

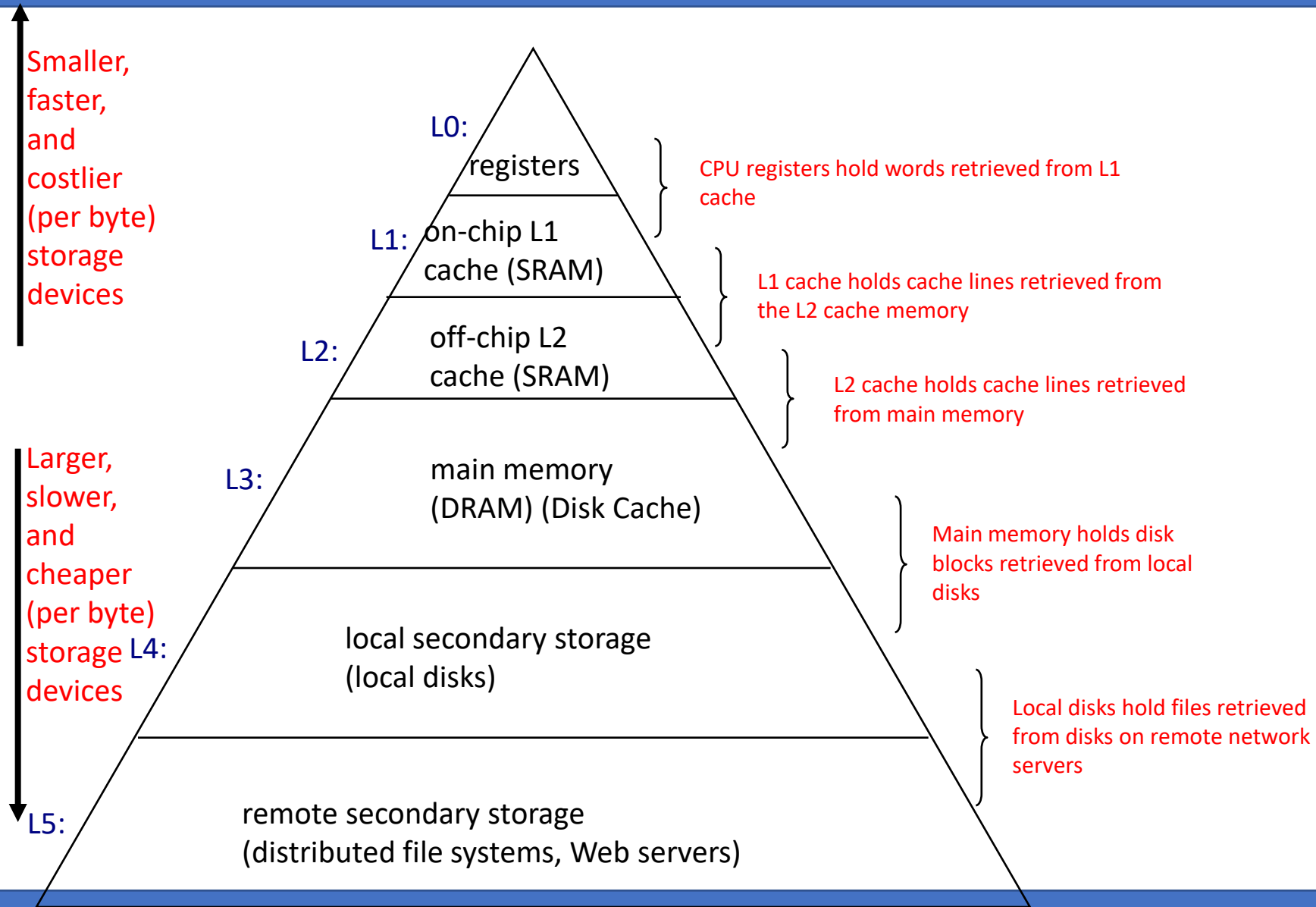
# Computer Fundamentals

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# Memory Hierarchy



# Hierarchy List

- Registers
  - L1 Cache
  - L2 Cache
  - Main memory
  - Disk cache
  - Disk
  - Optical
  - Tape
- As one goes down the hierarchy
    - Decreasing cost per bit
    - Increasing capacity
    - Increasing access time
    - Decreasing frequency of access of the memory by the processor – locality of reference



# Memory Access Method

## Sequential

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

## Random

- Individual addresses identify locations exactly
- Access time is independent of location or previous access
- e.g. RAM

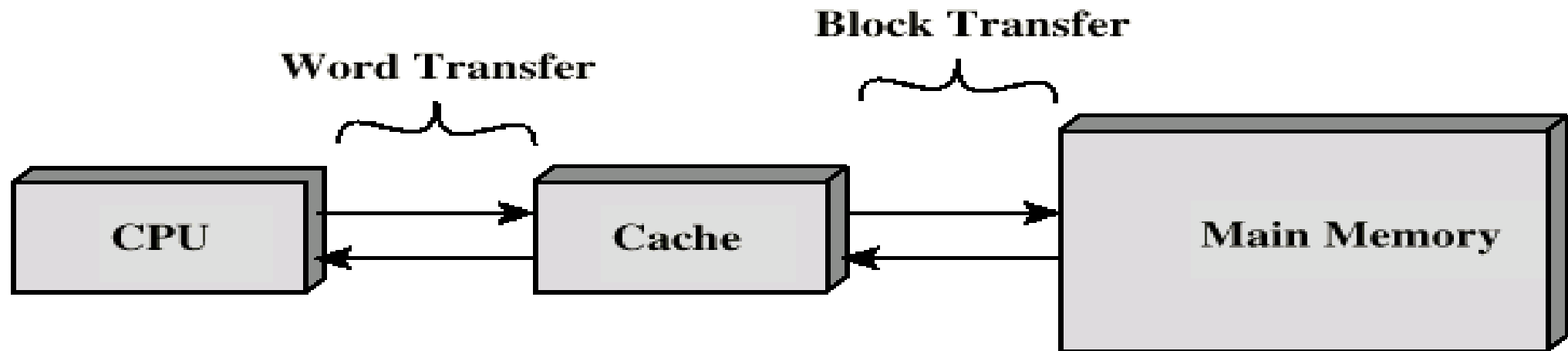
## Associative

- 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

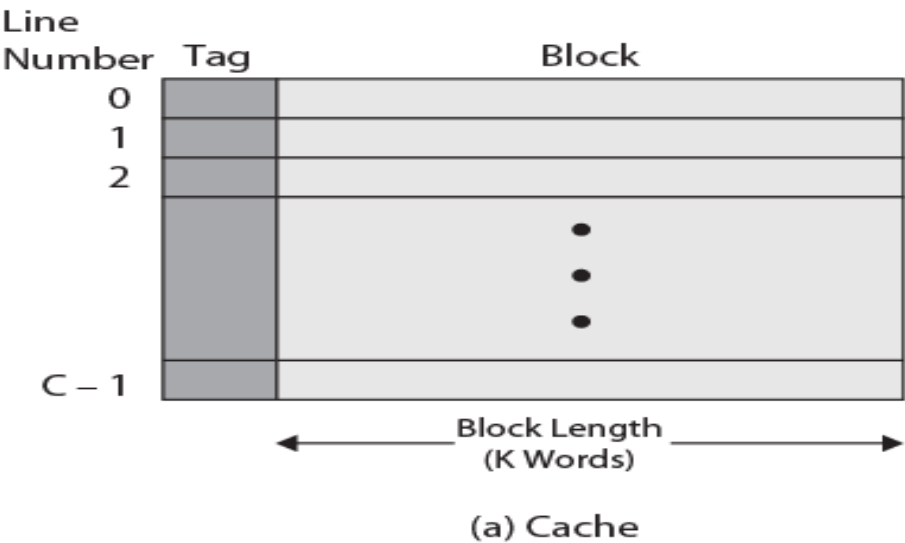


# Cache & Main Memory

- Small amount of fast memory
- Sits between normal main memory and CPU
- May be located on CPU chip or module
  - An entire blocks of data is copied from memory to the cache because the principle of locality tells us that once a byte is accessed, it is likely that a nearby data element will be needed soon.



# Cache/Main Memory Structure

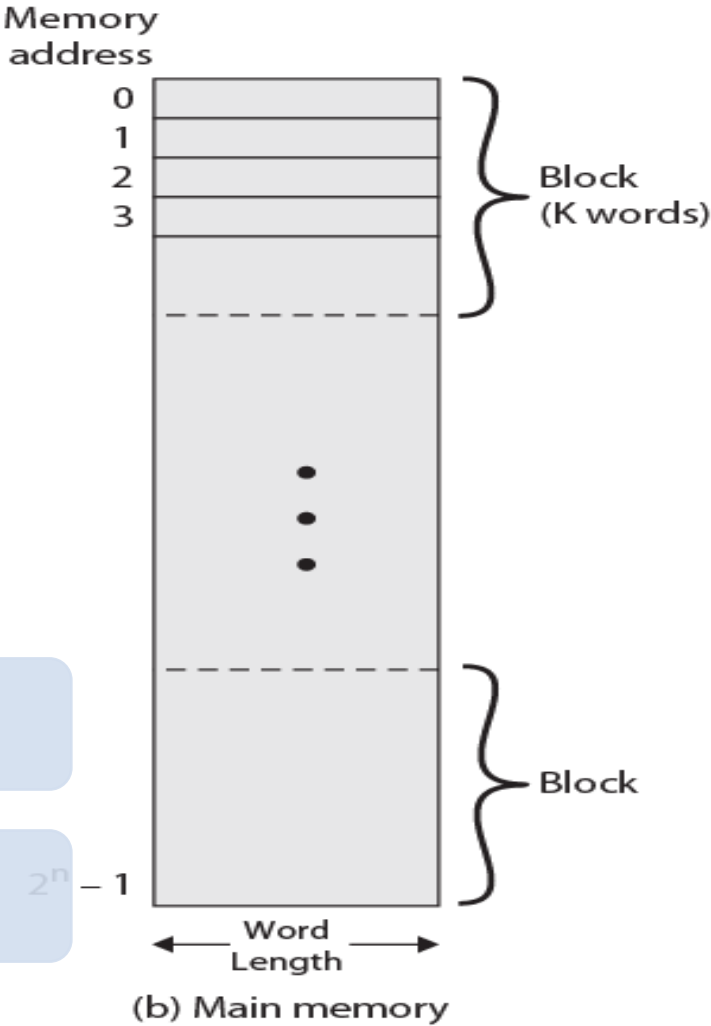


A Hit

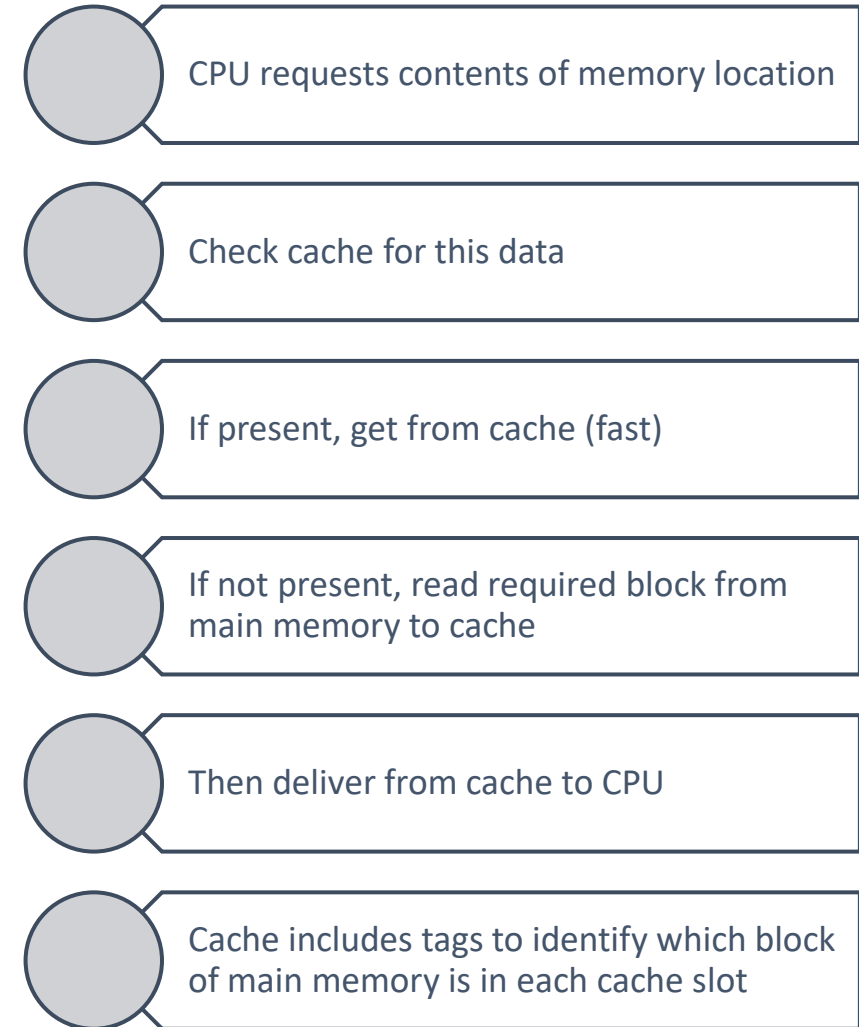
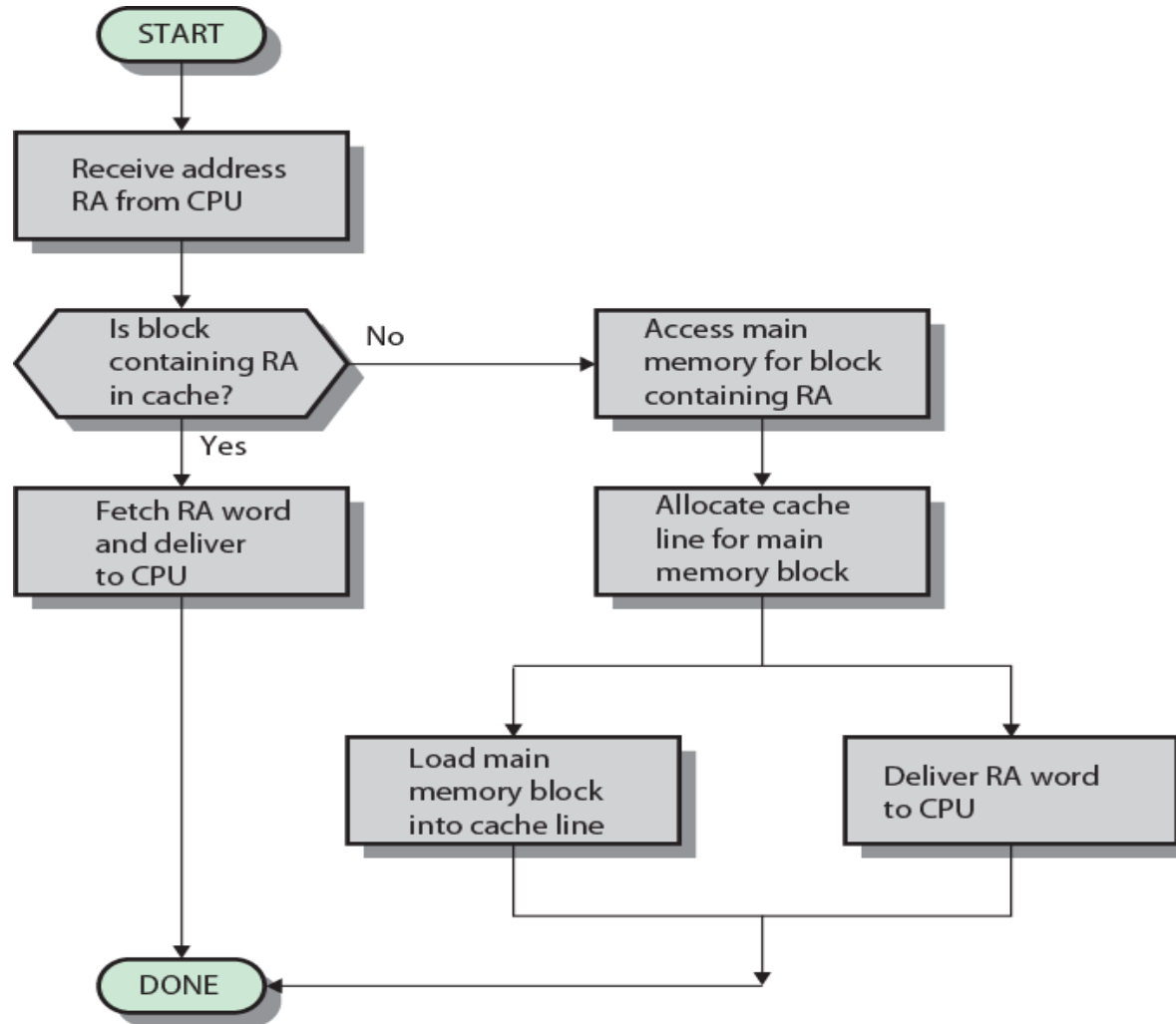
- is when data is found at a given memory level.

A miss

- is when it is not found.



# Cache Operations



# Random-Access Memory (RAM)

- Key features

- RAM is packaged as a chip, Basic storage unit is a cell (one bit per cell)
- Its internal memory of the CPU for storing data, program, and program result
- Used for Read/ Write
- Volatile (Temporary Storage)

## Static RAM (SRAM)

- memory retains its contents as long as power is being supplied.
- Made up of transistor
- Static because it doesn't need to be refreshed
- SRAM is more often used for system cache.
- SRAM is faster than DRAM

## Dynamic RAM (DRAM)

- memory must be constantly refreshed or it will lose its contents.
- This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second
- Made up of memory cells composed of capacitors and one transistor.
- DRAM is typically used for the main memory in computing devices





# ROM(Read Only Memory)

- The memory from which we can only read but cannot write on it.
- This type of memory is non-volatile.
- The information is stored permanently in such memories during manufacture.
- A ROM stores such instructions that are required to start a computer. This operation is referred to as **bootstrap**.
- **Different Types of ROM:**
  - MROM (Masked ROM)
  - PROM (Programmable Read Only Memory)
  - EPROM (Erasable and Programmable Read Only Memory)
  - EEPROM (Electrically Erasable and Programmable Read Only Memory)



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# Thank You

