Cache Memory in Computer Architecture

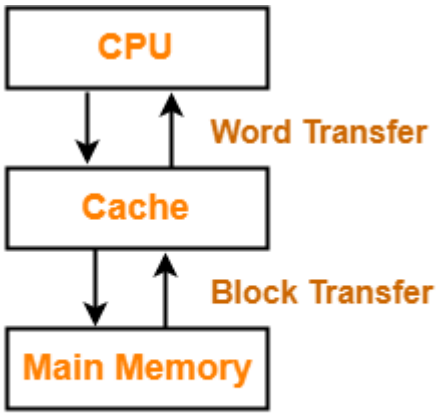
Computer Organization and Architecture

Cache Memory-

- Cache memory is a Random Access Memory.
- The main advantage of cache memory is its very fast speed.
- It can be accessed by the CPU at much faster speed than main memory.

Location-

- Cache memory lies on the path between the CPU and the main memory.
- It facilitates the transfer of data between the processor and the main memory at the speed which matches to the speed of the processor.



Cache and Main Memory

- Data is transferred in the form of words between the cache memory and the CPU.
- Data is transferred in the form of blocks or pages between the cache memory and the main memory.

Purpose-

- The fast speed of the cache memory makes it extremely useful.
- It is used for bridging the speed mismatch between the fastest CPU and the main memory.

- It does not let the CPU performance suffer due to the slower speed of the main memory.

Execution Of Program-

- Whenever any program has to be executed, it is first loaded in the main memory.
- The portion of the program that is mostly probably going to be executed in the near future is kept in the cache memory.
- This allows CPU to access the most probable portion at a faster speed.

Step-01:

Whenever CPU requires any word of memory, it is first searched in the CPU registers.

Now, there are two cases possible-

Case-01:

- If the required word is found in the CPU registers, it is read from there.

Case-02:

- If the required word is not found in the CPU registers, Step-02 is followed.

Step-02:

- When the required word is not found in the CPU registers, it is searched in the cache memory.

- Tag directory of the cache memory is used to search whether the required word is present in the cache memory or not.

Now, there are two cases possible-

Case-01:

- If the required word is found in the cache memory, the word is delivered to the CPU.
- This is known as **Cache hit.**

Case-02:

- If the required word is not found in the cache memory, Step-03 is followed.
- This is known as **Cache miss.**

Step-03:

- When the required word is not found in the cache memory, it is searched in the main memory.
- Page Table is used to determine whether the required page is present in the main memory or not.

Now, there are two cases possible-

Case-01:

If the page containing the required word is found in the main memory,

- The page is mapped from the main memory to the cache memory.
- This mapping is performed using cache mapping techniques.
- Then, the required word is delivered to the CPU.

Case-02:

If the page containing the required word is not found in the main memory,

- A page fault occurs.
- The page containing the required word is mapped from the secondary memory to the main memory.
- Then, the page is mapped from the main memory to the cache memory.
- Then, the required word is delivered to the CPU.

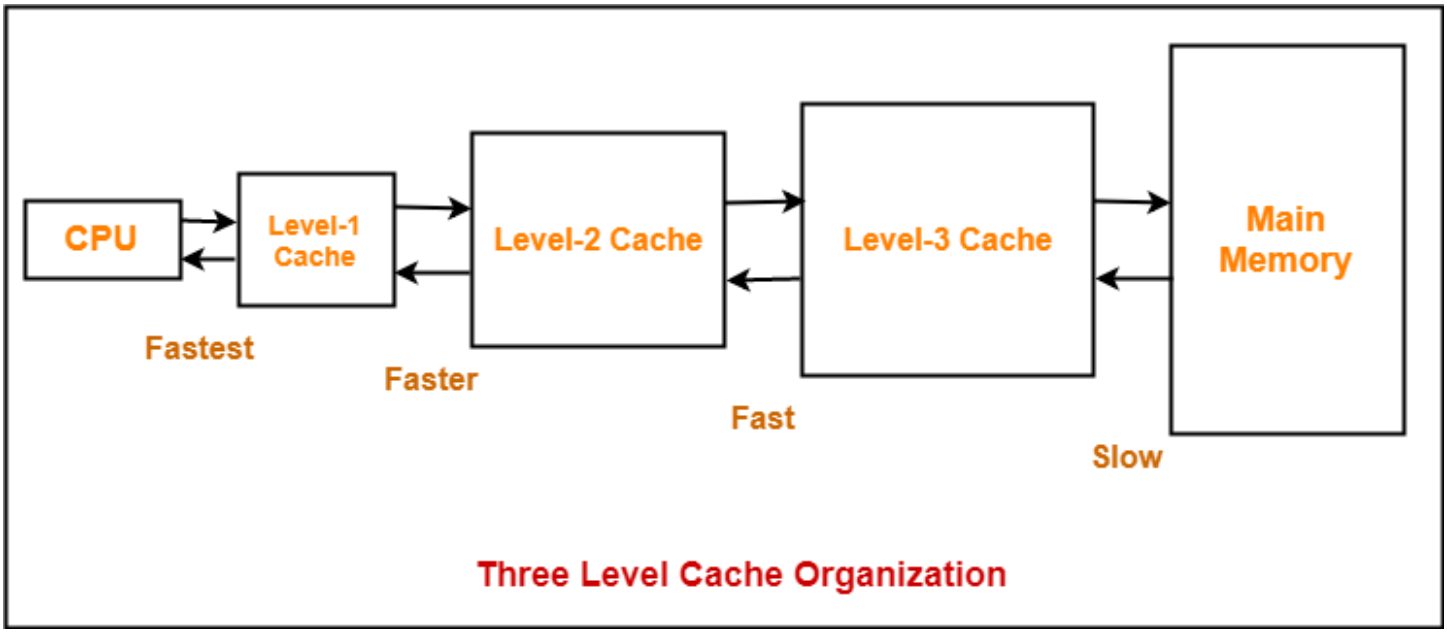
Multilevel Cache Organization-

- A multilevel cache organization is an organization where cache memories of different sizes are organized at multiple levels to increase the processing speed to a greater extent.
- The smaller the size of cache, the faster its speed.
- The smallest size cache memory is placed closest to the CPU.
- This helps to achieve better performance in terms of speed.

Example-

Three level cache organization consists of three cache memories of different size organized at three different levels as shown below-

Size (L1 Cache) < Size (L2 Cache) < Size (L3 Cache) < Size (Main Memory)



Three Level Cache Organization

To gain better understanding about Cache Memory,

Watch this Video Lecture

Next Article- Cache Mapping Techniques

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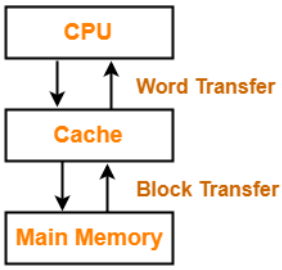
Summary



Cache and Main Memory

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Description	Cache memory in computer architecture is a special memory that matches the processor speed. Cache memory is located on the path between the processor and the memory. Its fast speed makes it extremely useful.
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