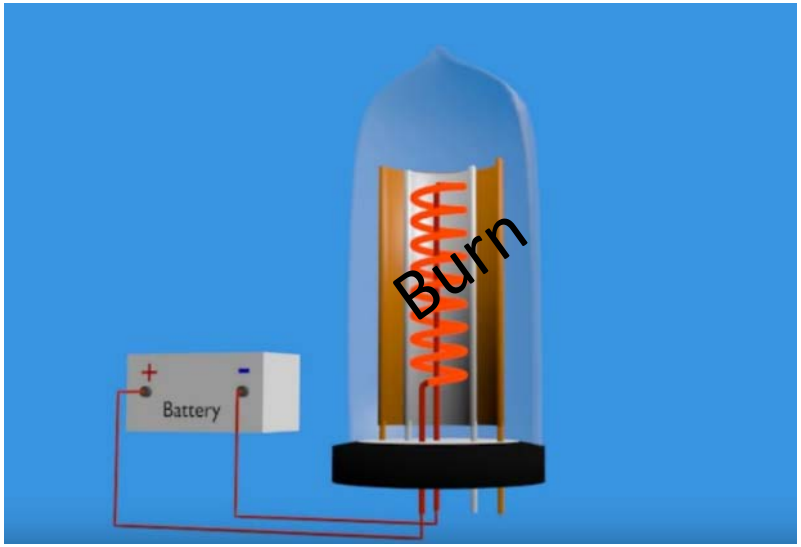
1.1.2 Vacuum Tube

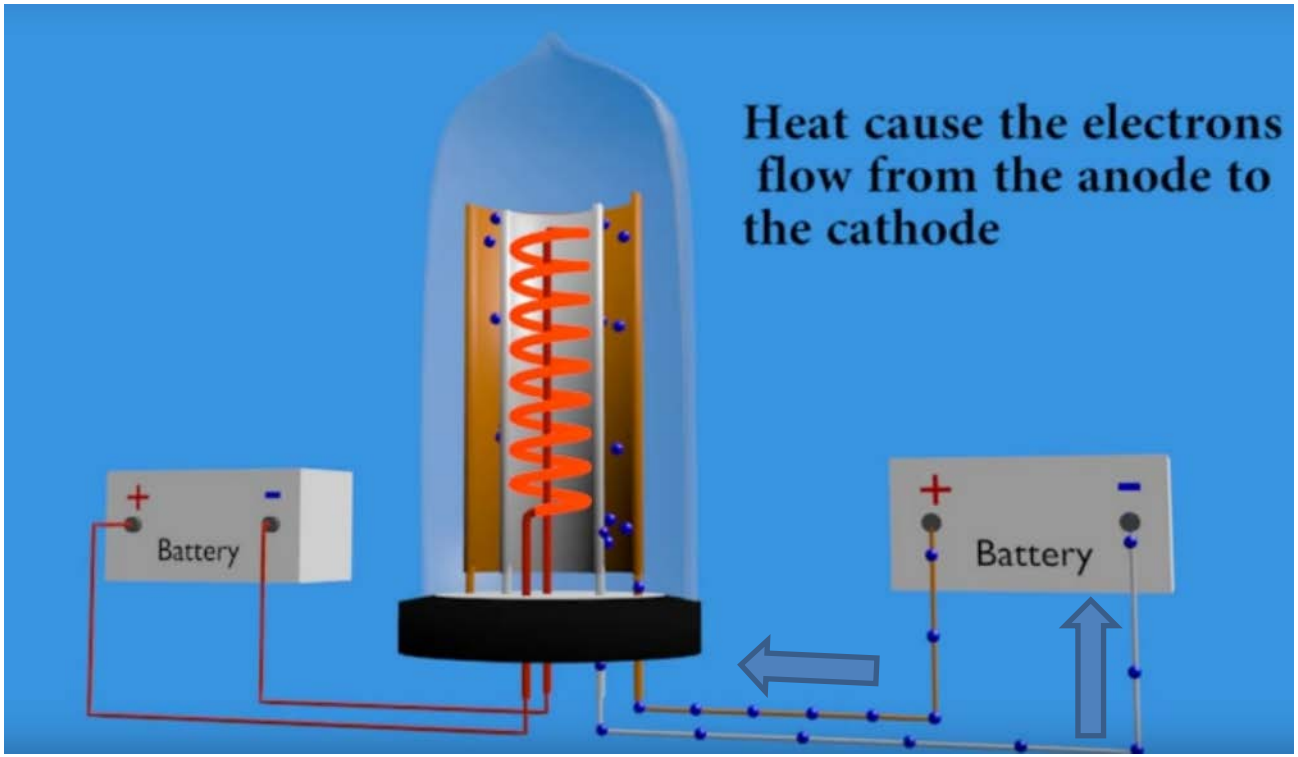
- Vacuum Tube was developed from *Incandescent lamp*.
- When *a tungsten*[74] *lead* gets heat, it spreads electron by moving to an anode plate.
- A grid plate uses controls number of electron moving from the tungsten lead to an anode plate.





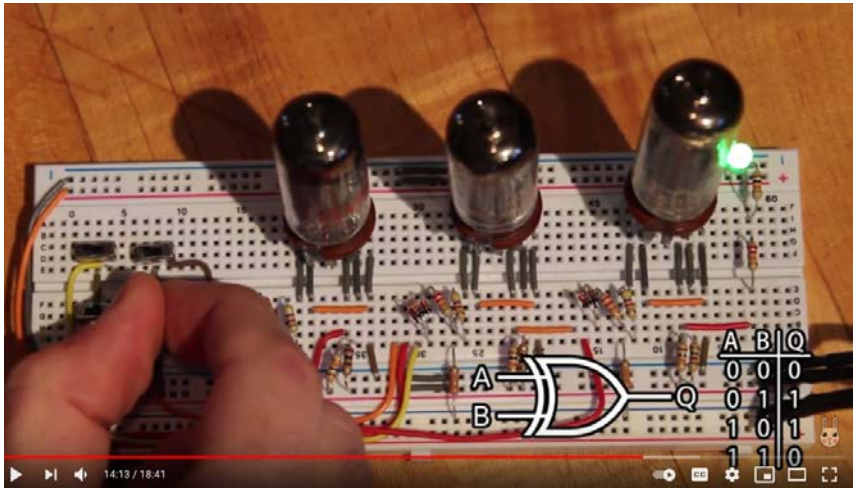






https://www.youtube.com/watch?v=K6BgZ8s1Vuw

Vacuum tube and future

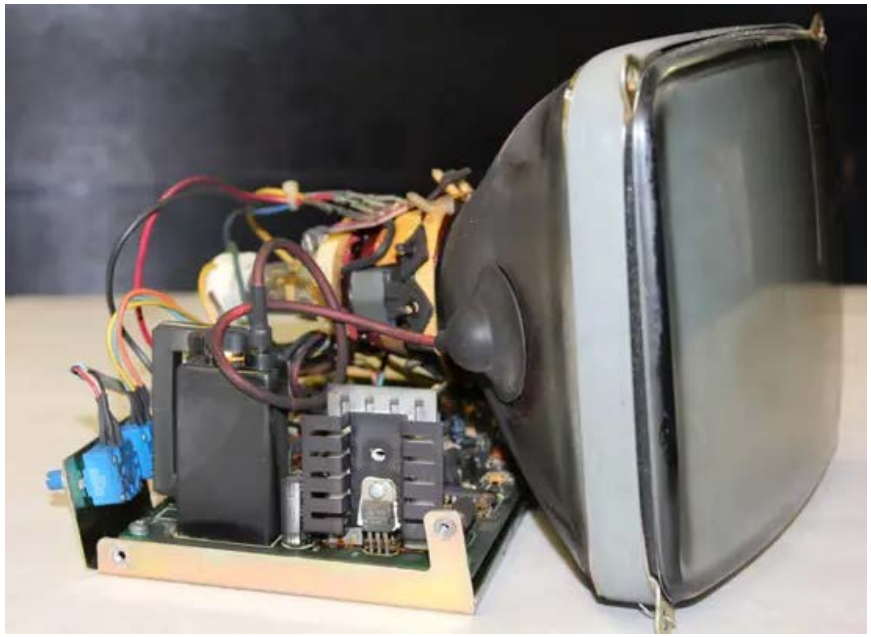


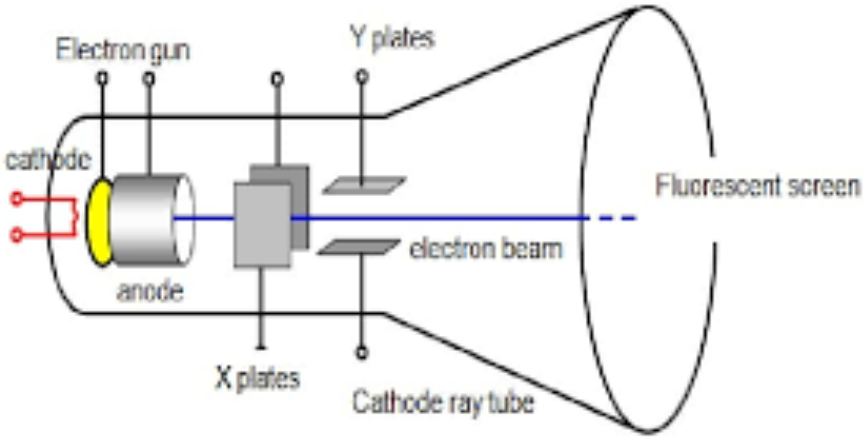
https://youtu.be/N-Sc6k_rlTM?t=853

4.) Future: The Nano Vacuum Tube

Vacuum tubes may make a comeback and replace standard microchips. Engineers have been able to build a structure in phosphorus doped silicon and use nanotubes to build a switch. These devices can operate 10 times faster than silicon transistors.

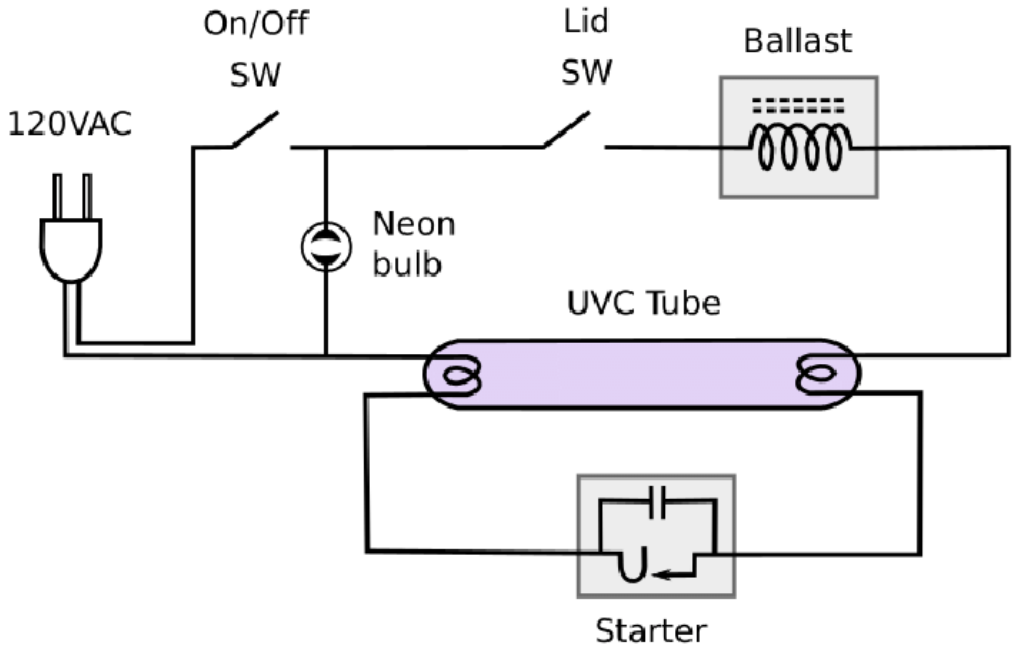
Cathod Ray Tube (CRT)





Activity1.2

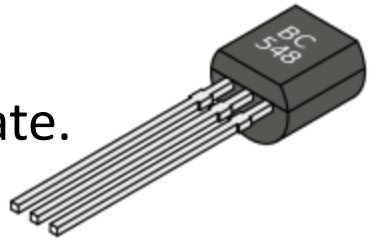
- The fluorescence lamp has two small tungsten coils. Do you know why does the fluorescence lamp generates light? (Discussion)

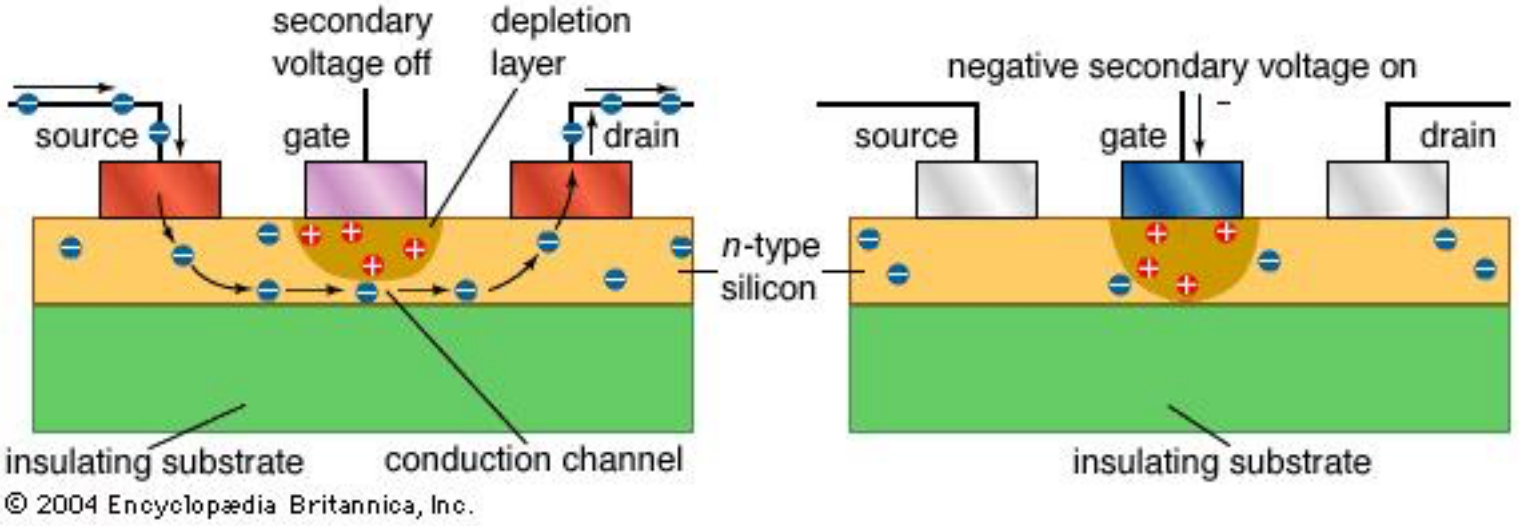


SILICON CHIP

Silicon Transistor

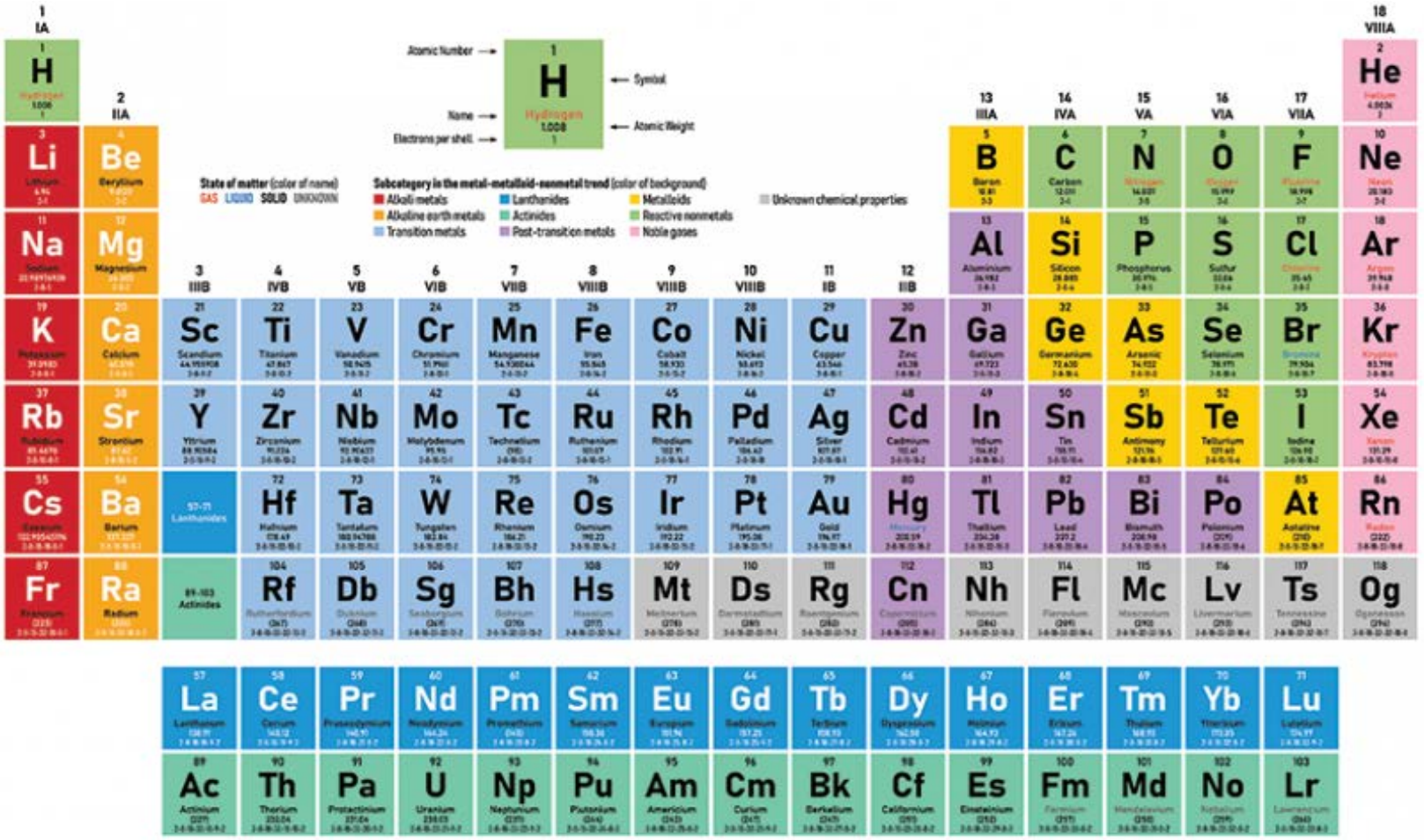
- Semiconductor is created from Silicon[14] and Germanium[32].
- Electron movement from a source pin to a drain pin is controlled by a gate pin.
- SGD pins are installed in a silicon or germanium substrate.





1.1.3 Silicon Transistor

- Where are Silicon, Germanium, Boron, and Antimony on the periodic table?



1.1.3 Silicon chip-making process

- Silicon
  - Make from the ordinary sand, quartz, rock crystal, amethyst, agate, flint, jasper, and opal.

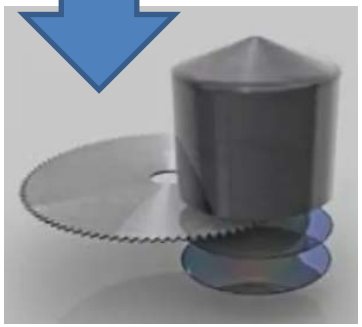
1.1.3 Silicon chip-making process

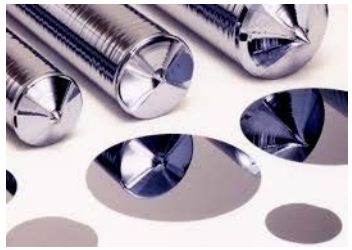
Burn

set

Pure silicon

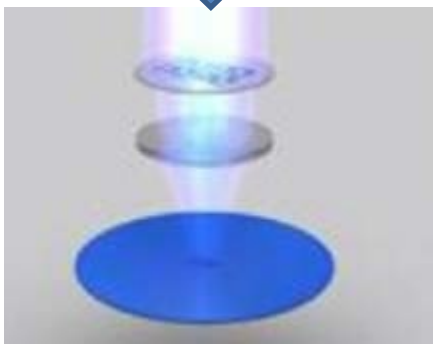
Cut





Wafer

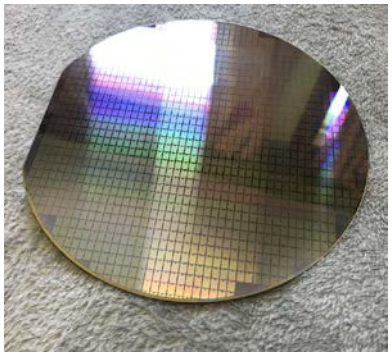
Exposure



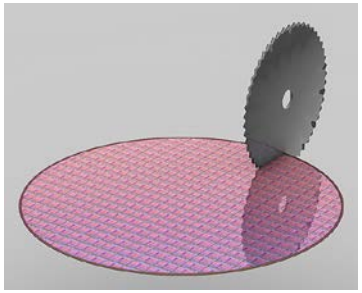
Engineer design circuit

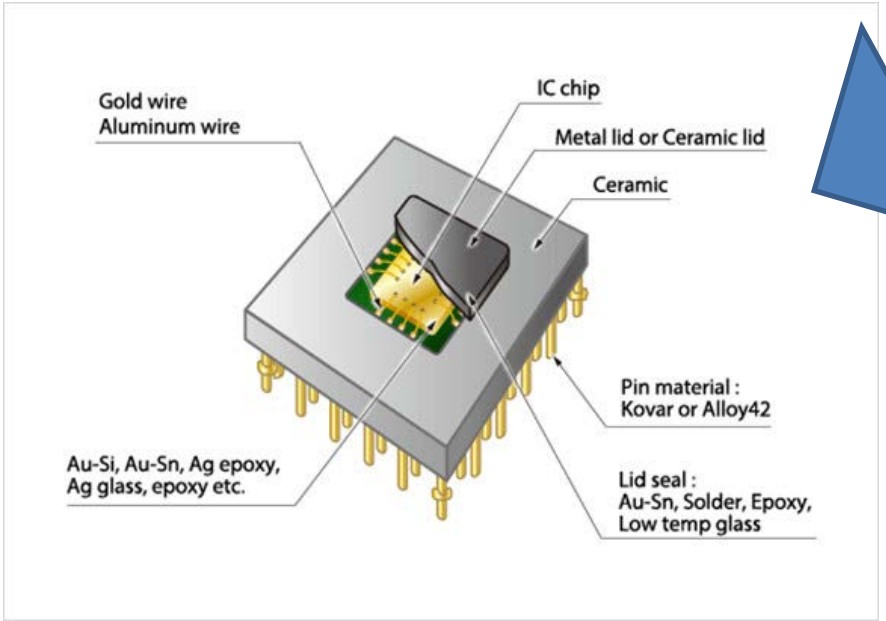
1.1.3 Silicon chip-making process

Expose
build each layer



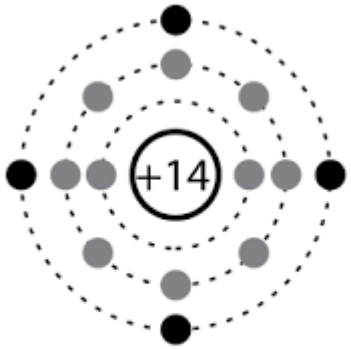
Cut and place
to package



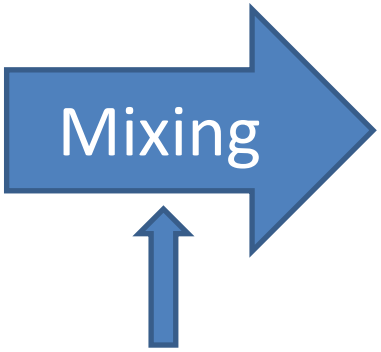


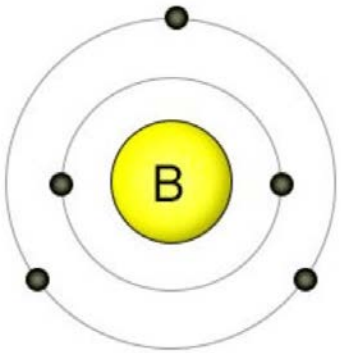
The main point of silicon chip

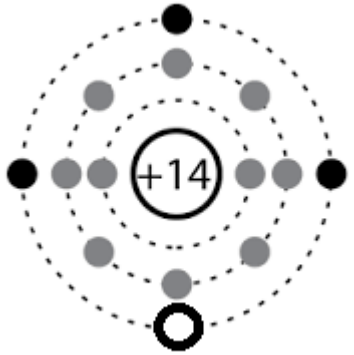
- Change from pure silicon to impure silicon by mixing boron to be P-type



Silicon



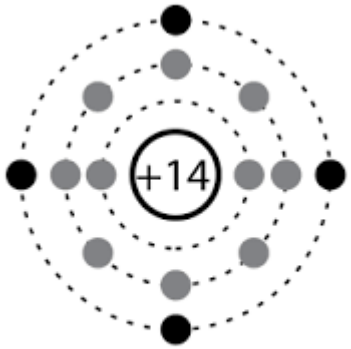




Impure silicon
(P-type)

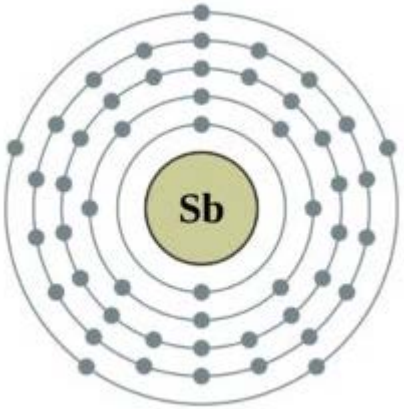
The main point of silicon chip

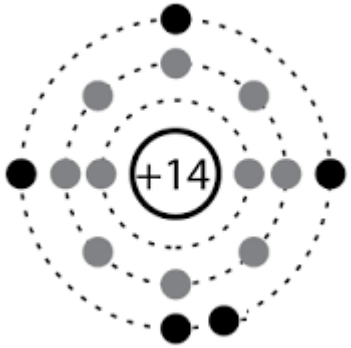
- Change from pure silicon to impure silicon by mixing antimonyแร่พวง to be N-type



Silicon

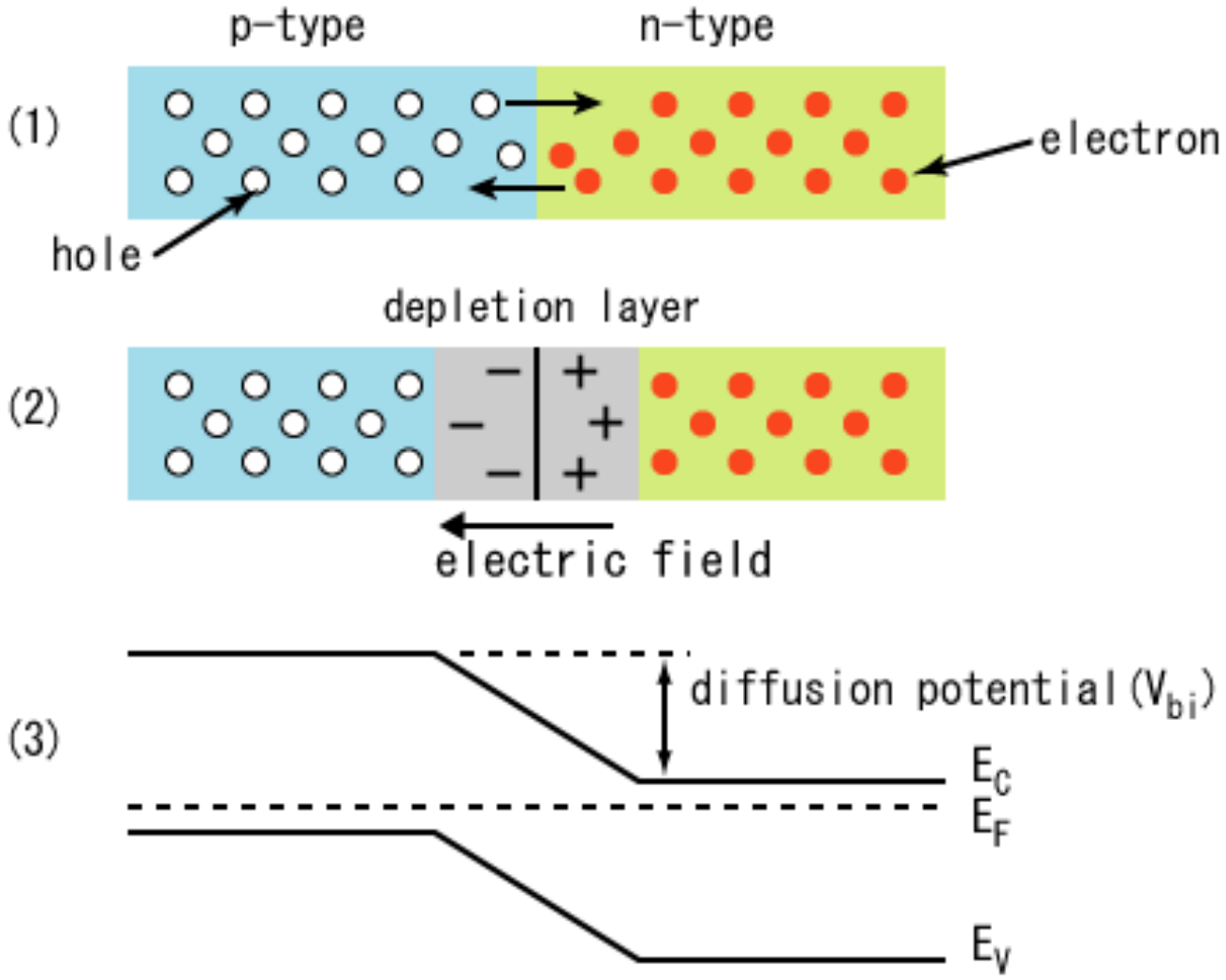
Mixing





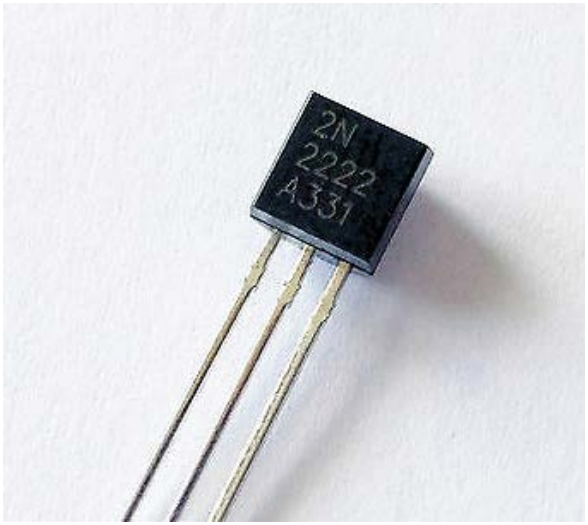
Impure silicon
(N-type)

N-type and P-type



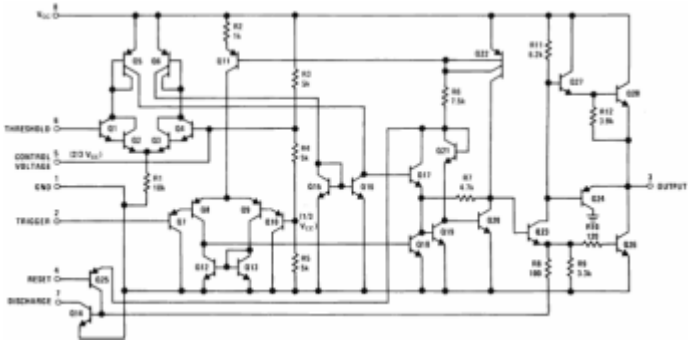
Activity1.3

- Find information or specification of IC or Transistor from Internet.

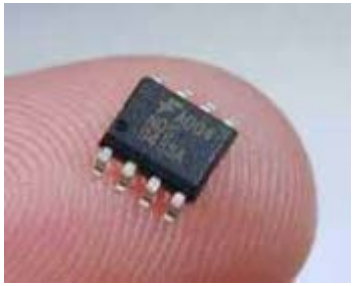


Integrated Circuit

- Discrete Circuit



- Integrated Circuit



Integrated Circuit: Chip Scale

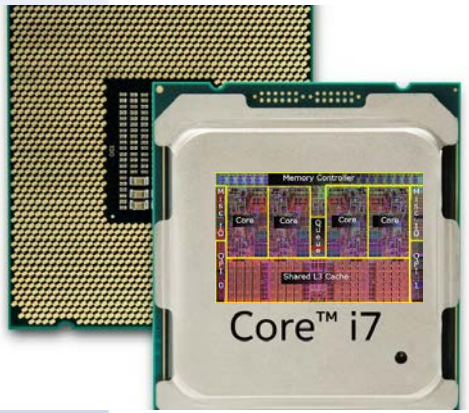
Name	Number of Transistors
Small Scale IC (SSI)	10
Medium SI (MSI)	10 – 1000
Large SI (LSI)	1K – 100K
Very LSI (VLSI)	100K – 1M
Ultra LSI (ULS)	> 1M

Year	Size of the transistor in chip
1971 - 1985	10 µm – 1 µm
1989 - 1999	800nm – 180nm
2001 - 2010	130nm – 32nm
2012 - 2017	22nm – 10nm
App. 2018	7nm
App. 2020	5nm

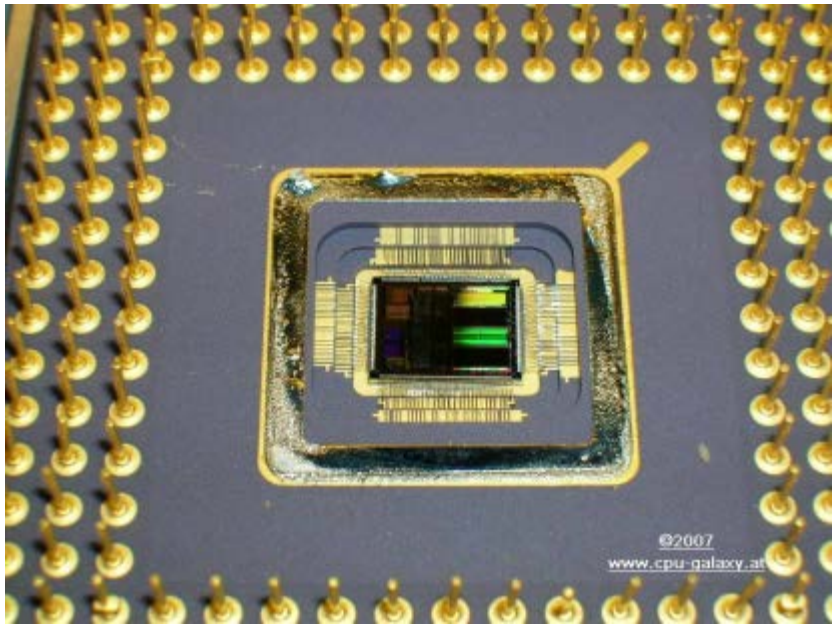
What is the effectiveness when developing small size of the chip?

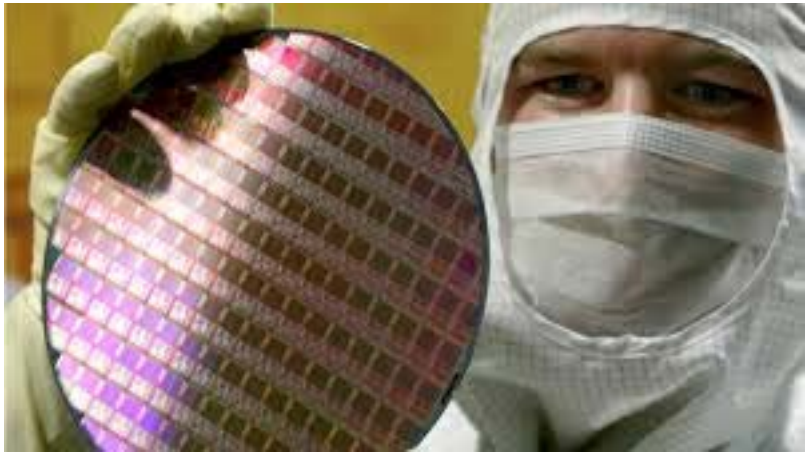
CPU die size

Years	Marketing names	Fabrication process
1971	Intel 4004	10um
1982	Intel 80286	1.5um
1994	Intel 80486	180nm
2004	Pentium IV (Prescott)	90nm
2006	Pentium IV (Cedar Mill)	65nm
2007	Core 2, Dual-core	45nm
2010	Core i3-i7	32nm
2012	Corei3-i7 (ivy bridge)	22nm
≈2014		14nm
≈2016		10nm
≈2018		7nm
≈2020		5nm



Chip

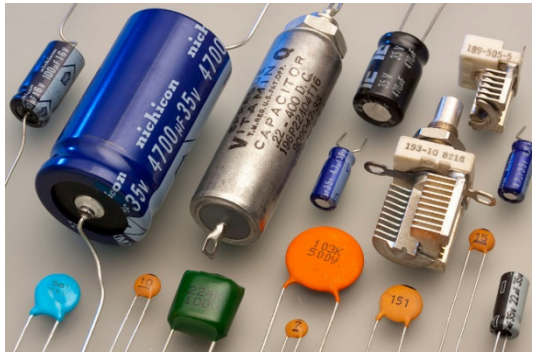


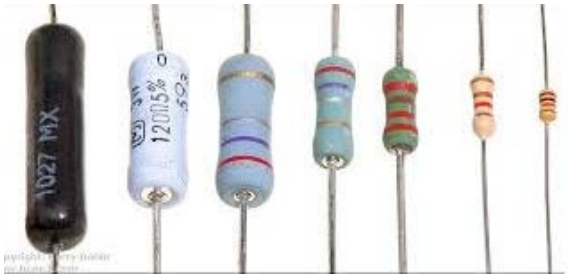


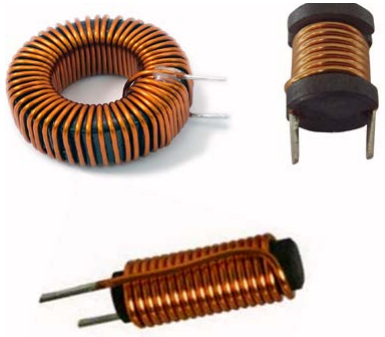
ELECTRONIC DEVICES

Electronic devices

- Passive device
  - Capacitor
  - Resistor
  - Inductor
  - Transformer

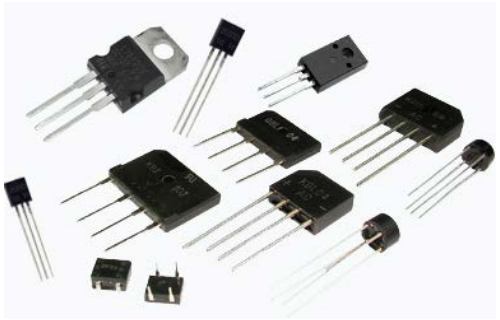


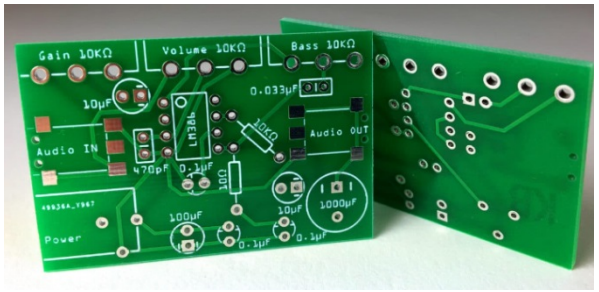




Electronic devices

- Active device
  - Diode
  - Transistor
  - Light Emitting Diode (LED)
  - IC, Chip
- Component
  - Print Circuit Board (PCB)





TYPE OF PROCESSOR

Computer Inside

- Processor
- Main memory
- System bus
- I/O Module

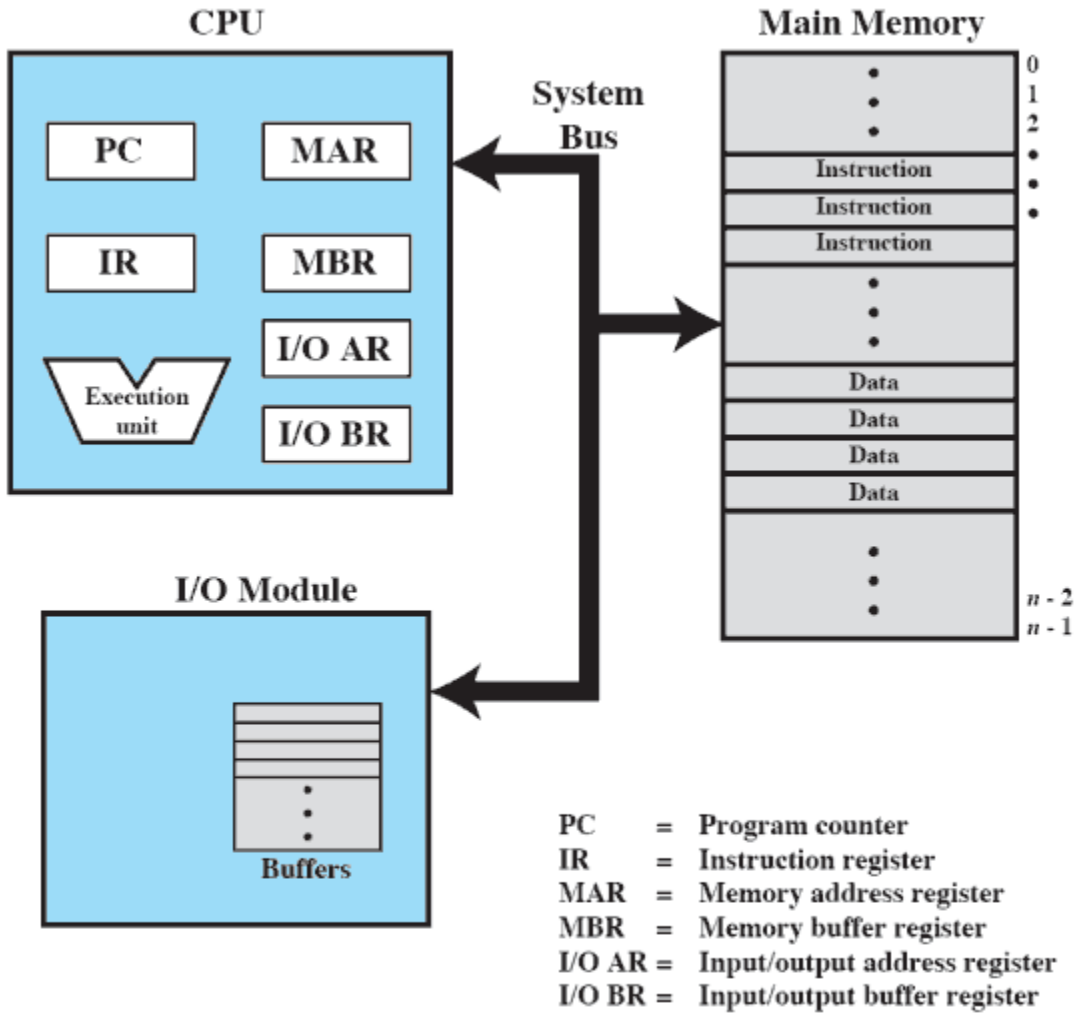
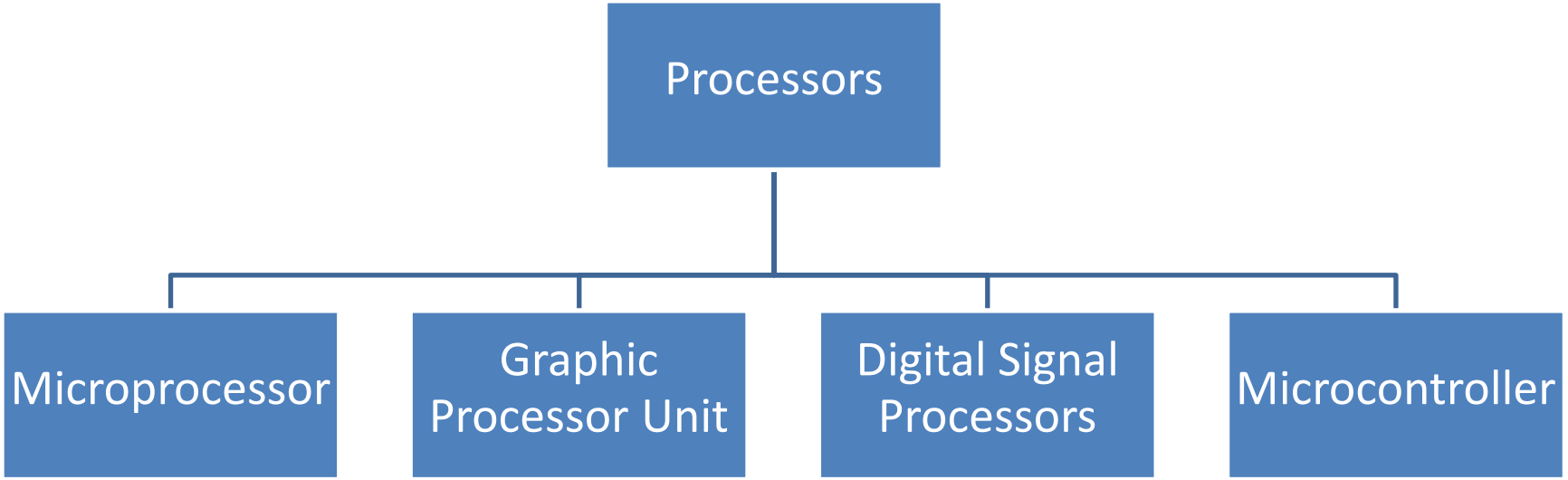
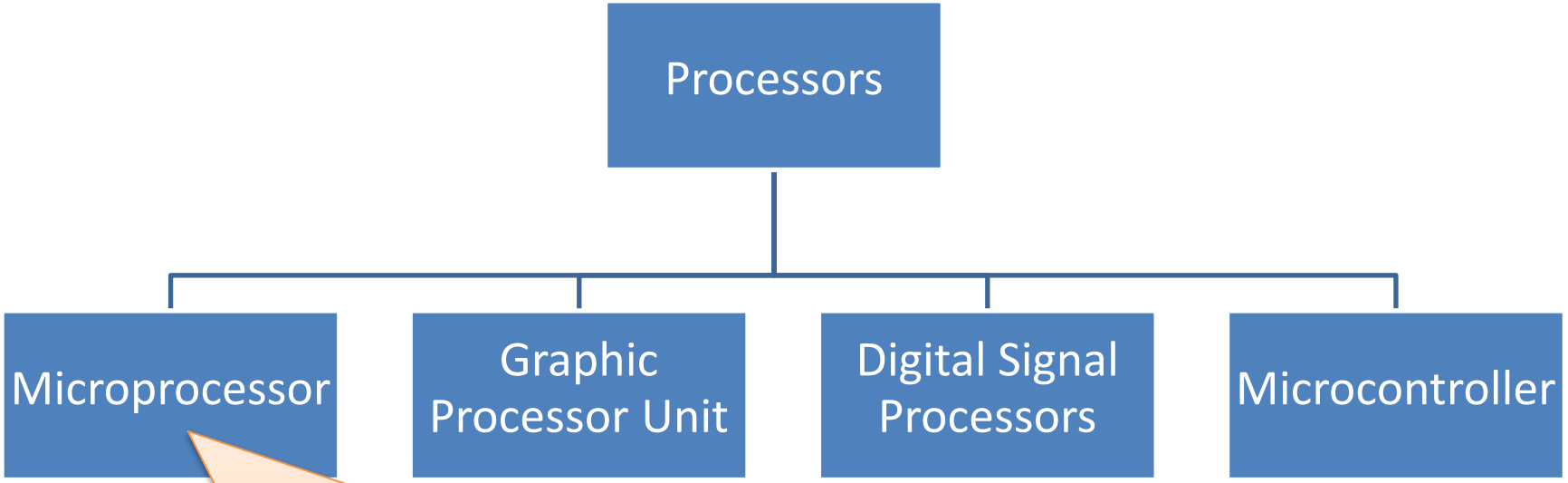
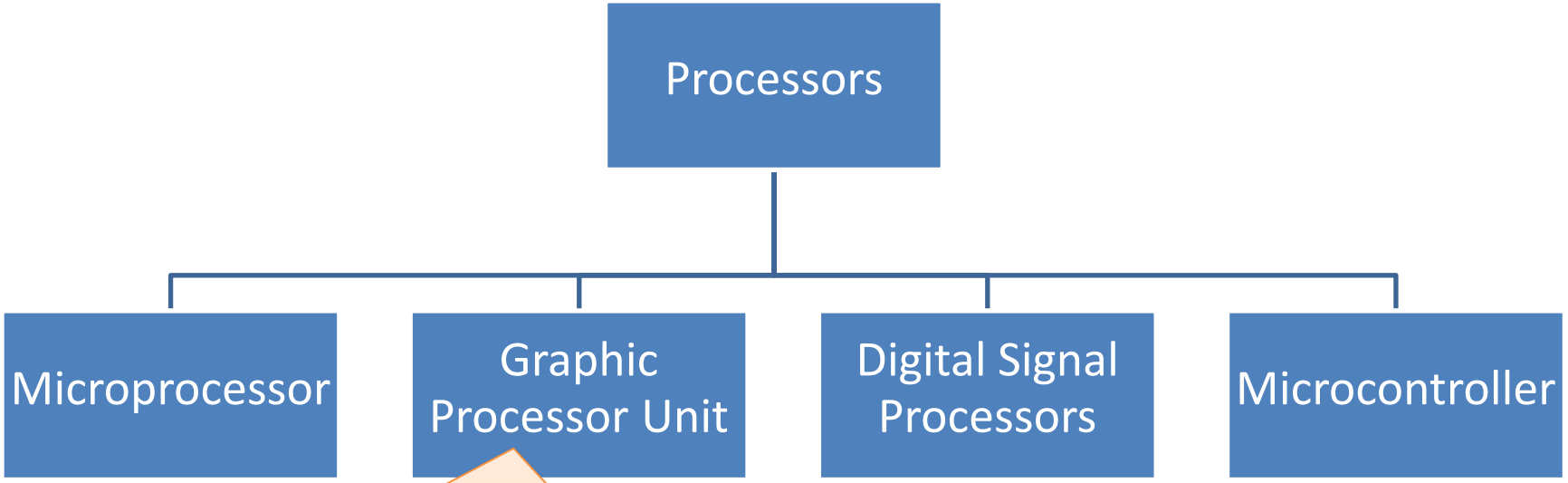


Figure 1.1 Computer Components: Top-Level View

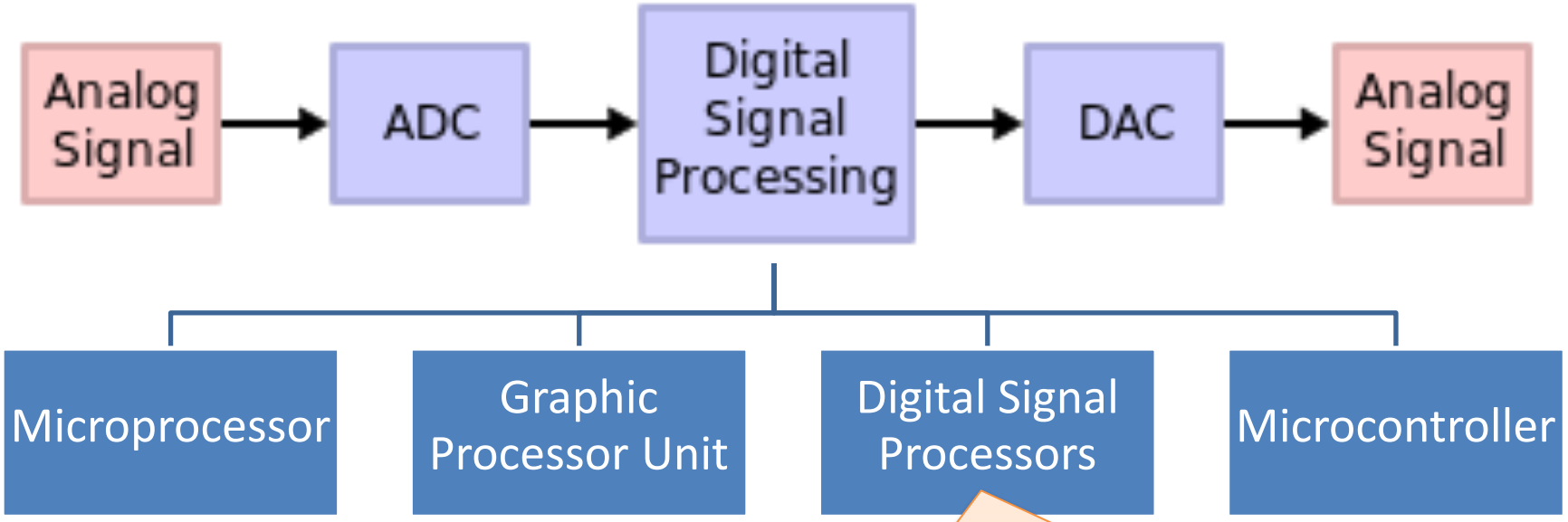

Processors
Microprocessor
Graphic Processor Unit
Digital Signal Processors
Microcontroller



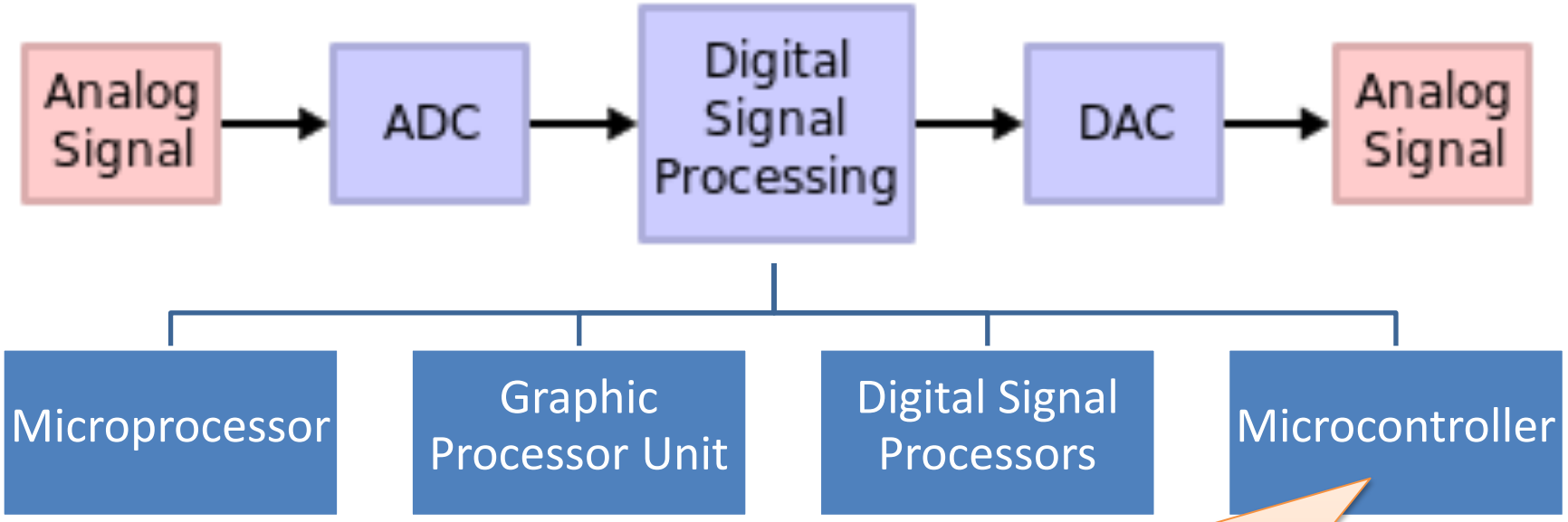
- General instruction set for general works
- No I/O ports directly
- Example
  - x86 CPUs
  - x64 CPUs



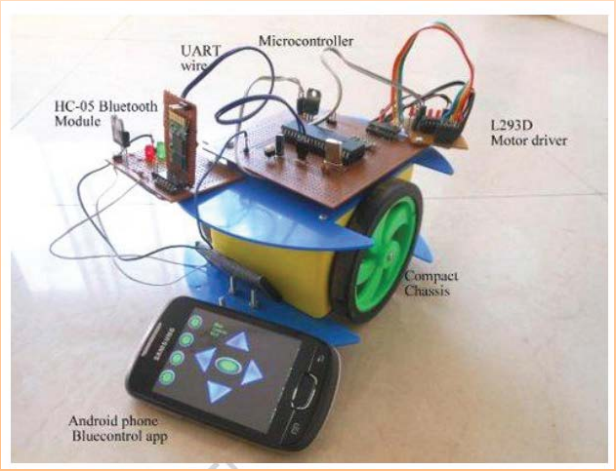
- Specific instruction set for vector and graphic computing and video rendering
- Dual ports memory interface
- Multicores
- Example family chips
  - GeForce, Radeon
  - Quadro, FirePro



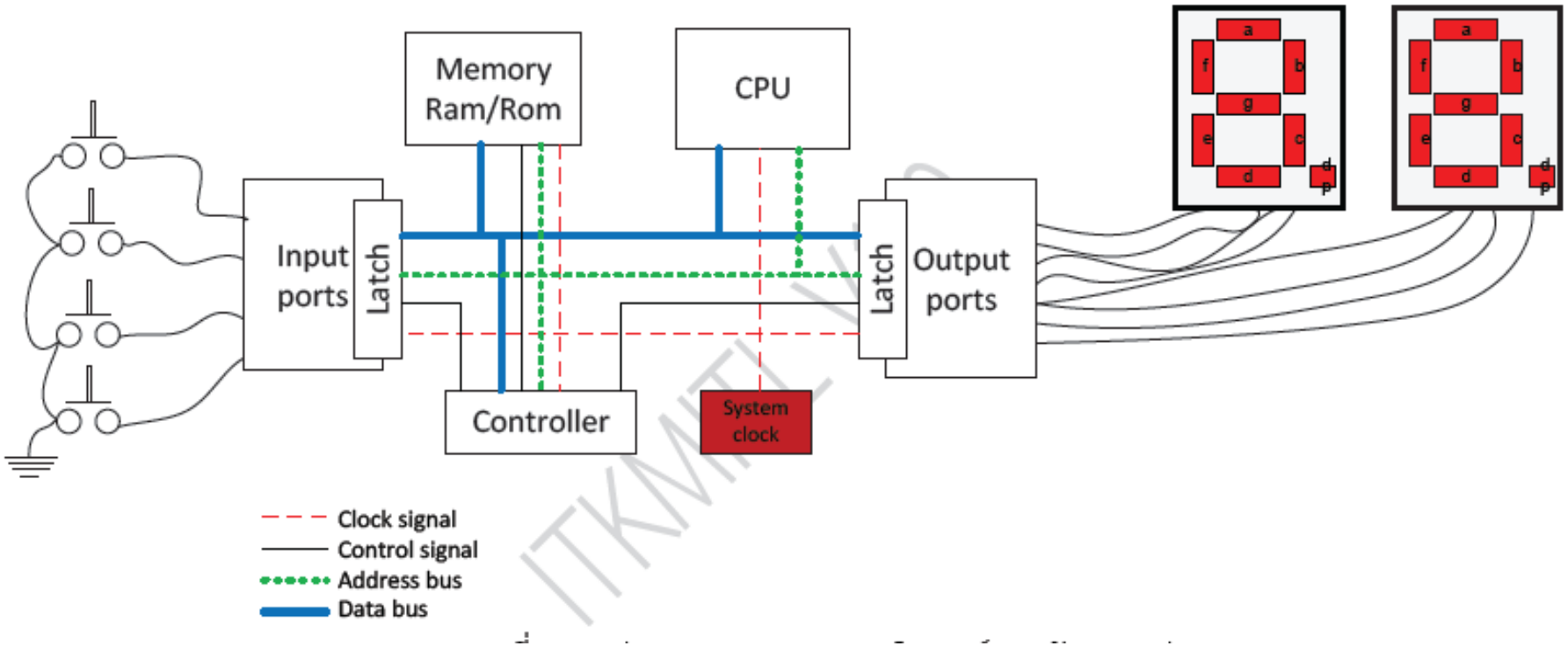
- Specific instruction set for streaming signal
  - Encoding audio/video
  - Decoding audio/video
- Example family chips
  - C6000 (Texas Instrument)
  - SHARC (Analog Devices)
  - EMU10K (Creative)



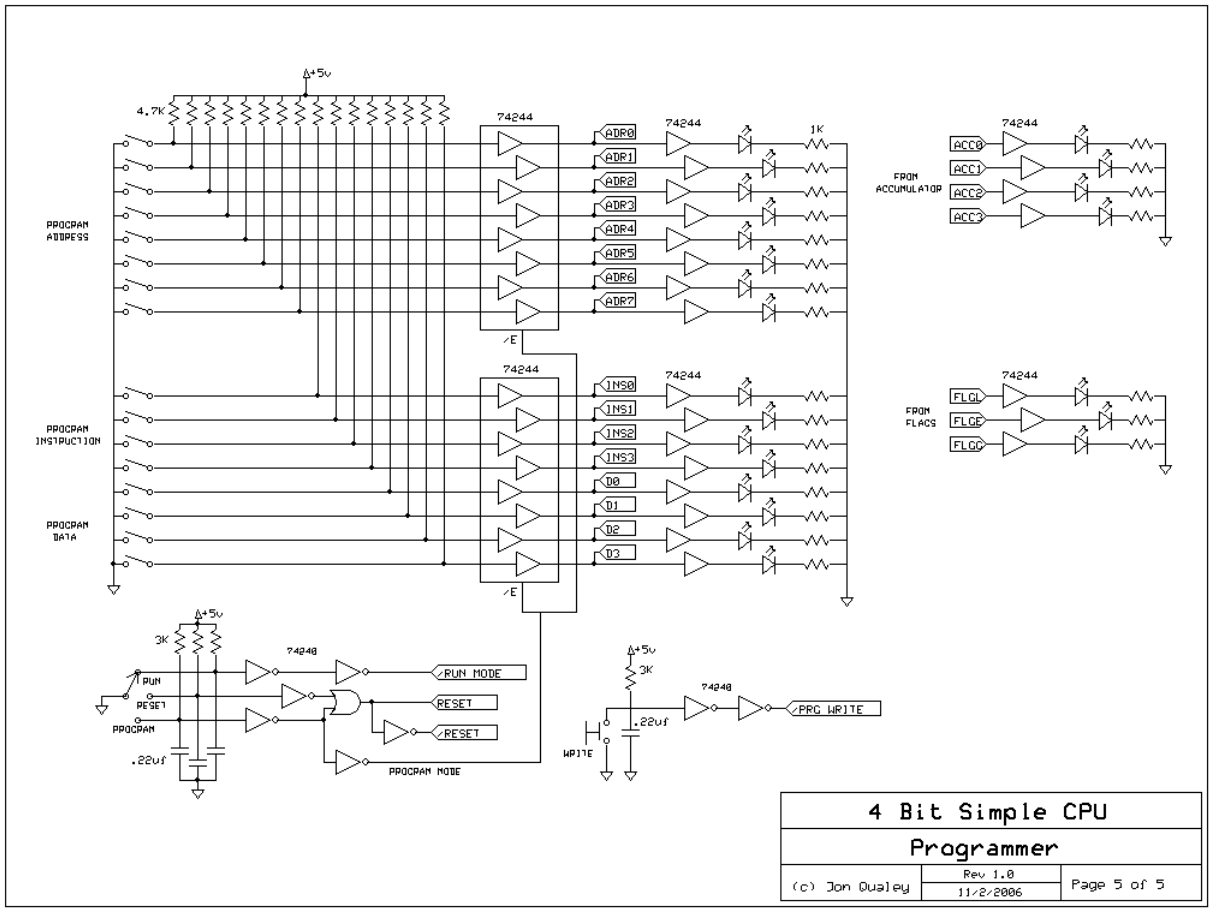
- Specific instruction set for input/output controlling
- I/O ports and timers
- Example family chips
  - PIC
  - MCS-51
  - ARM

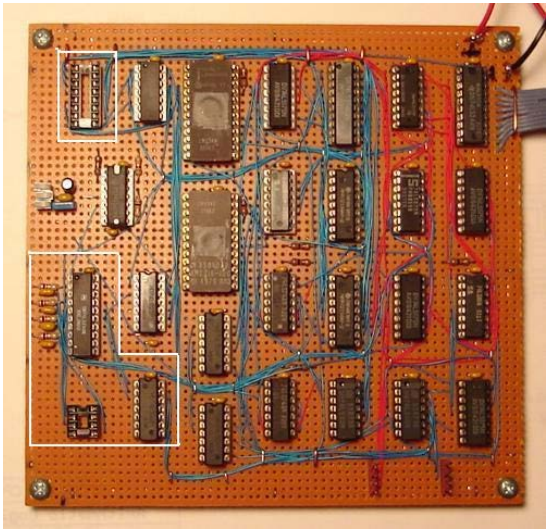


Device Connectivity in the computer



Why does the digital circuit become the computer?





http://www.galacticelectronics.com/4BitCPU_Programmer.HTML

Activity1.4

- Find the CPU specification from the list below with the Internet.
  - Z80
  - 8051
  - 68HC11
  - PIC 16Fxx
  - Arduino
  - 8088
  - 80286
  - 80386
  - Pentium

Summary