Programme : **S. Y. B. Sc.**

Subject : **Computer Science**

Semester : **IV**

Paper Code : **CSC 104**

Paper Title : **Computer Organization and Operating Systems**

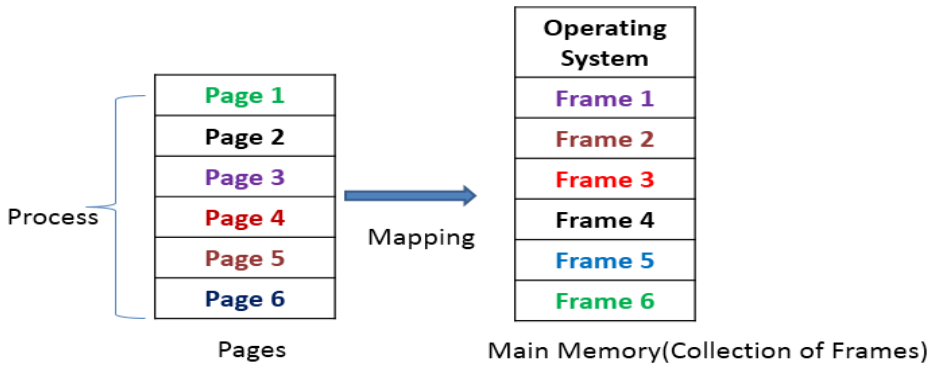
Unit 8 : Memory Management

Module Name : Paging

Module Number : 31

Paging

- Paging is a memory management scheme that permits the physical address space of a process to be non – contiguous.
- Paging is a fixed size partitioning scheme.
- In paging, secondary memory and main memory are divided into equal fixed size partitions.
- The partitions of secondary memory are called as pages.
- The partitions of main memory are called as frames.
- Each process is divided into parts where size of each part is same as page size.
- The pages of process are stored in the frames of main memory depending upon their availability.



Example

- Consider a process is divided into 4 pages P_0, P_1, P_2 and P_3.
- Depending upon the availability, these pages may be stored in the main memory frames in a non-contiguous fashion as shown-

P1
P3
P0
P2

Fig: Main memory

Translating Logical Address into Physical Address

- CPU always generates a logical address.
- A physical address is needed to access the main memory.

Following steps are followed to translate logical address into physical address :

Step-01:

- CPU generates a logical address consisting of two parts-
    1. Page Number
    2. Page Offset
- Page Number specifies the specific page of the process from which CPU wants to read the data.
- Page Offset specifies the specific word on the page that CPU wants to read.

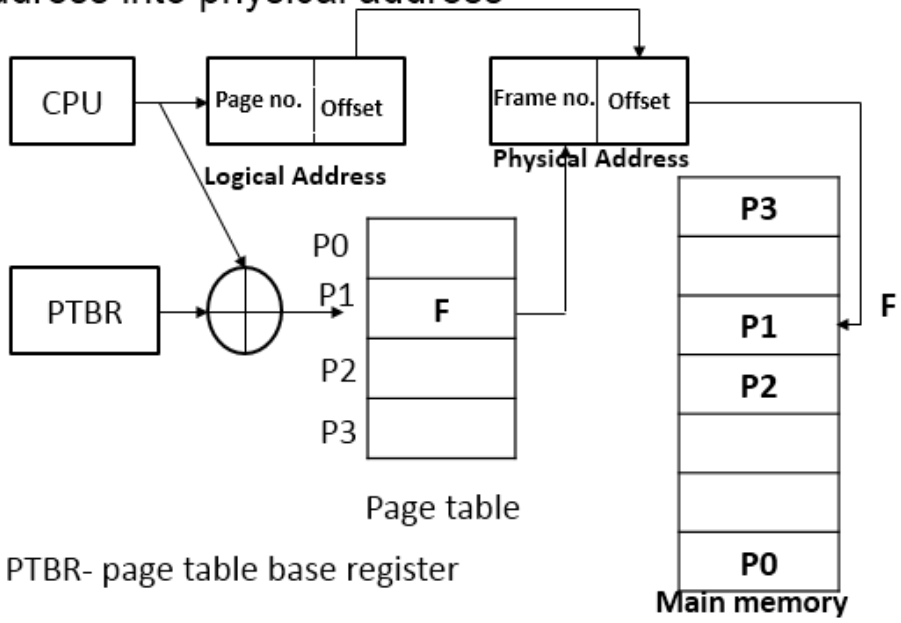
Step-02:

- For the page number generated by the CPU, Page Table provides the corresponding frame number (base address of the frame) where that page is stored in the main memory.

Step-03:

- The frame number combined with the page offset forms the required physical address.
- Frame number specifies the specific frame where the required page is stored.
- Page Offset specifies the specific word that has to be read from that page.

The following diagram illustrates the steps of translating logical address into physical address



Advantages

The advantages of paging are-

- It allows to store parts of a single process in a non-contiguous fashion.
- It solves the problem of external fragmentation

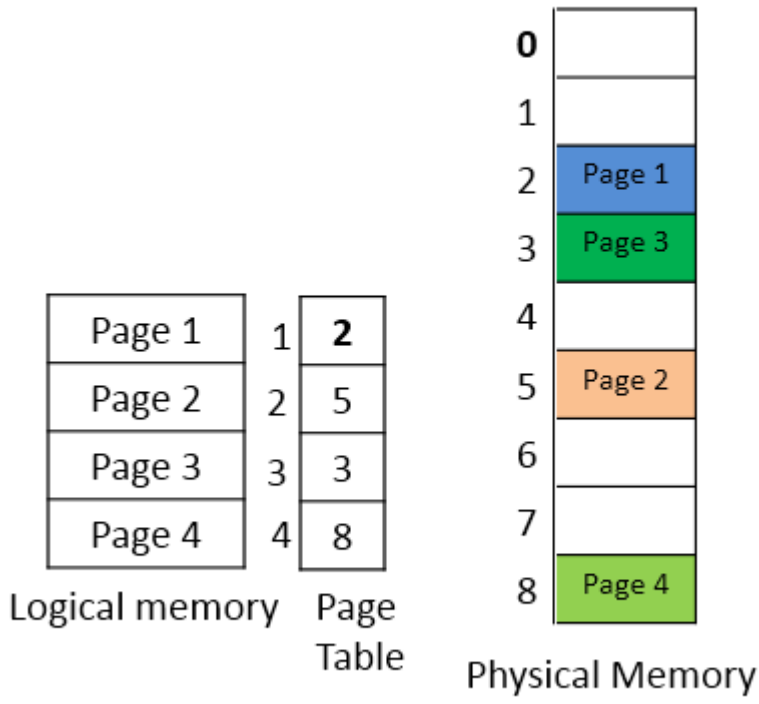
Disadvantages

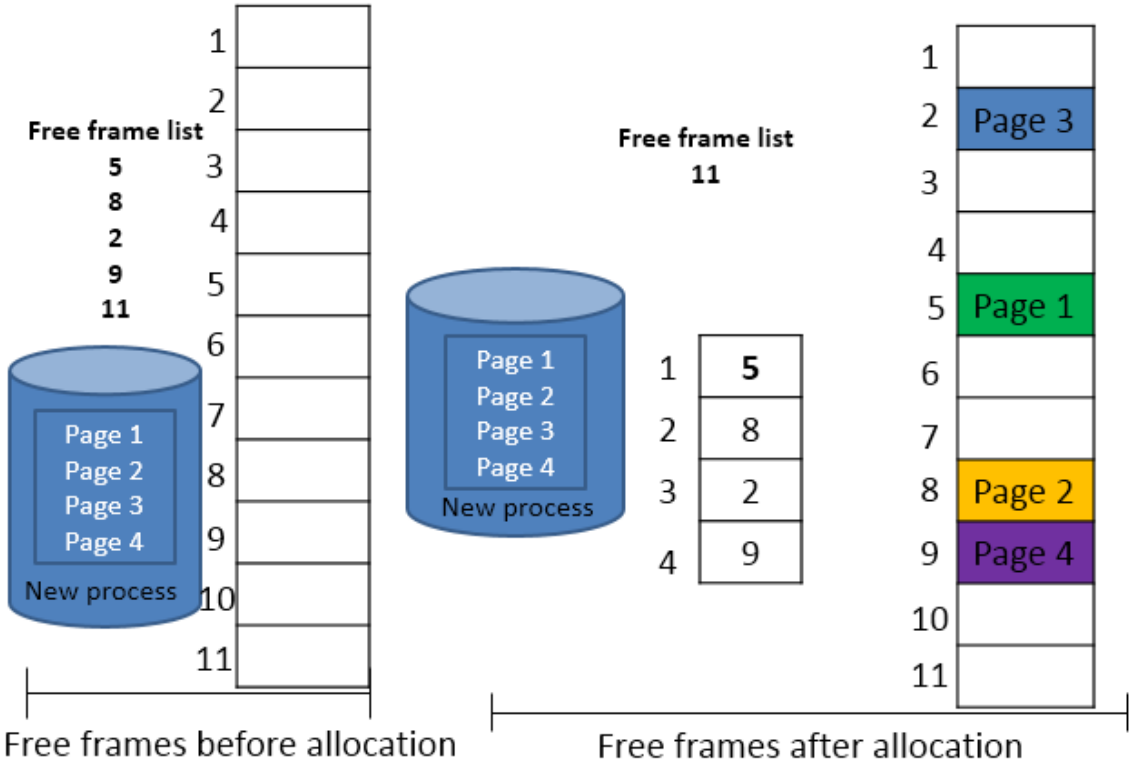
The disadvantages of paging are-

- It suffers from internal fragmentation.
- There is an overhead of maintaining a page table for each process.
- The time taken to fetch the instruction increases since now two memory accesses are required.

Example:

- If any process requires n pages then at least n frames are required.
- The first page of the process is loaded into the first frame that is listed on the free-frame list, and then the frame number is put into the page table.


Page 1
Page 2
Page 3
Page 4
1
2
3
4
2
5
3
8
Logical memory
Page Table
0
1
2
3
4
5
6
7
8
Page 1
Page 3
Page 2
Page 4
Physical Memory


Free frame list
5
8
2
9
11
Page 1
Page 2
Page 3
Page 4
New process
1
2
3
4
5
6
7
8
9
10
11
Free frames before allocation
Page 1
Page 2
Page 3
Page 4
New process
Free frame list
11
1
2
3
4
5
8
2
9
1
2
3
4
5
6
7
8
9
10
11
Page 3
Page 1
Page 2
Page 4
Free frames after allocation