

Computer System Architecture
COMP201Th
Lecture: 16
Memory Unit

A memory unit is a collection of storage cells together with associated circuits needed to transfer information in and out of storage.

- The memory stores binary information in groups of bits called words.
- A word in memory is an entity of bits that move in and out of storage as a unit.
 - A memory word is a group of 1's and 0's and may represent a number, an instruction code, one or more alphanumeric characters and any other binary-coded information.
 - A group of 8 bits is called a byte.
- Computer memories may range from 1024 words, requiring an address of 10 bits to 2^{32} words, requiring 32 address bits.
 - It is customary to refer to the number of words (or bytes) in a memory with one of the letters K(kilo), M(mega), or G(giga).
 - $K = 2^{10}$
 - $M = 2^{20}$
 - $G = 2^{30}$

Two major types of memories are used in computer systems:

- **Random Access Memory (RAM)**
- **Read Only Memory (ROM)**

Random Access Memory (RAM):

In RAM, the memory cells can be accessed for information transfer from any desired random location i.e. the process of locating a word in memory is the same and requires an equal amount of time no matter where the cells are located physically in memory.

A block diagram of a RAM unit is shown below:

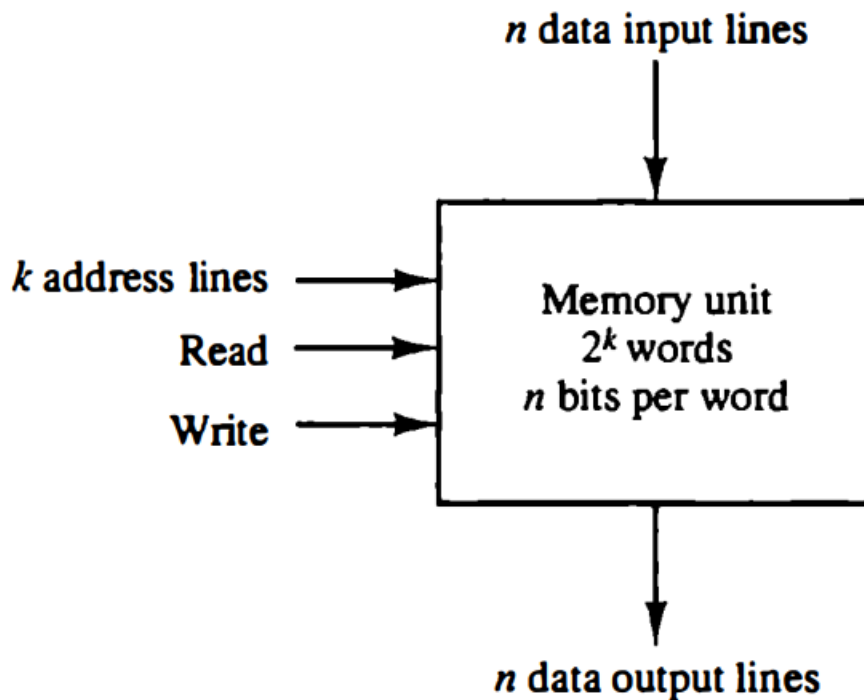


Fig: Block diagram of Random Access Memory (RAM)

- The n data input lines provide the information to be stored in memory.
- The n data output lines supply the information coming out of memory.
- The k address lines provide a binary number of k bits that specify a particular word chosen among 2^k available inside the memory.
- The two control inputs specify the direction of transfer desired.
 - The write signal specifies a transfer-in operation and the read signal specifies a transfer-out operation.

Q: Calculate number of memory chips needed to design 8K byte memory, if the memory chip size is 1024×1 ?

Ans: No of chips required = Total memory size / Size of one memory chip

$$= 8\text{Kbyte} / 1024 \times 1$$

$$= (8 \times 1024 \times 8) / 1024 \times 1 = 64 \text{ chips}$$

Read Only Memory (ROM):

ROM performs only the read operation i.e. it does not have a write capability. This implies that the binary information stored in a ROM is made permanent during the hardware production of the unit and cannot be altered by writing different words into it.

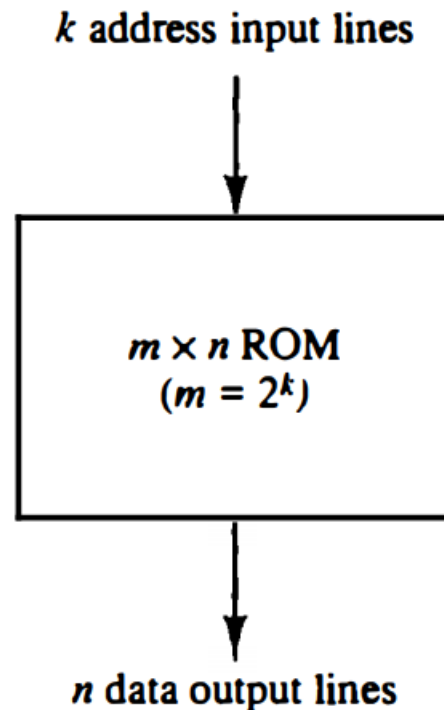


Fig: Block diagram of ROM

- An $m \times n$ ROM is an array of binary cells organized into m words of n bits each.
- ROM has k address input lines to select one of $2^k = m$ words of memory and n output lines, one for each bit of the word.
- A ROM is constructed internally with decoders and a set of OR gates. There is no need for providing storage capabilities as in a RAM, since the values of the bits in the ROM are permanently fixed.