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**TOPIC: COMPUTER MEMORY**

## REGISTER

**Registers** are used to perform operations on data that are used immediately by the CPU, there are various types of registers that are used for various purposes. Among them are registers named as AC or **Accumulator**, **Data Register** or DR, the AR or **Address Register**, **program counter** (PC), **Memory Data Register** (MDR) ,**Index register**, **memory Buffer Register**.

These Registers are used for performing various Operations. While we are working on the System then these Registers are used by the **CPU for Performing Operations**. When We Give Some Input to the System then the I**nput will be Stored into the Registers** and When the System will give us the Results after Processing, then the Result will also be from the Registers. So that they are used by the **CPU for Processing the Data** which is given by the User.

Registers vary in both number and size, depending on the CPU architecture. Some processors have 8 registers while others have 16, 32, or more. For many years, registers were 32-bit, but now many are 64-bit in size. A 64-bit register is necessary for a 64-bit processor, since it enables the CPU to access 64-bit memory addresses. A 64-bit register can also store 64-bit instructions, which cannot be loaded into a 32-bit register. Therefore, most programs written for 32-bit processors can run on 64-bit computers, while 64-bit programs are not backwards compatible with 32-bit machines.

## BUFFER

**Buffer** is a part of memory used to temporarily hold data while it is being moved from a location to another. A buffer is used when moving data between processes within a computer. Majority of buffers are implemented in software. Buffers are generally used when there is a difference between the rate at which data is received and the rate at which it can be processed. If we remove buffers, then either we will have data loss, or we will have lower bandwidth utilization. Buffers are set up in every program to hold data coming in and going out. In a video streaming application, the program uses buffers to store an advance supply of video data to compensate for momentary delays.

The purpose of a buffer is to hold data right before it is used. For example, when you download an audio or video file from the Internet, it may load the first 20% of it into a buffer and then begin to play. While the clip plays back, the computer continually downloads the rest of the clip and stores it in the buffer. Because the clip is being played from the buffer, not directly from the Internet, there is less of a chance that the audio or video will stall or skip when there is network congestion.

## CACHE

Cache stores recently used information so that it can be quickly accessed at a later time. Computers incorporate several different types of caching in order to run more efficiently, thereby improving performance. Common types of caches include browser cache, disk cache, memory cache, and processor cache.

1. **Browser cache** - Most web browsers cache web page data by default. For example, when you visit a webpage, the browser may cache the html, images, and any css or javascript files

referenced by the page. When you browse through other pages on the site that use the same images, CSS, or JavaScript, your browser will not have to re-download the files. Instead, the browser can simply load them from the cache, which is stored on your local hard drive.

2. **Memory cache** - When an app is running, it may cache certain data in the RAM. For example, if you are working on a video project, the video editor may load specific video clips and audio tracks from the hard drive into RAM. Since RAM can be accessed much more quickly than a hard drive, this reduces lag when importing and editing files.
3. **Disk cache** - Most HDDs and SSDs include a small amount of RAM that serves as a disk cache. A typical disk cache for a 1 terabyte hard drive is 32 megabytes, while a 2 TB hard drive may have a 64 MB cache. This small amount of RAM can make a big difference in the drive's performance. For example, when you open a folder with a large number of files, the references to the files may be automatically saved in the disk cache. The next time you open the folder, the list of files may load instantly instead of taking several seconds to appear.

4. **Processor cache** - Processor caches are even smaller than disk caches. This is because a processor cache contains tiny blocks of data, such as frequently used instructions, that can be accessed quickly by the CPU. Modern processors often contain an L1 cache that is right next to the processor and an L2 cache that is slightly further away. The L1 cache is the smallest (around 64 KB), while the L2 cache may be around 2 MB in size. Some high-end processors even include an L3 cache, which is larger than the L2 cache. When a processor accesses data from a higher-level cache, it may also move the data to the lower-level cache for faster access next time.

Most caching is done in the background, so you won't even notice it is happening. In fact, the only one of the above caches that you can control is the browser cache. You can open your browser preferences to view the cache settings and alter the size of your browser cache or empty the cache if needed.

## HOW COMPUTERS MANAGE MEMORY

**Memory management** is a form of management applied to computer memory. The essential requirement of memory management is to provide methods to dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed. This is critical to any advanced computer system where more than a single process might be underway at any time.

Several methods have been devised that increase the effectiveness of memory management. Virtual memory systems separate the memory addresses used by a process from actual physical addresses, allowing separation of processes and increasing the size of the virtual address space beyond the available amount of RAM using paging or swapping to secondary storage. The quality of the virtual memory manager can have an extensive effect on overall system performance.

In some operating systems, memory is managed by the operating system. Memory management within an address space is generally categorized as either manual memory management or automatic memory management.