Assignment No. 3

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Q.① Explain first in first out memory replacement algorithm with example.

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The first in first out (FIFO) page replacement algorithm replaces the oldest page in memory when a new page must be loaded. It works just like a queue - pages are inserted at the rear and removed from the front.

Working:

1. When a new page is referenced, check if it exist in memory.
2. If not (page fault), insert in memory.
3. If memory is full, remove the oldest page (first inserted).
4. Continue the process for the reference string.

Example:

Reference strings: 1, 2, 3, 1, 4, 5.
Frames = 3

Step	Page reference	Frames (after allocation)	Hit / Miss
1	1	1	Miss
2	2	1, 2	Miss
3	3	1, 2, 3	Miss
4	1	1, 2, 3	Hit
5	4	4, 2, 3 (1 replaced)	Miss
6	5	5, 2, 3 (4 replaced)	Miss

- Hits: 1 (when page 1 was referenced again)
- Misses: 5
- Pages were replaced in the order they came in FIFO.

Q. ② Explain associative mapping with example.

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Associative mapping is a cache memory technique where any block of main memory can be placed in any cache line. It provides complete flexibility but requires parallel searching.

Working:

- Each memory block is identified by a tag.
- To check if a block is in cache, all tags are compared simultaneously (parallel search).
- If found, it's a cache hit; otherwise, a miss occurs and the block is loaded into any free cache line.

Example:

Main memory = 64 blocks, Cache = 16 lines.

- Blocks 10, 25, and 45 can be stored in any cache line.
- When searching for block 25, all cache lines are checked in parallel for a matching tag.

Advantages:
① High flexibility, no restrictions on placement
② Efficient if proper hardware exists.

Disadvantages:
① Hardware is expensive (parallel comparators required)
② More power consumption.

Q. ③ Explain Interrupt Driven I/O with diagram
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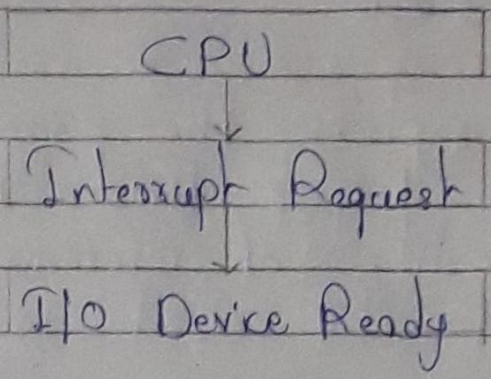
In interrupt driven I/O, the CPU is not forced to wait for I/O diagram devices. Instead, devices send an interrupt signal when they are ready, and the CPU executes an Interrupt Service Routine (ISR) to handle the transfer.

Working:

1. CPU executes a program
2. I/O device becomes ready and sends an interrupt.
3. CPU pauses the current task and save its state
4. ISR executes to complete data transfer.
5. CPU resumes its normal program execution.

Diagram:



Example: Keyboard input → CPU doesn't check continuously. When a key is pressed, an interrupt is generated and CPU reads the character.

Q. ⑨ Compare memory programmed I/O and memory mapped I/O.

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Feature	Programmed I/O	Memory Mapped I/O
Address Space	Seperate I/O address space	Same address space as memory
Instruction	Special I/O instruction (IN, OUT)	Normal instruction (LOAD, STORE)
Complexity	Simple Hardware	Sightly complex
Speed	Slower	Faster
Usage	Old/simple system	Modern systems
Flexibility	Less	High
Example	Intel 8085 (use IN/OUT)	ARM, RISC processor.

Q ⑤ Least Recently Used (LRU) Memory Replacement Algorithm with example.

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The LRU algorithm replaces the page that has not been used for the longest time. It is based on the principle of locality of reference (recently used papers are likely to be used again.

Working:

1. Maintain record of recent page usage
2. On a page fault, replace the page that was least recently used.
3. Update usage information after each access.

Example:

Reference string: 7,0,1,2,0,3,0,4
Frames = 3

- Insert 7,0,1 → Frames full
- Next 2 → replace 7
- Next 0 → already in memory
- Next 3 → replace 1
- Next 0 → already in memory
- Next 4 → replace 2.