



# COMPUTER SYSTEMS & PROGRAMMING

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## Solid-State Memory

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# Introduction

- Made of semi-conductor components
- Mesh of rows and columns connected at each intersection with memory cell
- Responsible to store memory
- Fast and Randomly accessed
- Requires a controller
- Types
  - Volatile (i.e. RAM)
  - Non volatile (i.e. ROM)
- RAM (Randomly Accessed Memory)
  - Contents are erased when it stops receiving power (i.e. volatile)
  - Used to support microprocessor for processing
  - Increase execution speed or throughput of system
  - Also used to hold data for other devices (i.e. buffer)
- ROM (Read Only Memory)
  - Its contents aren't erased (i.e. non-volatile)
  - Used for permanent storage (e.g. BIOS data, program code in microcontrollers)
  - Read operation is performed easily
  - Write operation isn't possible or requires special operation to perform depending on its type



# Random Access Memory

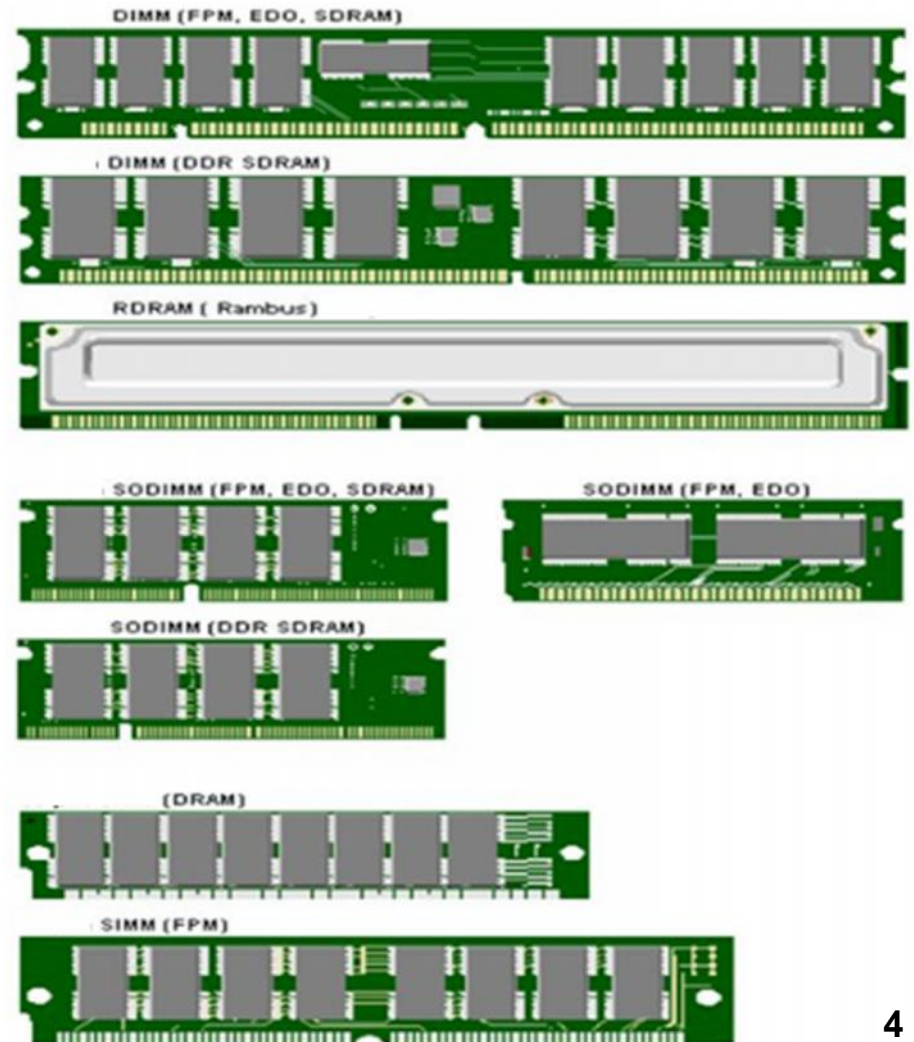
- Part of the systems from many decades
- Can be used via
  - Slots
    - SIMM – Single Inline Memory Module. Small Outline SIMM for notebooks
    - DIMM – Dual inline Memory Module. Small Outline DIMM for notebooks
    - RIMM – Rambus Inline Memory Module. Small Outline RIMM for notebooks
  - Sockets (for memory banks to be used with PCBs)
    - SOJ – Small Outline J-lead
    - TSSOP – Thin Shrink Small Outline Package
- Types
  - DRAM (Dynamic RAM)
  - SRAM (Static RAM)
- SRAM
  - Doesn't requires refreshing
  - Faster and costly
  - Used as cache memory
  - Uses a flip-flop in memory cell for storage





# Random Access Memory

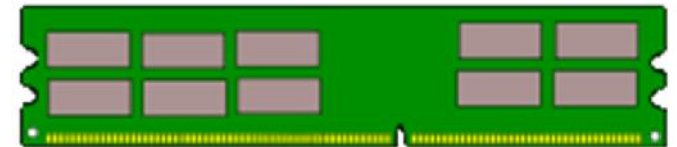
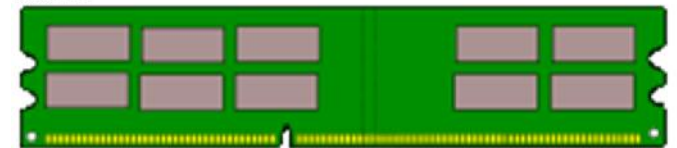
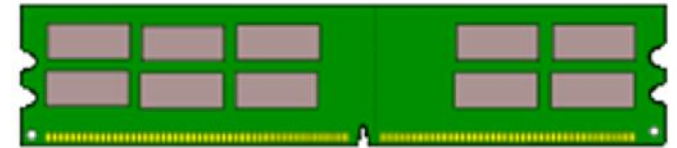
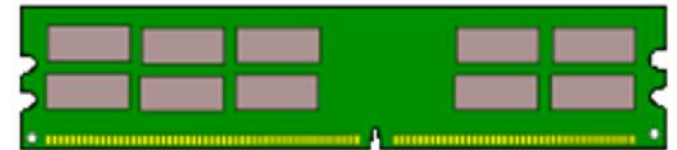
- DRAM
  - Requires refreshing at dynamic time
  - Cheaper and simple
  - Capacitor as storing element
  - Types
    - DRAM – Dynamic RAM
      - Single bit operation
    - FPM DRAM – Fast Page Mode DRAM
      - Reads a bit before and after of required bit
    - EDO DRAM – Extended Data Out DRAM
      - Reads only the next bit
    - SDRAM – Synchronous DRAM
      - Reads all bits from entire row
    - CMOS RAM – Complementary Metal Oxide Semiconductor RAM
      - Designed for low power consumption, used as part of BIOS
    - PCMCIA RAM – Personal Computer Memory Card International Association RAM
      - RAM cards designed for laptops





# Random Access Memory

- DRAM
  - Types
    - DDR SDRAM – Double Data Rate SDRAM
      - DDR 1 – 100 to 200 MHz
      - DDR 2 – 200 to 533.33 MHz
      - DDR 3 – 400 to 1066.67 MHz
      - DDR 4 – 1066.67 to 2133.33 MHz
      - DDR 5 – 1.125 to 8 GHz
      - DDR 6 – 8GHz
    - RDRAM – Rambus DRAM
      - Designed for RIMM with high speed Rambus channel – 800MHz





# Read Only Memory

- Being used for permanent storage from many years
- Can be used as part of PCB or as memory socket
- Types
  - ROM – Read Only Memory
    - ROM is fabricated w.r.t data it carries – diode is placed at intersection to represent 1
    - Only read operation can be performed
  - PROM – Programmable ROM
    - Write once, read many times – Fuse is placed at each intersection
    - Fuses are burned to represent 0
    - Used for prototyping ROM
  - EPROM – Erasable PROM
    - Write and Read can be done many times
    - Two transistors are connected with thin-oxide layer at each intersection
    - Write and Erase operation requires a tool called EPROM burner or programmer
    - Erase method is applied on all bits and reduces life of semi-conductor components
  - EEPROM – Electrically Erasable PROM
    - Same as EEPROM, only erase operation is performed using electrical technology
  - Flash Memory
    - Doesn't need external component
    - Write and Erase operation is done by in-circuit components
    - Works on chunk of bits



# Questions

