Summary Note: Non-Contiguous Memory Allocation and Virtual Memory

Storage Allocation and Management Techniques

The Storage allocation can be of two types:
(i) Contiguous storage allocation.
(ii) Non-contiguous storage allocation.

In this lecture, we will discuss non-contiguous storage allocation techniques.

Non-contiguous Storage Allocation

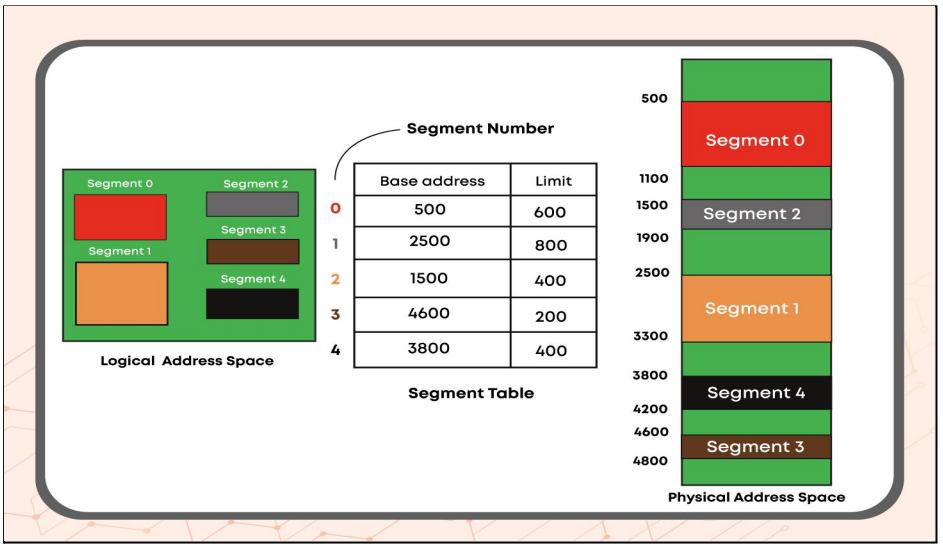
To resolve the problem of external fragmentation and to enhance the degree of multiprogramming to a greater extent, it was decided to sacrifice the simplicity of allocating contiguous memory to every process. It was decided to have a non-contiguous physical address space of a process so that a process could be allocated memory wherever it was available.

There are 2 techniques for non-contiguous allocation:

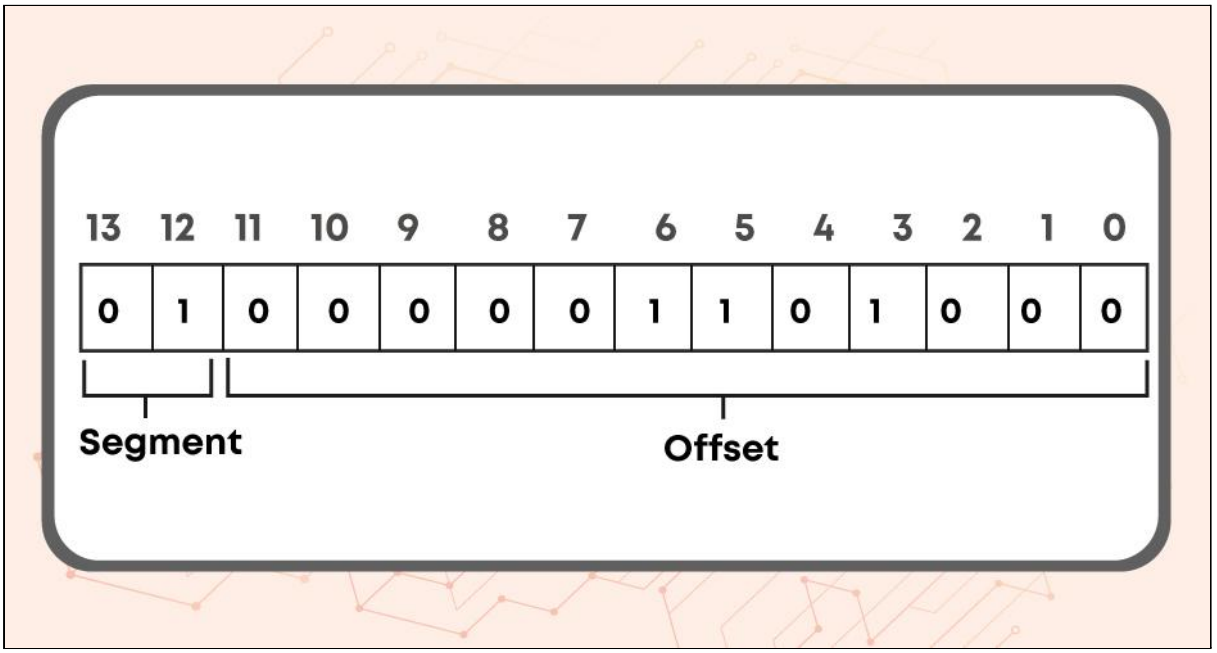
1. Segmentation
2. Paging

Segmentation

Segmentation is a technique for the noncontiguous storage allocation. For a programmer it might be more relevant to divide the logical address space of his program into variable sized segments (with respect to his view of main program, subroutines, data, etc.) than to divide it into fixed size pages. Such variable sized segments, which are a collection of logically related information, are the basis of segmentation technique.



For each segment, the table stores the starting address of the segment and the length of the segment. A reference to a memory location includes a value that identifies a segment and an offset.



Advantages and disadvantages of Segmentation

Advantages :

1. No internal fragmentation.
2. Segment tables consume less memory.
3. Lends itself to sharing data among processes.
4. Lends itself to protection.

Disadvantages:

1. Costly memory management algorithm.

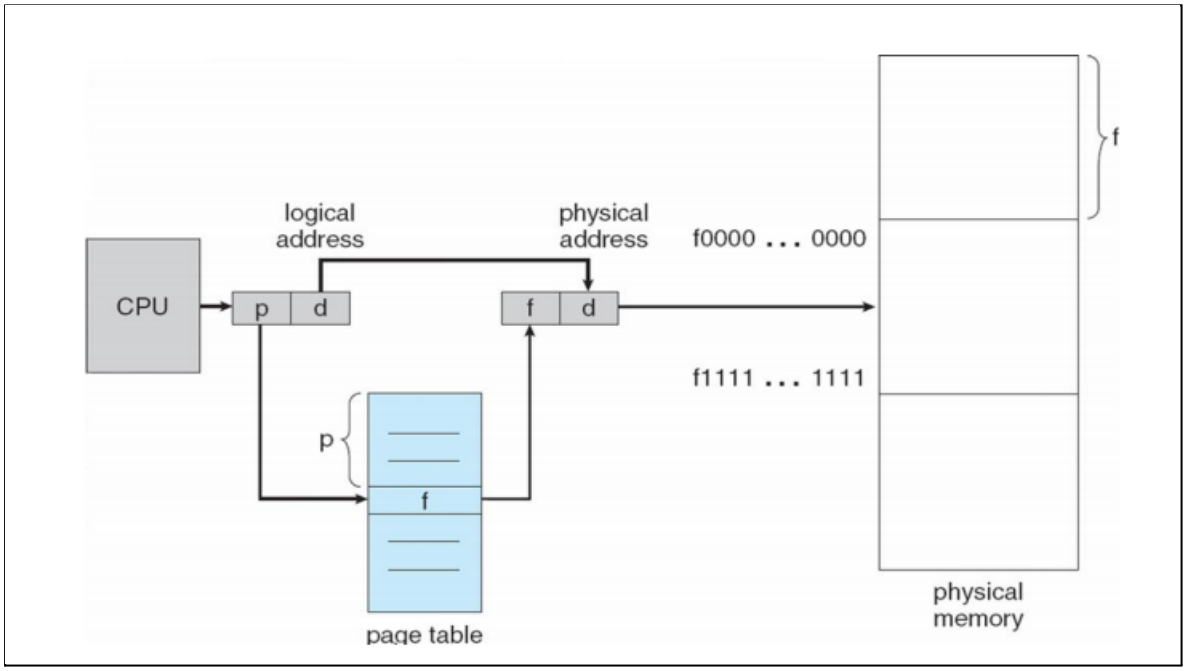
Paging

In paging, physical memory is divided into fixed-size blocks called frames and the virtual memory is divided into fixed-sized blocks called pages.

The size of a page is the same as that of a frame. The key idea of this method is to place the pages of a process into the available frames of memory, whenever, this process is to be executed. The address mapping is done by Page table.

Physical memory is divided into fixed size - blocks called FRAMES. (size is power of 2, for example 512 bytes)

Virtual/ Logical memory is divided into blocks of the same size called PAGES.



Example: Suppose, if the main memory size is 16 KB and Frame size is 1 KB. Here, the main memory will be divided into the collection of 16 frames of 1 KB each.

Advantages and Disadvantages of paging

Advantages:

1. No external fragmentation.
2. Simple memory management algorithm.
3. Swapping is easy(equal sized pages and page frame).

Disadvantages:

1. Internal fragmentation.
2. Page tables may consume more memory.

Since, owing to the huge size of modern day processes, the entire process cannot be added to main memory because of its limited size, hence, the concept of Paging was extended and support was taken from secondary memory.

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 drive that's set up to emulate the computer's RAM. Paging technique plays an important role in implementing virtual memory.

Page faults

Page fault dominates like an error. If any program tries to access a piece of memory or memory page but it does not exist in main memory, then page fault will occur. The fault specifies the O/S that it must trace the location of this memory page, and after that moves it from secondary memory to primary memory of the system. This swapping of memory pages is done by Page replacement algorithms.

Page Replacement Algorithm

When memory located in secondary memory is needed, it can be retrieved back to main memory.
Process of storing data from main memory to secondary memory ->swapping out
Retrieving data back to main memory ->swapping in

Why do we need a page replacement algorithm?

The main goal of page replacement algorithms is to provide the lowest page fault rate.

Algorithms

- First In First Out
- Least Recently USed