

CS101 Introduction to Computing Lec-5 Memory Memorabilia – Marching ahead

Memory Recap!

Address Bus



Memory
chip

Control Bus



Data bus -
Bidirectional



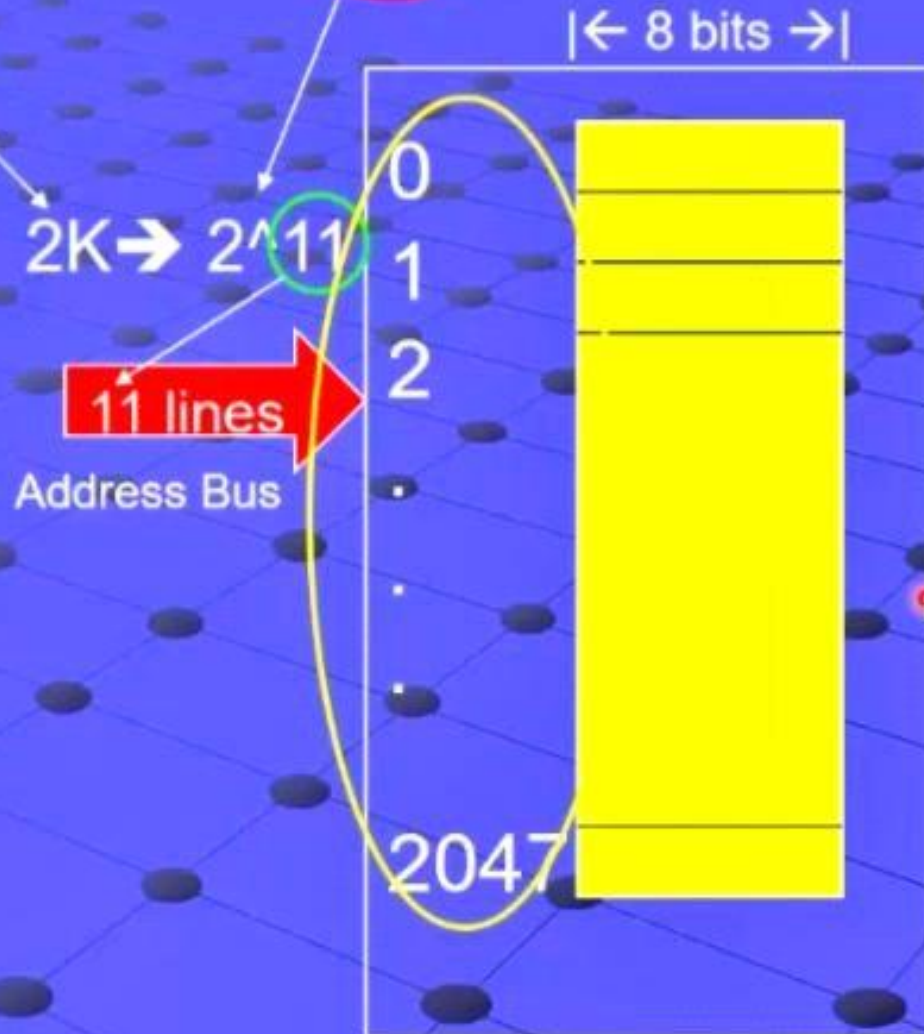
- 2KB \rightarrow 2048 x 8 (Has 2048 words each 8-bit wide)
- For every word to have a unique address this memory needs to have 2048 unique addresses (nos.)
- The number of bits required to generate 2048 unique addresses is thus 11.
- Why is that so? B'cos $2^{11} = 2048$
- So if we have n bits we can generate 2^n unique addresses.
- It also means that if a memory has say 2048 words, then it has an address bus whose width (no. of lines within this bus) is 11

E.g. Address Bus

2048x8 or 2KB

There are 2048 memory locations.

Address lines are thus 11 in number as a 11-bit address is required to select one of out of 2048 locations in the memory



E.g. Data Bus 2048x8 or 2KB

Each location within this memory can store 8 bits.

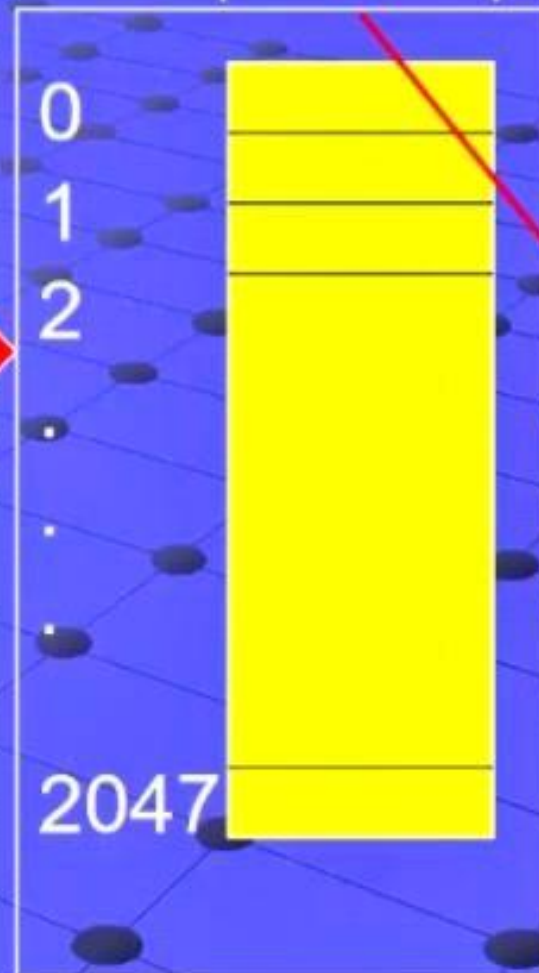
So we need to read or write 8 bits of information at a time.

The Data bus therefore has 8 lines.

Address Bus

11 lines

← 8 bits →



8 bits
Data bus -
Bidirectional

Taxonomy Memory: Based on Technology used

- Semiconductor based
- Magnetic: Hard disks
- Optical: CD/DVD
-

Taxonomy Memory: Based on Access Method

Random Access Memory (RAM)

- Individual addresses identify locations exactly
- Access time is independent of location or previous access
- e.g. RAM (we will come to this later)

Sequential Access Memory

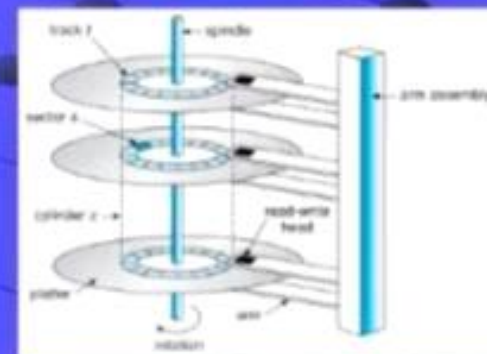
- Start at the beginning and read through in order
- Access time depends on location of data and previous location
- e.g. magnetic tape



Magnetic Tape

Direct

- Individual blocks have unique address
- Access is by jumping to vicinity plus sequential search
- Access time depends on location and previous location
- e.g. disk



Associative

- Data is located by a comparison with contents of a portion of the store
- Access time is independent of location or previous access
- e.g. cache



Taxonomy Memory: Based on Read/Write or Volatility

- Read/Write Memories (RWM or RAM)
- Read only Memories (ROM)
- Volatile
- Non-volatile

Of *RAM/ROMs*: The confusion within

- Both could be RAMs
- Huh, how is that?

Read Only Memory (ROM)

- PC uses it to hold BIOS both for system and I/O adapters
- Various forms:
 - Mask ROM
 - PROM
 - EPROM
 - EEPROM
- Non volatile

Random Access Memory - Read/Write Memory

Key Features

- RAMs are packaged as a chip.
- Basic storage unit is a **cell** (one bit per cell).
- Multiple RAM chips form a memory unit.
- **Volatile**.



Static RAM (SRAM)

- Each cell stores a bit with a **six-transistor** circuit.
- Retains value **indefinitely**, as long as it is kept powered.
- Relatively **insensitive** to disturbances such as electrical noise.
- **Faster** and more **expensive** than DRAMs.
- **Low packing density**
- **Bipolar** based

Dynamic RAM (DRAM)

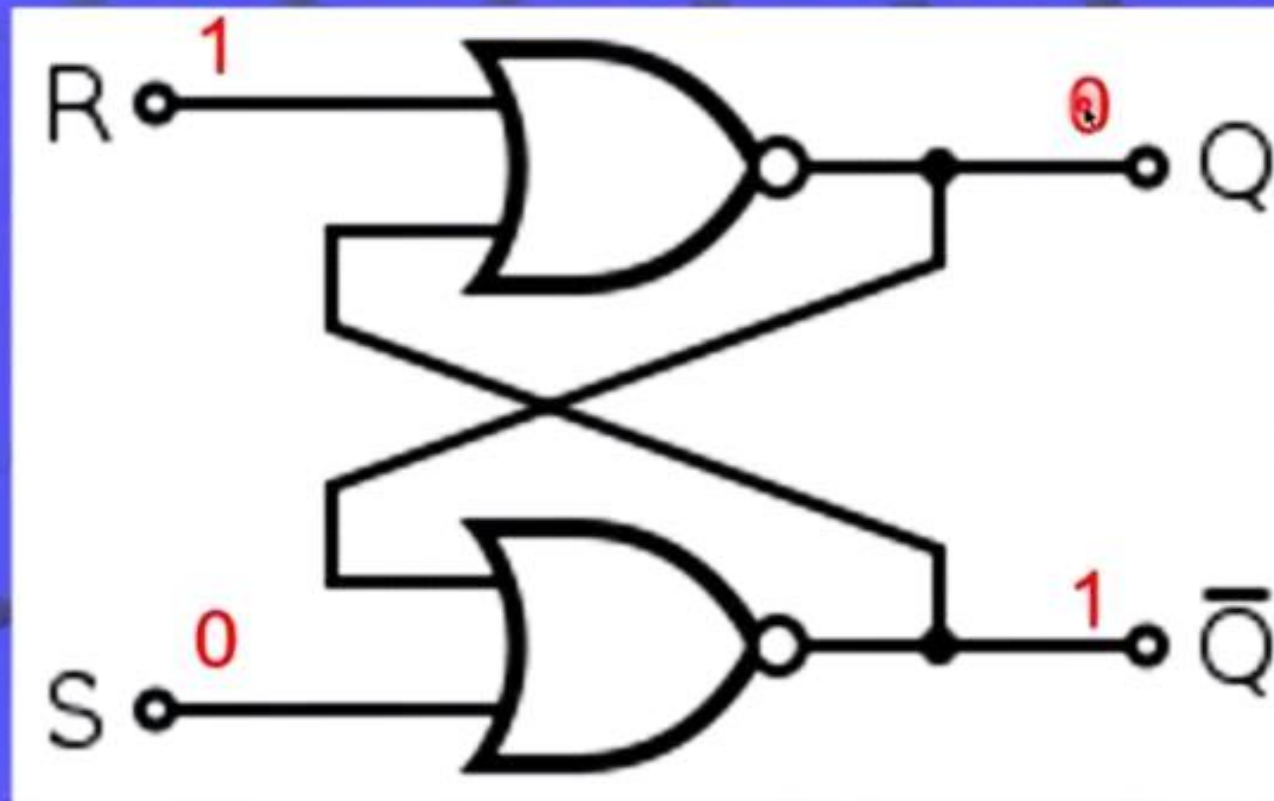
- Each cell stores a bit within a **capacitor** and **a transistor**.
- Value must be **refreshed** every 10-100 ms.
- **Sensitive** to disturbances.
- **Slower** and **cheaper** than SRAMs.
- **High Packing density**
- **MOS** Unipolar based.

RAM (RWM)

- Flip-flop:

A circuit made out of logic gates that stores one-bit of information forms the basic building block of the RAM

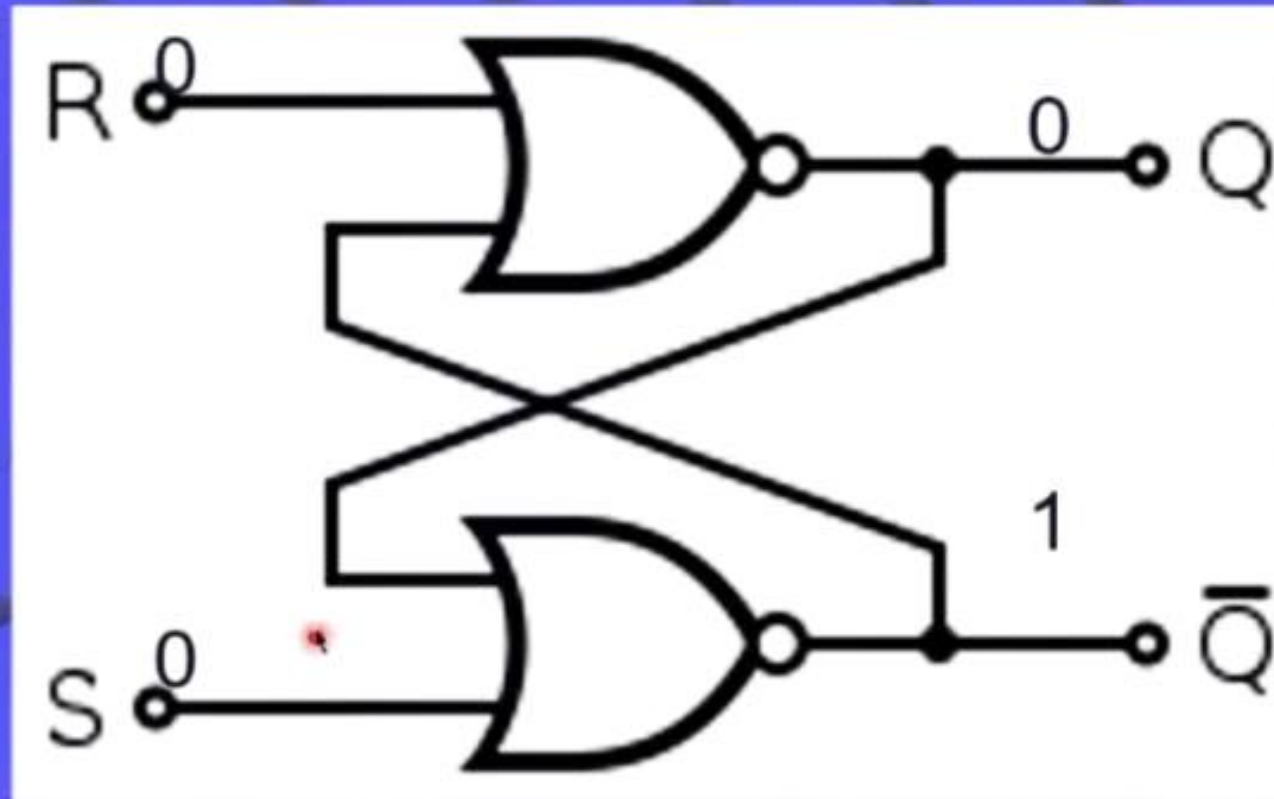
SR -Latch



NOR GATE		
A	B	$(A+B)'$
0	0	1
0	1	0
1	0	0
1	1	0

R	S	Q	Q'
1	0	0 (Reset)	1
0	0	0 (Older value)	1
0	1	1 (Set)	0
0	0	1	0
1	1	0/1 Confusing results for confusing inputs!	

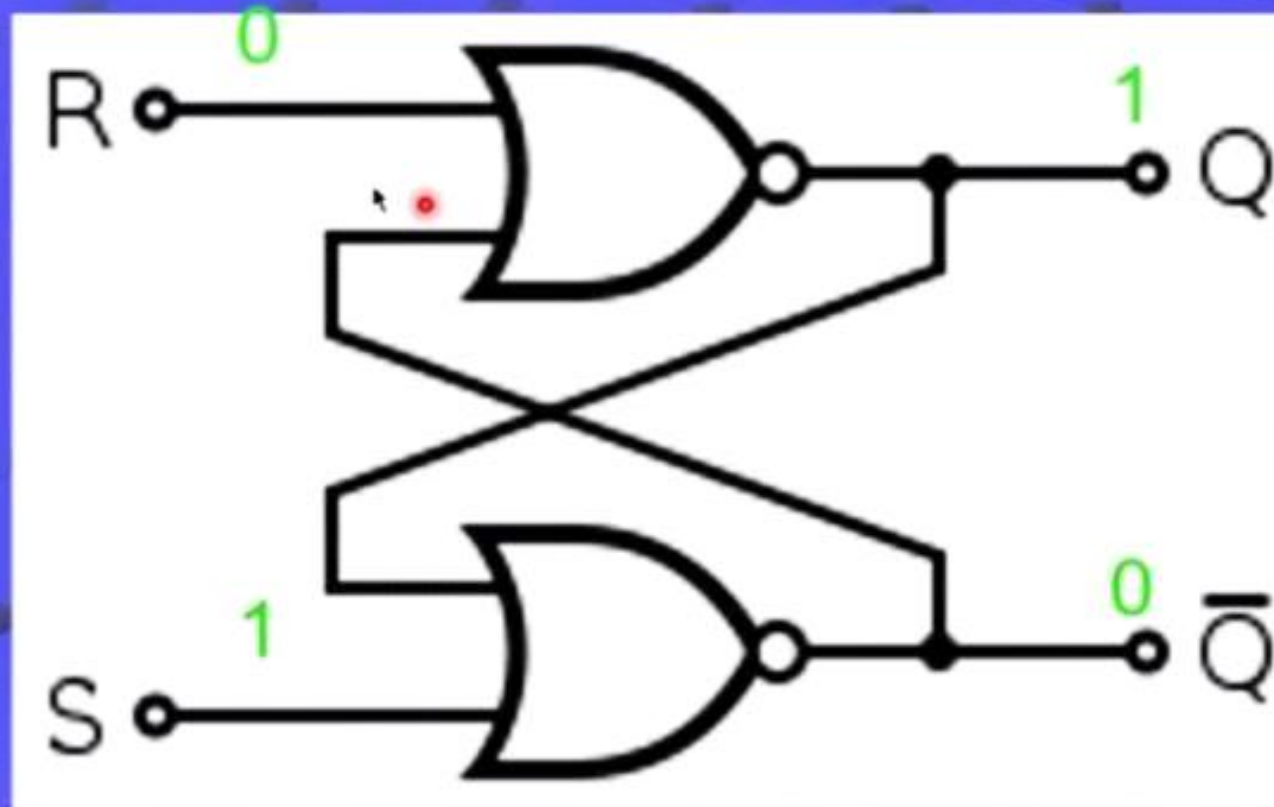
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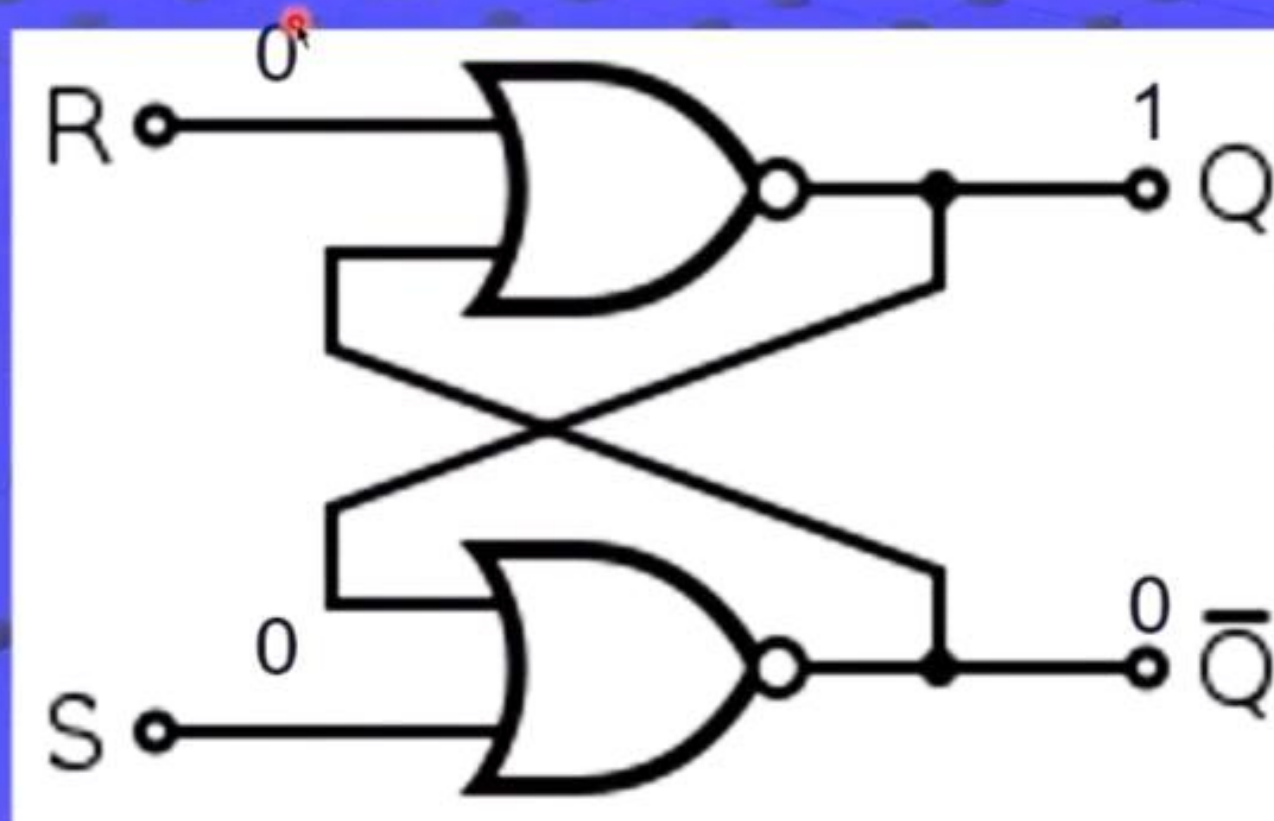
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