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1) Explain 3 types of memory mapping?
There are three different types of mapping used for the purpose of cache memory which are as follows: Direct mapping, Associative mapping, and Set Associative mapping. These are explained below. 1) Direct Mapping: The simplest technique, known as direct mapping, maps each block of main memory into only one possible cache line. or In Direct mapping, assigned each memory block to a specific line in the cache. If a line is previously taken up by a memory block when a new block needs to be loaded, the old block is trashed. An address space is split into two parts index field and a tag field. The cache is used to store the tag field whereas the rest is stored in the main memory. Direct mapping's performance is directly proportional to the Hit ratio. 2) Associative Mapping: In this type of mapping, the associative memory is used to store content and addresses of the memory word. Any

block can go into any line of the cache. This means that the word id bits are used to identify which word in the block is needed, but the tag becomes all of the remaining bits. This enables the placement of any word at any place in the cache memory. It is considered to be the fastest and the most flexible mapping form. 3) set-associative Mapping: This form of mapping is an enhanced form of direct mapping where the drawbacks of direct mapping are removed. Set associative addresses the problem of possible thrashing in the direct mapping method. It does this by
saying that instead of having exactly one line that a block can map to in the cache, we will group a few lines together creating a set. Then a block in memory can map to any one of the lines of a specific set. Set-associative mapping allows that each word that is present in the cache can have two or more words in the main memory for the same index address. Set associative cache mapping combines the best of direct and associative cache mapping techniques.

2) Explain the modes of I/O data transfer?

a) The method that is used to transfer information between internal storage and external I/O devices is known as I/O interface. The CPU is interfaced using special communication links by the peripherals connected to any computer system. These communication links are used to resolve the differences between CPU and peripheral. There exists special hardware components between CPU and peripherals to supervise and synchronize all the input and output transfers that are called interface units. Modes of transfer: The binary information that is received from an external device is usually stored in the memory unit. The information that is transferred from the CPU to the external device is originated from the memory unit. CPU merely processes the information but the source and target is always the memory unit. Data transfer between CPU and the I/O devices may be done in different modes. Data transfer to and from the peripherals may be done in any of the three possible ways 1. Programmed I/O. 2. Interrupt initiated I/O. 3. Direct memory access(DMA). Now let's discuss each mode one by one. 1)Programmed I/O: It is due to the

result of the I/O instructions that are written in the computer program. Each data item transfer is initiated by an instruction in the program. Usually the transfer is from a CPU register and memory. In this case it requires constant monitoring by the CPU of the peripheral devices.

2) Interrupt-initiated I/O: Since in the above case we saw the CPU is kept busy unnecessarily. This situation can very well be avoided by using an interrupt driven method for data transfer. By using interrupt facility and special commands to inform the interface to issue an interrupt request signal whenever data is available from any device. In the meantime the CPU can proceed for any other program execution. The interface meanwhile keeps monitoring the device. Whenever it is determined that the device is ready for data transfer it initiates an interrupt request signal to the computer. Upon detection of an external interrupt signal the CPU stops momentarily the task that it was already performing, branches to the service program to process the I/O transfer, and then return to the task it was originally performing.

3) Direct Memory Access (DMA): The data

transfer between a fast storage media such as magnetic disk and memory unit is limited by the speed of the CPU. Thus we can allow the peripherals directly communicate with each other using the memory buses, removing the intervention of the CPU. This type of data transfer technique is known as DMA or direct memory access. During DMA the CPU is idle and it has no control over the memory buses. The DMA controller takes over the buses to manage the transfer directly between the I/O devices and the memory unit.

*Cyclic Stealing: An alternative method in which DMA controller transfers one word at a time after which it must return the control of the buses to the CPU. The CPU delays its operation only for one memory cycle to allow the direct memory I/O transfer to "steal" one memory cycle. Steps Involved are: 1. Buffer the byte into the buffer 2. Inform the CPU that the device has 1 byte to transfer (i.e. bus grant request) 3. Transfer the byte (at system bus speed) 4. Release the control of the bus back to CPU

3) Explain micro operations?

Micro Operations: In computer central processing units, micro-operations (also known as micro-ops) are the functional or atomic, operations of a processor. These are low level instructions used in some designs to implement complex machine instructions. They generally perform operations on data stored in one or more registers. They transfer data between registers or between external buses of the CPU, also performs arithmetic and logical operations on registers. In executing a program, operation of a computer consists of a sequence of instruction cycles, with one machine instruction per cycle. Each instruction cycle is made up of a number of smaller units - Fetch, Indirect, Execute and Interrupt cycles. Each of these cycles involves series of steps, each of which involves the processor registers. These steps are referred as micro-operations. the prefix micro refers to the fact that each of the step is very simple and accomplishes very little. The operations executed on data stored in registers are called micro-operations. A micro-operation is an elementary operation performed on the information stored in

one or more registers. Example: Shift, count, clear and load. Types of Micro-Operations The micro-operations in digital computers are of 4 types: 1. Register transfer micro-operations transfer binary information from one register to another. 2. Arithmetic micro-operations perform arithmetic operations on numeric data stored in registers. 3. Logic micro-operations perform bit manipulation operation on non-numeric data stored in registers. 4. Shift micro-operations perform shift micro-operations performed on data Arithmetic Micro-Operations: Some of the basic micro-operations are addition, subtraction, increment and decrement

a) Add Micro-Operation: It is defined by the following statement: R3 → R1 + R2 b) Subtract Micro-Operation: In subtract micro-operation, instead of using minus operator we take 1's compliment and add 1 to the register which gets subtracted, i.e R1 - R2 is equivalent to R3 → R1 + R2' + 1 c) Increment/Decrement Micro-Operation Increment and decrement micro-operations are generally performed by adding and subtracting 1 to and from the register respectively. R1 → R1 + 1 R1 → R1 - 1 Logic Micro-Operations: These are

binary micro-operations performed on the bits stored in the registers. These operations consider each bit separately and treat them as binary variables. P: R ← R X-OR R2 Shift Micro Operations These are used for serial transfer of data. That means we can shift the contents of the register to the left or right. In the shift left operation the serial input transfers a bit to the right most position and in shift right operation the serial input transfers a bit to the left most position.

There are three types of shifts as follows: a) Logical Shift It transfers 0 through the serial input. The symbol "shl" is used for logical shift left and "shr" is used for logical shift right. R ← shr R b) Circular Shift This circulates or rotates the bits of register around the two ends without any loss of data or contents. In this, the serial output of the shift register is connected to its serial input. "cil" and "cir" is used for circular shift left and right respectively. c) Arithmetic Shift This shifts a signed binary number to left or right. An arithmetic shift left multiplies a signed binary number by 2 and shift left divides the number by 2. Arithmetic shift

micro-operation leaves the sign bit unchanged because the signed number remains same when it is multiplied or divided 2. Arithmetic Logical Unit Instead of having individual registers performing the micro-operations, computer system provides a number of registers connected to a common unit called as Arithmetic Logical Unit (ALU). ALU is the main and one of the most important unit inisde CPU of computer. All the logical and mathematical operations of computer are performed here. The contents of specific register is placed in the in the input of ALU. ALU performs the given operation and then transfer it to the destination register.