Chapter - 7

VIRTUAL MEMORY

Virtual Memory

Virtual memory is a memory management technique that allows the execution of processes which may not be completely in memory .The main advantage of this scheme is that user program can be larger than the physical memory.

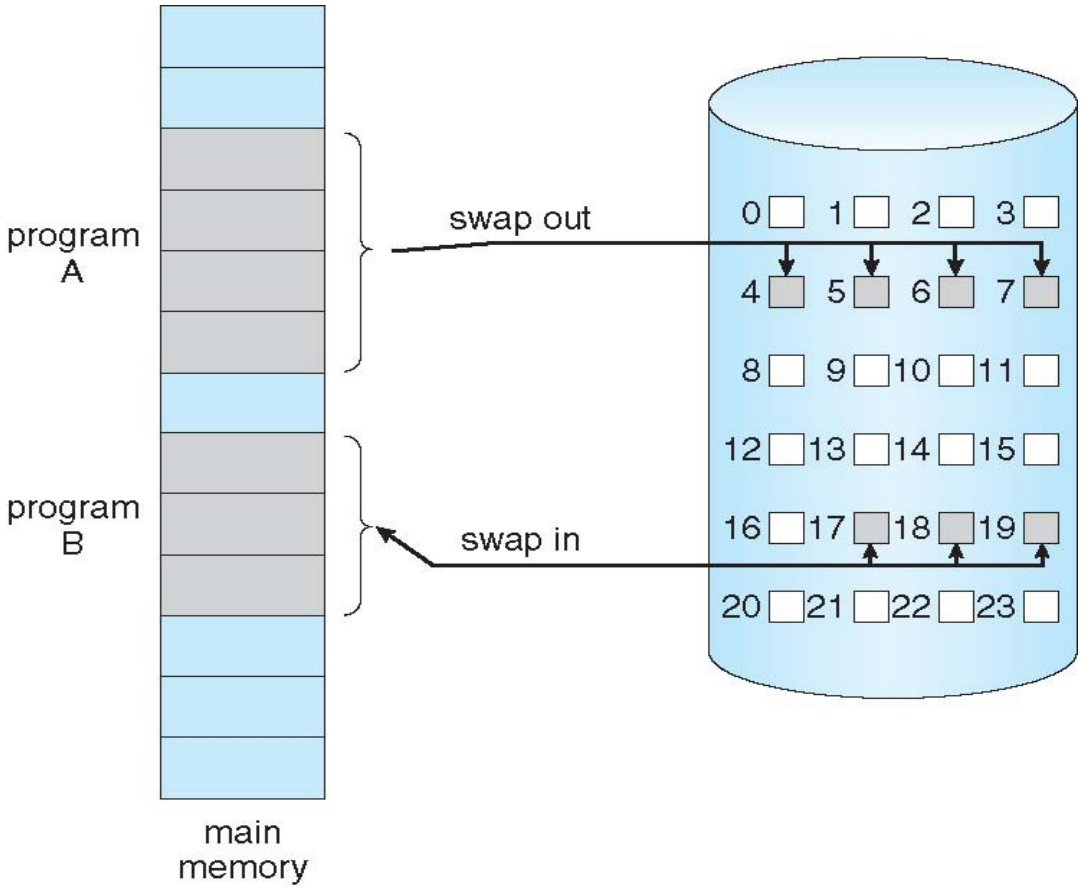
The operating system keeps only those parts of the program in memory which are required during execution. The rest of it kept on the disk.

- Virtual memory can be implemented via:
  - Demand paging
  - Demand segmentation

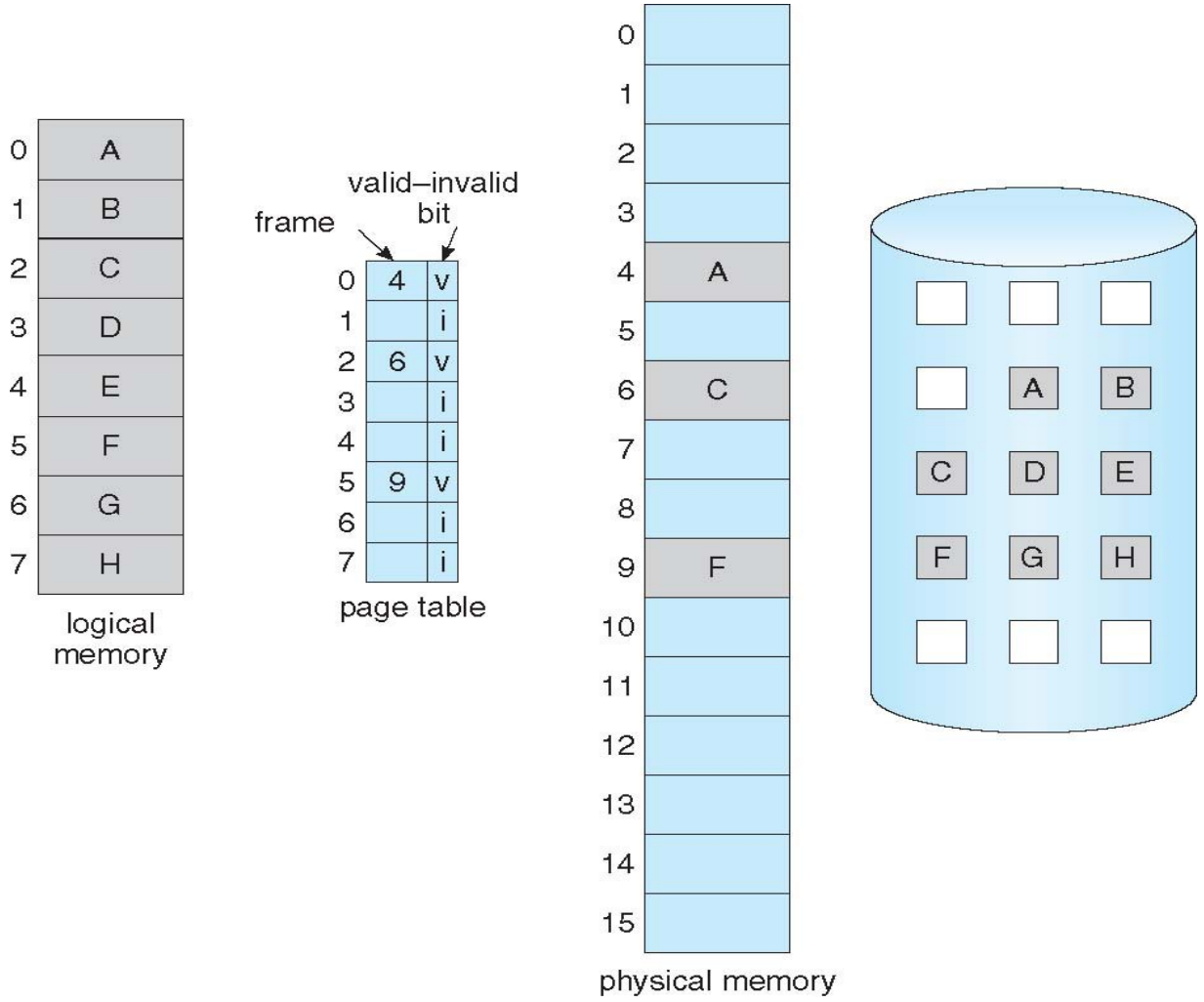
Demand Paging

- Demand paging system loads pages only on demand.
- Processes reside in a disk
- When a process needs to be executed, it is swapped into the memory.
- Instead of swapping the entire process , only lazy swapper is used.
- A lazy swapper brings only the necessary pages into the memory.

Demand paging



Page Table When Some Pages Are Not in Main Memory

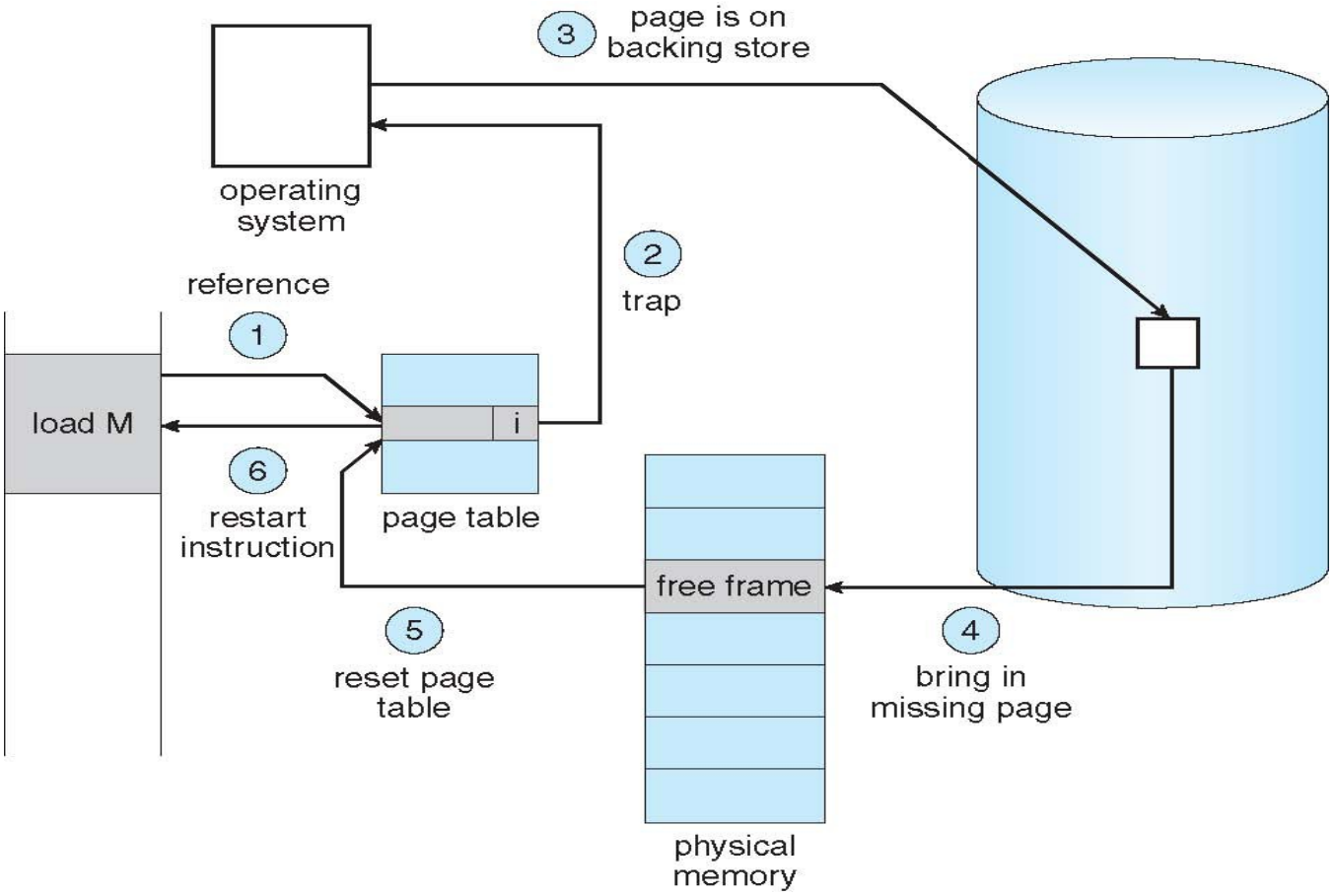


- The page table consists of a valid-invalid bit for each virtual page. The bit is said to be valid for the page that swapped into the main memory.
- If the entry bit is set into invalid ,it indicates that the page is not available in main memory.

Page fault

Page fault occurs when the operating system tries to access page marked invalid.

Steps in Handling a Page Fault



Performance of demand paging

- Effectice access time = (1-p) * ma + p * page fault time
- ma- 10 to 200 nano sec
- P-probability of page fault
- Page fault time

Time taken to service the page fault interrupt

Time taken to read the page

Page replacement

- Find the location of required page in secondary memory
- Find a free frame ,use it
- If no frame is free , use page replacement algorithm is used.

- FIFO algorithm
- Optimal page replacement algorithm
- Least recently used algorithm
- Least frequently used algorithm

Frames allocation algorithms

- Equal allocation
- Proportional allocation

Equal allocation

- Divide m frames among n processes giving an

  equal share of m/n frames.

Free frames – 62 (size – 1kb)

P1 = 10 kb

P2 = 127 kb

Propotional allocation

- Total no of frames are propotionaly split among the process depending on their requirement.

10/137 * 62 = 4 frames - p1

127/137 * 62 = 57 frames

Global and local allocation

- Global replacement selects a frame from set of all frames.
- Local replacement selects a frame from its own set of allocated frames.

Thrashing

- Thrashing is a condition in which excessive paging operations are taking place. This **causes** the performance of the computer to degrade or collapse.
- **Thrashing** is a state in which our CPU perform 'productive' work less and 'swapping' more. CPU is busy in swapping pages, so much that it can not respond to user program as much as required.

Working set model

- The set of pages , a process is currently using is called working-set

Usage of working set model

- The os allocates enough number of frames to the working set
- If extra frames are there , another process can be started.
- When sum of the working set sizes exceeds the total number of frames available, the os selects and suspends the process.
- The pages of the selected process are written and its frames are reallocated to

Virtual memory paging	Virtual memory segmentation
It is not necessary to load all the pages of a process .Only the required pages are brought into the memory later	It is not necessary to load all the segments of a process . The needed segments are brought into the memory later
No external fragmentation	Allows the external fragmentation
Higher degree of multiprogramming	Higher degree of multiprogramming
Allows internal fragmentation within page frames	No internal fragmentation
Programs are divided into equal sized pages	Programs are divided into unequal sized segments
OS maintains PMT for each process	OS maintains SMT for each process.
Absolute address is calculated using page number and offset	Absolute address is calculated using segment number and offset