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Computer Architecture

Memory

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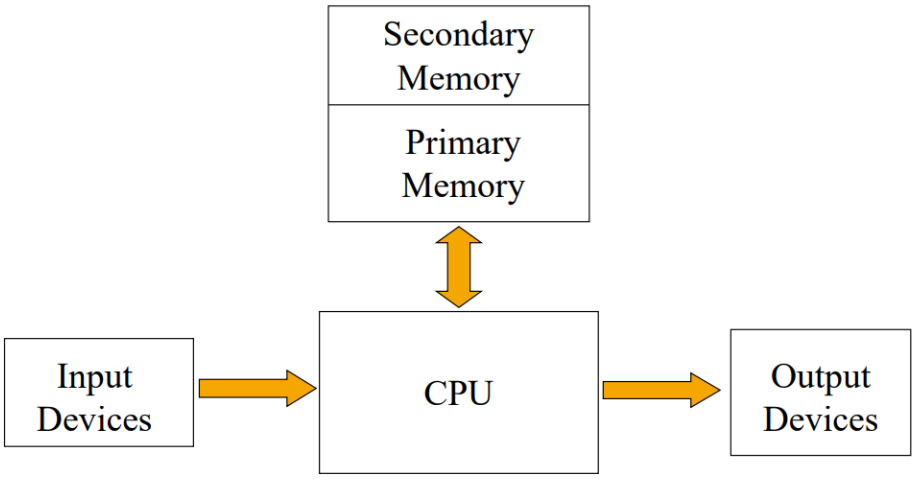
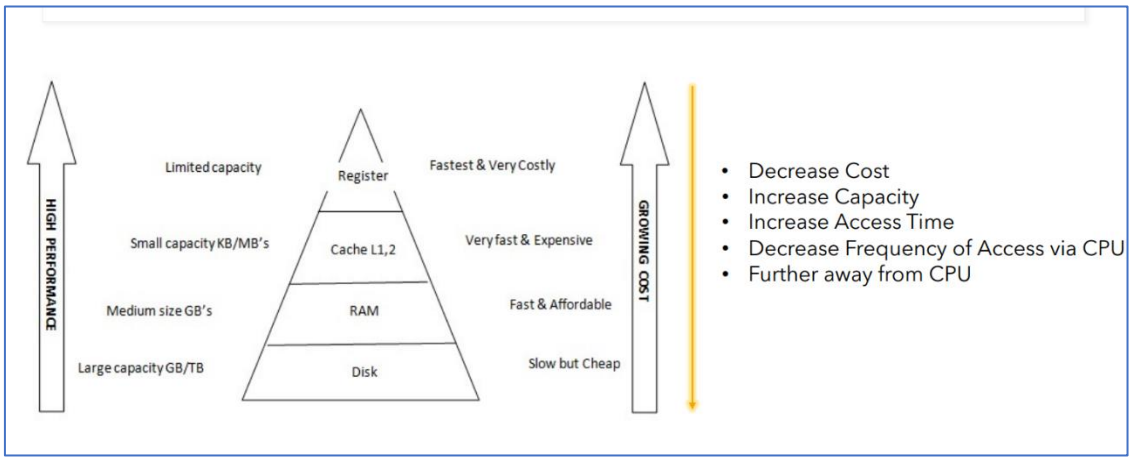
22691

Memory Basics



Memory Hierarchies

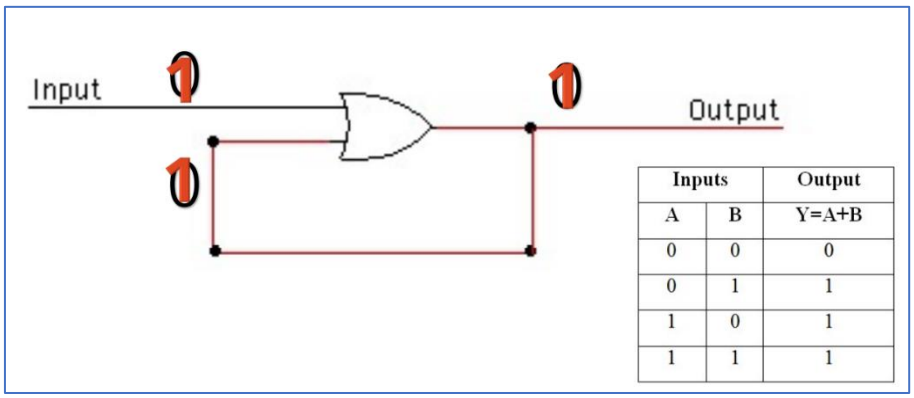


Computer Memory

Memory can be categorized into

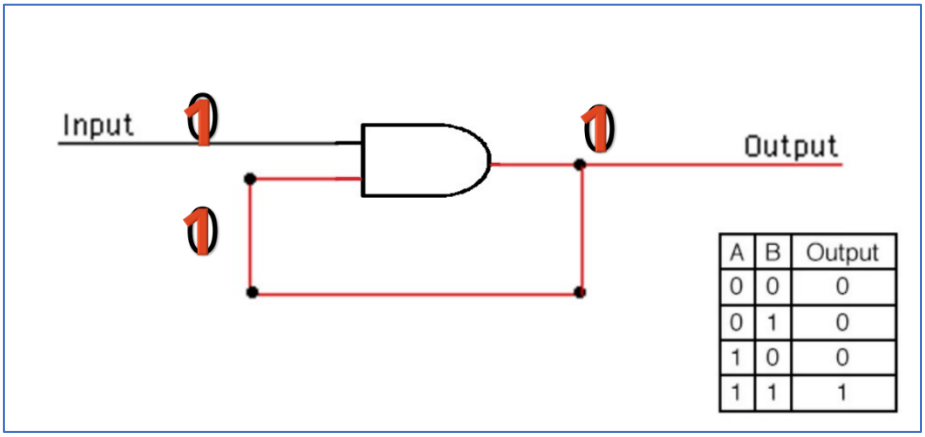
- Registers
    - Registers and primary or main memory are the purely electronic and volatile memory that a computer uses to store current data and code while executing a program or application.
- Primary memory (e.g. cache, main memory)
    - Primary memory works in tandem with the CPU to store data, programs, and processed information that can be made immediately and directly accessible to the CPU or to other system devices.
    - Primary memory also determines the size and number of programs that can be run simultaneously.
- Secondary memory (e.g. disks)

Looped OR gate



Inputs		Output
A	B	Y=A+B
0	0	0
0	1	1
1	0	1
1	1	1

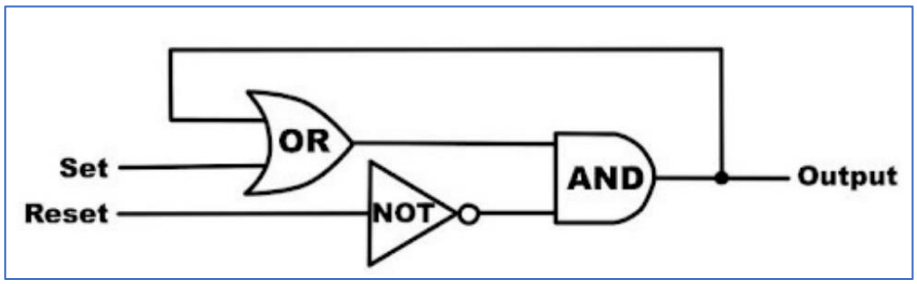
Looped AND gate



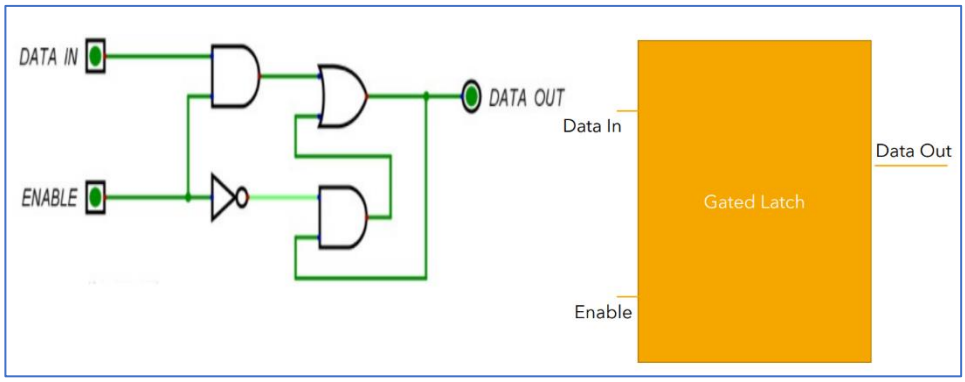
A	B	Output
0	0	0
0	1	0
1	0	0
1	1	1

AND OR Latch

- Called as Latch a circuit as it retains whatever output state results from a momentary input signal until reset by another signal.
- Putting data into the memory is called “writing”
- Fetching the data out from it called “Reading”



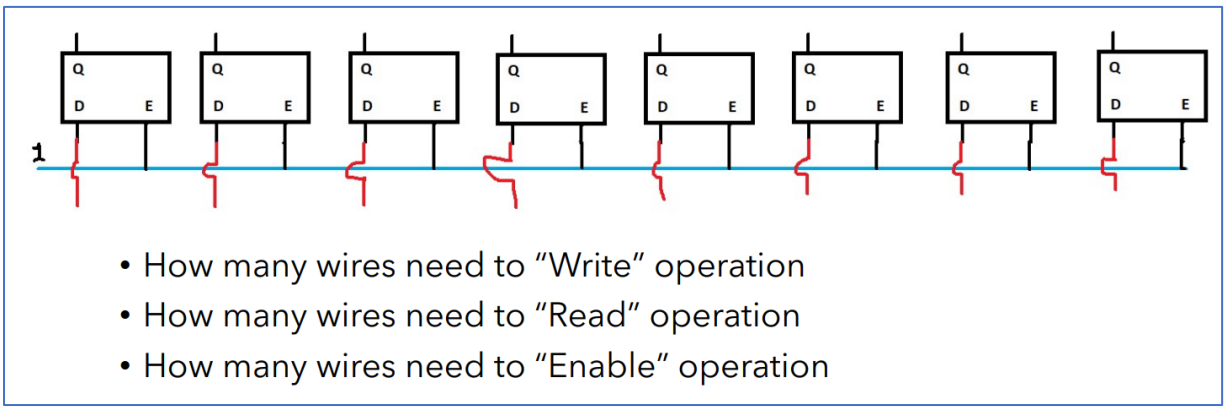
Gated Latch

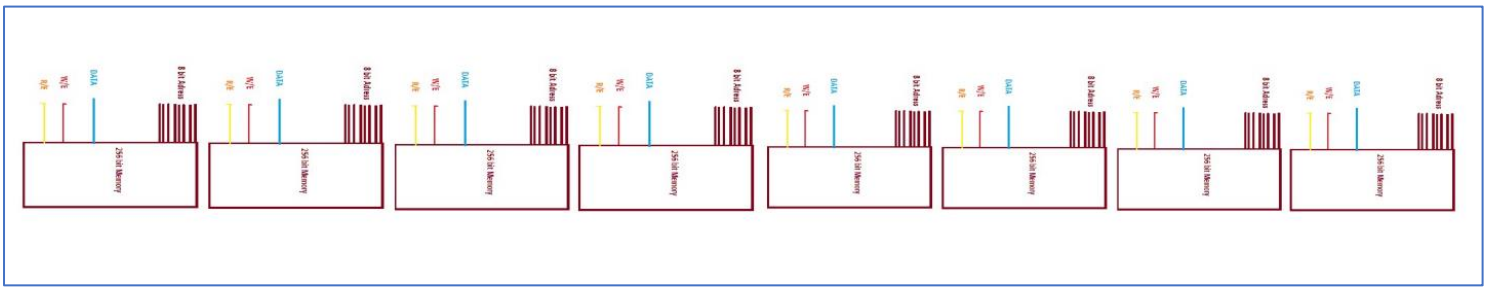


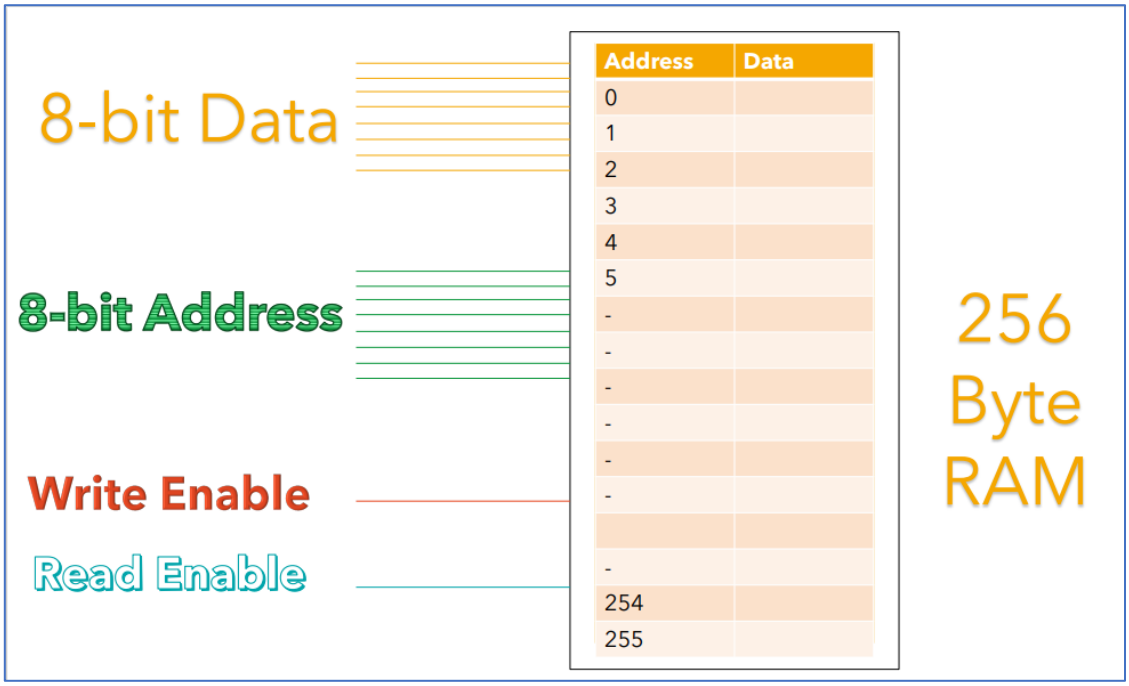
Register

- Group of latches combined.
- Can store a single number.
- number of latches / bits is called the width of that register
    - 8-bit registers
    - 16-bit registers
    - 32-bit registers
    - 64-bit registers

8-bit register



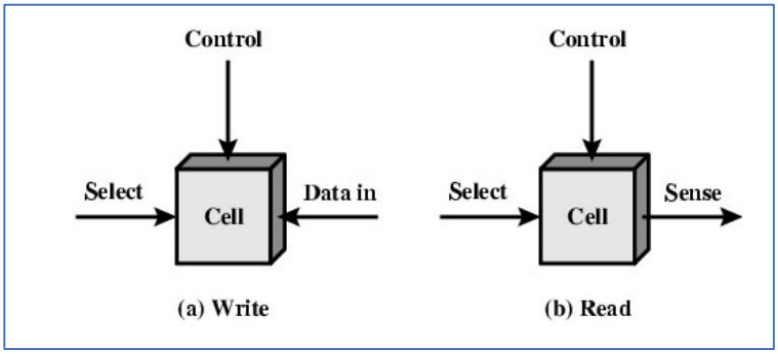




- SRAM (Static RAM)
- A gigabyte is 1,073,741,824 bytes

Primary Memory

- Computer's primary memory is arranged as a matrix of memory.
- cells" laid out in rows and columns, like squares on a checkerboard.



Write Operation

- Select the Memory Cell :- Address Bus
- Data-in :- Data Bus
- Write Signal :- Control Bus

Read Operation

- Select the Memory Cell:- Address Bus
- Read Signal:- Control Bus
- Sense the data:- Data Bus

Number of addresses = $2^{\text{Address bus width}}$

Capacity of memory = Number of addresses x Data bus width

Calculate the capacity (Size) of the memory

If, Address bus width= 8 bits

Data bus width= 8 bits

Calculate the capacity (Size) of the memory

If, Address bus width= 8 bits

Data bus width= 8 bits

Prefixes

- 2^{10}= k
- 2^{20}= M
- 2^{30}= G
- 2^{40}= T

Calculate the capacity of a memory

If, Address bus width= 32 bits

Data bus width= 8 bits

In a memory there are 16M addresses. What is the width of the address bus?

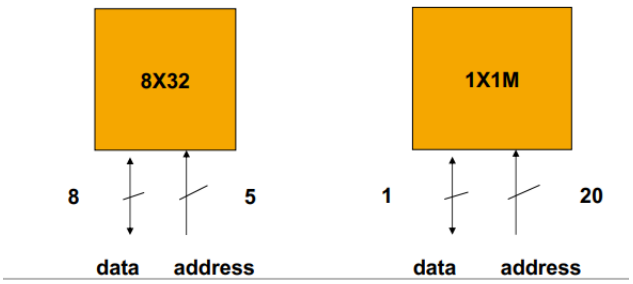
Calculate the capacity of a memory

If, no of address= 8M

Data bus width= 8 bits

RAM/ROM Naming Convention

- Examples 8X32, 8 by 32 →32 addresses 8-bit words
- 1X1M, 1 by 1M → 1M addresses 1-bit words

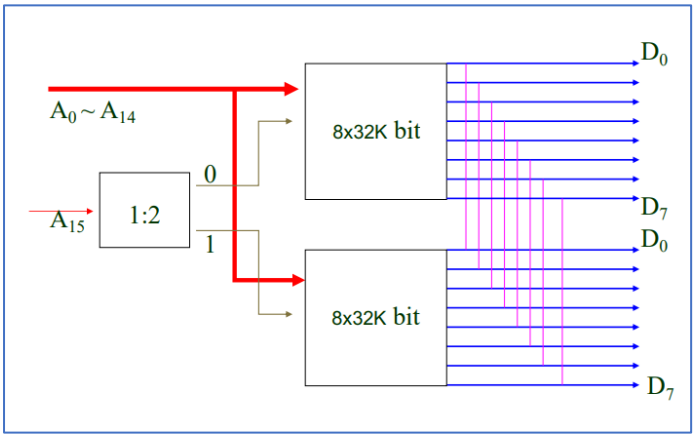


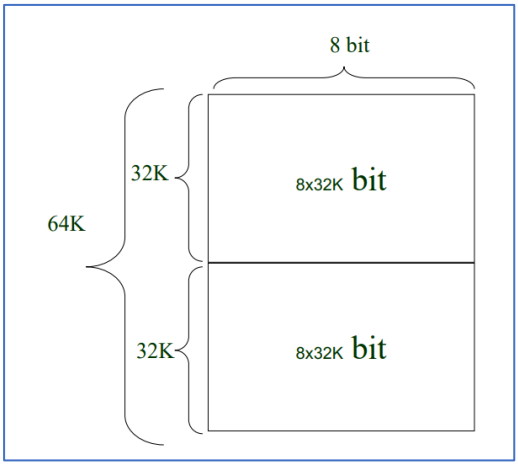
Memory Expansion

This refers to the construction of a larger memory in the sense of memory address space (No of memory locations) or word length.

Address Expansion

Ex1: Construct 8x64K memory using 8x32K units



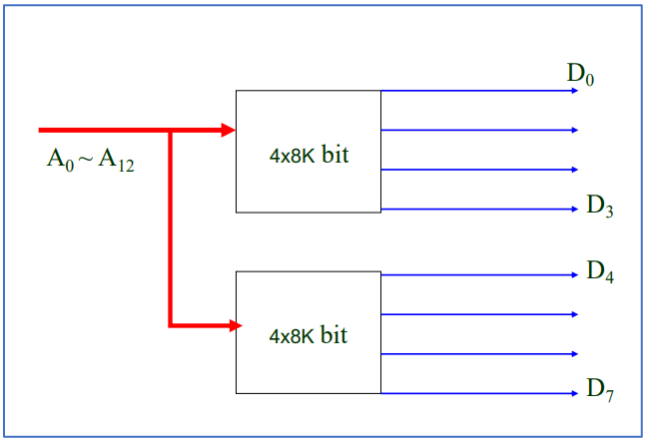


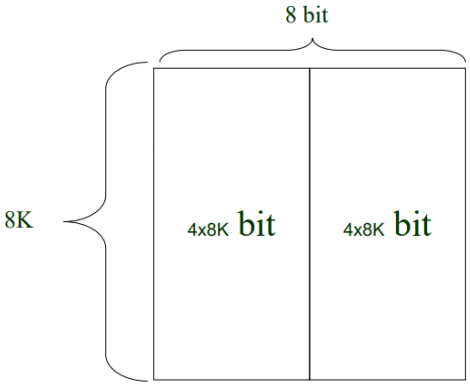
Ex2: Construct 4x32K memory using 4x8K units

Ex3: Construct 2x64K memory using 2x8K units

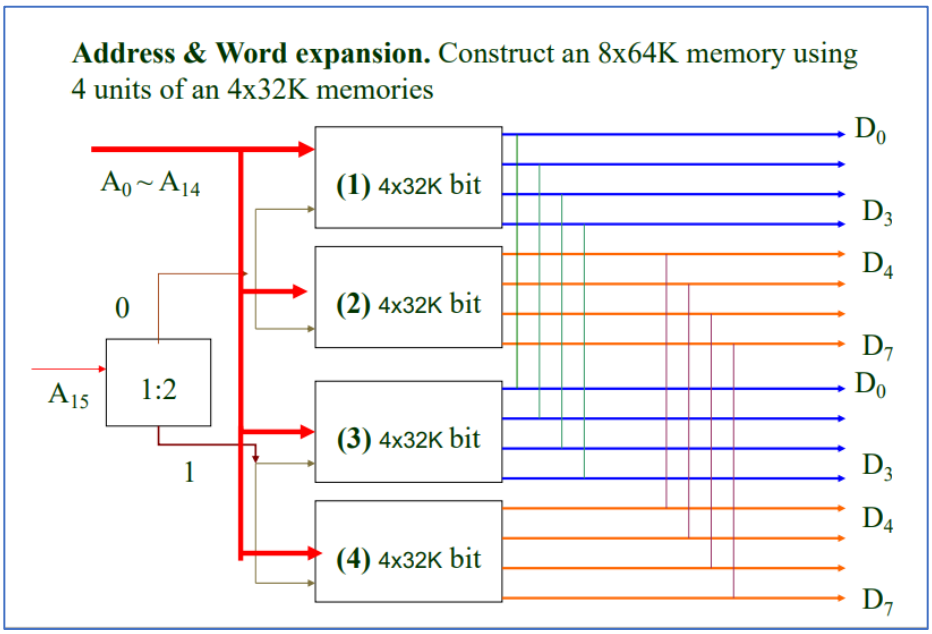
Word expansion.

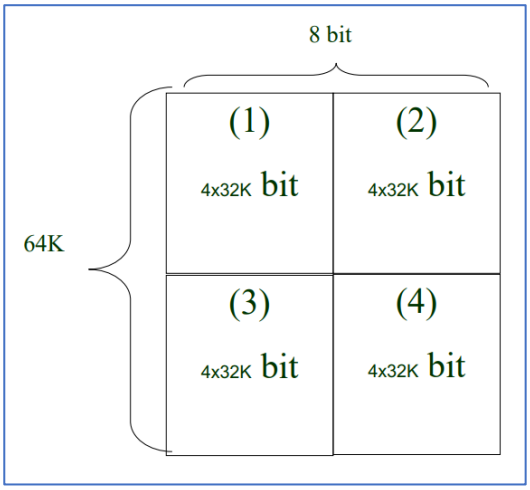
Construct an 8x8K bits memory using units of an 4x8K bits memories.





Construct an 4x8K memory using units of an 1x8K memories





Construct an 8x32k memory using 4x16k memories

Construct an 8x16K memory using 4x4k memories

Construct 2x64K memory using 2x16K units

Construct an 4x8K memory using units of an 1x8K memories

Construct an 4x16K memory using 1x4k memories