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Sahil Jindal 18CS10048

Ans) (a) Average process size $= S = 8$ kbytes

Page Table entry size $= K = 4$ bytes

Page size $= P$ bytes.

let avg internal fragmentation per segment $= P/2$

Average number of pages per segment $= S/P$

$\therefore$ Total overhead $= V = \frac{KS}{P} + \frac{P}{2}$

To find P for min overhead,

$\frac{dV}{dP} = 0 \Rightarrow P = \sqrt{2SK}$

$\therefore P = \left\lfloor \sqrt{2(8000)(4)} \right\rfloor = \lfloor 80\sqrt{10} \rfloor$

$\approx 80(3.14)$

≈ 251.2

$\approx$ 251 bytes

314
$\times 8$
$\overline{251.2}$

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(b) In second-chance page replacement algorithm, the candidates pages for removal are considered in a round robin manner. A page that has been accessed b/w consecutive considerations will not be replaced. The page replaced is the one which has not been accessed since its last consideration in round robin manner.

Eg:

(c) (i) Virtual pages:

0 : 0000H to 07FFH
1 : 0800H to 0FFFH
2 : 1000H to 17FFH
3 : 1800H to 1FFFH
4 : 2000H to 27FFH
5 : 2800H to 2FFFH
6 : 3000H to 37FFH
7 : 3800H to 3FFFH

(ii) 8500 = 2134H ⟶ Virtual page 4 ⇒ Memory address = 1934H

14000 = 36B0H → Virtual page 6 ⇒ Memory address = 06B0H

5000 = 1388H ⇒ Virtual page 2 ⇒ Memory address = 0B88H

2100 = 0834H ⇒ Virtual page 1 ⇒ page fault

Q2 (a) i) Single level page table

AMAT = 0.85 (TLB access + Main memory access)
+ 0.15 (0.98 * 2 * Main memory + 0.02 * Page replace Time)

= 0.85 (10 nsec + 100 nsec) + 0.15 (0.98 * 2 * 100 nsec + 0.02 * 2 msec)

= 93.5 nsec + 6029.4 nsec = 6.123 µs

ii) Three level:

AMAT = 0.85 (TLB + Main) + 0.15 (0.98 * 4 * Main + 0.02 * Page)

= 0.85 (10 nsec + 100 nsec) + 0.15 (0.98 * 4 * 100 nsec + 0.02 * 2 msec)

= 93.5 nsec + 6058.8 nsec = 6.152 µs.

(b) (i) Lower bound = n

(ii) Upper bound = P

A3 (b) (i) FIFO

7	3	5	2	1	0	7	4	7
7	7	7	7	3	5	2	1	no page fault
	3	3	3	5	2	1	0	
		5	5	2	1	0	7	
			2	1	0	7	4	

1	2	0	2	6	3	4
no pagefault	0	nopage fault	no pf	7	4	nopf
	7			4	2	
	4			2	6	
	2			6	3	

1	5	2	7
2	6	3	1
6	3	1	5
3	1	5	2
1	5	2	7

Thus, a total of 15 page faults.

(ii)

7	3	5	2	1	0	7	4	7
7	7	7	7	1	5	2	1	no pf
	3	3	3	3	2	1	0	
		5	5	5	1	0	7	
			2	2	0	7	4	

1	~~2~~	2	0	2	6	3	4
no pf		4	7	no pf	1	0	2
		7	1		0	2	6
		1	2		2	6	3
		2	0		6	3	4

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1	5	2	7
~~6~~	3	4	1
3	4	1	5
4	1	5	2
1	5	2	7

Thus, a total of 17 pf

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A3 (c) When there is no page fault, TLB hit & ~~EAT~~ TLB miss will be spent.
If there is page fault, we also need page swap time.

Thus, EAT = No page fault (TLB hit + TLB miss)

+ Page fault (TLB hit + TLB miss + Page swap time)

(Here, Page fault = rate of page fault
∴ No page fault + Page fault = 1)
TLB hit + TLB miss = Access time TLB.
Page swap time = Page fault service time.