CS & IT ENGINEERING

Operating System

Memory Management

DPP 07 DISCUSSION NOTES

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01 Question

02 Discussion

Q.1

The page table register should be made of_____?

[MCQ]

A. Very high-speed logic

B. Secondary memory.

C. Large memory space.

D. Very low speed logic.

Q.2

Consider a system implementing paging hardware with a TLB. Assume the entire page table and all the pages are in the physical memory. The effective memory access time is 400 msec. with TLB hit ratio 0.6 and search time of TLB is 20 msec, the main memory access time is _____(in msec.)

[MCQ]

A. 275 msec.

B. 271.43 msec.

C. 120.5 msec.

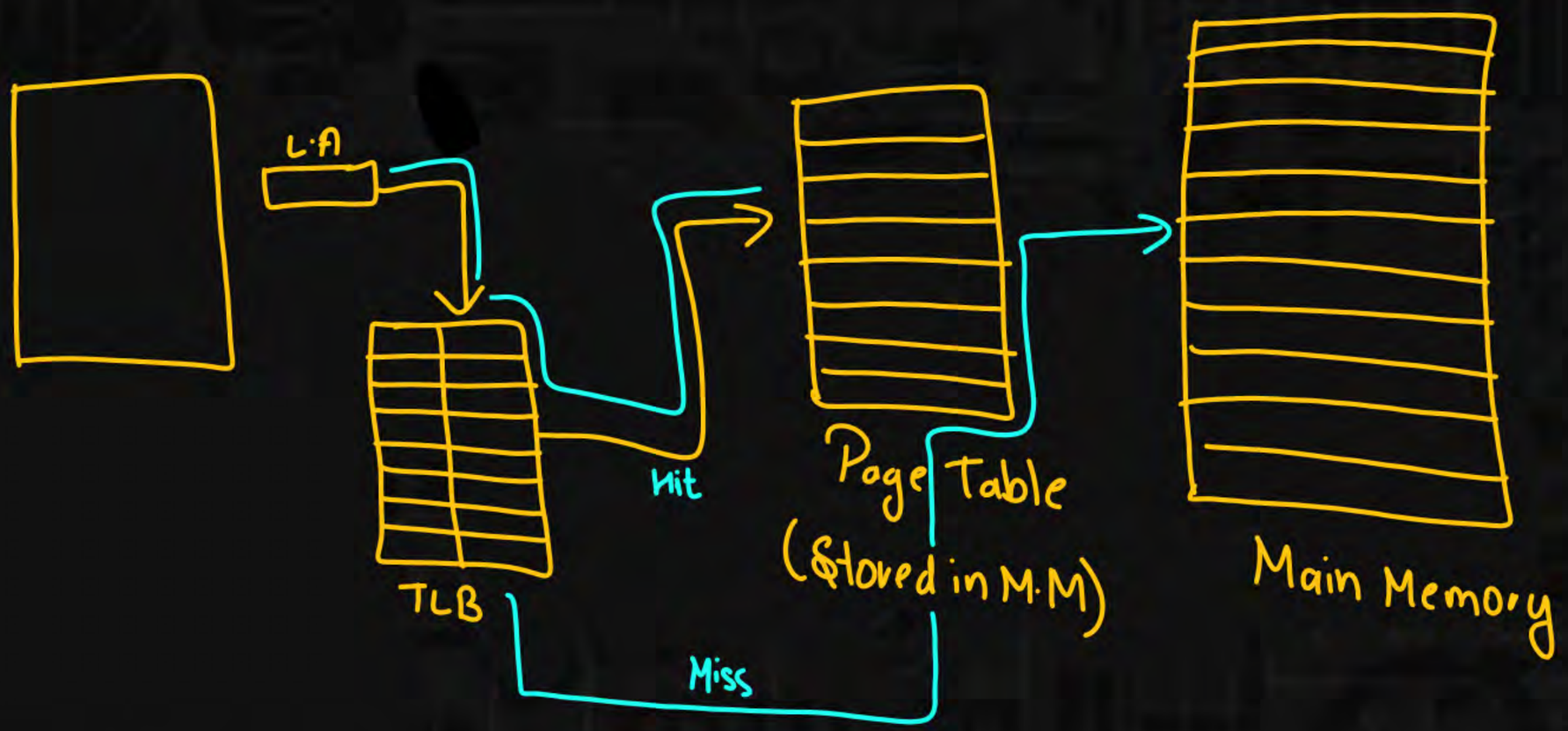
D. 240 msec.

Given: $E_{mat} = 400\,msec$

$TLB_H = 0.6$

$TLB_A = 20\,msec$

$E_{mat} = TLB_H[TLB_A + M.M] + (1 - TLB_H)[TLB_A + 2 * M.M]$


L.A
TLB
Hit
Miss
Page Table
(Stored in M.M)
Main Memory

$$E_{mat} = TLBH(TLB_A + M.M) + TLBM(TLB_A + 2^{*}M.M)$$

$$400 = 0.6(20 + M.M) + 0.4(20 + 2MM)$$

$$400 = 12 + 0.6MM + 8 + 0.8MM$$

$$400 = 20 + 1.4MM$$

$$380 = 1.4MM$$

$$\frac{380}{1.4} = MM \Rightarrow \underline{271.428\ msec}$$

Q.3

Consider a 2 level paging system with TLB support. The page table has divided into 4 K pages each of size 8K words. If the physical address space has 64 M words which divided into 8 K frames. TLB access time is 20 nsec. and main memory access time is 300nsec. The CPU finds 126 page reference in the TLB out of total reference of 180. Then what is the effective memory access time? [MCQ]

A. 545 nsec.

B. 440 nsec.

C. 420 nsec.

D. 500 nsec.

$TLB_H = \frac{126}{180} = 0.7$

$TLB_A = 20\ msec$

$M.M = 300\ msec$

$E.M.A.T = TLB_H(TLB_A + M.M) + (1 - TLB_H)(TLB_A + (n+1)^* M.M)$

(n+1) : Level of paging

$= 0.7(20 + 300) + 0.3(20 + 3^* 300)$

$\Rightarrow 0.7(320) + 0.3(920)$

$\Rightarrow 224.0 + 276.0$

$\Rightarrow$ 500 msec

Q.4

Consider an operating system having 32 bits virtual address space and 32 MB physical memory. If page size is 8KB. What is the approximate size of the page table in MB? **[NAT]**

V.A = 32 bits

P.A = 32MB (2^{25} B)

P.S = 8KB (2^{13} B)

1. No. of bits to represent page ⇒ 32 - 13 ⇒ 19 bits

2. P.T.E(e) ⇒ 25 - 13 ⇒ 12 bits

Page Table Size = 2^{19} * P.T.E

(P.T.S)

1

⇒ 2^{19} * 2^{1} Bytes

⇒ 2^{20} Bytes.

1MB

$\lceil \frac{12}{8} \rceil = \lceil 1.5 \rceil$ = 2 Bytes

Q.5

Consider a system using paging hardware with a TLB to reduce EMAT. Assume that the entire page table and all the pages are in the physical memory. It take 30 millisec to search the TLB and 110 millisec to access the physical memory. If the TLB hit ratio is 0.6, the EMAT (in millisec) is_____. **[NAT]**

$TLB_A = 30$ ms

$M.M = 110$ ms

$TLB_H = 0.6$

$EMAT \Rightarrow 0.6(30+110) + 0.4(30+2*110)$

$\Rightarrow 0.6(140) + 0.4(250)$

$84.0 + 100.0$

184 msec.

Q.6

A demand paging system takes 240 time units to service a page fault and 300 time units to replace a dirty page. Main memory access time is 20 time units. The probability of page fault is 0.4. In case of a page fault the probability of page being dirty is 0.06. The average access time ____time units. [NAT]

$(1-0.4) = 0.6$

Given:

P.F.S.T = 240

R.D.P = 300

M.M = 20

P.f.r = 0.4

D.P = 0.06

$1-0.06 = 0.94$

Average access time $\Rightarrow$ $0.6(20) + 0.4\left[0.94(240) + 0.06(300)\right]$

$\Rightarrow$ $12.0 + 0.4\left[225.6 + 1800\right]$

$12.0 + 0.4\left[243.6\right]$

$12.0 + 97.44$

$\Rightarrow$ 109.44 time units

Q.7

Consider a 32 bit machine where four-level paging scheme is used. If the TLB hit ratio is 90% and it takes 30 nsec to search the TLB and main memory access time is 100 nsec so, what is the effective memory access time in nanoseconds? **[MCQ]**

A. 115 nsec.

B. 160 nsec.

C. 170 nsec.

D. 180 nsec.

$TLB_H = 0.9$

$TLB_A = 30\,nsec$

$M.M = 100\,nsec$

$\therefore EMAT = 0.9(30+100) + 0.1(30+(4+1)*100)$

$= 0.9(130) + 0.1(530)$

$\Rightarrow 117.0 + 53.0$

$\Rightarrow$ **170 nsec**


THANK YOU GW
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