Ans: no. 1

(a) offset = $\log_2(1024)$ = 10 bits

(b) Physical address = $\log_2(256 \times 2^{20})$ = 28 bits

(c) Number of Virtual Pages = $\frac{2^{32}}{2^{10}} = 2^{22}$

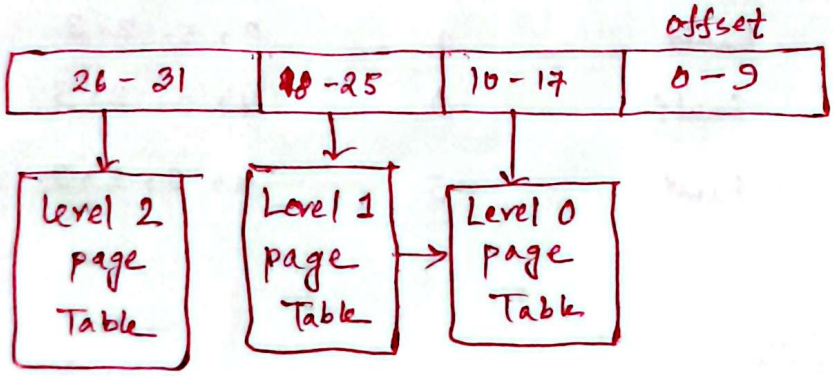
∴ Size of single level page table = $2^{22} \times 4$ bytes

$= 2^4 \times 2^{20}$ bytes

= 16 MB

(d) Number of bits required at each level

$= \log_2\left(\frac{\text{Page size}}{\text{PTE size}}\right) = \log_2\left(\frac{1024}{4}\right)$ = 8 bits



Ans: no. 2

Page Num	Hit/Fault	Evicted	Memory State
0	Fault	x	0
1	"	x	0, 1
2	"	x	0, 1, 2
3	"	x	0, 1, 2, 3
0	Hit	x	0, 1, 2, 3
4	Fault	1	0, 4, 2, 3
2	Hit	x	0, 4, 2, 3
1	Fault	3	0, 4, 2, 1
0	Hit	x	0, 4, 2, 1
5	Fault	4	0, 5, 2, 1
2	Hit	x	0, 5, 2, 1
3	Fault	1	0, 5, 2, 3
4	Fault	0	4, 5, 2, 3
1	Fault	5	4, 1, 2, 3

Ans: no. 3

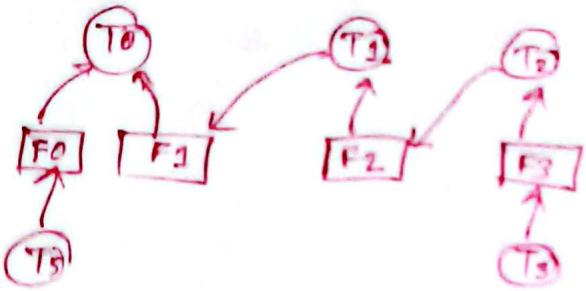
offset = $\log_2(256)$ = 8 bits

∴ VPN = 16 − 8 = 8 bits (MSB)

	VPN	PFN	Physical Address
(1)	0x02	Page fault	
(2)	0x06	"	"
(3)	0x0A	0x4	0x410

Ans: no. 4

Threads	Hold	Wait
~~sleep~~ T0 (if)	F0, F1	
~~sleep~~ T1	F2	F1
~~sleep~~ T2	F3	F2
T3 (if)		F3
~~sleep~~ T4	F5, F4	
T5		F0



4(b) No deadlock

Output:

When Syn. meets Deadlock!
Are philosophers in deadlock?
.. ..

~~blbp~~
When Syn. meets Deadlock!
Are philosophers in deadlock?
. .. . ?

4(c)

Resources will be released before requesting for another resource which prevents Hold & wait

Ans: no. 5. [4+2=6]

	Need				Available				Safe state
	A	B	C	D	A	B	C	D	T_2
T_0	2	1	0	3	0	3	0	0	T_1
~~T_1~~	1	0	0	1	3	~~3~~	2	~~1~~	~~T_3~~
~~T_2~~	0	2	0	0	5	~~7~~	3	~~1~~	
T_3	4	1	0	2	~~5~~	~~10~~	4	~~1~~	
T_4	2	1	1	3					

∴ T_0, T_3 and T_4 are not in safe state.

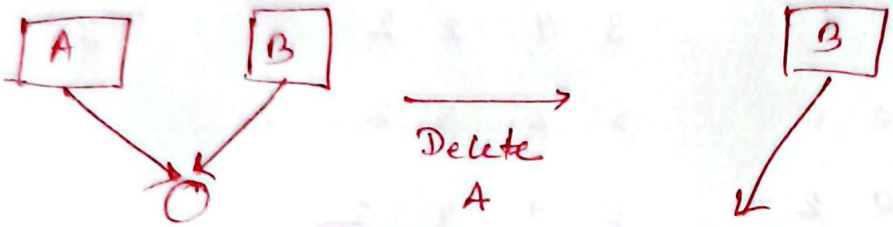
Minm number of additional available resources required = {0,0,0,~~1~~}

5(b)

Available >= Request

6(a)

Dangling pointers: A pointer pointing to a memory location that has been deleted.

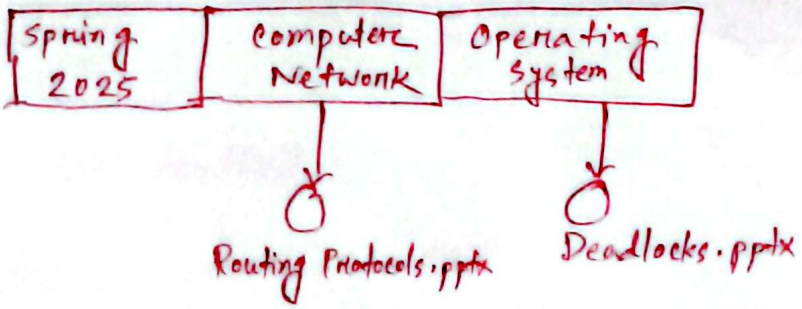


3 solutions to dangling pointers: ① Back pointers

② Daisy chain organization of Back pointers

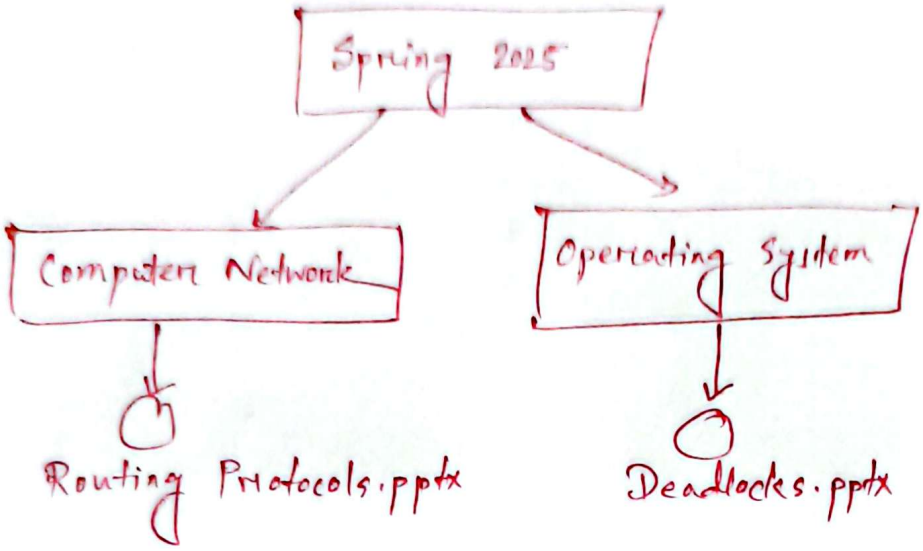
③ Entry-hold count

6(b)



Problem: Logs the ~~the~~ information of grouping

Solution using Tree Structure:



7(a)

Indexed file allocation method.

7(b)

- Need to traverse the linked list to find contiguous free blocks.
- Modification: Counting. Keep the count of n free contiguous blocks, thus improving traversal time.