

Operating System:

Page Replacement: LIFO, LFU, MFU

By: Vishvadeep Gothi



VISHVADEEP GOTHI SIR

**AIR- 19, 119, 440, 682
in GATE**



**ME from IISc Bangalore
Mtech BITS Pilani in Data
Science**



**14+ Years of Teaching Experience,
10+ Years in GATE/IES**



Subjects Taken:
Computer Organization & Architecture,
data structure, operating system,
C-Programming, Data science,
Machine Learning, Python,
coding interview problems,





Vishvadeep Gothi

#1 Educator in CS & IT · GATE & ESE

- GATE AIR-19, 119, 440, 682 - ME from IISc, - MTech BITS Pilani (Data Science) - 14 years experience

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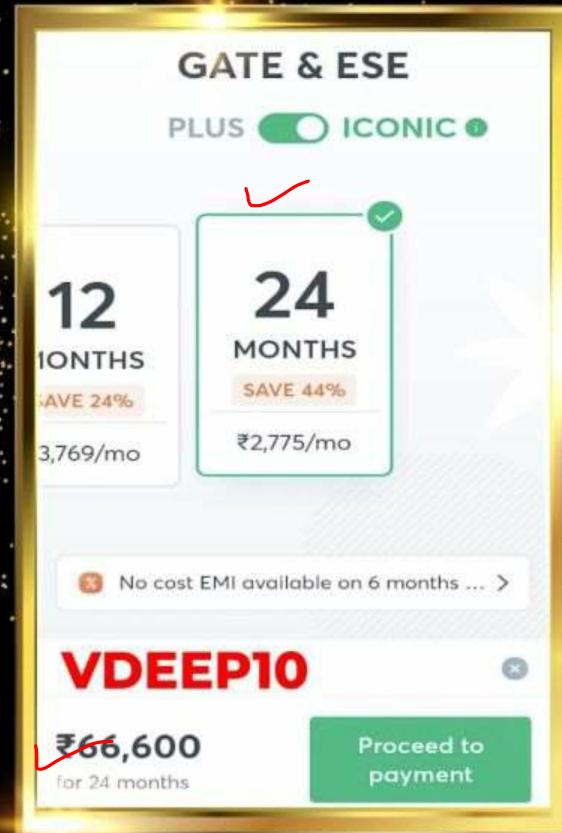
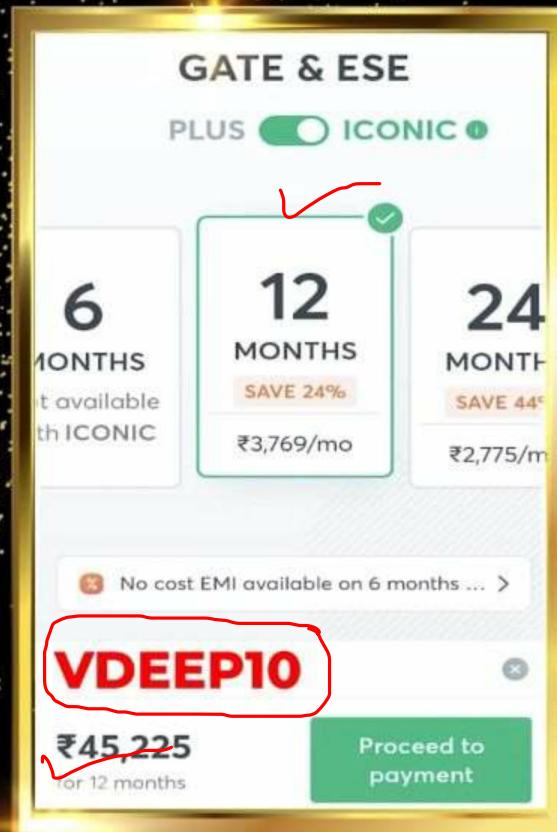
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Virtual Memory

- ◎ Feature of OS
- ◎ Enables to run larger process with smaller available memory

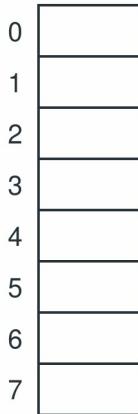


Virtual Memory

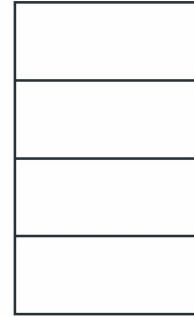
Process



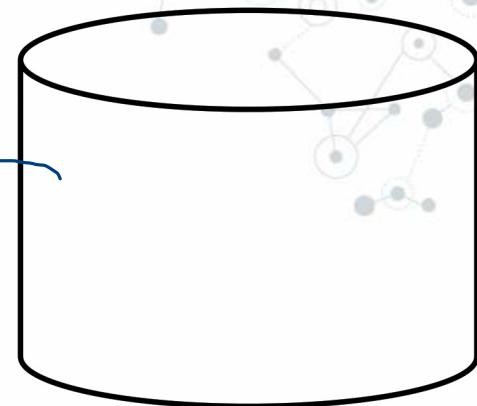
Page Table



Physical Memory



Secondary Memory



Page Replacement Policies

- ✓ First In First Out (FIFO)
- ✓ Optimal Policy
- ✓ Least Recently Used (LRU)

1. Least Frequently Used (LFU)
2. Most Frequently Used (MFU)
3. Last In First Out (LIFO)
4. Second Chance

Counting Algorithms

- ◎ Counting algorithms look at the number of occurrences of a particular page and use this as the criterion for replacement.
- ◎ Such counting algorithms includes:
 - LFU (Least Frequently Used)
 - MFU (Most Frequently Used)



Least Frequently Used (LFU)

↳ replace page which has been used min. no. of times.

Assume:

- ◎ Number of frames = 3 (All empty initially)
- ◎ Page reference sequence: 1 2 0 3 0 4 2 3 0 3 2

$$\text{no. of page faults} = 7$$

$$\text{page fault rate} = \frac{7}{11}$$

1	2	0	3	0	4	2	3	0	3	2
1	1	1	3	3	3	2	2	3	0	2
	2	2	2	0	4	4	4	0	3	
✓	✓	✓	✓	x	✓	✓	✓	x	x	x

Most Frequently Used (MFU)

↳ replace page which has been used max no. of times.

Assume:

- Number of frames = 3 (All empty initially)
- Page reference sequence: 1 2 0 3 0 4 2 3 0 3 2

no. of page faults = 7
page fault rate = 7/11

1	2	0	3	0	4	2	3	0	3	2
1	1	1	3	3	3	3	3	3	3	2
	2	2	2	2	2	2	2	0	0	0
	0	0	0	0	4	4	4	4	4	4
✓	✓	✓	✓	✗	✓	✗	✗	✓	✗	✓

Last In First Out (LIFO)

↪ replace the page which comes in physical memory at last.

Assume:

- ◎ Number of frames = 3 (All empty initially)
- ◎ Page reference sequence: 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5

no. of page faults = 8

page fault rate = $\frac{8}{12}$

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

✓ ✓ ✓ ✓ ✗ ✗ ✓ ✗ ✗ ✓ ✓ ✓

Second Chance Replacement

- It is a variant of FIFO
- But gives a second chance to those pages, to which CPU used again

FIFO
LRU

each page will have an associated reference bit.

- When we bring a new page in mm $\Rightarrow R = 0$
- When a page got used (refered) $\Rightarrow R = 1$
- Replace page using FIFO but with ($R = 0$) .
- When a page given second chance, then reset $R = 0$

Second Chance Replacement

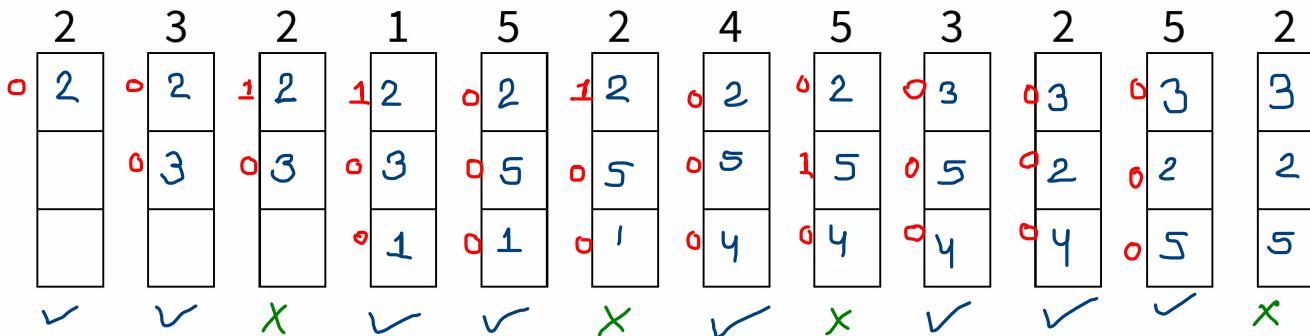
Assume:

- Number of frames = 3 (All empty initially)
- Page reference sequence: 2, 3, 2, 1, 5, 2, 4, 5, 3, 2, 5, 2

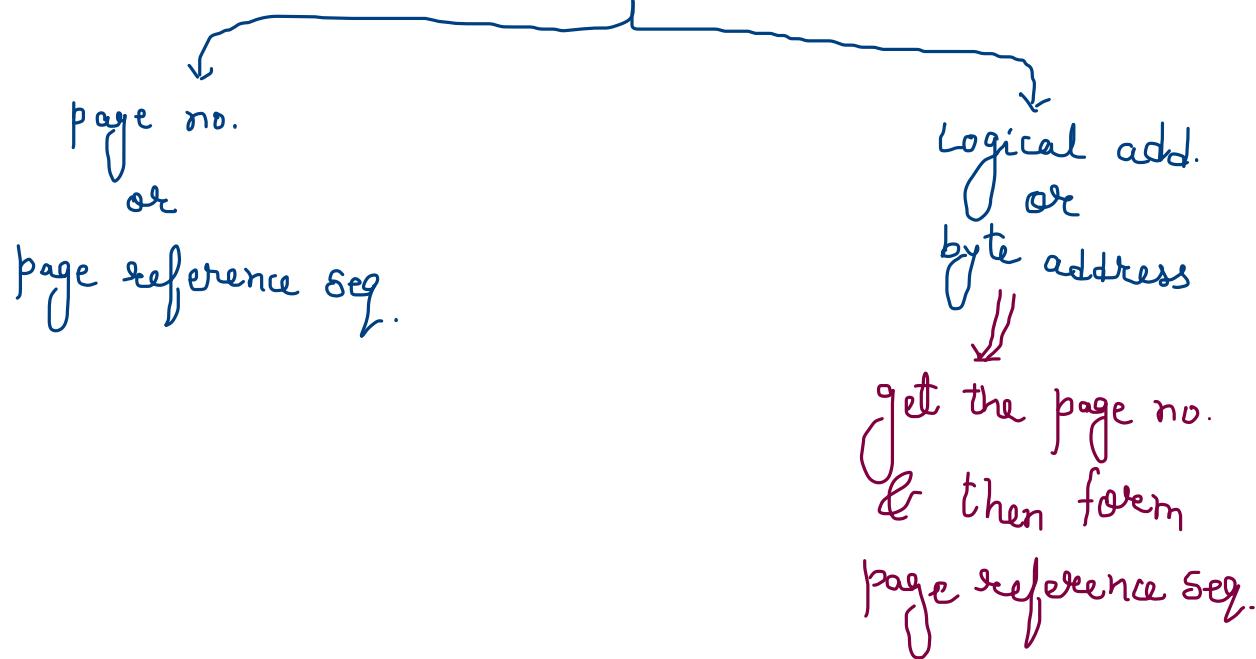
$$\text{no. of page faults} = 8$$

$$\text{page fault rate} = \frac{8}{12}$$

$$\text{Hit rate} = \frac{4}{12}$$



2 types of requests



Next Class

Frame Allocation

Working Set Model



Thrashing



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SESSIONS ON:

LIST OF REFERENCE BOOKS

LIST OF IMPORTANT TOPICS

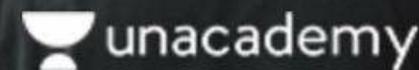
REVISION STRATEGY

HOW TO MAKE NOTES

STARTING FROM: 12 JULY

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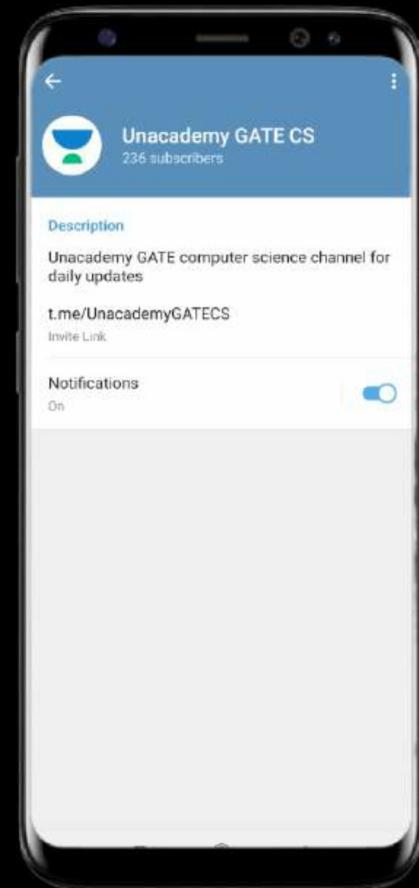
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