



United International University

Name
(Optional)

ID No.

Section

.....
Invigilator's
Signature with date

Course Code

Trimester / Semester: Spring / Summer / Fall, 20.....

Date:

Name of Exam: Class Test / Mid-term / Mid-term (Makeup/Improvement) / Final / Final (Makeup/Improvement)

Spring '25 : CSE 4509

CT- 3 Solution

1) (a) Physical Address = $\lceil \log_2 (48 \times 2^{20}) \rceil = 26 \text{ bits}$

(b) PTE size = PFN + Flags
= $(17 + 4)$ bits
= 21 bits
= $\lceil \frac{21}{8} \rceil$ bytes
= 3 bytes

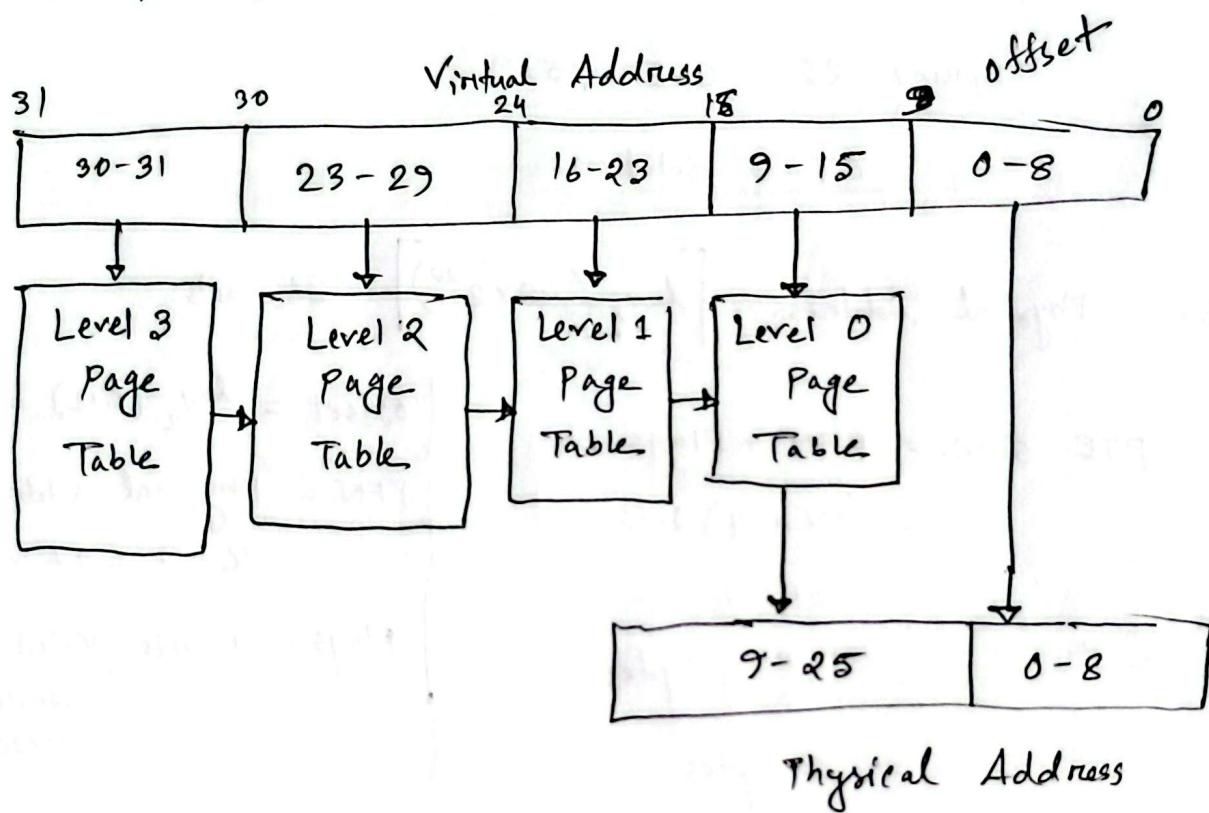
$$\left. \begin{array}{l} \text{offset} = \log_2 (512) = 9 \text{ bits} \\ \text{PFN} = \text{Physical address} - \text{offset} \\ = 26 - 9 = 17 \text{ bits} \\ \text{Flags} = 4 \text{ bits } (\text{valid, Read, Write and Execute bits}) \end{array} \right\}$$

(c) Number of virtual pages = $\frac{\text{Virtual Memory Size}}{\text{Page size}}$
 $= \frac{2^{32}}{512} = \frac{2^{32}}{2^9} = 2^{23}$

\therefore Size of a single level page table = $2^{23} \times 3 \text{ bytes}$
= $2^9 \times 3 \times 2^{20} \text{ bytes}$
= 24 MB

(d) Number of bits required at each level of page table

$$\begin{aligned}
 &= \left\lceil \log_2 \left(\frac{\text{Page size}}{\text{PTE size}} \right) \right\rceil \\
 &= \left\lceil \log_2 \left(\frac{512}{3} \right) \right\rceil \quad [\text{Floor function is used}] \\
 &= \lfloor 7.415 \rfloor \\
 &= 7 \text{ bits}
 \end{aligned}$$



(e) If a process uses only one page, then one page from each level of page table will be required.

∴ Used ~~same~~ memory of this multi level page table

$$= 4 \text{ pages} = 4 \times 512 \text{ bytes} = 2 \text{ KB}$$

(f) Number of PTEs per page = $\left\lceil \frac{512}{3} \right\rceil = 170$

For level 0, pages required = $\left\lceil \frac{2^{23}}{170} \right\rceil = 49345$ pages

For level 1, " " = $\left\lceil \frac{49345}{170} \right\rceil = 291$ pages

For level 2, " " = $\left\lceil \frac{291}{170} \right\rceil = 2$ pages

For level 3, " " = $\left\lceil \frac{2}{170} \right\rceil = 1$ page

∴ Total memory required = $(49345 + 291 + 2 + 1) \times 512$ bytes

Ans.

Ans: no. 2

$$\text{offset} = \log_2 (4 \times 2^{10}) = 12 \text{ bits}$$

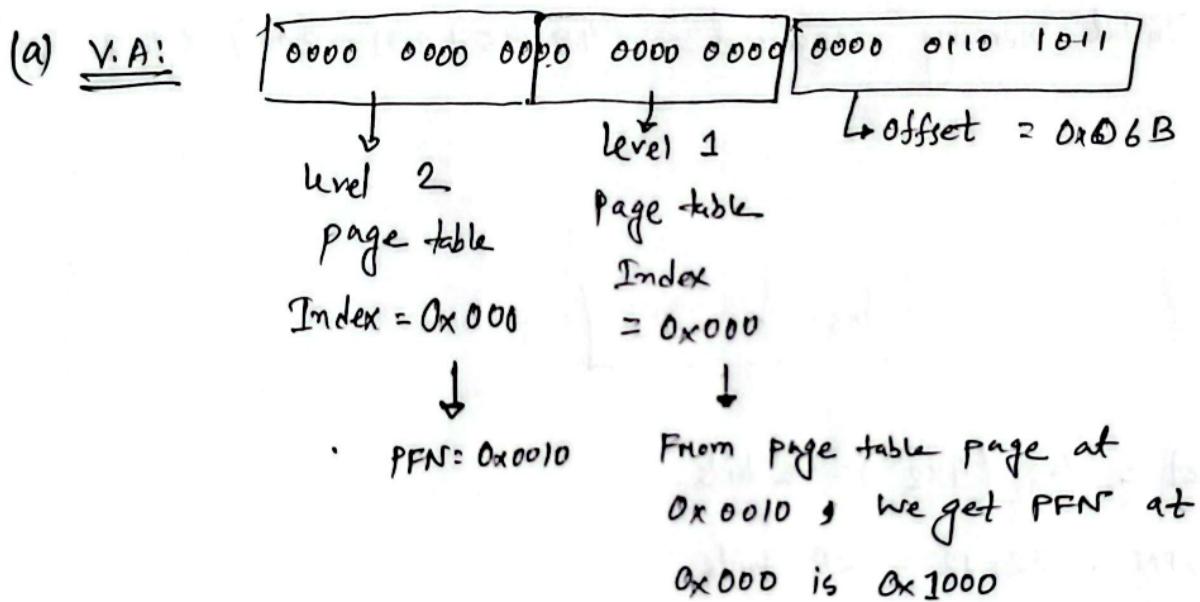
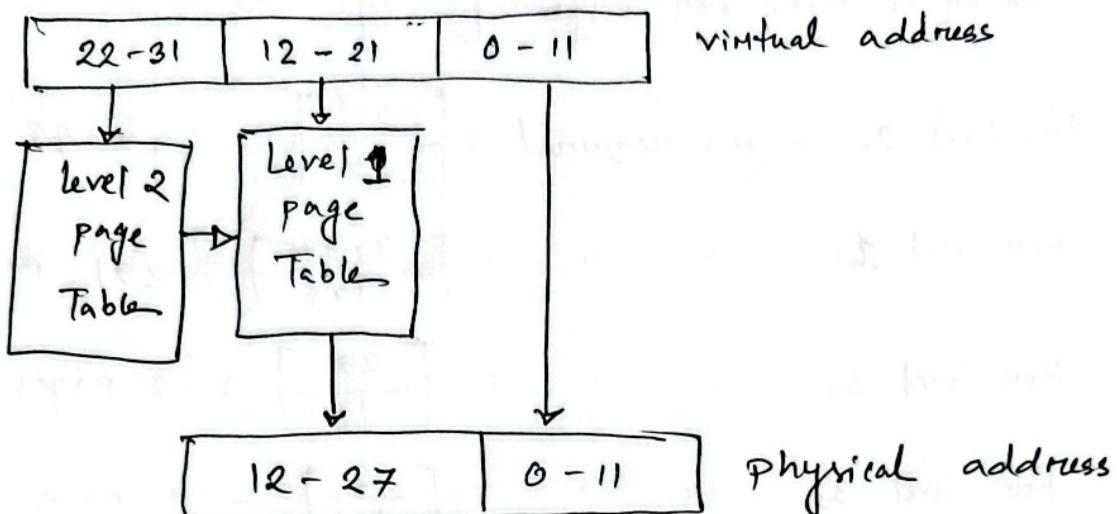
$$\therefore \text{VPN} = 32 - 12 = 20 \text{ bits}$$

$$\text{PFN} = 28 - 12 = 16 \text{ bits}$$

Number of bits required for each level of page table

$$= \log_2 \left(\frac{\text{pagesize}}{\text{PTE size}} \right) = \log_2 \left(\frac{4 \times 2^{10}}{4} \right) = 10 \text{ bits}$$

P.T.O.



$$\therefore \text{physical address} = 0x100006B$$

Similarly, (b) physical address = 0x30000FF

(c) physical address = Exception: Invalid Address