

Virtual Memory.

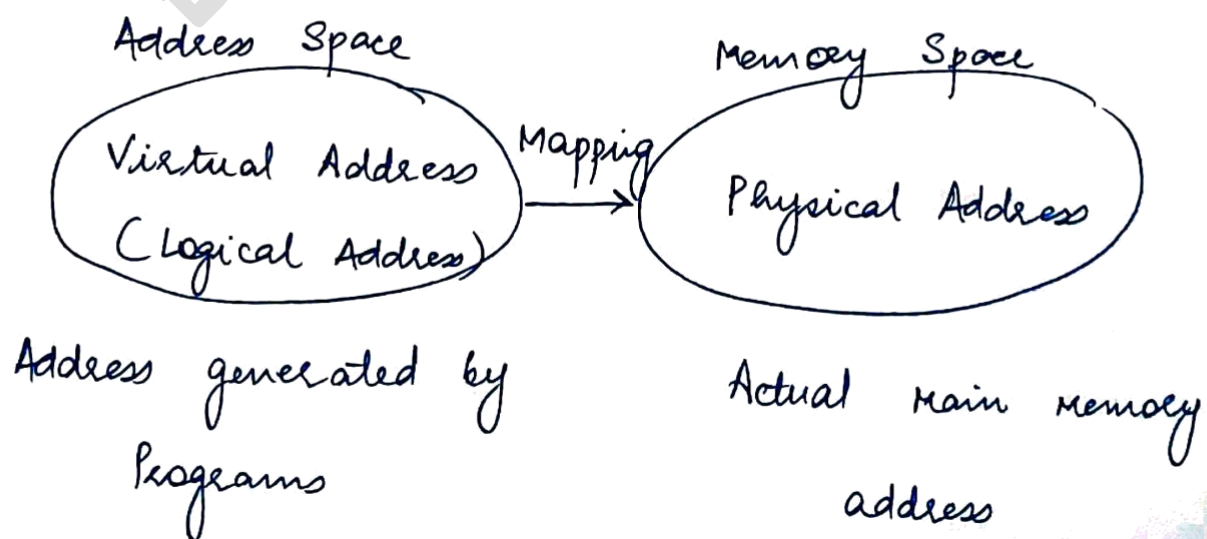
- It is a concept used in some larger computer systems that permit the user to construct programs as though a large memory space were available.
- A virtual memory system provides a mechanism for translating programs generated addresses into correct main memory locations.

→ Address Space

An address used by programmer will be called virtual address, and the set of such addresses the address space.

→ Memory Space

An address in main memory is called location or physical address. The set of such locations is called memory space.



→ Page Replacement:

When a page fault occurs in a virtual memory system, it signifies that the page referenced by the CPU is not in the main memory.

If main memory is full, it would be necessary to remove a page from a memory block to make room for new page.

The most common replacement algorithms are:

- 1) FIFO (First In First Out)
- 2) LRU (Least Recently Used)
- 3) OPR (Optimal Page Replacement)

FIFO

- It selects for replacement the page that has been in memory for long time.
- Each time a page is loaded into memory, the identification number is pushed into FIFO stack.

Advantage - Easy to Implement.

Disadvantage - Under certain circumstances pages are removed and loaded from memory too frequently.

LRU

- Implemented by associating a counter with every page.
- Replace the page which has not been used for longest period of time.

(OPT)

- Optimal Replacement
- lowest page fault rate of all algorithms.

eg Consider three memory frames.
 Reference String

First In First Out (FIFO)

7 0 1 2 0 3 0 4 2 3 0 3 1 2 0

f3			1	1	1	X	0	0	X	3	3	3	X	2	2
f2		0	0	0	X	3	3	X	2	2	2	X	1	1	1
f1	7	7	X	2	2	2	X	4	4	X	0	0	0	0	0
	*	*	*	*	Hit	*	*	*	*	*	*	Hit	*	*	Hit

Main Memory frame

Page Hit = 3, Page Miss = 12, Hit Ratio = $\frac{\text{No. of Hits}}{\text{Total References}}$

$$\begin{aligned} \text{Miss Ratio} &= \frac{\text{No. of Miss}}{\text{Total Reference}} \\ &= \frac{12}{15} \times 100 = 80\% \end{aligned}$$

Optimal Page Replacement (OPR)

→ Replace the Page which is not used in longest dimension of time in future.

7 0 1 2 0 3 0 4 2 3 0 3 1 2 0

		1	1	1	3	3	3	3	3	3	3	1	1	1
	0	0	0	0	0	0	4	4	4	0	0	0	0	0
7	7	7	2	2	2	2	2	2	2	2	2	2	2	2
	*	*	*	*	Hit	*	Hit	*	Hit	Hit	*	Hit	*	Hit

Hit = 7
 Miss = 8

$$\text{Hit Ratio} = \frac{7}{15} \times 100$$

$$\text{Miss Ratio} = \frac{8}{15} \times 100$$

Least Recently Used (LRU)															
7	0	1	2	0	3	0	4	2	3	0	3	1	2	0	
		1	1	1	3	3	3	2	2	2	2	1	1	1	→ Replace the page that is least recently used.
	0	0	0	0	0	0	0	0	3	3	3	3	3	0	
7	7	7	2	2	2	2	4	4	4	0	0	0	2	2	
*	*	*	*	Hit	*	Hit	*	*	*	*	Hit	*	*	*	

- If the page demanded, is not present in the main memory is refer as page fault.
- Then information is fetch from hard disk (virtual memory) and placed in main memory.
- If the frames in main memory are full, then replace the page (via page replacement algorithm)
- If the demanded page is already placed in main memory it is refer as Hit.