Memory Organization

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I.INTRODUCTION

The memory is organized in the form of a cell, each cell is able to be identified with a unique number called address. Each cell is able to recognize control signals such as “read” and “write”, generated by CPU when it wants to read or write address.
The memory system in a computer is composed of different levels of hierarchy, each with its own characteristics and purpose.
These include:
Cache memory: This is the smallest and fastest level of memory, located closest to the CPU. It stores recently accessed data and instructions for quick access by the CPU.

Random Access Memory (RAM): This is the main memory of the computer, where data and instructions are temporarily stored for use by the CPU. There are two main types of RAM:

Static RAM (SRAM): This type of RAM uses flip-flops to store each bit of data, and is faster and more expensive than the other type of RAM.
Dynamic RAM (DRAM): This type of RAM stores data in capacitors, which must be periodically refreshed, making it slower and less expensive than SRAM.

Read-Only Memory (ROM): This is a type of non-volatile memory that can only be read and not written to. There are several types of ROM:

Masked ROM: This type of ROM is permanently programmed at the factory and cannot be modified.
Programmable ROM (PROM): This type of ROM can be programmed by the user, but only once.

Erasable Programmable ROM (EPROM): This type of ROM can be reprogrammed by exposing it to ultraviolet light.

Electrically Erasable Programmable ROM (EEPROM): This type of ROM can be reprogrammed electronically, without the need for UV light.

Cache memory is a high-speed memory that stores recently accessed data and instructions for quick access by the CPU. It is located closest to the CPU in the memory hierarchy, and is much faster and more expensive than main memory (RAM).

Memory hierarchy refers to the different levels of memory in a computer system, with each level having a different speed and cost. In general, the higher the level in the hierarchy, the faster and more expensive the memory is. The memory hierarchy includes cache memory, main memory (RAM), and non-volatile memory (such as hard drives and solid-state drives).

Locality of reference refers to the tendency of a program to access the same data and instructions multiple times. This property is exploited by the memory hierarchy, with the CPU keeping a small amount of recently accessed data and instructions in the cache memory for quick access. When the CPU needs to access a piece of data, it first checks the cache memory before looking in main memory.

Cache operation is the process of storing and retrieving data from the cache memory. When the CPU needs to access a piece of data, it first checks the cache memory to see if that data is already stored there. If it is, the data is accessed quickly from the cache. If not, the data is retrieved from main memory and stored in the cache for future use.

Address mapping is the process of mapping virtual memory addresses used by the CPU to physical memory addresses used by the memory hierarchy. Virtual memory addresses are used by the CPU to access data and instructions, while physical memory addresses are the actual locations of that data and instructions in the memory hierarchy. The CPU uses an address translation mechanism to convert virtual

memory addresses to physical memory addresses, and vice versa.
Interleaved memory is a type of memory organization in which multiple memory banks are accessed in a rotating pattern, rather than sequentially. The goal of interleaving memory is to increase memory bandwidth by allowing the CPU to access multiple memory banks simultaneously.

In an interleaved memory system, the memory is divided into a number of banks, and the memory addresses are arranged such that the addresses are distributed evenly among the banks. When the CPU accesses memory, it accesses one bank at a time, but in a rotating pattern. This allows the CPU to access more memory in a shorter period of time, increasing the overall memory bandwidth.

Associative memory is a type of memory organization in which data is stored based on its relationship to other data, rather than its location in memory. An associative memory is a content-addressable memory (CAM), which means that data is retrieved based on its content rather than its memory address.

In an associative memory, each memory location stores a piece of data along with an associated key. When a search is made, the memory compares the search key with the keys stored in each memory location. If a match is found, the associated data is retrieved. This type of memory is used in applications where the data is constantly changing, and it is difficult to predict where the data will be located in memory. It is also used in hardware implementations of hash tables and other data structures

RAID

RAID (Redundant Array of Independent Disks) is a method of storing data on multiple hard drives to improve performance and/or provide data redundancy. RAID uses multiple hard drives to create a single logical drive, with the data distributed across the drives in a variety of ways.

There are several different RAID levels, each with its own characteristics and benefits:

RAID 0: Also known as striping, data is split across multiple drives to improve performance. RAID 0 provides no data redundancy, so if one drive fails, all data is lost.

RAID 1: Also known as mirroring, data is duplicated across multiple drives. If one drive fails, the data is still available on the other drive(s).

RAID 5: Data is striped across multiple drives, and parity data is also stored on one or more drives. If one drive fails, the data can be reconstructed from the remaining drives and the parity data.

RAID 6: Similar to RAID 5, but uses two sets of parity data, allowing for the failure of two drives before data is lost.

RAID 10: A combination of RAID 1 and RAID 0, data is mirrored across multiple drives and striped across multiple sets of drives.

RAID is commonly used in servers, storage systems and other high-availability systems, as it can increase performance, provide data redundancy, and allow for recovery from hard drive failures.

It is important to note that RAID is not a replacement for backups, it is a data protection method, it does not protect against data loss due to human error, malware, ransomware or other software issues.

CONCLUSION

The memory is organized in the form of a cell, each cell is able to be identified with a unique number called address. Each cell is able to recognize control signals such as “read” and “write”, generated by CPU when it wants to read or write address.

REFERENCE

[1] https://www.wikipedia.org/
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