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Course Title: Computer Architecture
Course Code: CSE 313
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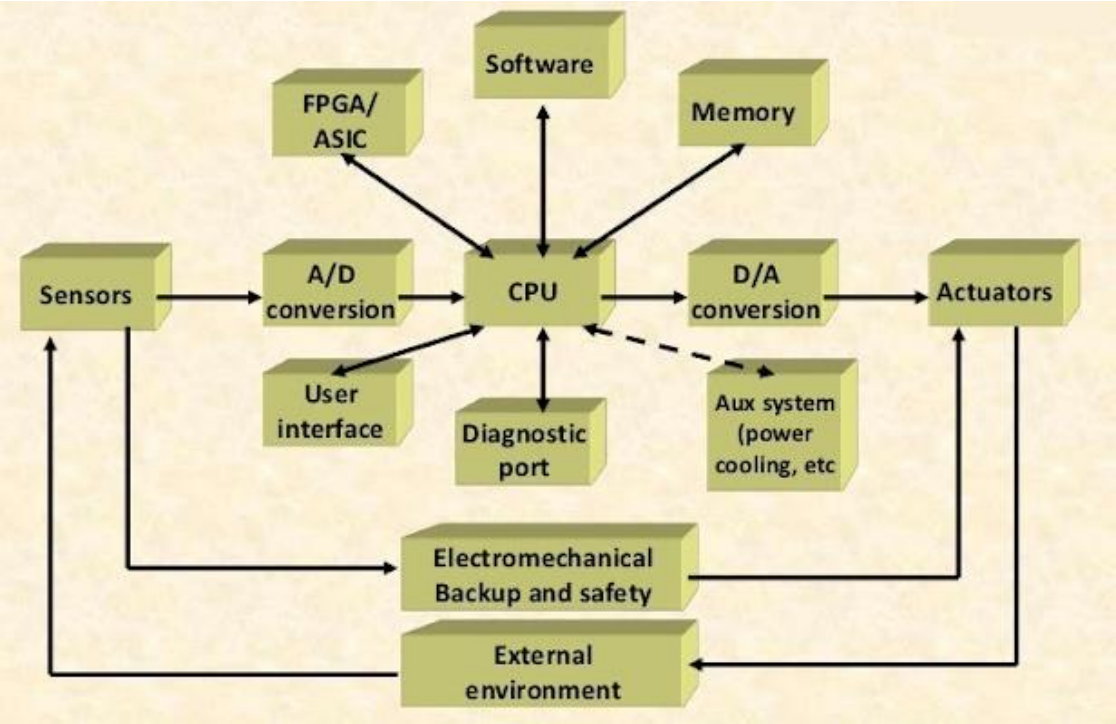
Ans to the Que No 1(A)

Embedded System:

An embedded system is a microprocessor-based computer hardware system with software that is designed to perform a dedicated function, either as an independent system or as a part of a large system. At the core is an integrated circuit designed to carry out computation for real-time operations.

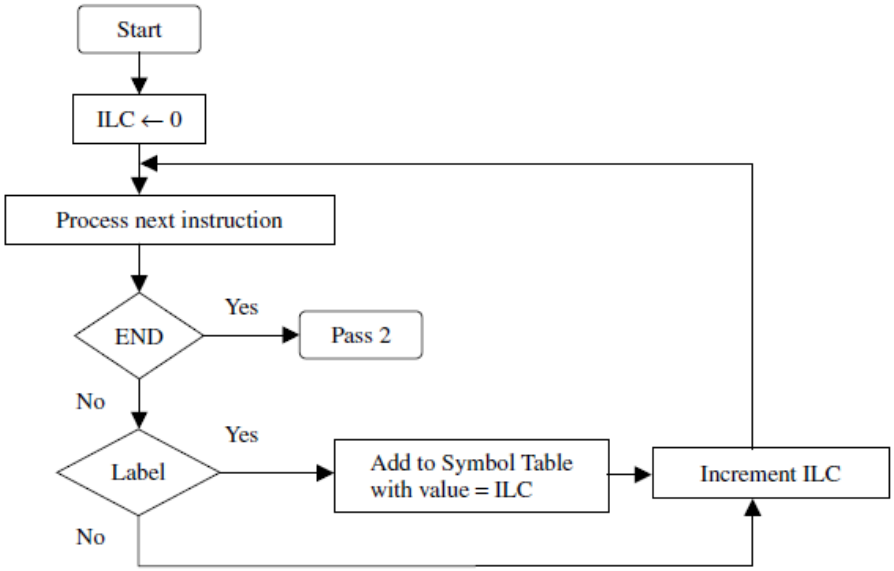
Complexities range from a single microcontroller to a suite of processors with connected peripherals and networks; from no user interface to complex graphical user interfaces. The complexity of an embedded system varies significantly depending on the task for which it is designed.

Embedded system applications range from digital watches and microwaves to hybrid vehicles and avionics. As much as 98 percent of all microprocessors manufactured are used in embedded systems.

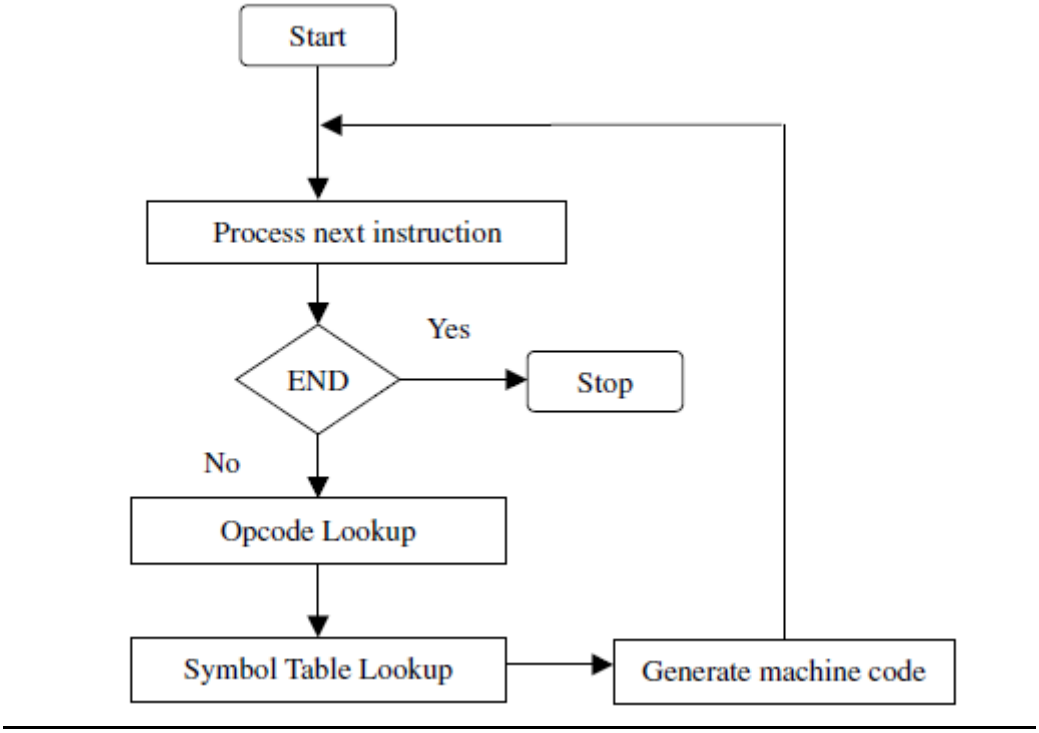


Ans to the Que No 1(B)

Simplified pass one in a two-pass assembler:



Simplified pass two in a two-pass assembler:



Ans to the Que No 1(C)

The Levels of CPU Cache Memory: L1, L2, and L3

CPU Cache memory is divided into three "levels": L1, L2, and L3. The memory hierarchy is again according to the speed and, thus, the size of the cache.

L1 Cache:

L1 (Level 1) cache is the fastest memory that is present in a computer system. In terms of priority of access, the L1 cache has the data the CPU is most likely to need while completing a certain task. The size of the L1 cache depends on the CPU. Some top-end consumer CPUs now feature a 1MB L1 cache, like the Intel i9-9980XE, but these cost a huge amount of money and are still few and far between. Some server chipsets, like Intel's Xeon range, also feature a 1-2MB L1 memory cache.

L2 Cache:

L2 (Level 2) cache is slower than the L1 cache but bigger in size. Where an L1 cache may measure in kilobytes, modern L2 memory caches measure in megabytes. For example, AMD's highly rated Ryzen 5 5600X has a 384KB L1 cache and a 3MB L2 cache (plus a 32MB L3 cache).

The L2 cache size varies depending on the CPU, but its size is typically between 256KB to 8MB. Most modern CPUs will pack more than a 256KB L2 cache, and this size is now considered small. Furthermore, some of the most powerful modern CPUs have a larger L2 memory cache, exceeding 8MB. When it comes to speed, the L2 cache lags behind the L1 cache but is still much faster than your system RAM. The L1 memory cache is typically 100 times faster than your RAM, while the L2 cache is around 25 times faster.

L3 Cache:

Onto the L3 (Level 3) cache. In the early days, the L3 memory cache was actually found on the motherboard. This was a very long time ago, back when most CPUs were just single-core processors. Now, the L3 cache in your CPU can be massive, with top-end consumer CPUs featuring L3 caches up to 32MB. Some server CPU L3 caches can exceed this, featuring up to 64MB.

The L3 cache is the largest but also the slowest cache memory unit. Modern CPUs include the L3 cache on the CPU itself. But while the L1 and L2 cache exist for each core on the chip itself, the L3 cache is more akin to a general memory pool that the entire chip can make use of.

Ans to the Que No 2(A)

Memory Access Register:

Register memory is the smallest and fastest memory in a computer. It is not a part of the main memory and is located in the CPU in the form of registers, which are the smallest data holding elements. A register temporarily holds frequently used data, instructions, and memory address that are to be used by CPU. They hold instructions that are currently processed by the CPU. All data is required to pass through registers before it can be processed. So, they are used by CPU to process the data entered by the users.

Registers hold a small amount of data around 32 bits to 64 bits. The speed of a CPU depends on the number and size (no. of bits) of registers that are built into the CPU. Registers can be of different types based on their uses. Some of the widely used Registers include Accumulator or AC, Data Register or DR, the Address Register or AR, Program Counter (PC), I/O Address Register, and more.

Types and Functions of Computer Registers:

Data Register: It is a 16-bit register, which is used to store operands (variables) to be operated by the processor. It temporarily stores data, which is being transmitted to or received from a peripheral device.

Program Counter (PC): It holds the address of the memory location of the next instruction, which is to be fetched after the current instruction is completed. So, it is used to maintain the path of execution of the different programs and thus executes the programs one by one, when the previous instruction gets completed.

Instructor Register: It is a 16-bit register. It stores the instruction which is fetched from the main memory. So, it is used to hold instruction codes, which are to be executed. The Control Unit takes instruction from Instructor Register, then decodes and executes it.

Accumulator Register: It is a 16-bit register, which is used to store the results produced by the system. For example, the results generated by CPU after the processing are stored in the AC register.

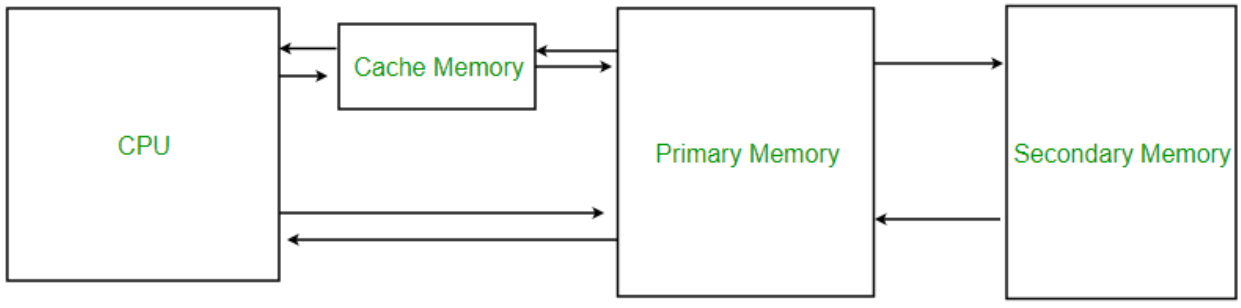
Address Register: It is a 12-bit register that stores the address of a memory location where instructions or data is stored in the memory.

I/O Address Register: Its job is to specify the address of a particular I/O device.

I/O Buffer Register: Its job is to exchange the data between an I/O module and the CPU.

Ans to the Que No 2(B)

Cash Memory:



Cache Memory is a special very high-speed memory. It is used to speed up and synchronize with high-speed CPU. Cache memory is costlier than main memory or disk memory but more economical than CPU registers. Cache memory is an extremely fast memory type that acts as a buffer between RAM and the CPU. It holds frequently requested data and instructions so that they are immediately available to the CPU when needed. Cache memory is used to reduce the average time to access data from the Main memory. The cache is a smaller and faster memory that stores copies of the data from frequently used main memory locations. There are various different independent caches in a CPU, which store instructions and data.