

- Using two semaphores S1 and S2, show how a deadlock can occur between two processes, even if the semaphores are used correctly.
- List the five conditions necessary for deadlock.
- Is the following system safe?

	Has				Max				Free			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	1	1	0	0	1	1	0	5	1	2	1	2
P1	3	0	0	2	4	2	0	2				
P2	0	1	1	0	4	2	1	0				
P3	0	0	1	1	3	3	2	1				
P4	0	0	0	1	0	4	3	1				

- Is the following system deadlocked?

	Has				Req				Free			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	1	1	2	1	1	1	0	4	0	0	0	0
P1	0	0	0	1	3	0	0	0				
P2	1	1	1	1	0	0	0	0				
P3	1	0	1	2	1	0	0	1				
P4	1	0	0	1	0	2	1	0				

- Is the following system deadlocked?

	Has				Req				Free			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	2	1	0	1	0	0	0	0	0	0	0	0
P1	1	1	2	2	4	1	1	0				
P2	1	1	0	0	0	0	0	3				
P3	2	0	1	1	0	0	0	0				
P4	2	3	1	2	0	0	3	0				

- Determine the number of page faults that will occur with the following reference string using the algorithms OPT, FIFO, and LRU. Simulate each algorithm for three page frames and four page frames.

1 2 3 1 2 1 3 4 5 4 5 3 1 2 1 2 3 1 5 4 3 4 3 4 5

7. Assume you have a decimal machine with both virtual and physical addresses consisting of 4 digits. The page number is two digits and the offset is two digits. Given the following page table, translate the given virtual addresses into real addresses. If a virtual address can't be translated, write "page fault" for the real address. The page table is 12 entries long.

Page Table

35xx
52xx
61xx
70xx
32xx
01xx
11xx
45xx
60xx
59xx
91xx
22xx

Virtual	Real
0121	
3241	
0715	
1237	
0977	
1192	
1066	
0256	
0621	
0599	

8. Translate the following real addresses into virtual addresses using the following hierarchical page table. Addresses are specified in decimal, with four digits per address. The first digit indexes the first-level table while the second indexes the second-level table. If an address can't be translated, write "Page Fault" in the real address box.

First-Level Table.	Secondary table contents			
	2100	1300	0400	2200
2100	13xx	61xx	13xx	81xx
1300	14xx	67xx	75xx	46xx
0400	22xx	40xx	80xx	77xx
2200	38xx	19xx	92xx	91xx

Virtual	Real
0101	
0232	
1234	
2141	
2432	
3325	
7122	
2020	
3188	
9231	