

Operating System

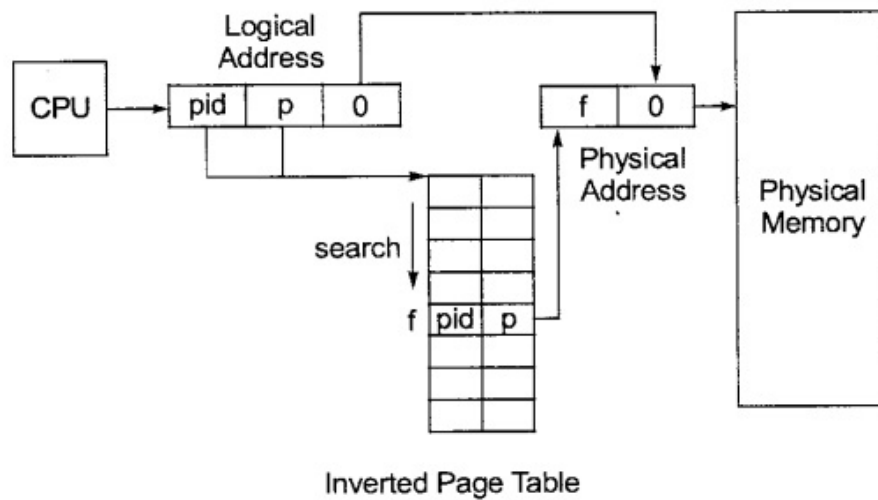
(L-8)

- 1) Inverted paging
- 2) Multilevel paging
- 3) Page fault
- 4) Swapping
- 5) Optimal page replacement algorithm
- 6) FIFO
- 7) LRU
- 8) MRU
- 9) Thrashing

Inverted Paging

more processes, more page tables

→ overhead of maintaining page table for every process.



→ Only one inverted page table \Rightarrow global page table

→ Entries in inverted page table must include process id.

→ Maps physical frames to virtual pages

Advantages

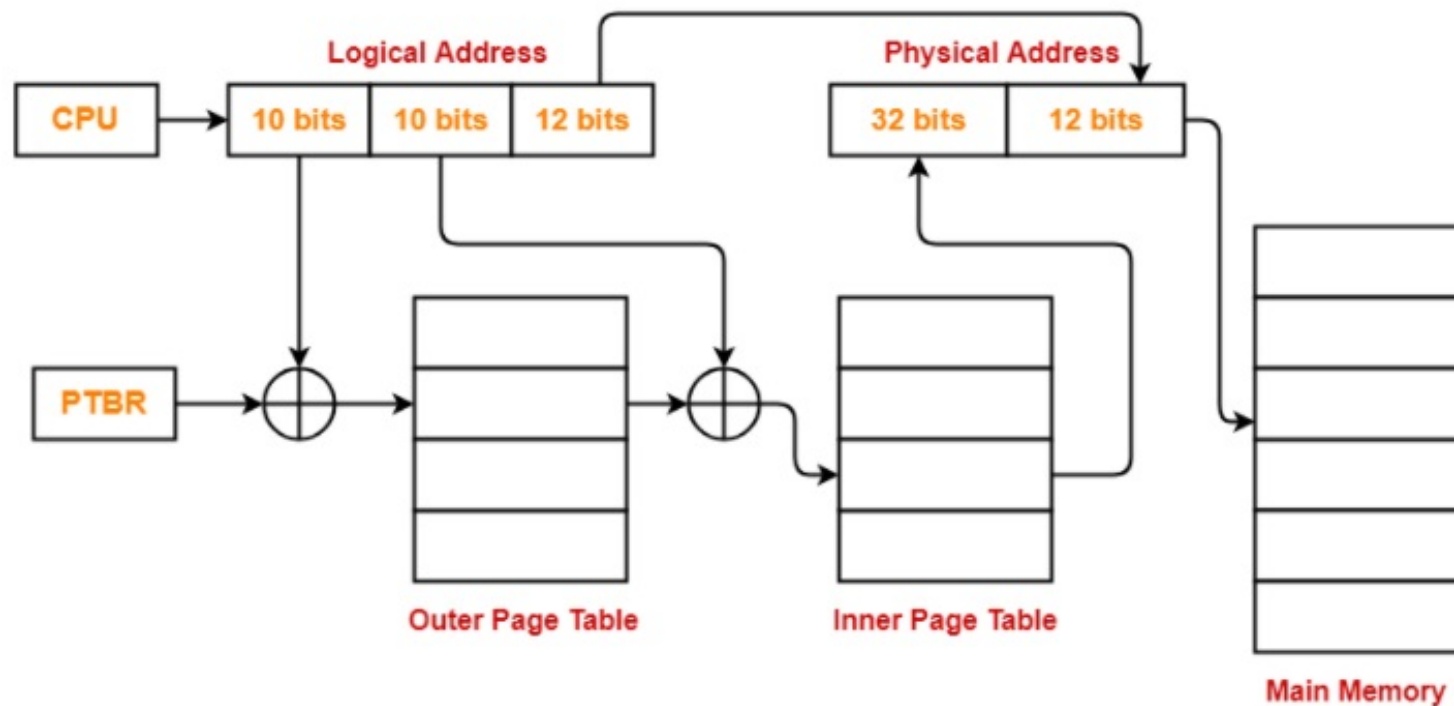
- 1) Only one table for many processes

Disadvantages


- 1) Look up time is increased

Multi-level Paging

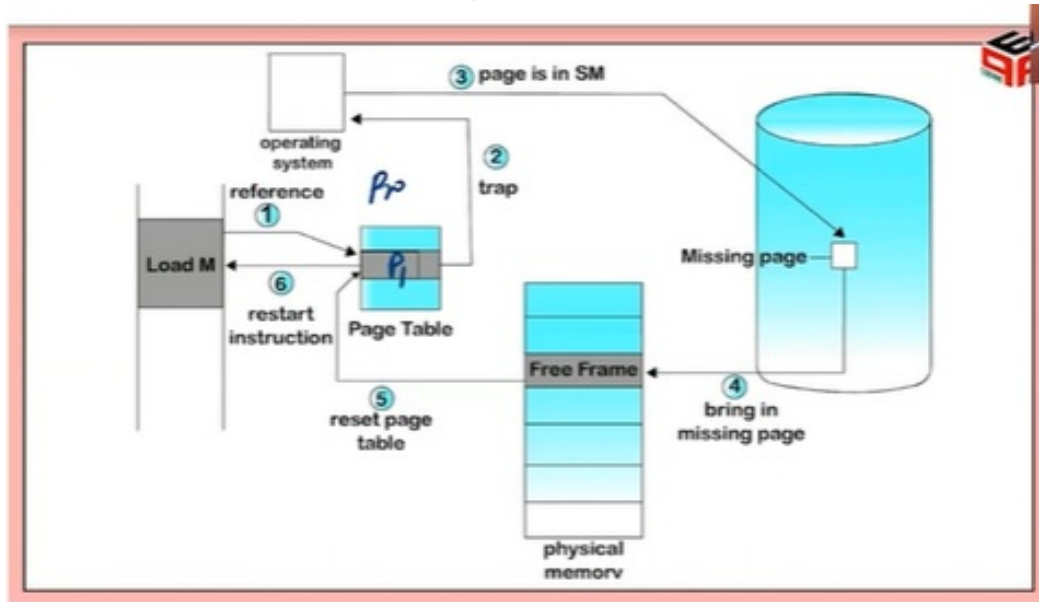
if size of page table is more than the frame size



Page Fault

1. Valid/Invalid bit in PTE
if  0, then page is not present in frame.
Page fault occurs -

Handling a Page Fault



- 1) Check for the page's location in Page Table
- 2) If valid bit is 0, page fault occurs
Trap the OS.
- 3) Check if authentic user is asking for that page or not.
- 4) If yes, load the page from sec. memory to m.m.
- 5) Reset page table
- 6) Restart instruction

Swapping / Page replacement Algo.

free frame not available, so existing pages are swapped out

Swap out, swap in.

- 1) optimal page replacement-
- 2) FIFO
- 3) LRU
- 4) MRU

Optimal Page Replacement

Principle:- to be swapped out with a page which is not required in future for the longest time gap, or not required in the future at all.

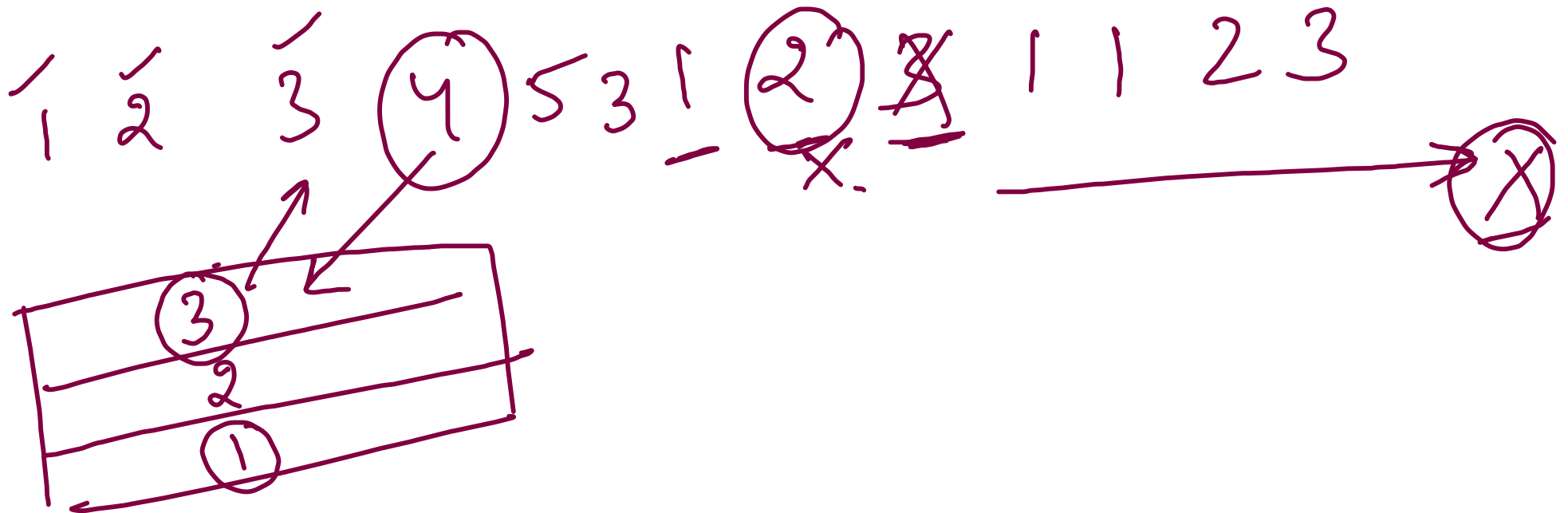
Optimal Page Replacement Algo

1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5,

+											

Page fault
 Page hit ✓
 Page miss → swap

Principle → replace the req. page with a page that won't be used for the largest time gap, won't be used ever now.



1	2	3	4	<u>1</u>	<u>2</u>	5	<u>1</u>	<u>2</u>	3	4	<u>5</u>
		3	4	4	4	5	5	5	5	5	5
	2	2	2	2	2	2	2	2	2	4	4
+1	1	1	1	1	1	1	1	1	3	3	3

$p.h \rightarrow \checkmark$
 $p.m \rightarrow X$

$p.h \rightarrow 5$
 $p.m \rightarrow 7$

$p.h \rightarrow 5/7$
 $p.m \rightarrow \checkmark$

FIFO - First in First out

'Jo sabse pehle aaya, sabse pehle bahar bhi jaega'

- the page which has been present in memory for the longest time is replaced.
- Independent of the locality of the process.

Belady's anomaly.

- Inc. in no. of frames do not guarantee dec. page miss
- Page miss ^{or} can inc. with inc. in no. of frames

Belady's anomaly

1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5,

A blank grid consisting of 10 columns and 4 rows, formed by red lines. The grid is intended for drawing a picture.

Least Recently used :-

→ Jo itne time se use nahi hua, ab kya hoga.

9, 8, 1, 2, 8, 5, 8, 4, 2, 5, 8, 5, 2, 1, 2, 8, 1, 9, 8, 1

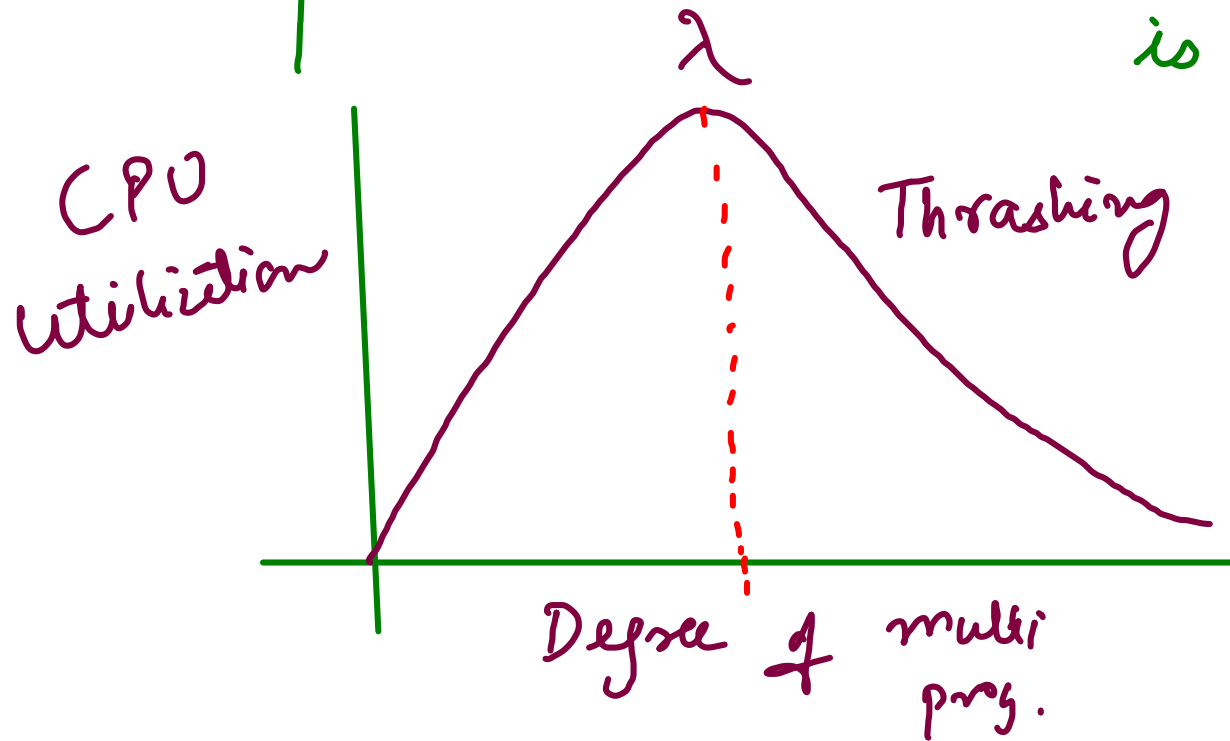
A blank 10x4 grid for writing the number 1000. The grid is composed of 10 columns and 4 rows. The top row is the header row. The second row is the first data row. The third row is the second data row. The fourth row is the third data row. The grid is used for writing the number 1000 in the first data row.

Most Recently Used

9, 8, 1, 2, 8, 5, 8, 4, 2, 5, 8, 5, 2, 1, 2, 8, 1, 9, 8, 1

Thrashing

To inc. CPU utilization \propto multiprogramming is done.



1) Page size = 4 kB

Page table entry takes = 4 B

How many levels of page tables will be
required to map 32 bit address space

if every page fits into a single page.