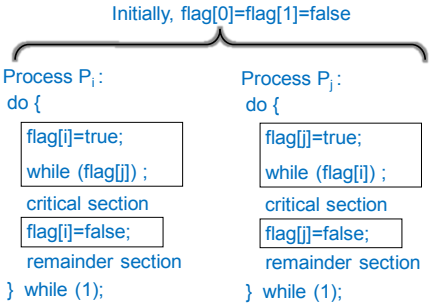
長庚大學105學年度第一學期作業系統期末測驗（滿分100）

系級: 姓名: 學號:

1. (10%) For the **second version** of **Peterson's Solution**, please explain the problem when we use the following algorithm for protecting the critical sections of P_i and P_j:



Answer: When the two processes set flag[i] and flag[j] as true, no one can break the while loop of the enter section.

2. (12%) Let's consider the **Readers and Writers Problem**. The pseudo code is provided as follows. Semaphores wrt and mutex are initialized as 1, and integer readcount is initialized as 0. In the source code of **Reader**, please (a) explain Lines 3 and 4, and (b) explain Lines 9 and 10.

```
Writer:
1   wait(wrt);
2   ……
3   writing is performed
4   ……
5   signal(wrt)
```

```
Reader:
1   wait(mutex);
2   readcount++;
3   if (readcount == 1)
4         wait(wrt);
5   signal(mutex);
6   … reading…
7   wait(mutex);
8   readcount--;
9   if (readcount== 0)
10        signal(wrt);
11  signal(mutex);
```

Answer: (a) For Lines 3 and 4, the first reader has to make sure that there is no writer running in the critical section before it enter the critical section. (b) For Lines 9 and 10, the last reader has to check whether there are some writers waiting for semaphore wrt when it finishes its critical section. If there is at least one writer waiting, pick one and let it enter critical section.

3. (14%) Banker's Algorithm is a deadlock avoidance algorithm. Assume there are 5 processes {P_0, P_1, P_2, P_3, P_4} and three types of shared resources {A, B, C} in the system, and the details are in the following table. (1) By Banker's Algorithm, is the system in a safe state? If your answer is yes, please provide a safe sequence. If your answer is no, please provide the reason. (2) Now, P_0 further has a request (1, 1 , 0) to use 1 more instance of A and 1 more instance of B. Should the request be granted? Again, provide the reason to support your answer.

	Allocation			Max			Need			Available		
	A	B	C	A	B	C	A	B	C	A	B	C
P0	0	1	0	7	5	3	7	4	3	3	3	2
P1	1	0	1	2	4	3	1	4	2			
P2	3	0	2	9	0	2	6	0	0			
P3	0	1	1	0	2	2	0	1	1			
P4	2	1	1	6	4	2	4	3	1			

Answer:

(1) Yes.

Run the Banker's Algorithm: Available(3, 3, 2) → P3 Need(0, 1, 1) → Available(3, 4, 3) → P1 Need(1, 4, 2) → Available(4, 4, 4) → P4 Need(4, 3, 1) → Available(6, 5, 5) → P2 Need(6, 0, 0) → Available(9, 5, 7) → P0 Need(7, 4, 3)

(2) No.

After the system grants the request: Available(3, 3, 2) → Available(2, 2, 2). P0 has Need(6, 3, 3) and Allocation(1, 2, 0).

We then run the Banker's Algorithm again: Available(2, 2, 2) → P3 Need(0, 1, 1) → Available(2, 3, 3) → No one can run now!

4. (10%) To manage deadlocks, an OS can run Banker's Algorithm to avoid deadlocks. If an OS does not do deadlock avoidance, the OS has to do deadlock detection. When deadlocks are detected, the OS will do system recovery from the deadlocks. (a) When should we choose deadlock avoidance instead of deadlock detection? (b) When should we choose deadlock detection instead of deadlock avoidance?

Answer:

(a) When the cost of recovery from deadlock is too high, and the system sometimes has deadlocks.

(b) When the system can tolerate deadlocks, and the system rarely has deadlocks.

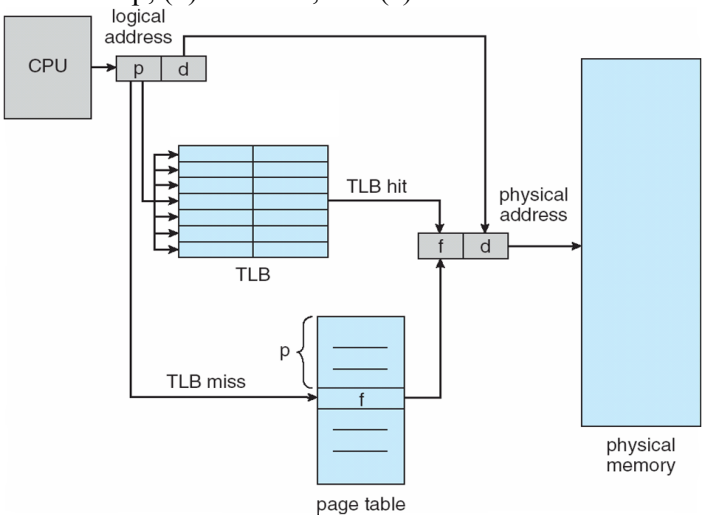
5. (10%) Please define (a) the external fragmentation and (b) the internal fragmentation of memory management.

Answer:

(a) External Fragmentation – total memory space exists to satisfy a request, but it is not contiguous

(b) Internal Fragmentation – allocated memory may be slightly larger than requested memory; this size difference is memory internal to a partition, but not being used

6. (12%) For memory management with page tables, considering the following figure, please define (a) what is p, (b) what is f, and (c) what is d. Please also explain (d) what does TLB do.



Answer:

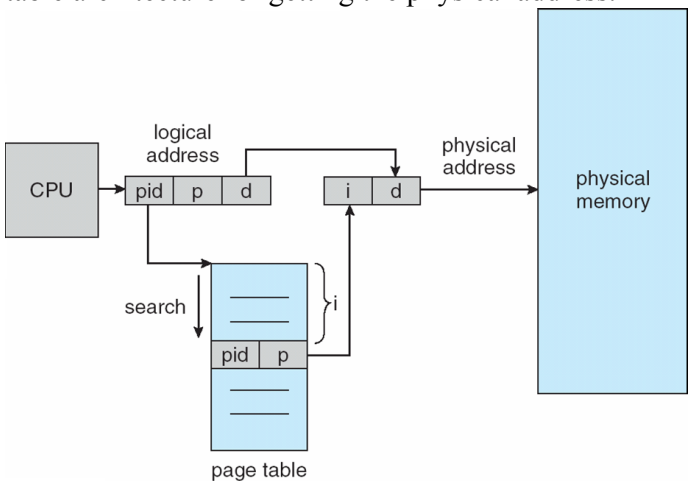
(a) Page number

(b) Frame number

(c) Offset

(d) TLB is usually some on-chip SRAM and can keep the frame numbers of recently referred pages so as to solve the "two memory accesses" problem of using page table.

7. (10%) For the inverted page table architecture, please briefly explain the mechanism of inverted page table architecture for getting the physical address.



Answer: It sequentially searches the pair (pid, p) in the page table. When the pair is found in the i-th entry of the page table, i is then used as the the frame number of the physical address, and d is the offset in the frame.

8. (12%) There is system with only 3 memory frames. Given a reference string of pages {1→2→0→3→0→3→7→4→1→3→7}. Please illustrate the page replacement of (1) the LRU algorithm and (2) the optimal algorithm. You should show the memory frames and the queue for the LRU algorithm. The explanation for each page replacement of the optimal algorithm should be provided.

Answer:

(1) (7%)

Memory Frame

1	1	1	3	3	3	3	3	1	1	1
	2	2	2	2	2	7	7	7	3	3
		0	0	0	0	0	4	4	4	7
LRU Queue										
1	2	0	3	0	3	7	4	1	3	7
	1	2	0	3	0	3	7	4	1	3
		1	2	2	2	0	3	7	4	1

(2) (7%)

Memory Frame

1	1	1	1	1	1	1	1	1	1	1(d)
	2	2	3(a)	3	3	3	3	3	3	3(d)
		0	0	0	0	7(b)	4(c)	4	4	7(d)

(a) 2 is no more used . (b) 0 is no more used. (c) The distance of 1 is 1, the distance of 3 is 2, and the distance of 7 is 3. Thus, replace 7. (d) Replace what ever you like. None of 1, 3, and 4 is going to be used again.

9. (10%) Copy-on-Write (COW) allows both parent and child processes to initially share the same pages in memory. So, please explain the details of COW.

Answer: Copy-on-Write allows both parent and child processes to initially share the same pages in memory. If either process modifies a shared page, then the page is copied. Thus, it allows more efficient process creation as only modified pages are copied.