

# CS & IT ENGINEERING

**Operating Systems** 

Memory Management



Lecture No. 6



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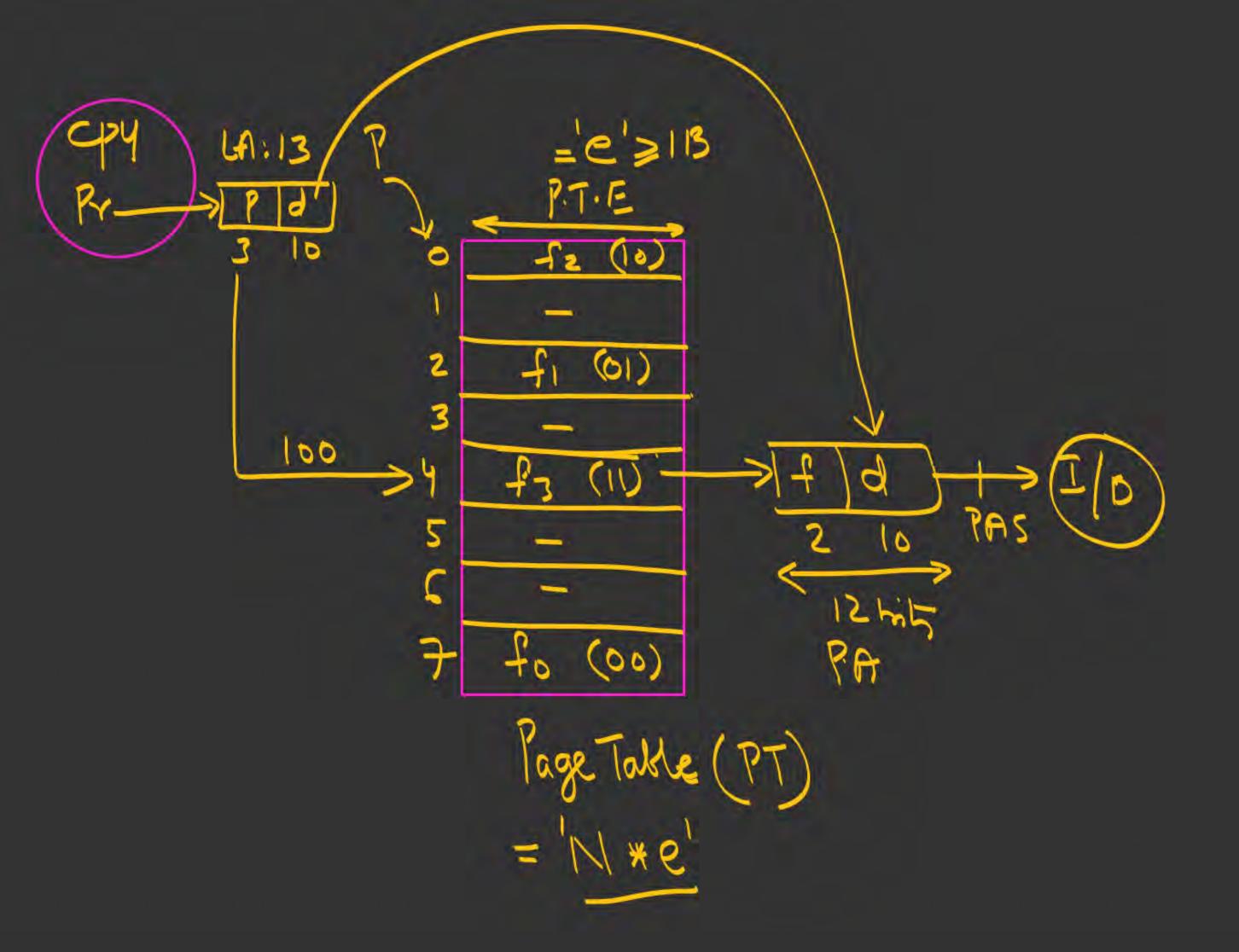
TOPICS TO BE COVERED **Simple Paging** 

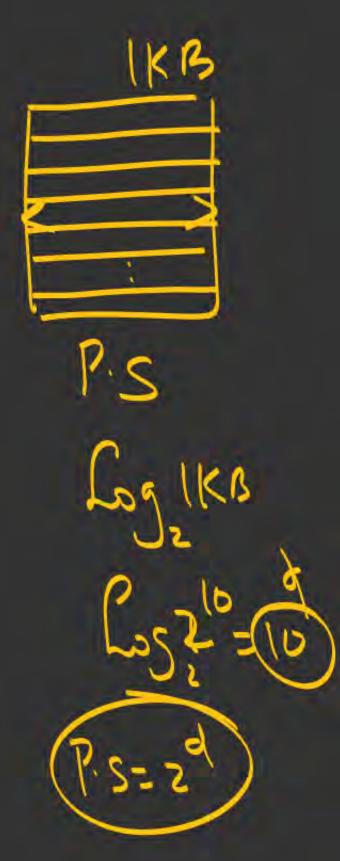
Performance of Paging

**Hashed Paging** 

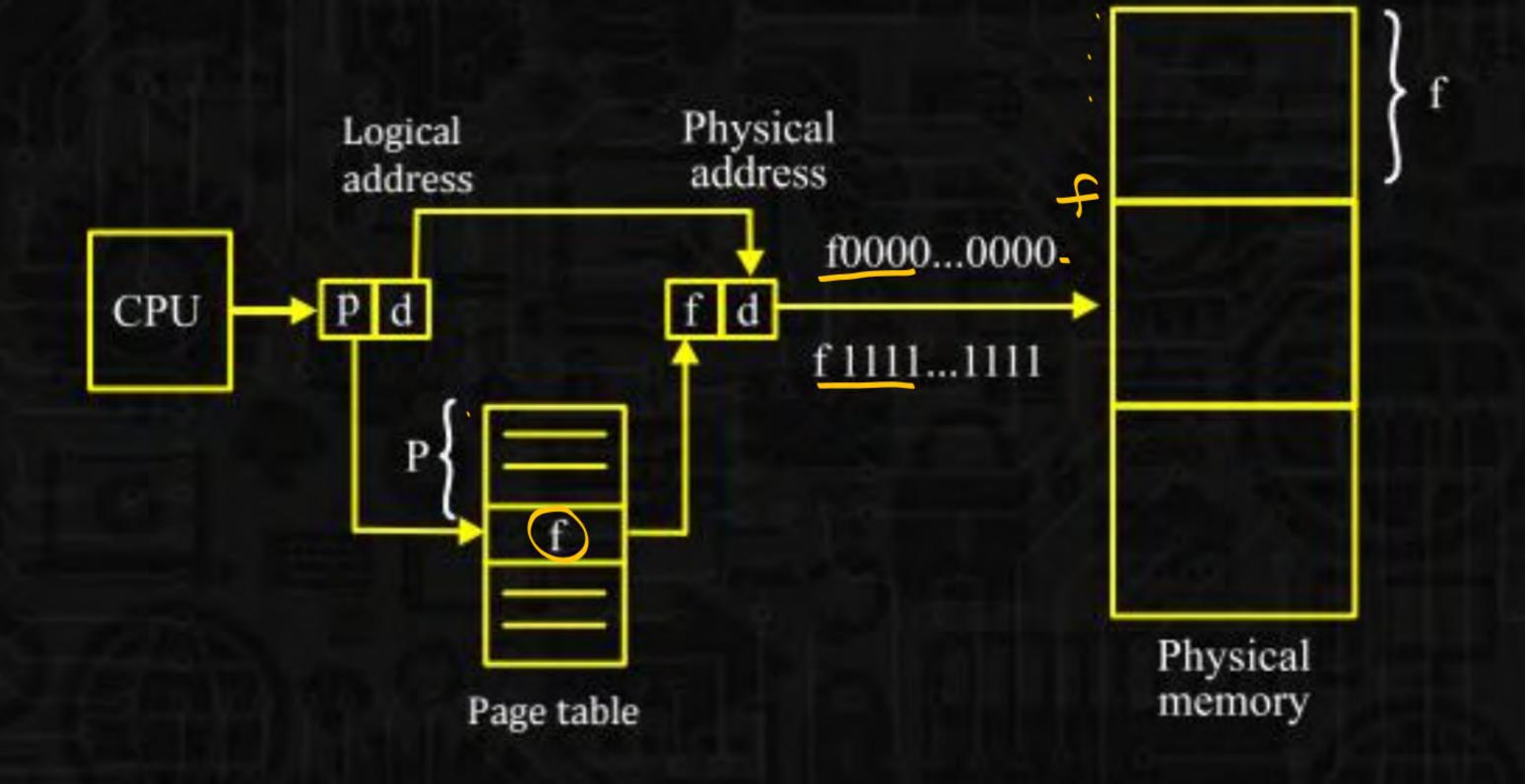
LAS=8KB; P.A.S=4KB; P.S=1KB LA=1365 PA=1265 d=1066

-> d= Log PS boits P.S = 29 By -> f = Log Marames boils P1:47 <-

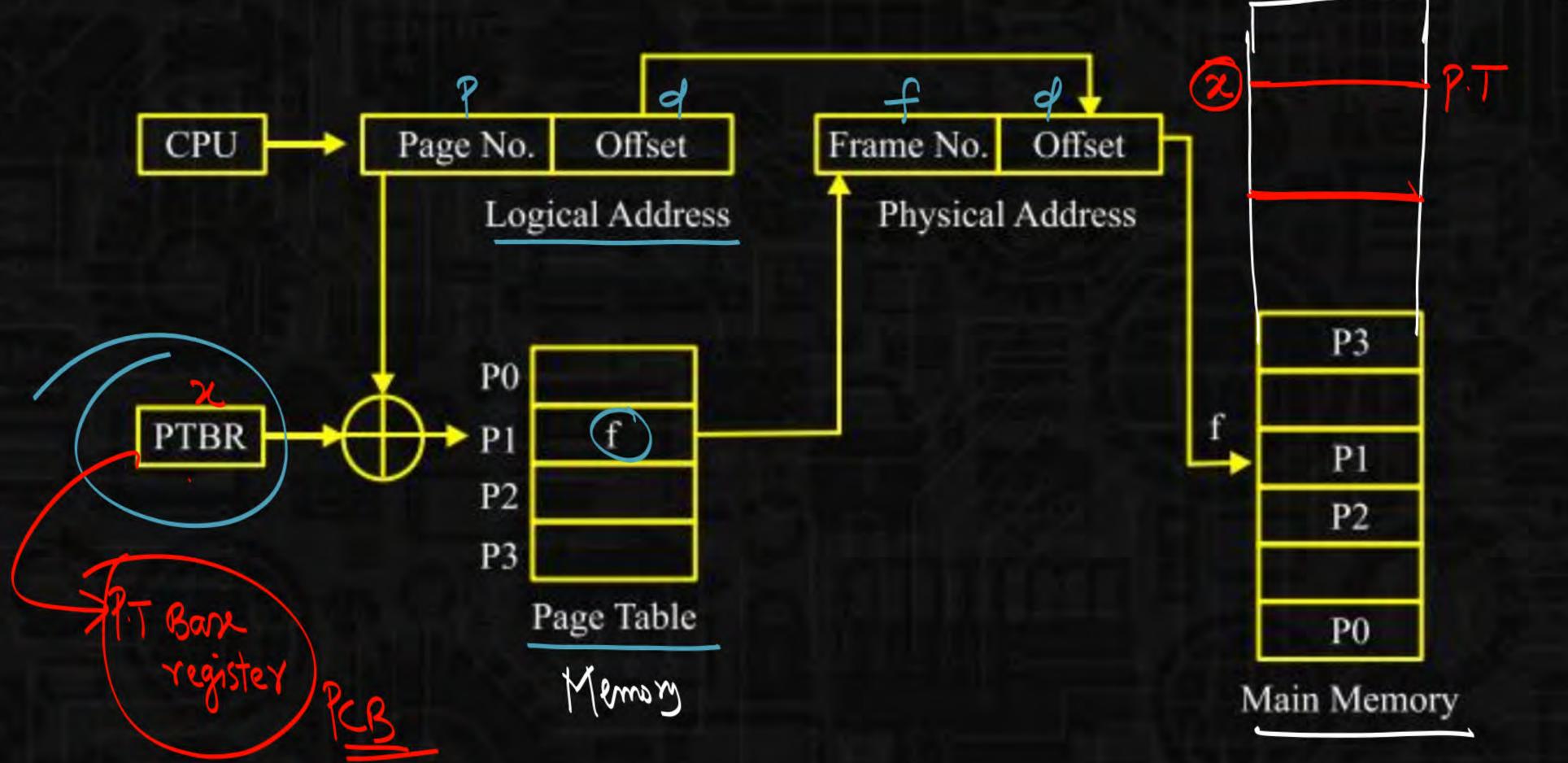


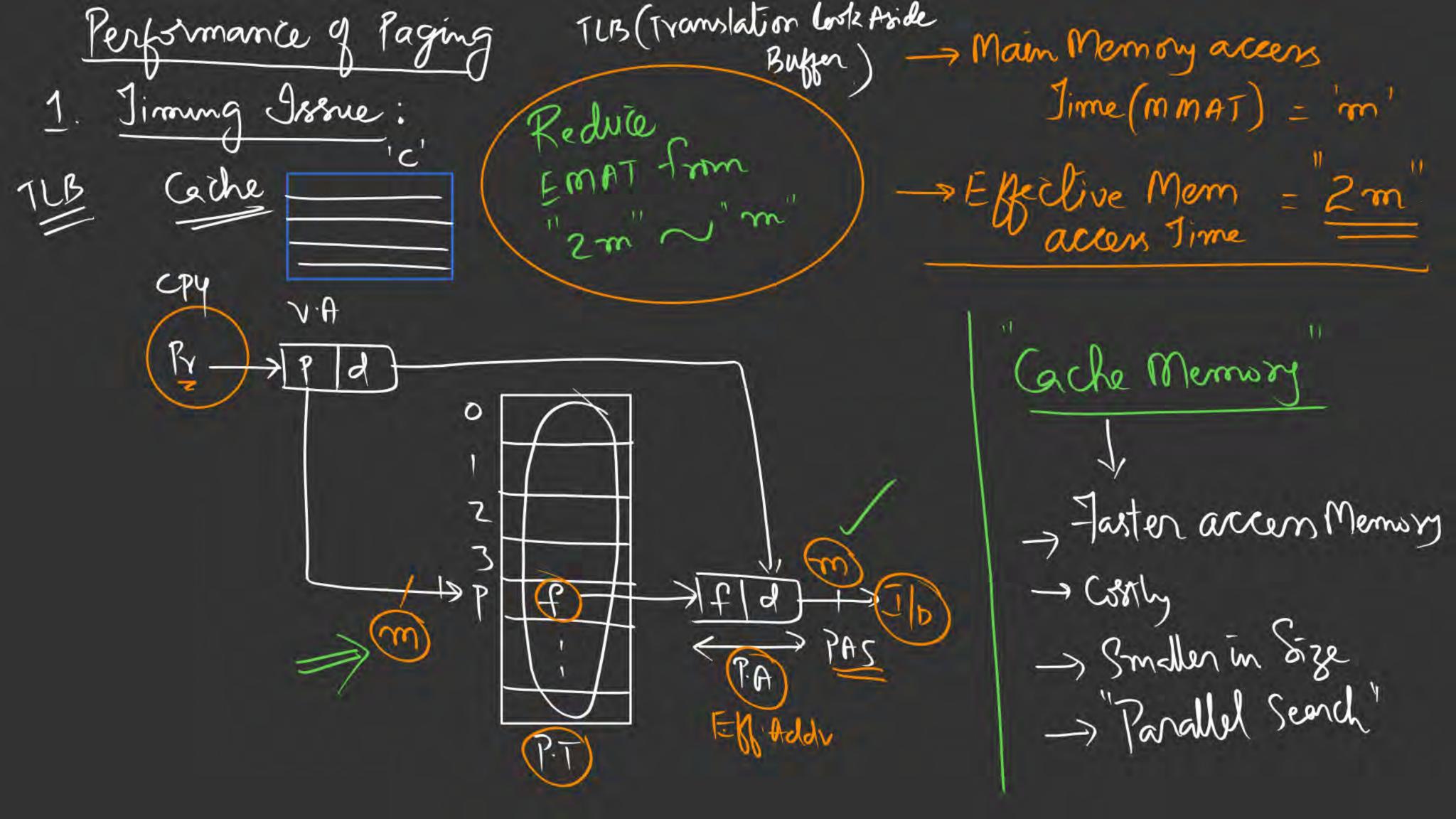






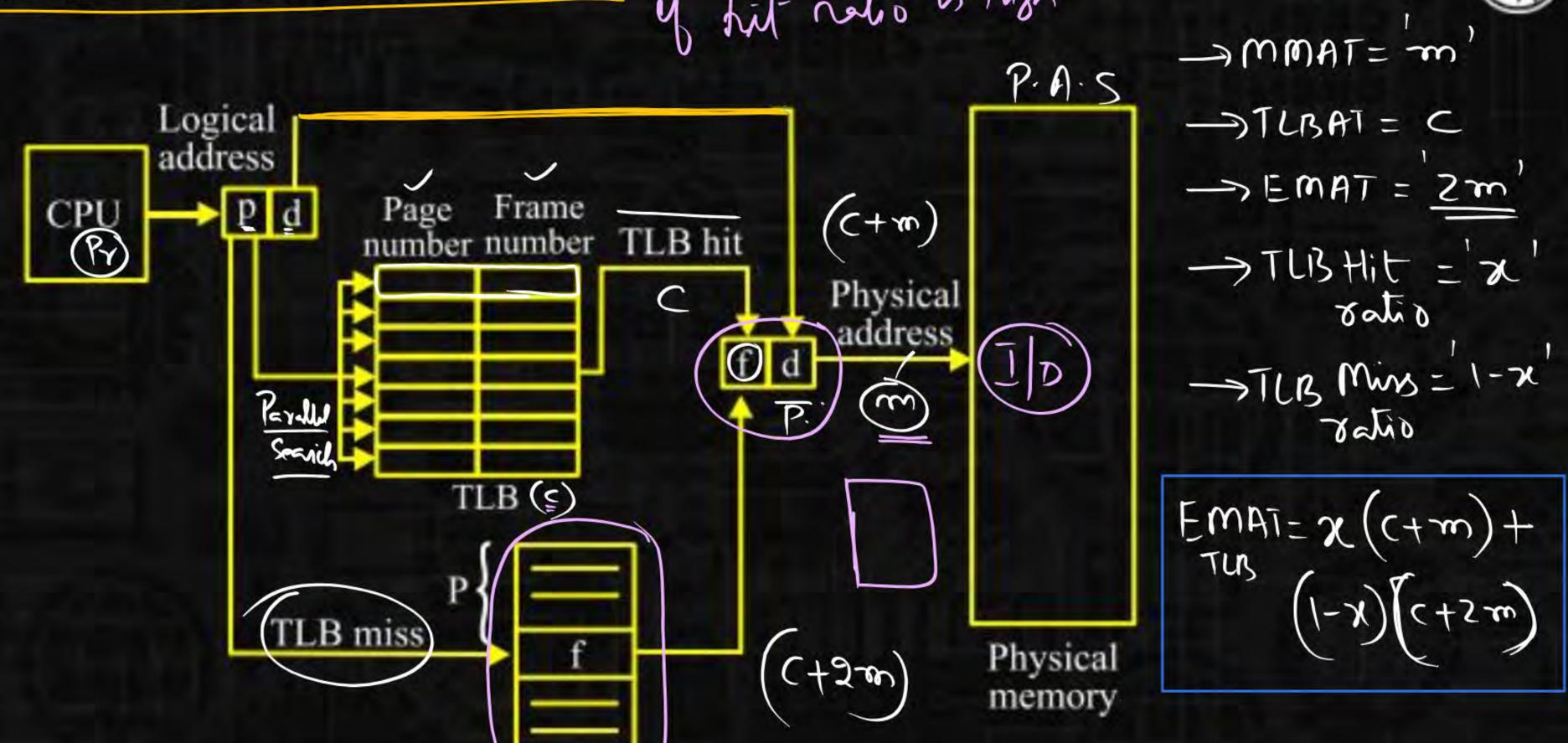






#### Paging Hardware with T.L.B

The use of TLB will be quotified only if hit natio is High



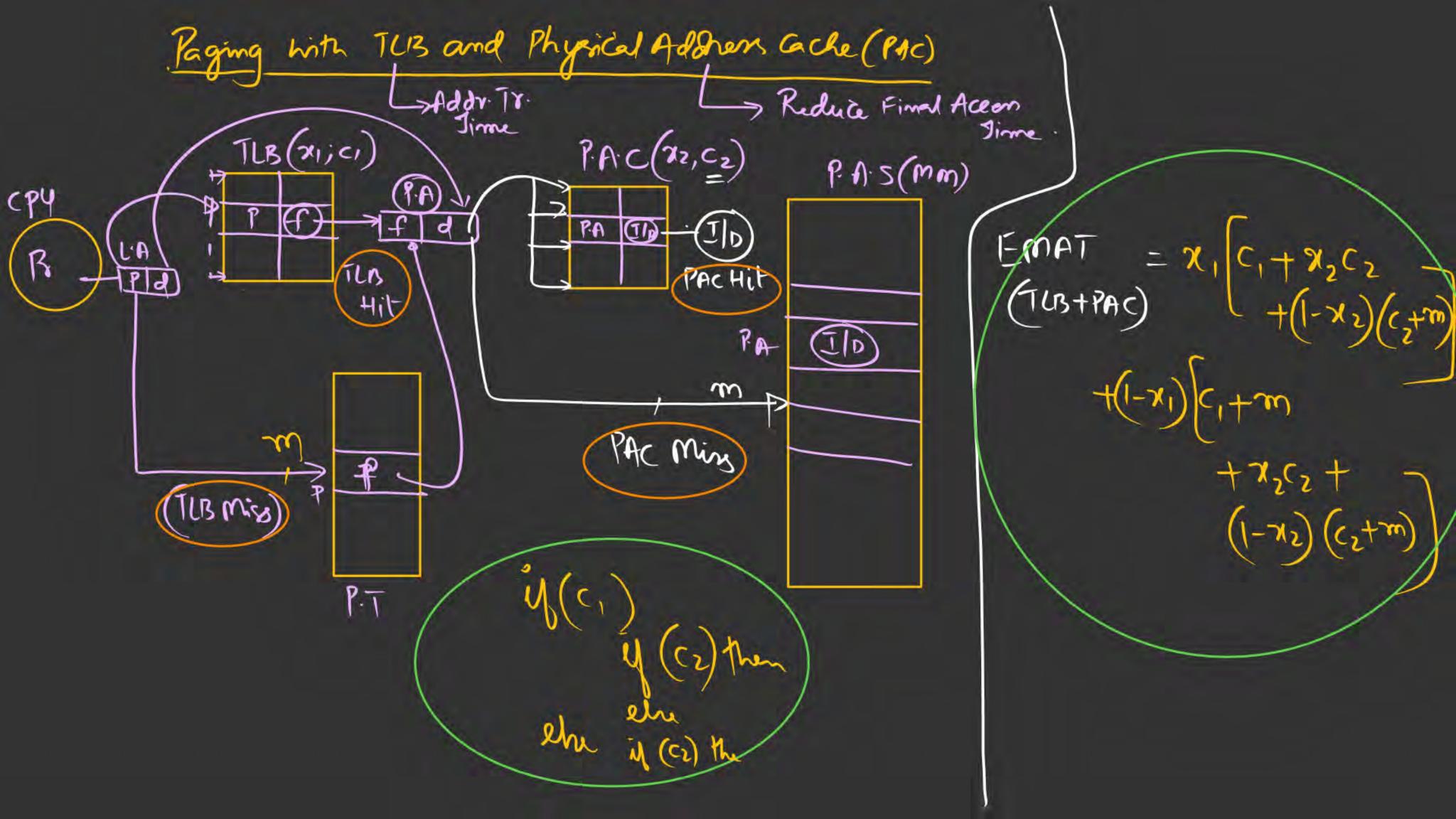
(1) 
$$m = 100 \text{ mS}$$

$$C = 20 \text{ mS}$$

$$S = 20$$

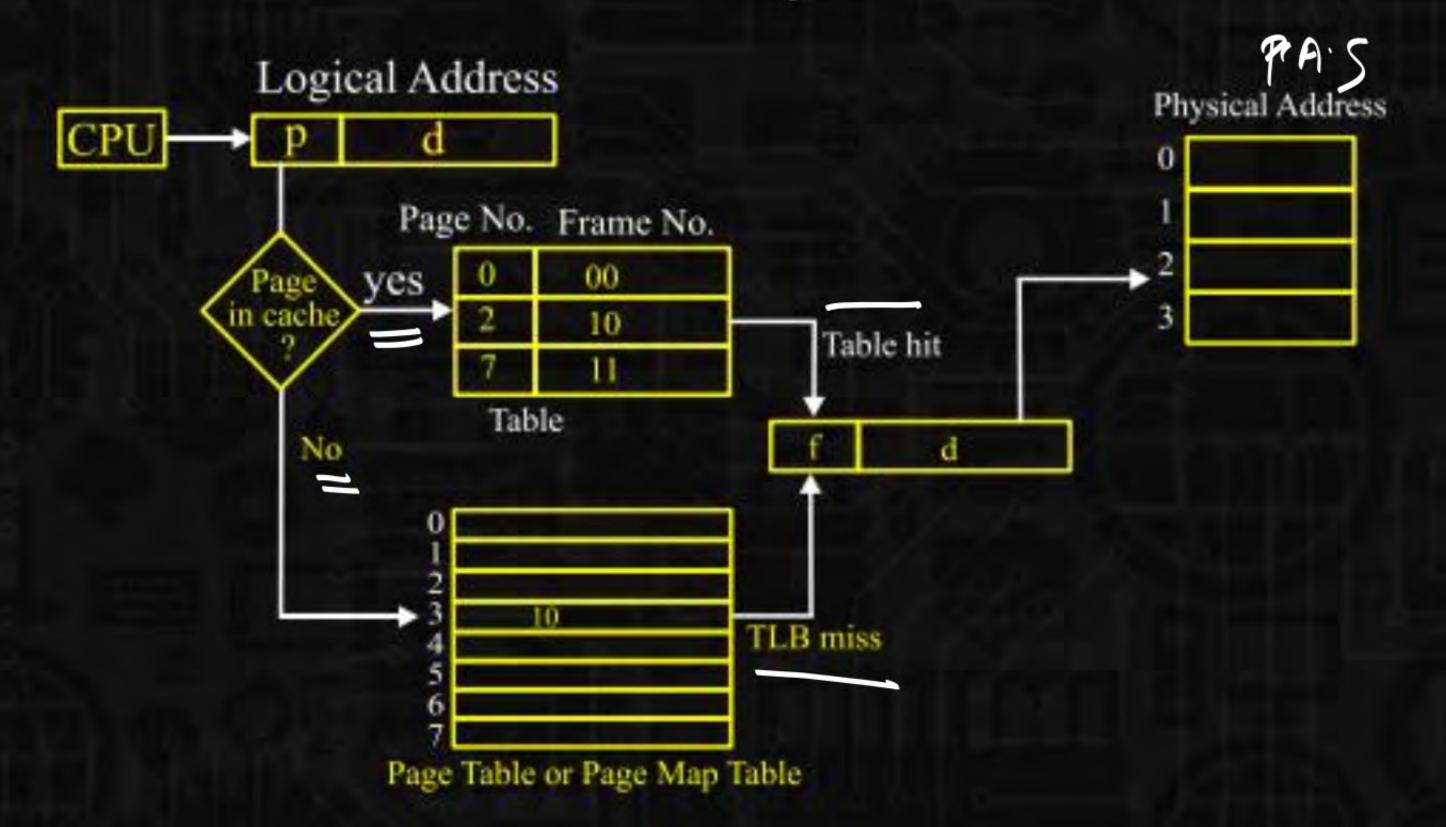
b) If 
$$x = 90$$
; what,  $x = 0.9$ ;  $(1-x) = 0.1$   
is  $EmaT = x(c+m) + (1-x)(c+2m)$   
 $TCB = 0.9(120) + 0.1(220) = 108 + 22 = 130 ms$  [20~120]

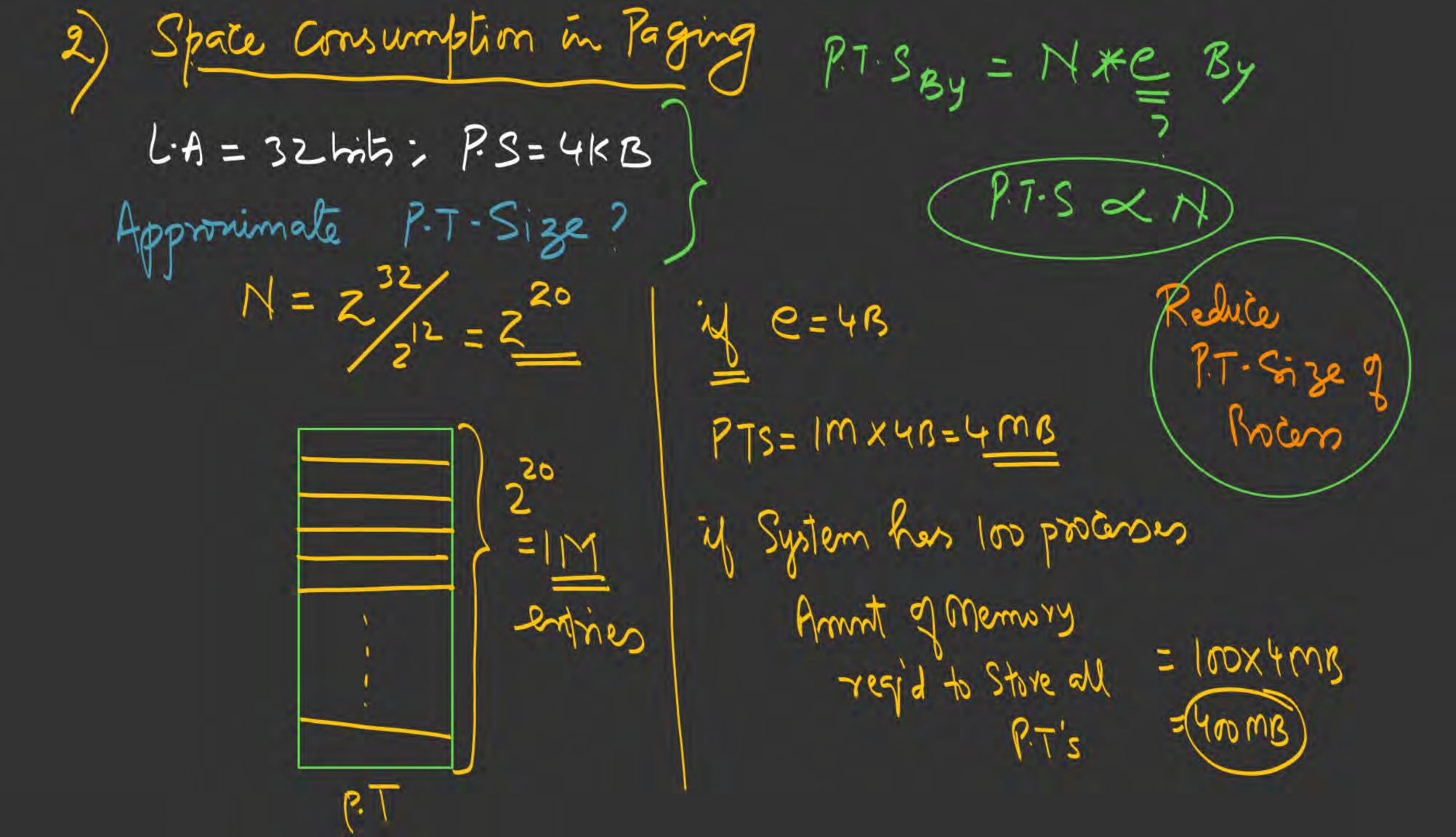
c) 
$$91 \times 100 \times 10$$



## Paging with TUB







## Reduce P.T. Size/Assoc. Smaller P.T's with Processes

Li Reduce P.7-S by Increasing

A Computer System using Paging Technique implements an 8KB Page with a Page Table of Size 24MB. The Page Table Entry is 24 bits. What is the length of Virtual Address in this System?

Consider a computer system with 40-bit virtual addressing and page size of sixteen kilobytes. If the computer system has a one-level page table per process and each page table entry requires 48 bits, then the size of the per process page table is megabytes.

V.A: 40 hits 
$$N = \frac{2^{40}}{2^{14}} = 2^{6}$$

P.S: 16 KB  $N = \frac{2^{14}}{2^{14}} = 2^{6}$ 

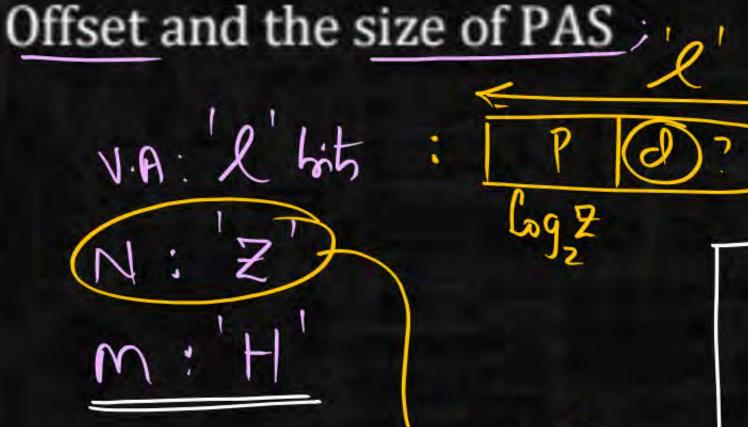
PTE: 48 hits = 6B

P.T.S = N \* e

= 64 m \* 6B

= (384 mB)

A Computer System using Paging technique has a Virtual Address of length  $\mathcal{L}$ . The Number of Pages in the Address Space are 'Z'. There are 'H' Frames in PAS. Calculate the number of bits in Page





Consider a System using Simple Paging Technique with Logical Address (LA) of 32 bits. Page Table Entry (PTE) of 32 bits. What must be the Page Size in bytes, such that the Page Table of the Process Exactly fits in one Frame of Memory (PAS)?

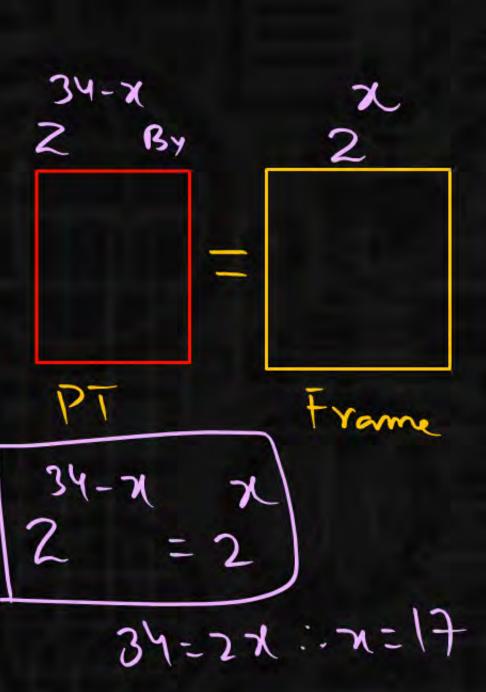
LiA: 32 hits

PTE=e=32 hits=4B

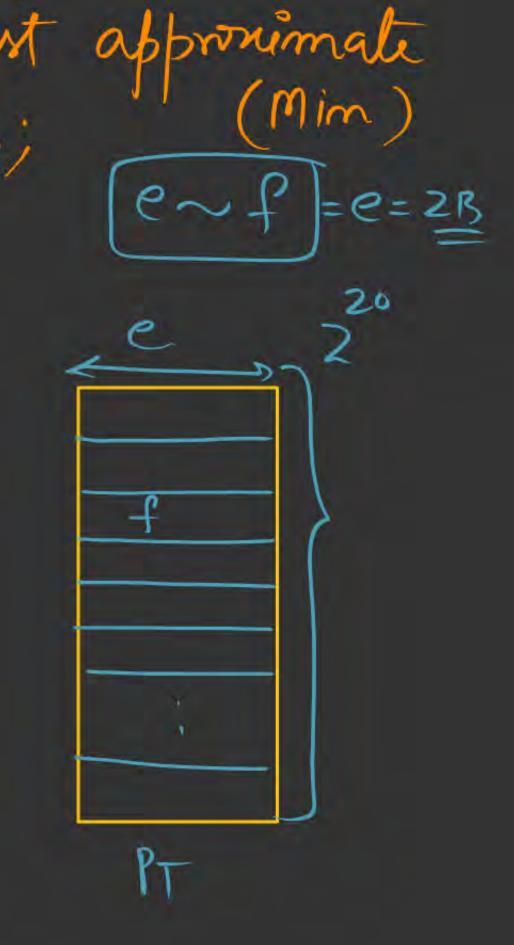
P:S=?

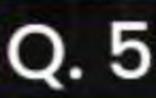
PTS= 
$$\frac{32}{2x} = \frac{32-x}{2x}$$

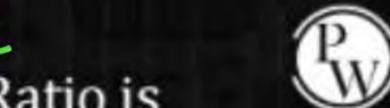
P:TS= $\frac{32-x}{2x} = \frac{32-x}{2x}$ 



Q) Consider a System using Paging Jechnique, with VA = 32 hits and P.S = 4KB; What must approximate P.T.S in Bytes, given P.A.S=64MB; (Mim) 7AS=64MB P.S= 4KB =1m x 2B







Consider a System using Paging with TLB. What Hit Ratio is required to reduce the EMAT from 'D' ns to 'Z' ns using TLB. Assume that TLB access time is 'K' ns.

$$2m = D$$

$$\Rightarrow m = D/2$$

$$E \cdot M \cdot AT = x (c+m) + (-x)(c+2m)$$

$$\frac{1}{Z'} = x (k+2) + (-x)(k+m)$$



