ASSIGNMENT NO: 6

Title : Page Replacement Algorithms

AIM: Implement the C program for Page Replacement Algorithms: FCFS, LRU, and Optimal for frame size as minimum three.

THEORY:

What are PAGE REPLACMENT Algorithms?

- As studied in Demand Paging, only certain pages of a process are loaded initially into the memory.
- This allows us to get more processes into memory at the same time.
- But what happens when a process requests for more pages and no free memory is available to bring them in.
- Following steps can be taken to deal with this problem:
  1. Put the process in the wait queue, until any other process finishes its execution thereby freeing frames.
  2. Remove some other process completely from the memory to free frames.
  3. Find some pages that are not being used right now, move them to the disk to get free frames. This technique is called Page replacement and is most commonly used.
- In this case, if a process requests a new page and supposes there are no free frames, then the Operating system needs to decide which page to replace.
- The operating system must use any page replacement algorithm in order to select the victim frame.
- The Operating system must then write the victim frame to the disk then read the desired page into the frame and then update the page tables. And all these require double the disk access time.

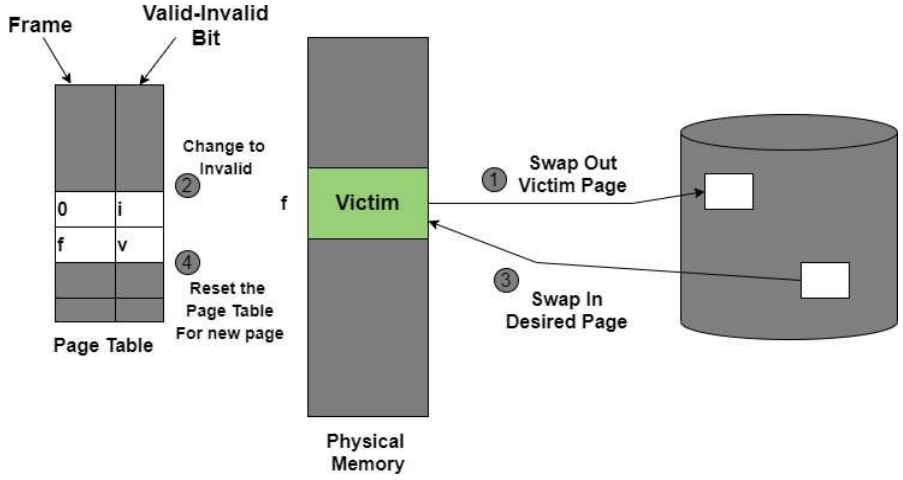
- **Page Replacement in OS**

In Virtual Memory Management, Page Replacement Algorithms play an important role. The main objective of all the Page replacement policies is to decrease the maximum number of page faults.

- **Page Fault –** It is basically a memory error, and it occurs when the current programs attempt to access the memory page for mapping into virtual address space, but it is unable to load into the physical memory then this is referred to as Page fault.

- **Basic Page Replacement Algorithm in OS**

Page Replacement technique uses the following approach. If there is no free frame, then we will find the one that is not currently being used and then free it. A-frame can be freed by writing its content to swap space and then change the page table in order to indicate



that the page is no longer in the memory.

1. First of all, find the location of the desired page on the disk.
2. Find a free Frame: a) If there is a free frame, then use it. b) If there is no free frame then make use of the page-replacement algorithm in order to select the victim frame. c) Then after that write the victim frame to the disk and then make the changes in the page table and frame table accordingly

3. After that read the desired page into the newly freed frame and then change the page and frame tables.
4. Restart the process.

- **Page Replacement Algorithms in OS**

1. FIFO Page Replacement Algorithm

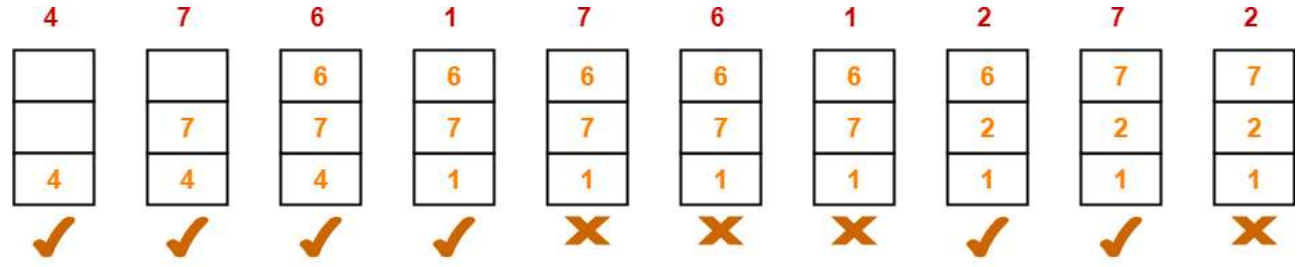
- It is a very simple way of Page replacement and is referred to as First in First Out.
- This algorithm mainly replaces the oldest page that has been present in the main memory for the longest time.
- This algorithm is implemented by keeping the track of all the pages in the queue.
- As new pages are requested and are swapped in, they are added to the tail of a queue and the page which is at the head becomes the victim.
- This is not an effective way of page replacement but it can be used for small systems.

Example:

- A system uses 3 page frames for storing process pages in main memory.
- It uses the First in First out (FIFO) page replacement policy.
- Assume that all the page frames are initially empty.
- What is the total number of page faults that will occur while processing the page reference string given below-
  4 , 7, 6, 1, 7, 6, 1, 2, 7, 2
- Also calculate the hit ratio and miss ratio.

Solution-

Total number of references = 10



From here,

Total number of page faults occurred = 6

Calculating Hit ratio-

Total number of page hits=Total number of references-Total number of page misses or page faults

Total number of page hits = 10 – 6 = 4

Thus,

Hit ratio = Total number of page hits / Total number of references

= 4 /10 = 0.4 or 40%

Calculating Miss ratio-

Total number of page misses or page faults = 6

Thus,

Miss ratio = Total number of page misses / Total number of references

= 6 /10 = 0.6 or 60%

Alternatively, Miss ratio

= 1 – Hit ratio

= 1 – 0.4

= 0.6 or 60%

ALGORITHM:

Step 1: Start the program.

Step 2: Declare the necessary variables.

Step 3: Enter the number of frames.

Step 4: Enter the reference string end with zero.

Step 5: FIFO page replacement selects the page that has been in memory the longest time and when the page must be replaced the oldest page is chosen.

Step 6: When a page is brought into memory, it is inserted at the tail of the queue.

Step 7: Initially all the three frames are empty.

Step 8: The page fault range increases as the no of allocated frames also increases.

Step 9: Print the total number of page faults.

Step 10: Stop the program.

2. LRU Page Replacement Algorithm in OS

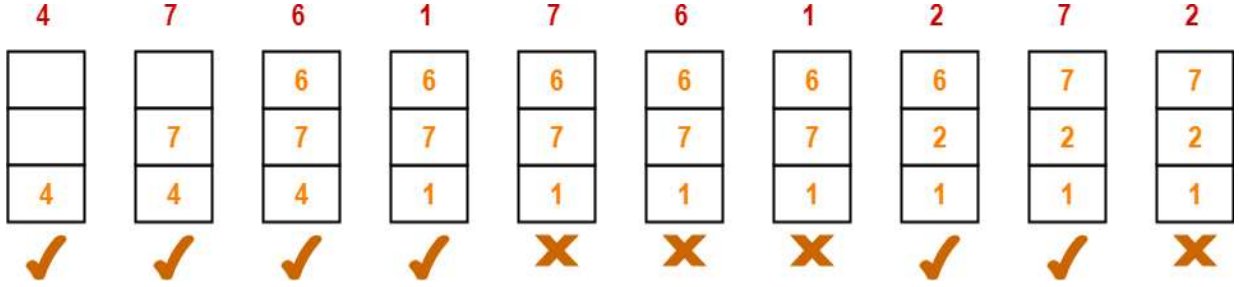
- This algorithm stands for "Least recent used" and this algorithm helps the Operating system to search those pages that are used over a short duration of time frame.
- The page that has not been used for the longest time in the main memory will be selected for replacement.
- This algorithm is easy to implement.
- This algorithm makes use of the counter along with the even-page.

Example

- A system uses 3 page frames for storing process pages in main memory.
- It uses the Least Recently Used (LRU) page replacement policy.
- Assume that all the page frames are initially empty.
- What is the total number of page faults that will occur while processing the page reference string given below-

  4 , 7, 6, 1, 7, 6, 1, 2, 7, 2
- Also calculate the hit ratio and miss ratio.

Solution-



Total number of references = 10
Total number of page faults occurred = 6
In the similar manner as above- Hit ratio = 0.4 or 40%
Miss ratio = 0.6 or 60%

ALGORITHM:

Step 1: Start the process
Step 2: Declare the size
Step 3: Get the number of pages to be inserted
Step 4: Get the value
Step 5: Declare counter and stack
Step 6: Select the least recently used page by counter value
Step 7: Stack them according the selection.
Step 8: Display the values
Step 9: Stop the process

3. Optimal Page Replacement Algorithm

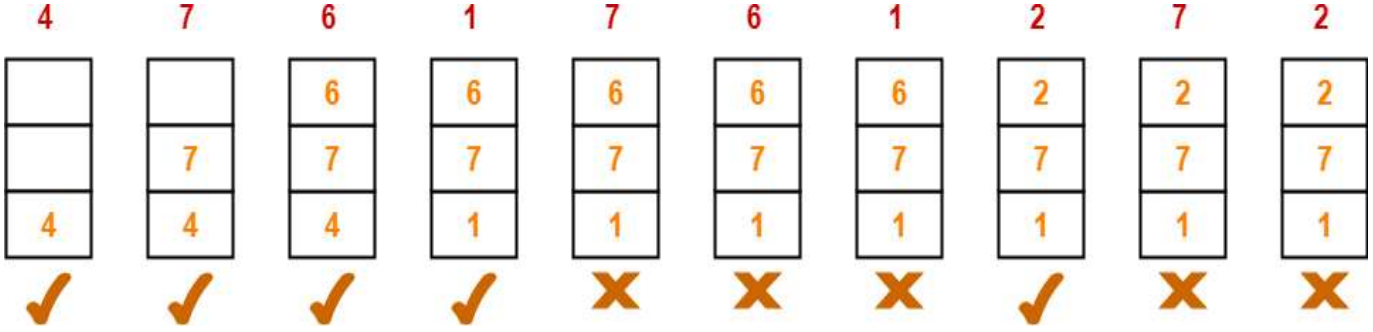
- This algorithm mainly replaces the page that will not be used for the longest time in the future.
- The practical implementation of this algorithm is not possible.
- Practical implementation is not possible because we cannot predict in advance those pages that will not be used for the longest time in the future.
- This algorithm leads to less number of page faults and thus is the best- known algorithm
- Also, this algorithm can be used to measure the performance of other algorithms.

Example:

- A system uses 3 page frames for storing process pages in main memory.
- It uses the Optimal page replacement policy.
- Assume that all the page frames are initially empty.
- What is the total number of page faults that will occur while processing the page reference string given below-
  4 , 7, 6, 1, 7, 6, 1, 2, 7, 2
- Also calculate the hit ratio and miss ratio.

Solution-

Total number of references = 10
Total number of page faults occurred = 5
In the similar manner as above-
Hit ratio = 0.5 or 50%
Miss ratio = 0.5 or 50%



ALGORTHIM:

Step 1. Start Program
Step 2. Read Number Of Pages And Frames
Step 3. Read Each Page Value
Step 4. Search For Page In The Frames
Step 5. If Not Available Allocate Free Frame
Step 6. If No Frames Is Free Replace The Page With The Page That Is Leastly Used
Step 7. Print Page Number Of Page Faults
Step 8. Stop process.