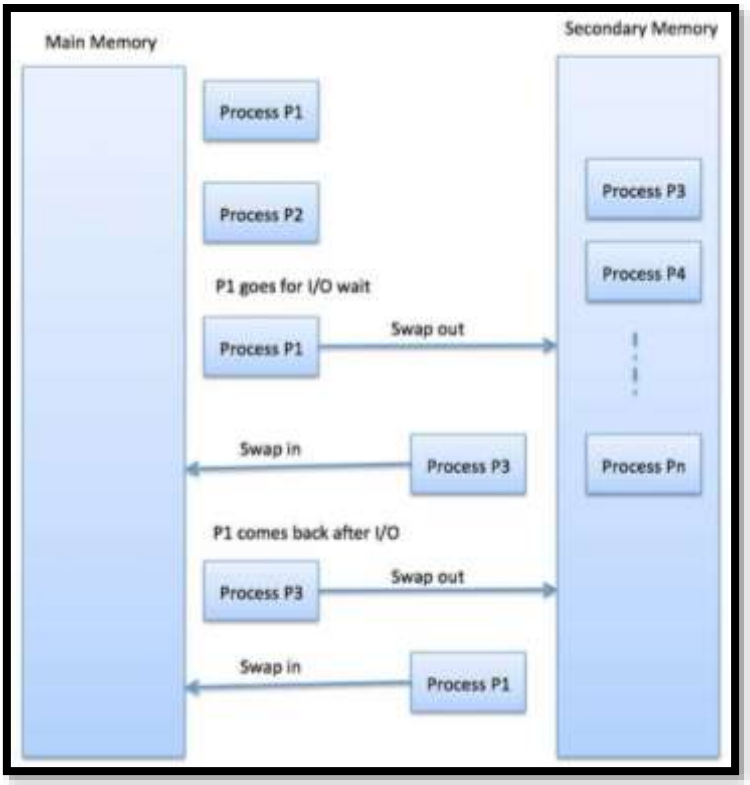
Q1 Swapping

Swapping is a mechanism in which a process can be swapped temporarily out of main memory (or move) to secondary storage (disk) and make that memory available to other processes. Later, the system swaps back the process from the secondary storage to main memory. Though performance is usually affected by swapping process but it helps in running multiple and big processes in parallel and that is the reason, Swapping is also known as a technique for memory compaction.

The total time taken by swapping process includes the time it takes to move the entire process to a secondary disk and then to copy the process back to memory, as well as the time the process takes to regain main memory.



Q2 Memory Fragmentation

As processes are loaded and removed from memory, the free memory space is broken into little pieces. It happens after sometimes that processes cannot be allocated to memory blocks considering their small size and memory blocks remains unused. This problem is known as Fragmentation. It is of two types –

- External fragmentation – Total memory space is enough to satisfy a request or to reside a process in it, but it is not contiguous, so it cannot be used.
- Internal fragmentation – Memory block assigned to process is bigger. Some portion of memory is left unused, as it cannot be used by another process.

External fragmentation can be reduced by compaction or shuffle memory contents to place all free memory together in one large block. To make compaction feasible, relocation should be dynamic.

The internal fragmentation can be reduced by effectively assigning the smallest partition but large enough for the process.

Q3 Virtual Memory

A computer can address more memory than the amount physically installed on the system. This extra memory is actually called virtual memory and it is a section of a hard disk set up to emulate the computer's RAM.

The main visible advantage of this scheme is that programs can be larger than physical memory. Virtual memory serves two purposes. First, it allows us to extend the use of physical memory by using disk. Second, it allows us to have memory protection, because each virtual address is translated to a physical address.

Virtual memory is commonly implemented by demand paging. It can also be implemented in a segmentation system. Demand segmentation can also be used to provide virtual memory.

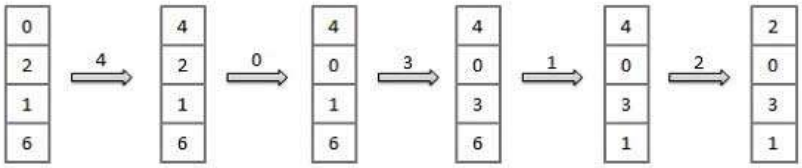
Q4 Page Scheduling Algorithms

Page replacement algorithms are the techniques using which an Operating System decides which memory pages to swap out, write to disk when a page of memory needs to be allocated.

1. First In First Out (FIFO) algorithm
    a. Oldest page in main memory is the one that will be selected for replacement.
    b. Easy to implement, keep a list, replace pages from the tail and add new pages at the head.

Reference String : 0, 2, 1, 6, 4, 0, 1, 0, 3, 1, 2, 1

Misses : x x x x x x x x x

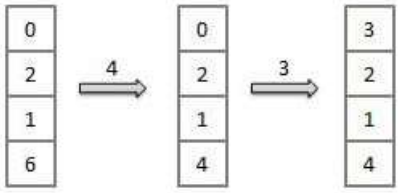


Fault Rate = 9 / 12 = 0.75

    c.
2. Optimal Page algorithm
    a. An optimal page-replacement algorithm has the lowest page-fault rate of all algorithms. An optimal page-replacement algorithm exists, and has been called OPT or MIN.
    b. Replace the page that will not be used for the longest period. Use the time when a page is to be used.

Reference String : 0, 2, 1, 6, 4, 0, 1, 0, 3, 1, 2, 1

Misses : x x x x x x

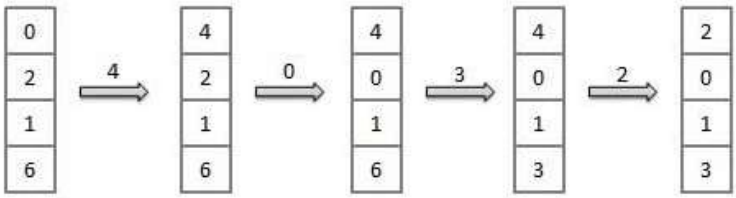


    c. Fault Rate = 6 / 12 = 0.50

3. Least Recently Used (LRU) algorithm
    a. Page that has not been used for the longest time in main memory is the one, which will be selected for replacement.
    b. Easy to implement, keep a list, replace pages by looking back into time.

Reference String : 0, 2, 1, 6, 4, 0, 1, 0, 3, 1, 2, 1

Misses : x x x x x x x x



c. Fault Rate = 8 / 12 = 0.67

Q5 Demand Paging

A demand paging system is quite similar to a paging system with swapping where processes reside in secondary memory and pages are loaded only on demand, not in advance. When a context switch occurs, the operating system does not copy any of the old program's pages out to the disk or any of the new program's pages into the main memory Instead, it just begins executing the new program after loading the first page and fetches that program's pages as they are referenced.

While executing a program, if the program references a page, which is not available in the main memory because it was swapped out a little ago, the processor treats this invalid memory reference as a page fault and transfers control from the program to the operating system to demand the page back into the memory.