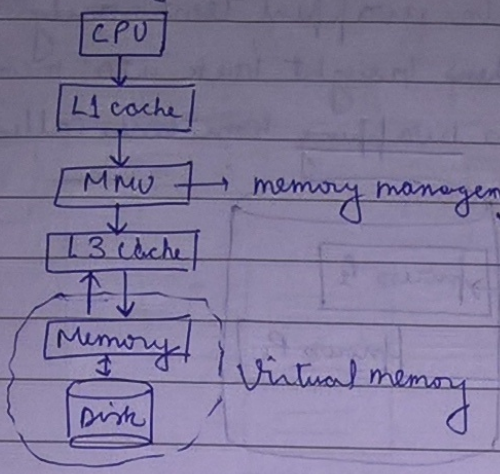
UNIT-4

① **Memory Hierarchy** –



↘ run-time mapping from virtual to physical addresses is done by a hardware

② **Concept of memory management** –

→ **Functions of memory management** –

(1) Keep track of the status of each memory location
(2) Determining allocation policy for memory.
(3) Memory allocation technique, information must be updated
(4) Deallocation technique and policy.

→ **Requirement of memory management** –

(1) Relocation
(2) Protection
(3) Sharing
(4) Logical organization
(5) Physical organization

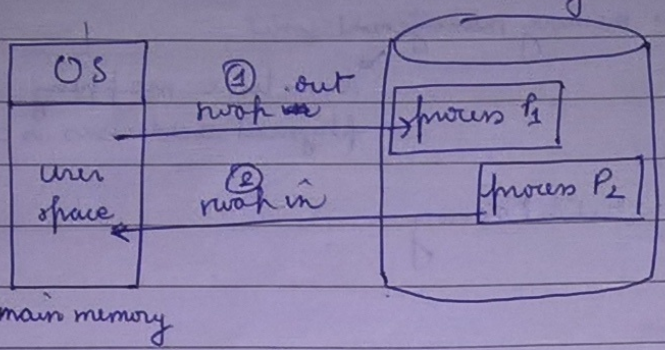
③ MFT → multiple contiguous fixed partition allocation (static allocation) (no longer used)
MVT → multiple contiguous variable partition allocation (dynamic allocation)

④ **Logical address** – an address generated by the CPU
Physical address – One loaded into memory address register of the memory.

Set of all logical addresses generated by a program is a **logical address space**; the set of all physical addresses corresponding to these logical addresses is a **physical address space**.

⑤ Swapping -

A process, however, can be swapped temporarily out of memory to a backing store and then brought back into memory for continued execution. This is known as swapping sometimes called roll out, roll in



⑥ Contiguous Memory allocation -

Each process is contained in a single contiguous section memory.

→ Dynamic Storage allocation problem solution -

First fit - Allocate the first hole that is big enough.

Best fit - Allocate the smallest hole that is big enough.

Worst fit - Allocate the largest hole.

→ Fragmentation

→ External fragmentation - As processes are loaded and removed from memory the free memory space is broken into little pieces. External fragmentation exists when there is enough total memory space to satisfy request, but the available space are not contiguous

Internal fragmentation - Memory that is internal to a partition but is not being used.

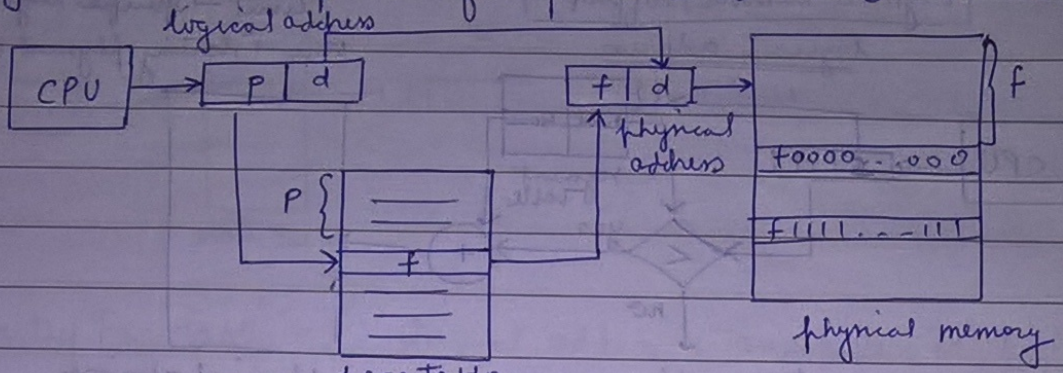
→ Solution → Compaction, permit the logical address space of the processes to be noncontiguous.

Non-contiguous memory allocation -

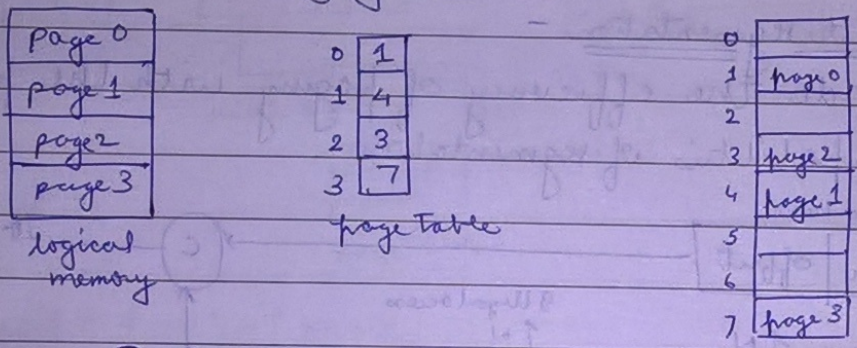
Each process, a portions of process is distributed among many areas of memory.

⑦ Paging -

It is a memory management scheme that permits the physical address space of a process to be a non-contiguous



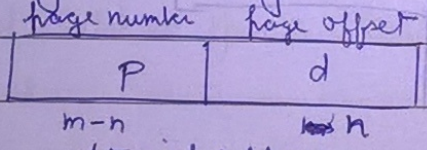
Paging Hardware



Paging model of logical and physical memory

Basic Method -

Breaking physical memory into fixed sized blocks called frames & breaking logical memory into blocks of the same size called pages



→ logical address space = 2^m
page size = 2^n

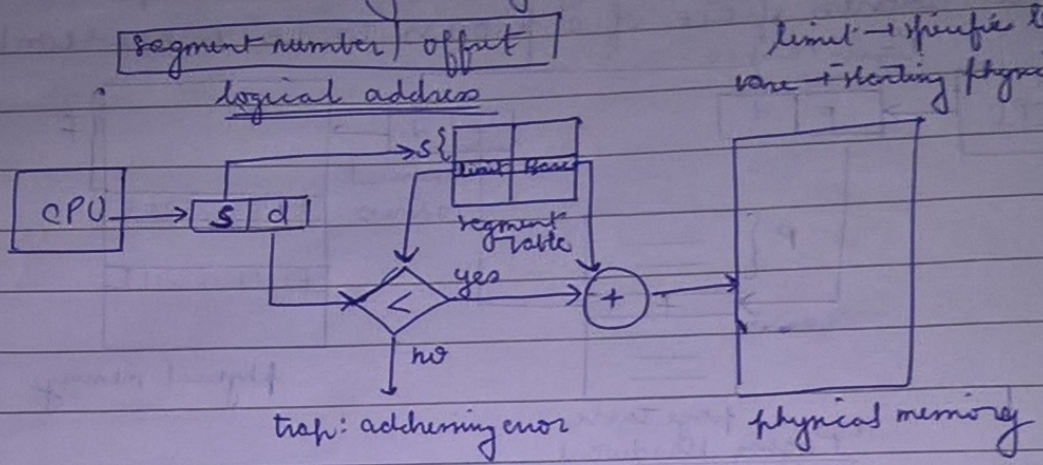
Page table base register (PTBR) points to the page table

Translation look-aside buffer (TLB) → special, small, fast-lookup hardware cache, high-speed memory.

Page table length register (PTLR) · indicate the size of the page table

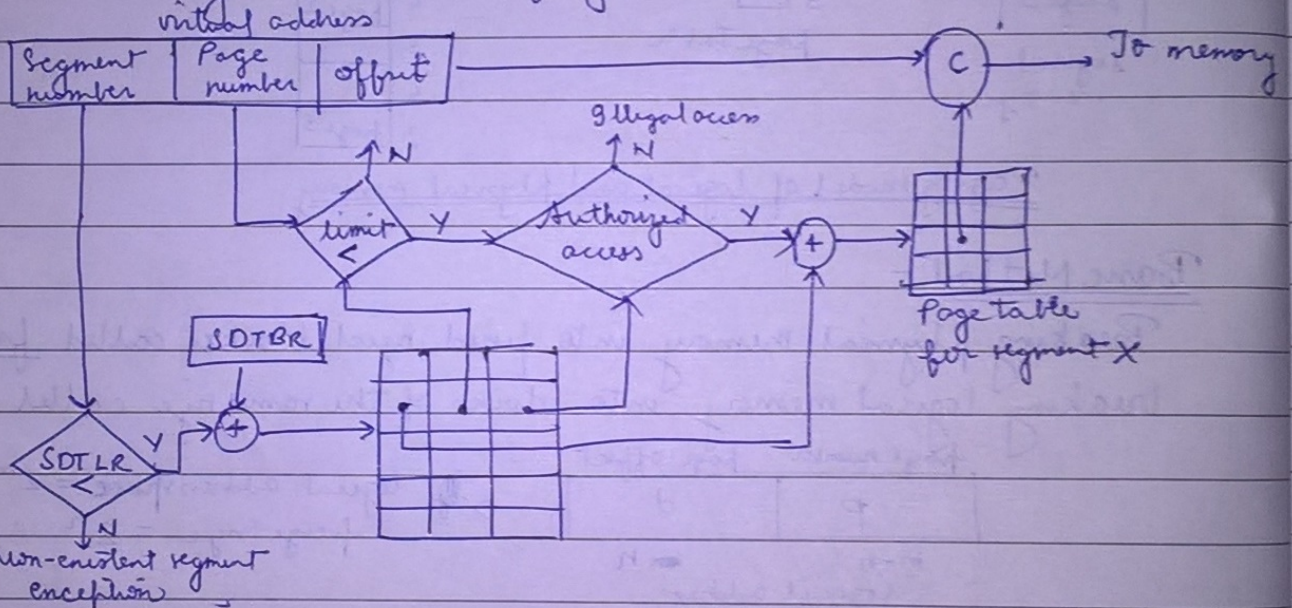
⑧ Segmentation –

It is a memory management scheme that supports user view of



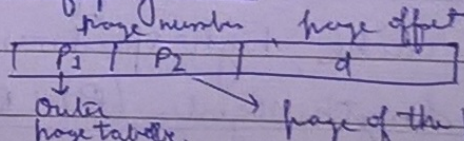
⑨ Page combined with segmentation –

To provide the efficiency of paging with the protection and sharing capabilities of segmentation.

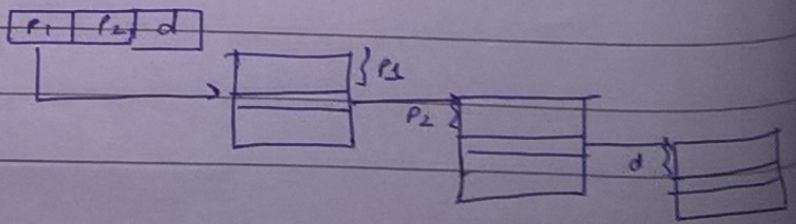


⑩ Structure and implementation of page table –

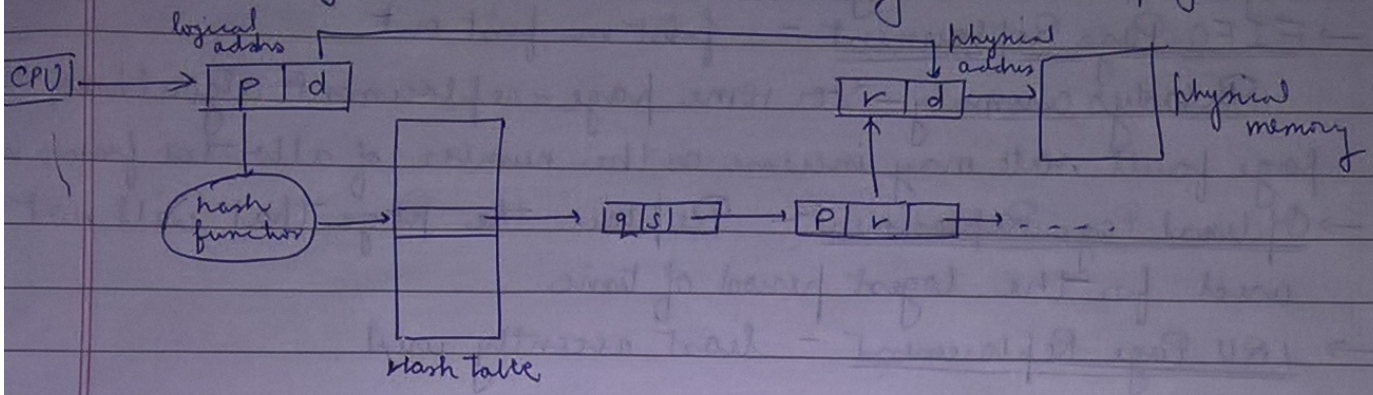
Hierarchical Paging –



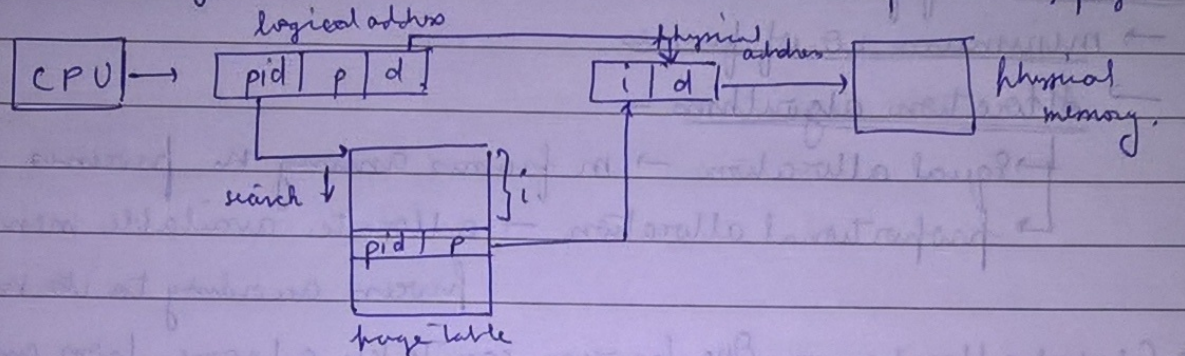
~~Hashed Page tables~~ –



Hashed Page tables – hash value being the virtual page number.



Inverted Page tables – Virtual addres contain process id, page number, offset.



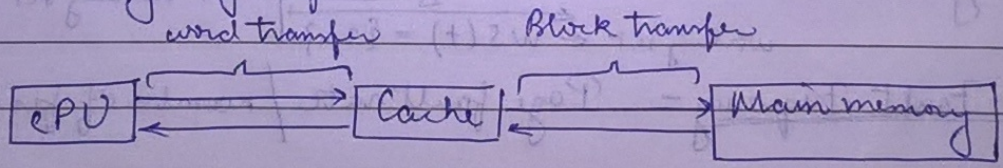
(11) **Concept of virtual memory** –

Virtual memory is a technique that allows the execution of processes that are not completely in memory.

Virtual addres space of a process refers to the logical (or virtual) view of how a process is stored in memory.

Virtual addres space that includes holes are known as sparse addres space.

(12) **Cache memory organization** –



(13) **Demand Paging** –

A strategy is to initially load pages only as they are needed

Pager is concerned with the individual pages of a process.

effective access time = $(1-p) \times$ memory access time + $p \times$ page fault time

$p \rightarrow$ probability of a page fault.

(14) Page Replacement Algorithms -

→ FIFO Page Replacement - first in first out

Belady's anomaly - For some page-replacement algorithms, the page fault rate may increase as the number of allocated frames inc

→ Optimal Page Replacement - Replace the page that will not b used for the longest period of time.

→ LRU Page Replacement - least recently used.

(15) Allocation of frames -

→ minimum no. of frames

→ Allocation algorithms -

- Equal allocation → m frames among n process
- proportional allocation → allocate available memory to process according to its size.

→ Global allocation - One process can take a frame from another

local allocation - Each process select from only its own set of allo

(16) Thrashing - high paging activity.

A process is thrashing if it is spending more time pagin than executing.

→ Cause of thrashing → low CPU Utilization

limits the effects of thrashing by a local replacement algorithm (priority replacement algorithm)

→ Working set model - 12 4 4 4 3 4 4 4 3 (most recent page refer

working set window

working set ← WS(t) = {3,4}

To prevent Thrashing → Page-Fault Frequency - Page fault rate / number of frames.

(17) Demand Segmentation - Used when insufficient hardware to implement demand paging.