

Chapter 14

Memories

SKEE1223 Digital Electronics

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Memory

Memory

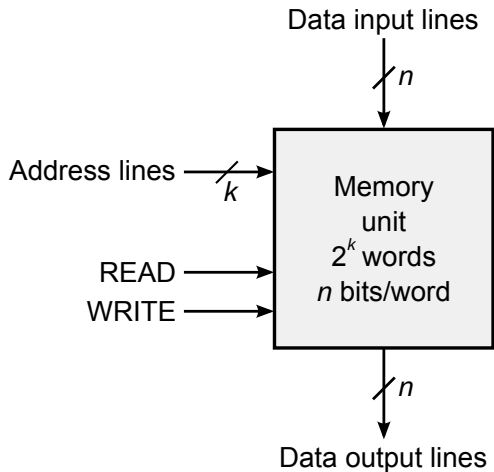
Memories are devices to which binary information is transferred for storage, and from which information is available for processing as needed

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

Memory

	RAM	ROM
Stands for	Random Access Memory	Read-Only Memory
Use	Stores currently active program and data	Stores the program required to initially boot the computer.
Volatility	Volatile: i.e. its contents are lost when the device is powered off.	Non-volatile: i.e. its contents are retained even when the device is powered off.
Changeability	Can be changed or deleted (read/write)	Cannot be changed (read-only)

Memory Simplified

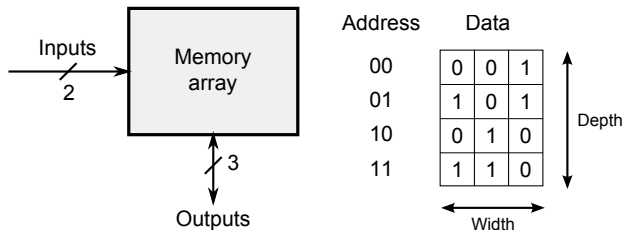


Memory Simplified

Memory Word

- A word is a group of bits transferred at the same time through n data lines.
- Location of each word (address) is identified by m address lines.
- Number of addresses is 2^m numbered from 0 through $2^m - 1$.

4 × 3 Memory Array



- 4 × 3 memory means:
 - $m = 2 \rightarrow 2$ address lines
 - #locations = $2^m = 4$
 - Addresses are 00, 01, 10 and 11 (0 thru 2^2-1)
 - $n = 3 \rightarrow 3$ bits per location
 - #bits stored = $4 \times 3 = 12$

RAM Types

SRAM – Static RAM

Store info in latches. Stored info stays until powered in cut off. Typically 4 to 6 transistors per bit.

DRAM – Dynamic RAM

Stores info in capacitors. Capacitors need recharging by dedicated refresh circuit.

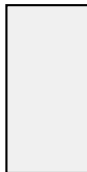
Read/Write Memory Compared

$2^k \times n$ memory implemented as:

Register
file



SRAM



DRAM



Type	Speed	Cost
Register file	Fastest	Most expensive
SRAM	Fast	Expensive
DRAM	Slow	Cheap

ROM Types

Acronym	Stands for
MROM	Mask programmed Read-Only Memory
PROM	Programmable Read-Only Memory
EPROM	Erasable Programmable Read-Only Memory
EEPROM	Electrically-Erasable Programmable Read-Only Memory

ROM Compared

Parameter	MROM	PROM	EPROM	EEPROM	Flash
Field-programmable		✓	✓	✓	✓
Reprogrammable			✓	✓	✓
Erasability level			Chip	Byte	Block
Erase Cycle			5-30 min	5-50 ms	>100 ms
Write Cycle	Weeks	Minutes	Minutes	1-10 ms	< 100 μ s
Programming site	Factory	Burner	Burner	In-system	In-system