- Memory is an essential part of digital computer.
- Memory is use to store program and data for computer.
- The basic unite of memory storage is bit i.e. 0 or 1.
- Memory is quite similar to human brain if we assume human body as a machine i.e. brain=storage element+processor and eyes=I/O's devices.
- There are mainly three types of storage elements used in computer system i.e. main memory, secondary memory and cache memory.

- **The main memory store the software along with the data.**
- **Secondary memory is permanent storage of software and data for future point of view.**

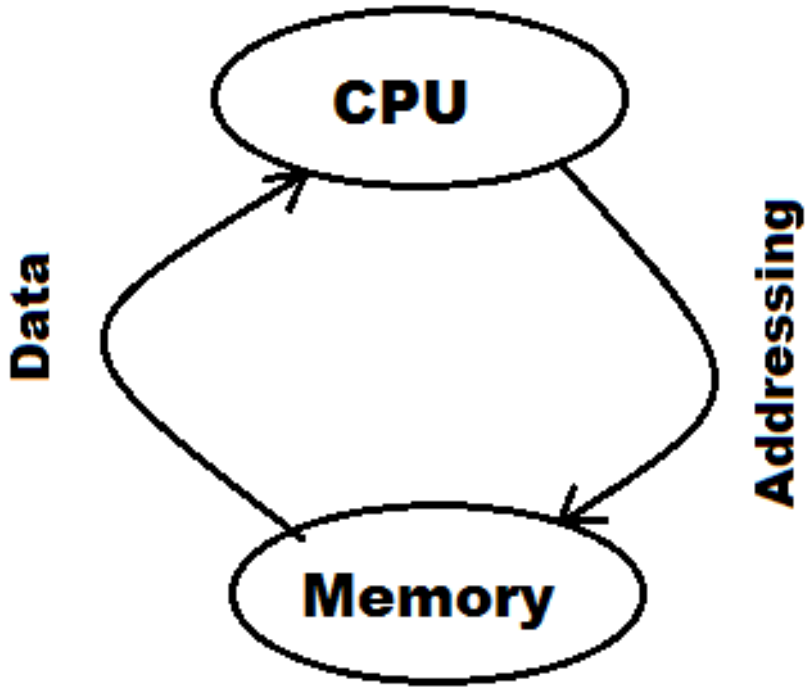

Figure : Relation between CPU and Memory

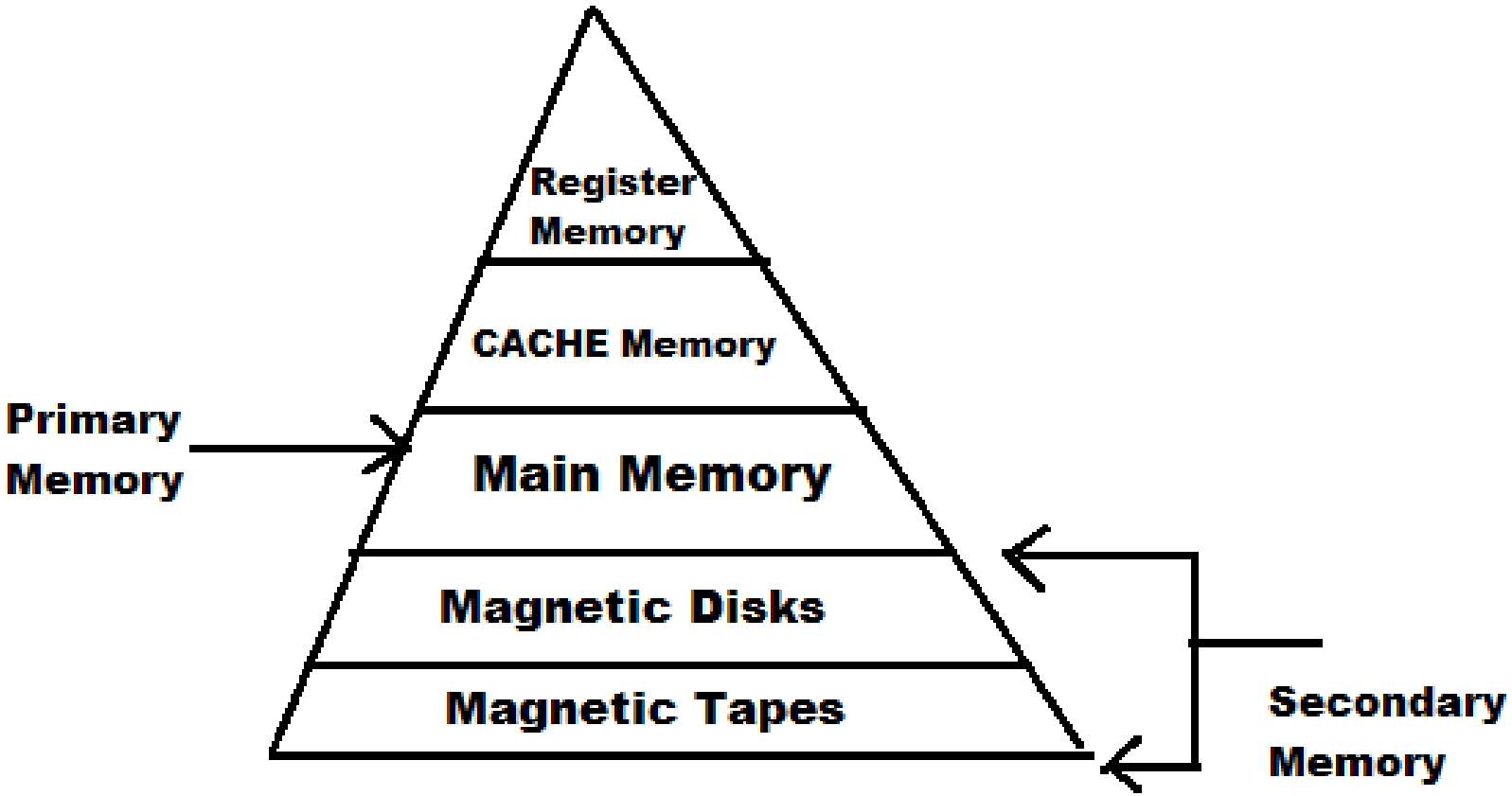

Figure : Memory hierarchy

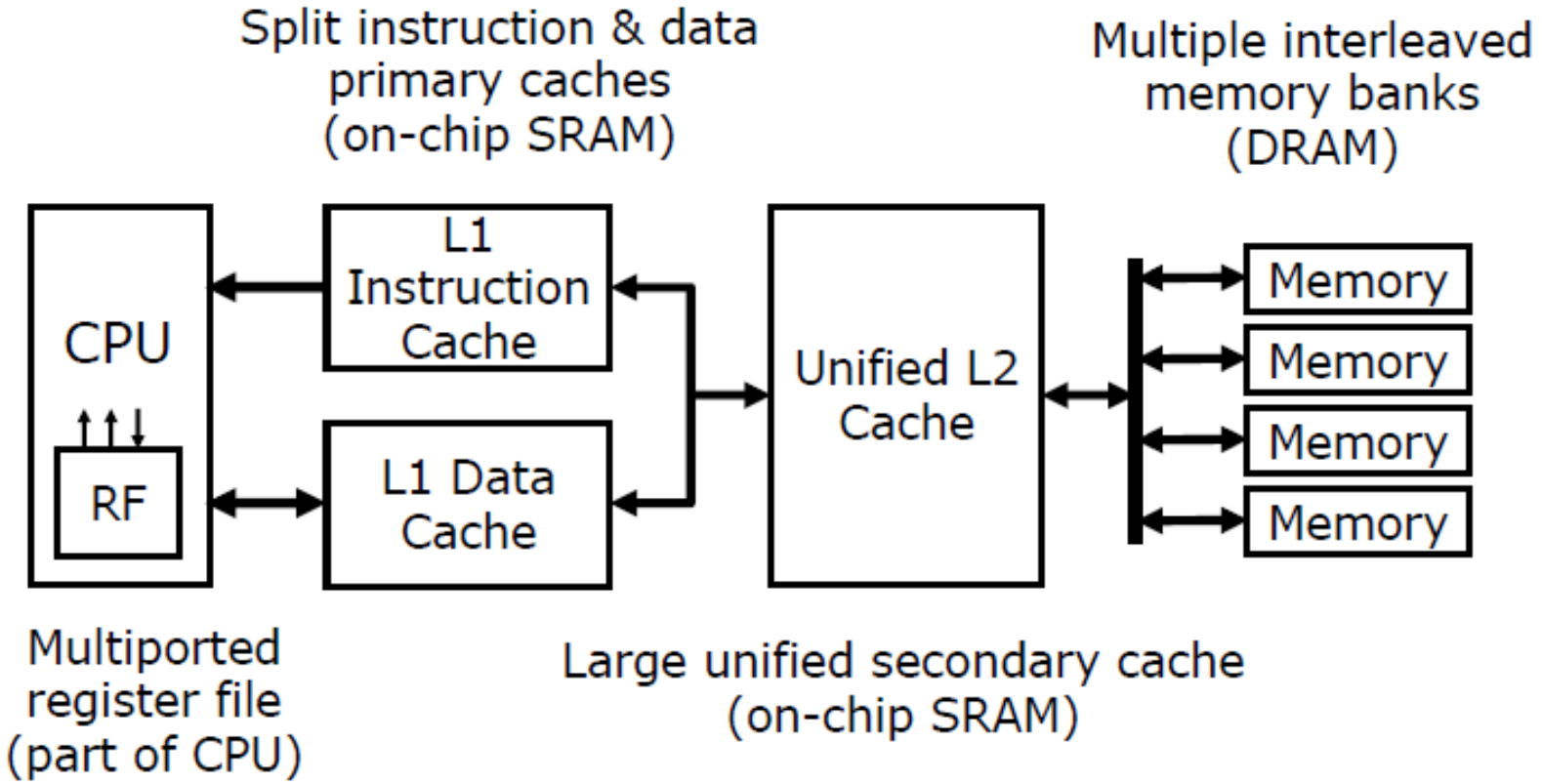

Figure : Memory hierarchy

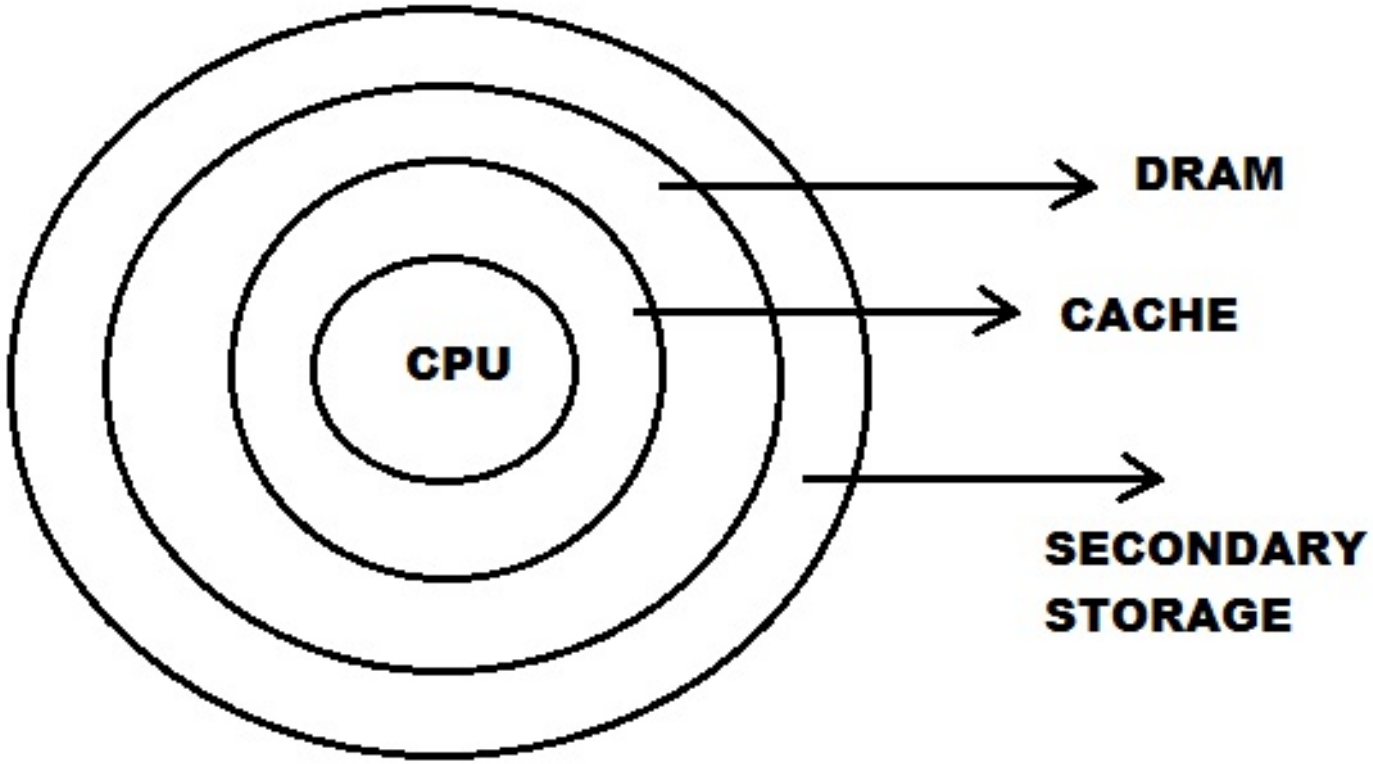

Figure : Cell like structure of memory hierarchy

- **CACHE is placed between CPU and main memory.**
- **CACHE is the fastest memory than DRAM.**

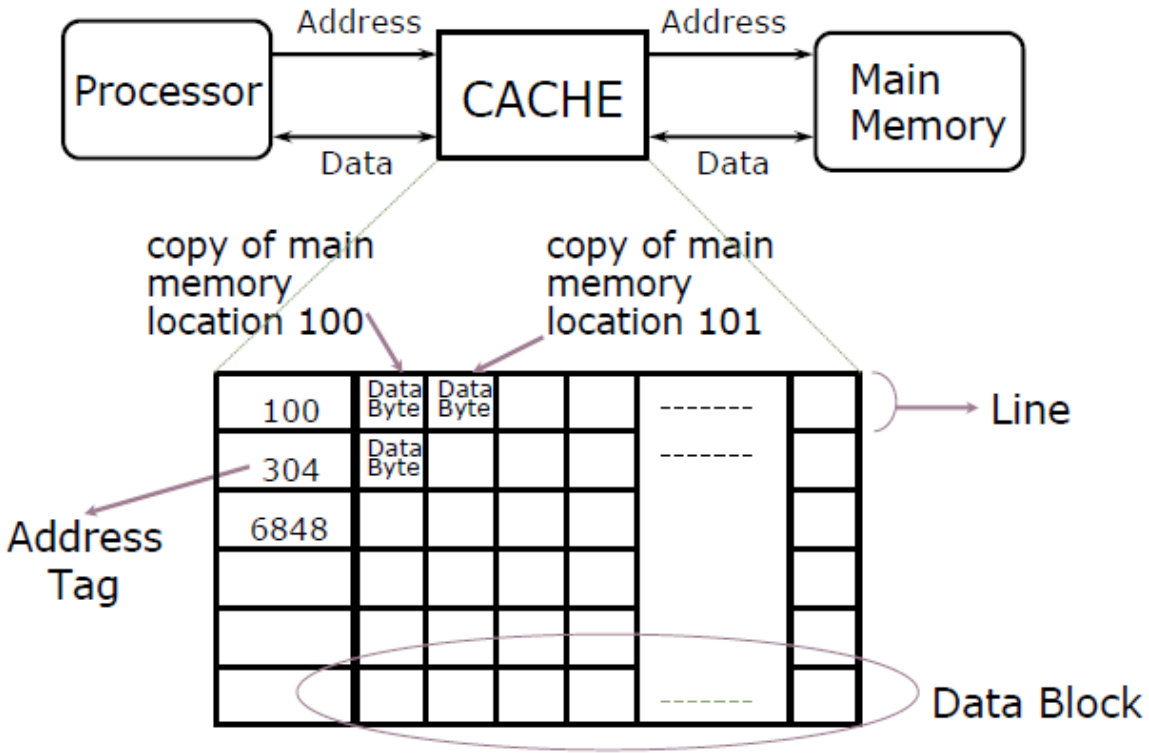

Figure : Internal structure of CACHE Memory

- **For read operation bit line (BL)must be active.**
- **For write operation bit line (BL) and word line (WL) must be active.**

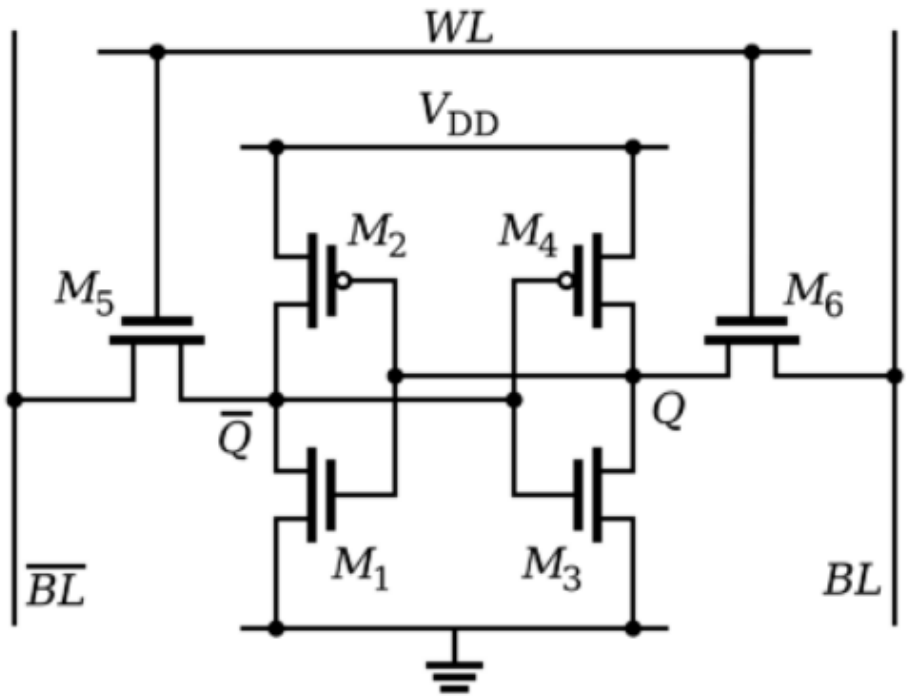

Figure : Internal structure of CACHE Memory (SRAM cell) at transistor level.

- **DRAM is the fastest memory than secondary storage but slowest than SRAM.**
- **Packing density of DRAM is higher than SRAM.**
- **Cost of DRAM is lower than SRAM.**
- **DRAM required the periodic charging of the capacitor node.**

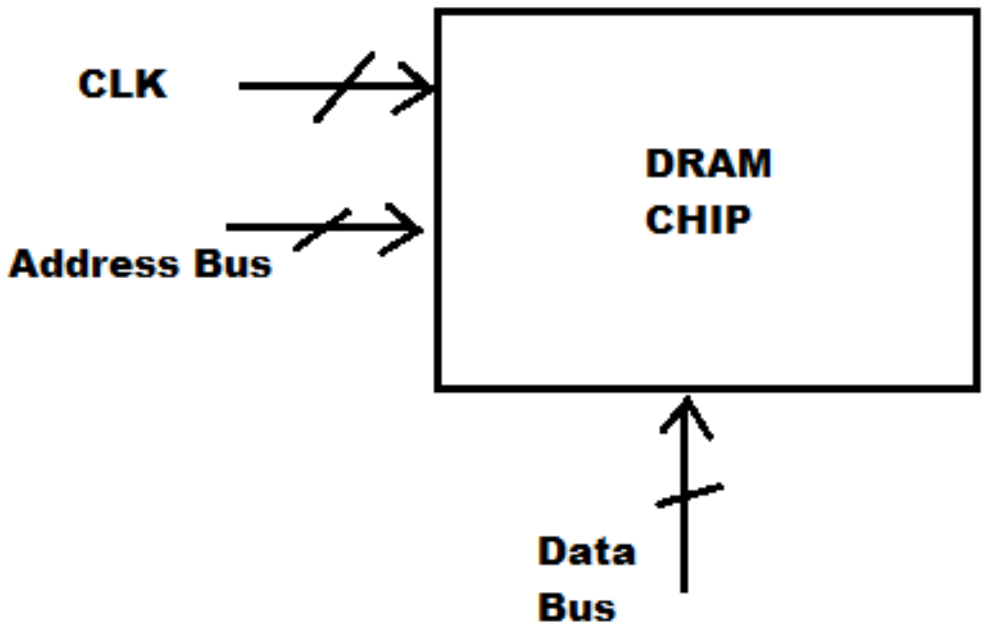

Figure : Block diagram of DRAM chip.

- **Bits stored in 2-dimensional arrays on chip.**

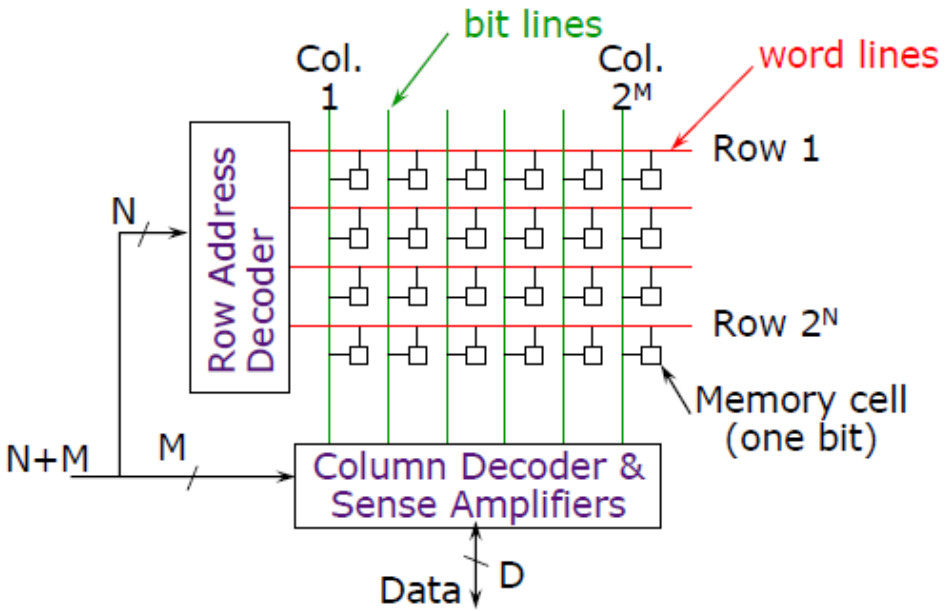

Figure : DRAM architecture.

- **A DRAM cell consists of a capacitor connected by a pass transistor to the bit line.**

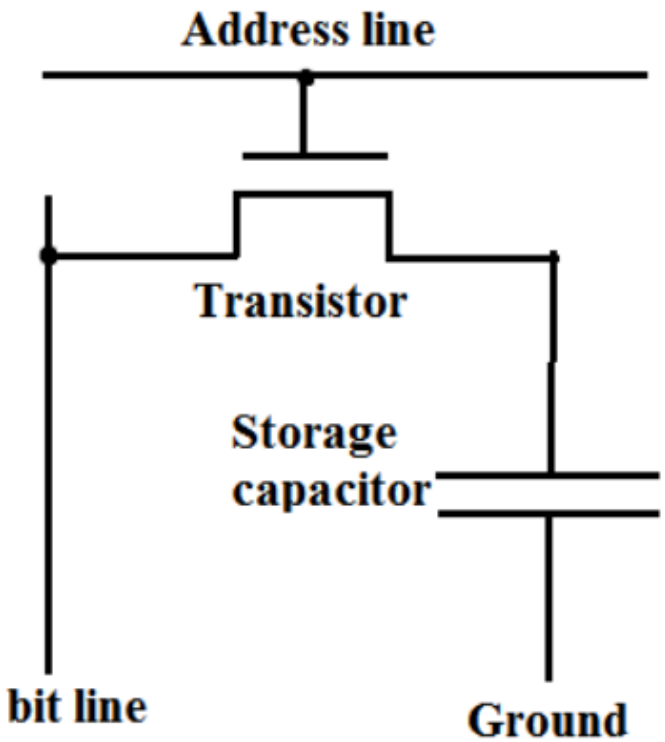

Figure : DRAM cell at transistor level.

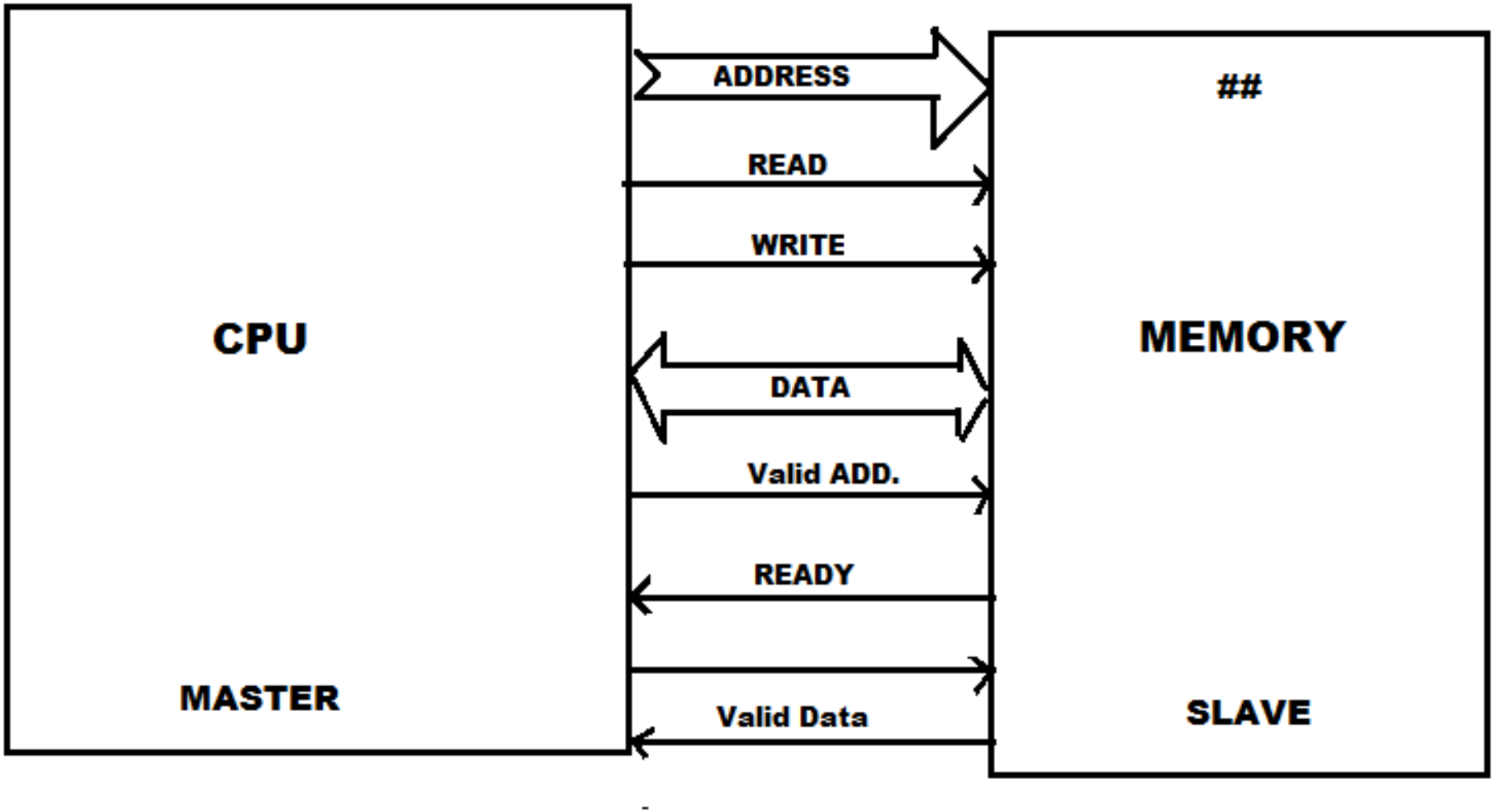

Figure : Block diagram of CPU and memory with control signal.

- **Read Cycle:I/P to memory or O/P of CPU.**
- **Write Cycle:I/P to memory or O/P of CPU.**
- **Ready Cycle:I/P to CPU or O/P of memory.**
- **Valid address:I/P to memory or O/P of CPU.**
- **Valid data:I/P to CPU or O/P of memory.**

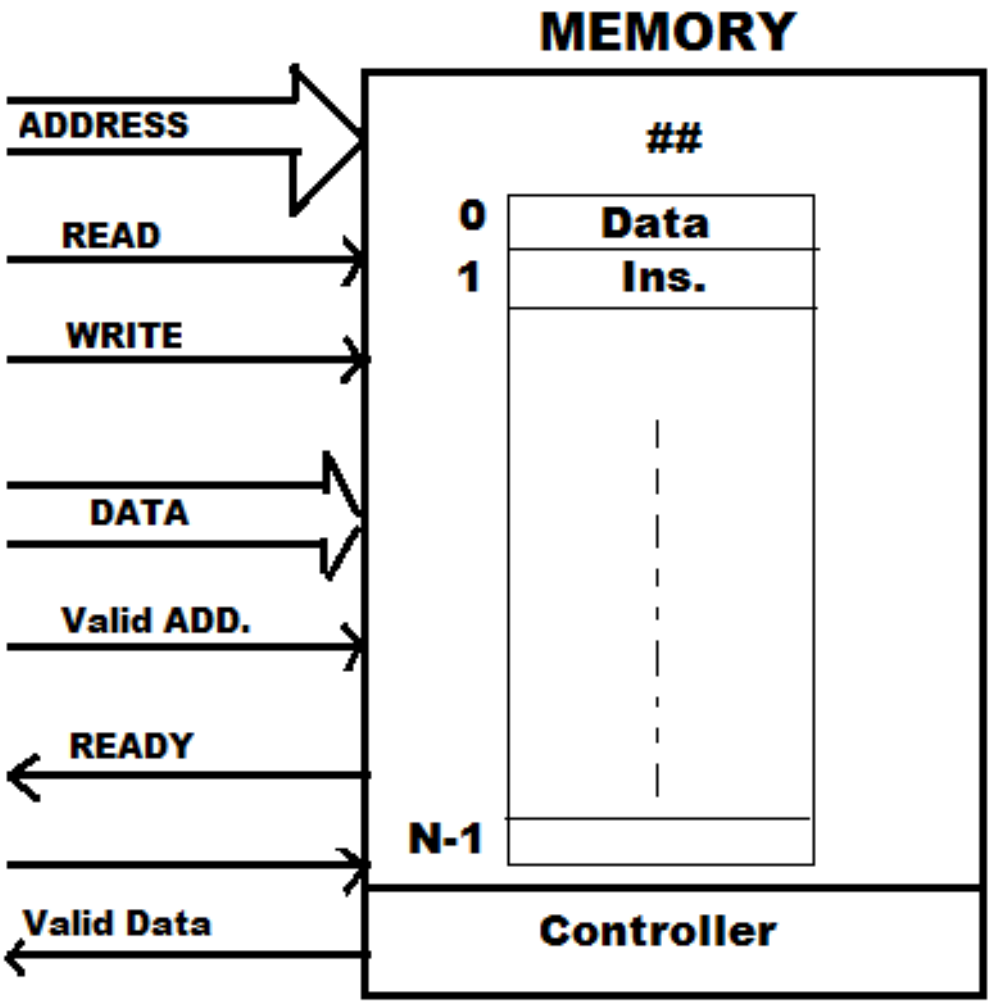

Figure : Internal block diagram of memory.

- **Address space:**
- **The number of location occupied by the memory.**
- **n-bit address will occupies the 2^n locations.**
  Example:
  n=4
  16 memory locations (0 to 15)
- **coded: 16 add. lines required.**
- **Linearly select: 4 add. lines required.**
- **Principal of locality:**
- It will search the content of the address near by the fist address fetched.
- This will cause the faster operation of CPU.

- **Speed:Cost:Size**
- If speed needs to be high, penalty in terms of cost but we can play with size to compensate.
- **CACHE (SRAM):Fast**
- **DRAM: Medium**
- **Secondary Storage(Magnetic tapes): Slow**