# chap-9 (virtual memory)

Qus: what is virtual memory?

Ans: virtual memory is a technique that allows the execution of processes that are not completely in memory.

* Hard disk এর যে অংশ টুকু RAM হিসাবে কাজ করে কিন্তু Actual RAM না।

Qus: Advantage of virtual memory?

Ans:

1. virtual memory is larger than the physical memory.
2. virtual memory allows processes to share files easily and to implement shared memory.
3. It provides an efficient mechanism for process creation.
4. It is in-expensive
5. Enhanced data security
6. It provides multiprogramming, multitasking and collaboration
7. It allows more applications to be run at the same time.
8. There is no specific limit on the degree of multiprogramming.

Qus: How virtual memory works?

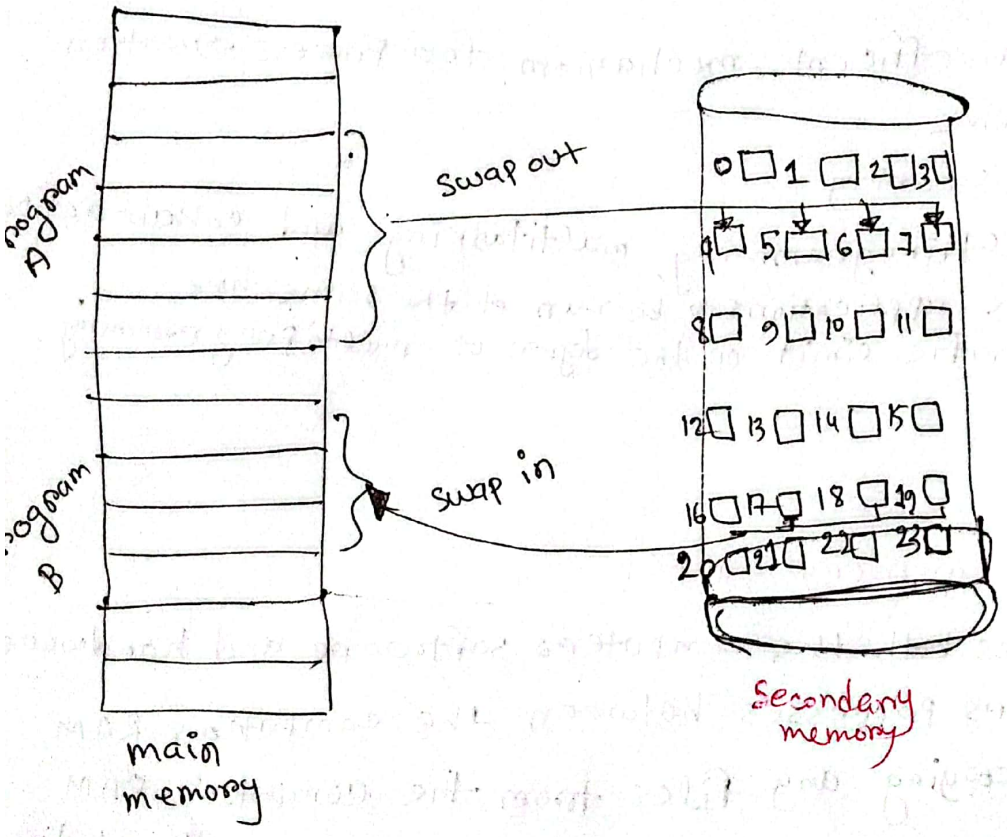
virtual memory uses both the computer's software and hardware to work. It transfers processes between the computer's RAM and hard disk by copying any files from the computer's RAM that aren't currently in use and moving them to the hard disk. By moving unused files to the hard disk, a computer frees up space in its RAM to perform current tasks, such as opening a new application. If the computer later needs to use its RAM for a more urgent task, it can swap files to make the most of the

available RAM.

Qus: what is Demand Pagging explain with Block diagram.

Ans:

Demand Paging :- Demand Paging is a technique used in virtual memory systems where pages enter main memory only when requested or needed by the CPU.




explain: A demand-paging system is similar to a paging system with waping. where processes reside in a secondary memory (usually disk). when we want to execute a process, we swap it into memory. Rather than swapping the entire process into memory,

we use a lazy ~~memory~~ swapper. A Lazy ~~memory~~ swapper never swaps a page into memory unless that page will be needed. ~~Since we are now viewing~~

A swapper manipulates entire processes, whereas a page is concerned with the individual page of a process. Thus we use pager, rather than swapper, in connection with demand paging.

Qus: write down the steps in handling a page fault?

Ans:-

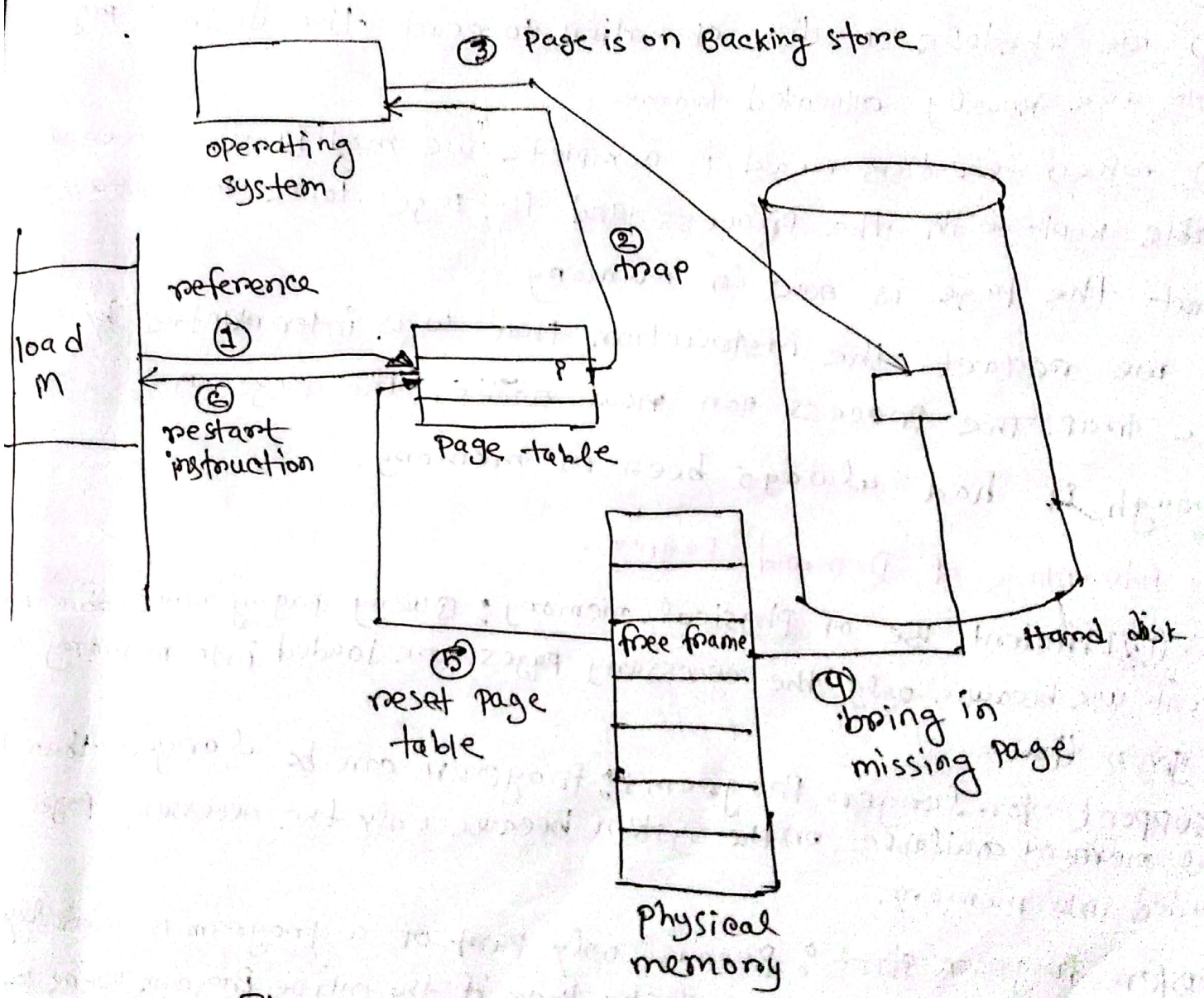



Fig: steps in handling a Page fault.

The Procedure for handling this page fault is straightforward:

(1) we check an internal table (usually kept with the Process control block) for this process to determine whether the reference was a valid or an invalid memory access.

(2) If the reference was invalid, we terminate the process. If it was valid, but we have not yet brought in that page, we now page it in.

(3) we find a free frame

(4) we schedule a disk operation to read the desired page into the newly allocated frame.

(5) when the disk read is complete, we modify the internal table kept with the process and the page table to indicate that the page is now in memory.

(6) we restart the instruction that was interrupted by the trap. The process can now access the page as though it had always been in memory.

Qw: Advantage of Demand Paging ?

Soln: (1) Efficient use of Physical memory: Query paging allows for more efficient use because only the necessary pages are loaded into memory at any given time.

(2) support for larger Programs: Program can be larger than the Physical memory available on the system because only the necessary Pages will be loaded into memory.

(3) faster Program start: Because only part of a program is initially loaded into memory, Progpams can start faster than if the entire Program were loaded at once.

(4) Reduce memory usage.

(5) If we use demand paging, then we have a large virtual memory.

(6) no requirement for compaction (7) The sharing of pages is easy.

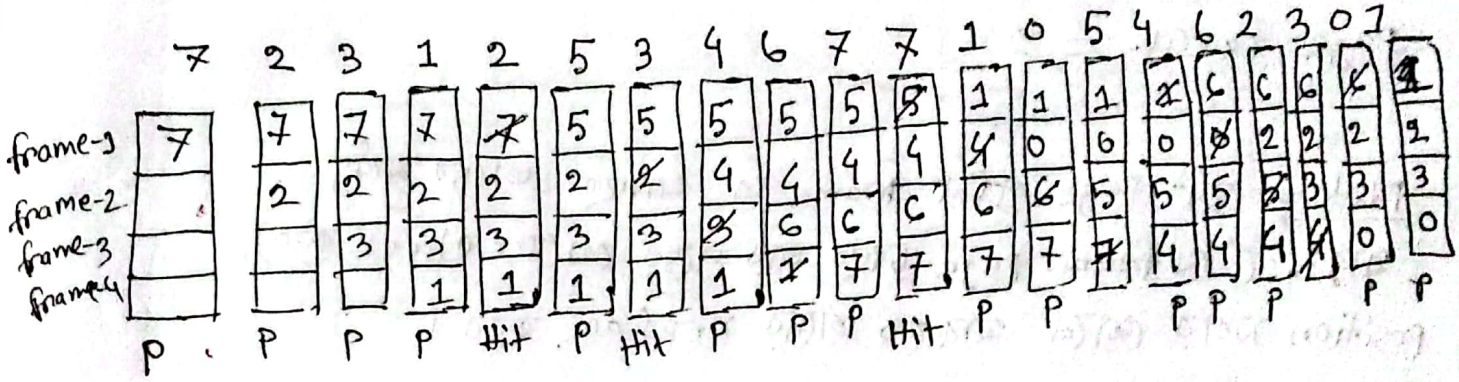
## FIFO Page replacement:

consider the following page reference string:

7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0, 1

How many page faults would occur for the following replacement algorithm, assuming four (04) frames? Remember that all frames are initially empty.

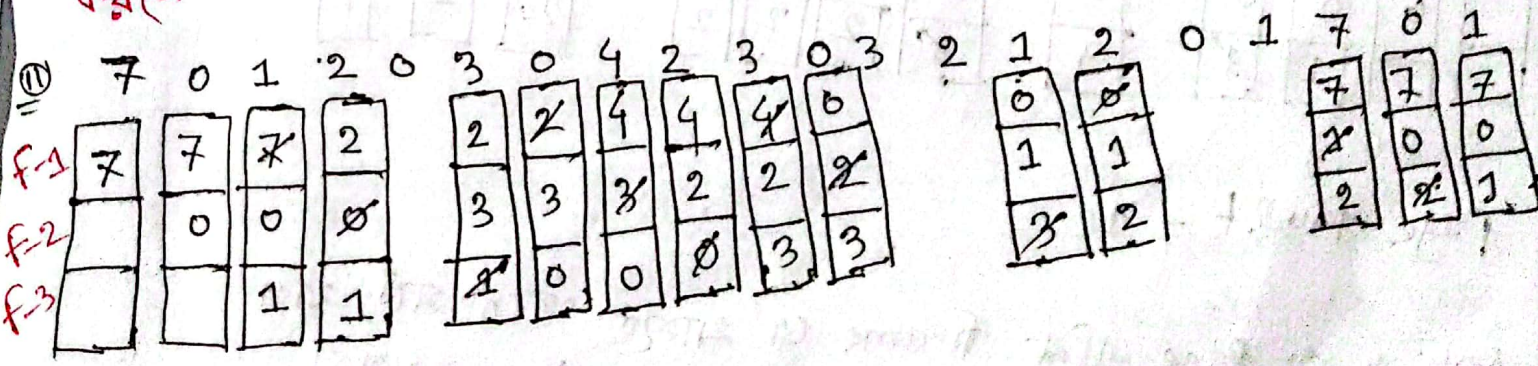
① FIFO page replacement




P = Page fault

Page fault = 15

Note: যেখানে যে page ~~[illegible]~~ frame এ থাকবে, তাকেই replace করবো।

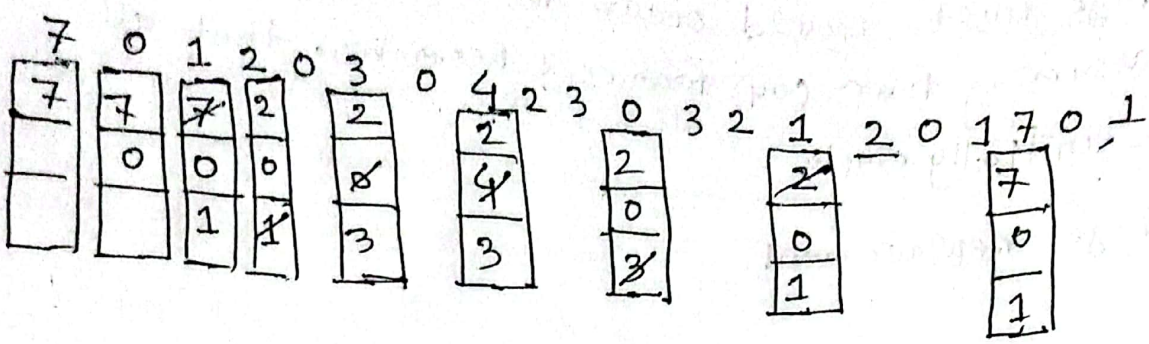



Page fault = 15

frame = 3.

## Optimal Page Replacement

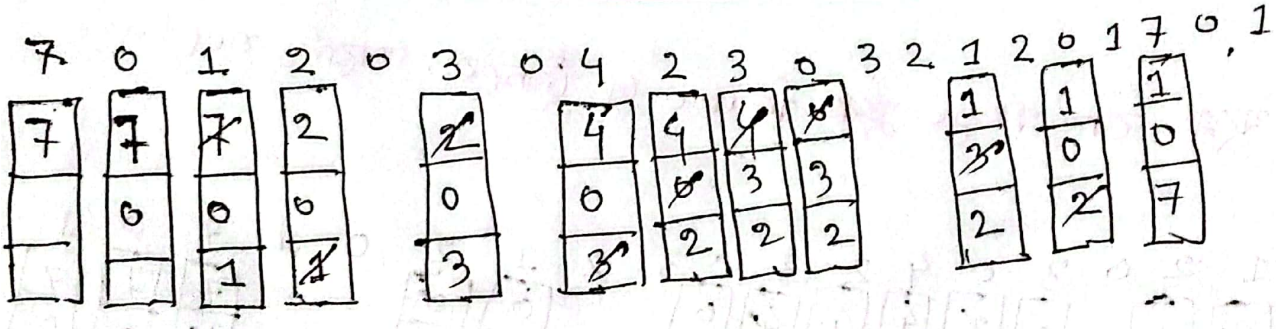
Replace the page which is not used in next longest dimension of time in future.




Page fault = 9.

Note: যে page গুলি frame এ থাকবে তাদের মধ্যে যাবা, (যে page টুকে তার পরের থেকে check করব), position অনুযায়ী শেষে থাকবে তাদের replace করব।

## LRU (Least Recent-used) Algorithm




Page fault = 12.

Note: যে Page গুলি frame এ থাকবে তাদের মধ্যে যারা (যে page টুকবে তার আগের page গুলি check করবে) position অনুযায়ী শেষে যে থাকবে তাকে replace করবে।

Ans: Justify the following statement with suitable example: "virtual memory is larger than physical memory".

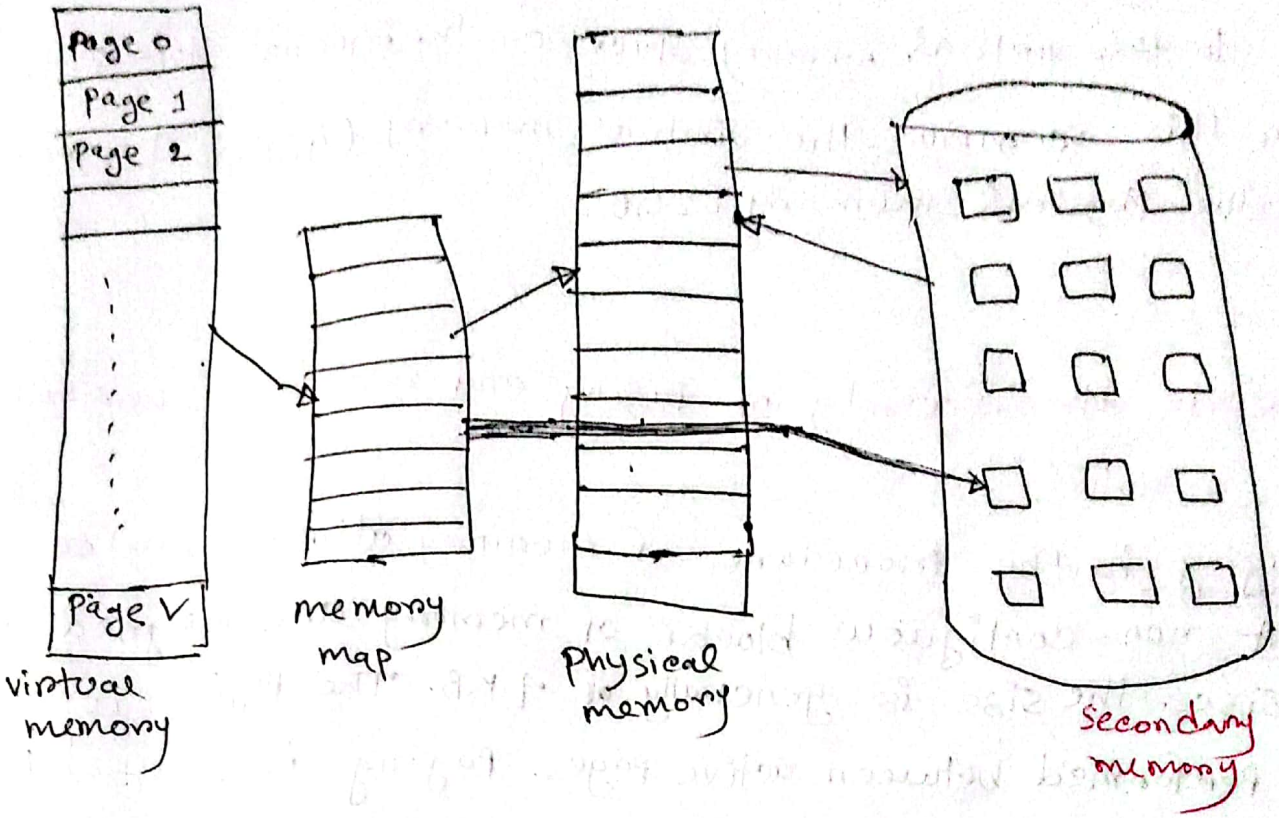



Fig: Diagram showing virtual memory that is larger than physical memory.

an example:

Imagine you have a smartphone with 2GB of physical RAM. you're using several apps simultaneously, and they collectively require more memory than what is available in the physical RAM. In this case, virtual memory comes into play. The operating system allocates a portion of the internal storage as virtual memory space. For instance, if the operating system allocates 4GB of virtual memory, it means that the system can access up to

4 GB memory space, even though only 2GB is physically installed when an apps needs memory that is not currently available in physical RAM, the operating system transfers some data from RAM to the virtual memory space on the internal storage. So, in this scenario, the virtual memory (4GB) is larger than the physical memory (2GB).

Qus: write the necessity of paging and swapping in our modern os.

Ans: Paging is the procedure of memory allocation where different non-contiguous blocks of memory are assigned a fixed size. The size is generally of 4 KB. The paging is always performed between active pages. Paging is essential for multitasking environments allowing multiple processes to run concurrently while efficiently managing limited physical memory resources.

Swapping:-
swapping is a process of swapping a process temporarily to a secondary memory from the main memory which is faster than compared to secondary memory. But as RAM is of less size so the process that is inactive is transferred to secondary memory. The main part of swapping is transferred time and the total time, is directly proportional to the amount of memory swapped.

| swapping | Paging |
|---|---|
| It is the procedure of copying out the entire process. | It is a technique of memory allocation. |
| swapping occurs when whole process is transferred to the disk | Paging occurs when some page of the process is transferred to the disk |
| It done in inactive process | only active process can perform paging |
| It perform without memory management | need non-contiguous memory management |
| It is slower | Relatively faster |

## * Disadvantage of Demand Paging :-

1. Internal fragmentation
2. It takes longer to access memory (page table lookup)
3. memory requirements.
4. Guards page table
5. inverted page table.
6. Gnc

* Low cost, low-power embedded system may no have a memory mangement unit that supports page replacement
* memory management with Page replacement algorithm becomes slightly more complex
* possible security risk, including vulnerability to timing attacks
* memory thrashing which may occurs due to repeated page faults.

## ⊗ Disadvantage of Virtual memory :-

1. Holds ~~virtual~~ vital storage space
2. Slower speed than Physical memory.
3. Context switch requires extra time
4. Stability Problems.
5. The algorithm for virtual memory is difficult to implement.