

CPU

- * it's an integrated circuit that performs calculations, Arithmetical and logical operations.
- * The central Processing unit is the heart of computers.
- * microProcessor is a term commonly used in a Personal computer, while CPU is used in Embedded.
- * All CPU are micro Processors, but not all microprocessors are CPUs, the micro Processor is the updated version of CPU.
- * CPU contains three basic unit: ALU, CU, and Cache. these units are connected together through buses.

Micro Controller

- * it's an integrated circuit that contains CPU and its peripherals and variety of very important modules such as A/D, Pwm, serial and GPIOs... etc.
- * MCUs are slower than microprocessors, have a smaller memory, tiny power consumption compared with MPUs.
- * the heart of Embedded systems

Embedded Systems

- * As the word "Embedded" suggests, those systems are Embedded inside other electrical, mechanical or even Electromechanical systems, to make these systems smarter, more efficient and environment friendly.
- * for example: The Embedded systems replaced carburettor by Injection system.
- * Sensors to save power in light Poles, they turn light off at morning, turn it on at evening.
- * Generally, the Embedded system contains MCU/ MCUs, sensors and actuators, all of them are connected together to perform a special Purpose.

* Mecha-tronics :

- * A mechatronic system is a combination of Engineering fields, Electronics, Computer and mechanical Engineering which are combined together to create smarter, simpler systems.
- * they deal with robotics, control systems and electromechanical systems.

n-bit Processors

- * for example: 8 bit, 16 bit, 32 and 64 bit Processor.
- * it's the width of instruction, buses and registers inside CPU.
- * it's the number of bits the CPU can process in one instruction.

feature	MCU	MPU
Speed	in MHZ	in GHZ
RAM, ROM, flash	inside Package	connected Externally
Power consumption	Low	medium-high
Purpose	Special	General
cost	Low, medium	high
uses	Embedded systems	Personal computers

ROM

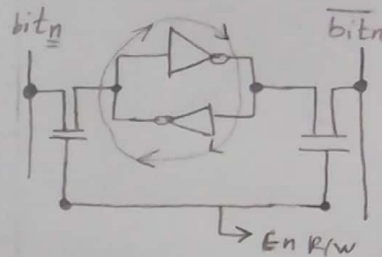
(Read only Memory)

Masked ROM or PROM	EPROM Erasable PROM	EEPROM Electrically EPROM
<p>(Masked) it can be Programmed only once by Manufacturer (OTP PROM)</p> <p>it can be Programmed only once by the user</p>	<p>it can be Programmed and <u>erased</u> many times.</p> <p>to program it we need a programmer to erase it we use <u>uv radiation</u> through it's window</p>	<p>It's like EPROM unless the writing and Erasing Process is done electrically.</p>

Q4

Q5

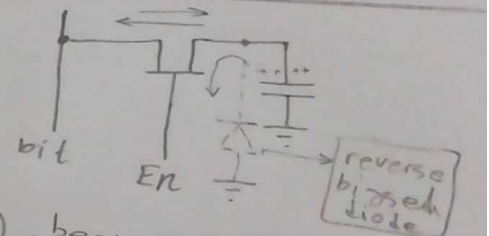
* Static RAM (Random Access Memory)



- it's Read and write Memory
- so expensive because one cell contains 6 transistors.
- does NOT need refresh so it's the fastest RAM type.
- the power loss, the data will be loss.

* Dynamic RAM

Q5

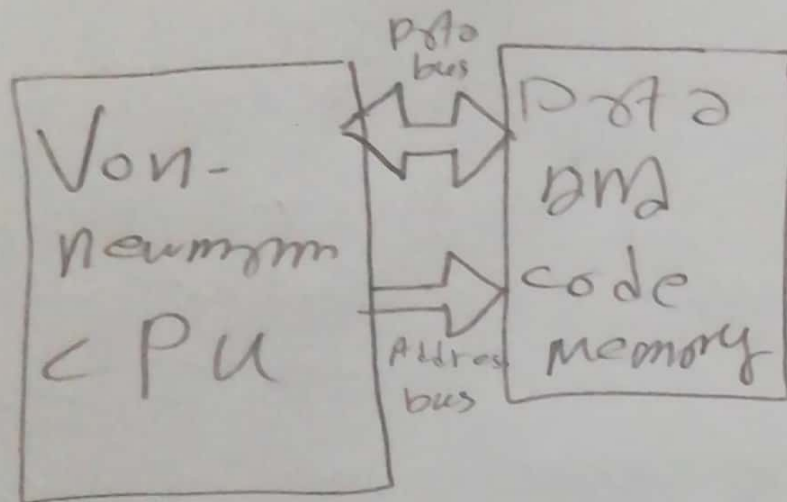


- it's Read and write Memory
- cheap compared with static.
- it needs to refresh Periodically ($\leq 64\text{ms}$), because capacitor inside
- like all RAM mems, the data will be loss when Power is shut off.

Q6

actually, it depends on the type we are talking about!

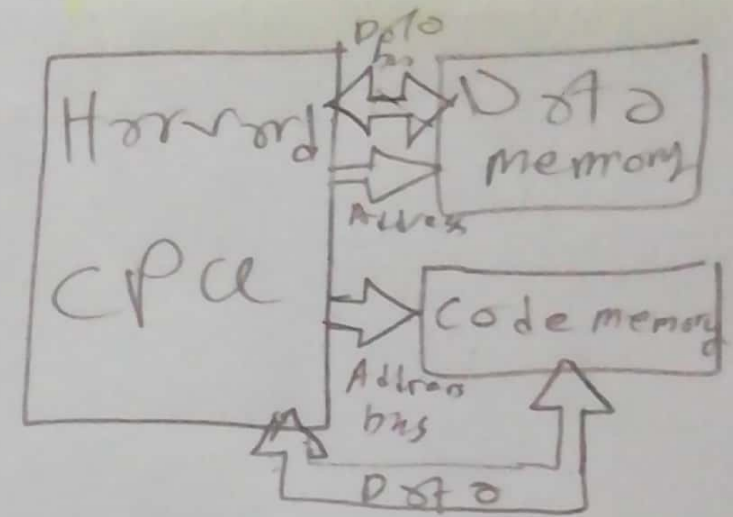
- EEPROM, for Example, we divided it under ROM types because it's non volatile memory.
- PROM can be Program once, then read from forever.



* same buses for Data and code

* less

* code and data are executed serially.



* separate Busses

* costly

* Code and Data are executed in Parallel

type	volatile?	writable?	Erse size	Max Erse cycle	cost	speed
SRAM	✓	✓	Byte	unlimited	EXPENSIVE	fast
DRAM	✓	✓	Byte	unlimited	moderate	Moderate
PROM	X	X <u>only once</u>	X	X	Moderate	fast
EPROM	X	✓	Entire	limtd	Moderate	fast
EEPROM	X	✓	Byte	limtd	EXPENSIVE	R → fast W → slow
flash	X	✓	Page - Sector	limtd	Moderate	R → fast W → slow