長庚大學103學年度第一學期作業系統期末測驗（滿分106）

系級: 姓名: 學號:

1. (10%) Please (1) define "Race Condition" and (2) provide an example for Race Condition. You can use the case, counter ++ and counter -- are in two different processes, as the example. (Hint: the assembly code of counter ++ could be: r_1 = counter; r_1 = r_1 + 1; counter = r_1;)

Answer:

(1) (5%) A situation where the outcome of the execution depends on the particular order of process scheduling.

(2) (5%)

- One counter++ and one counter--

  r1 = counter r2 = counter
  r1 = r1 + 1 r2 = r2 - 1
  counter = r1 counter = r2
- Initially, let counter = 5
  1. P: r1 = counter
  2. P: r1 = r1 + 1
  3. C: r2 = counter
  4. C: r2 = r2 – 1 ⇒ A Race Condition!
  5. P: counter = r1
  6. C: counter = r2 = 4
- The result can be 4, 5 or 6

2. (12%) There are three processes:

- P_1: a * b → c
- P_2: c + d → c
- P_3: c - e → c

- P_1 should run before P_2 and P_3 do
- The access to valuable "c" must be protected
- The initial states are: S_1=0; S_2=0; S_3=1;
- The code of P_1 is: c = a * b; signal(S_1); signal(S_2);

Please provide P_2 and P_3 by using wait() and signal()

Answer: (2% for each column)

- P_2: wait(S_1); wati(S_3) ; c = c + d ; signal(S_3) ;
- P_3: wait(S_2); wati(S_3) ; c = c - e ; signal(S_3) ;

3. (9%) Deadlock prevention is to prevent the necessary conditions which can form the deadlock problem. One of the necessary conditions is **Mutual Exclusion**. Please list the other three necessary conditions.

Answer: (3% for each answer)

Hold and Wait, No Preemption, Circular Wait

4. (16%) 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. By Banker's Algorithm, the system is in a safe state now. Let's further consider the following two requests respectively: (1) P_0 has a request (3, 2, 1) to use 3 more instances of type A, 2 more instances of type B and 1 more instance of type C. (2) P_1 has a request (2, 2, 0) to use 2 more instances of type A and 2 more instances of type B. Please answer the above two sub-questions, independently. If your answer is yes, please provide a safe sequence and the available resources when each process is completed. If your answer is no, please provide the reason.

	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	2	0	0	3	2	2	1	2	2			
P2	3	0	2	9	0	2	6	0	0			
P3	2	1	1	2	2	2	0	1	1			
P4	0	0	2	4	3	3	4	3	1			

Answer:

(1) (4%) Yes, there are two reasons:

I. the request (3 ,2 ,1) is no more than the need (7,4,3) of P_0.

II. (6%) After the request is granted, <P_3,P_1,P_0,P_2,P_4> is a safe sequence with the available resources (0,1,1)→(2,2,2)→(4,2,2)→(7,5,3)→(10,5,5). Note that after the request is granted, for P_0, the allocated resources are (3,3,1), the maximum resources are (7,5,3), and the needed resources are (4,2,2) .

(2) (2%) No,

(4%) the request (2 ,2 ,0) violates the need (1,2,2) of P_1.

5. (12%) Please define (1) logical address, (2) physical address, (3) external fragmentation and, (4) internal fragmentation.

Answer: (3% for each definition)

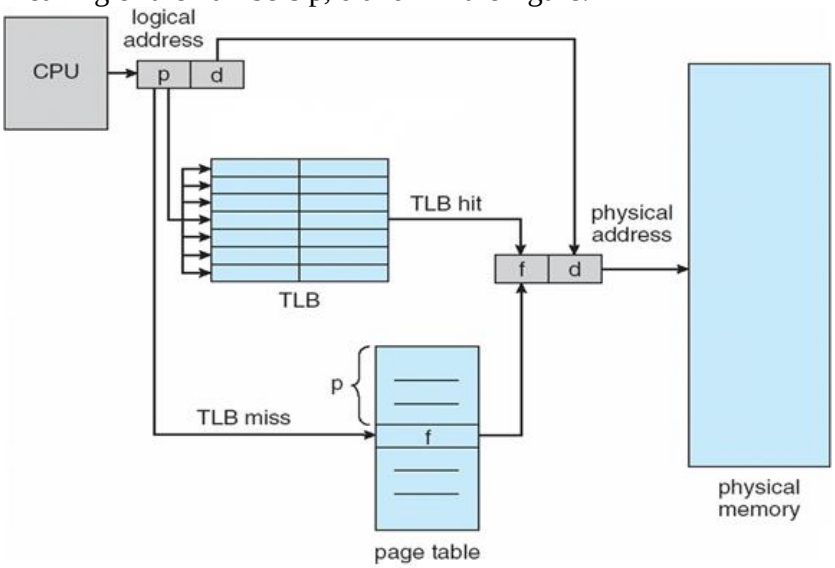
(1) Logical address – generated by the CPU; also referred to as virtual address

(2) Physical address – seen by the memory unit

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

(4) 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. (9%) For a system with a page table and a TLB, as shown in the following figure, please explain the meaning of the numbers p, d and f in the figure.



Answer: (3%) p is the page number which points to a page in the logical address of the process. (3%) d is the offset which points out the location of the to-be-accessed data in the page. (3%) f is the frame number which identifies the location in the physical memory for the page.

7. (10%) Virtual memory is a technique that allows the execution of a process that may not be completely in memory. Please provide at least one potential benefit for using virtual memory.

Answer: (provide at least one reason to get 10%)

- Programs can be much larger than the amount of physical memory
  - Users can concentrate on their problem programming
- The level of multiprogramming increases because processes occupy less physical memory
- Each user program may run faster because less I/O is needed for loading or swapping user programs

8. (16%) There is system with only 3 memory frames. Given a reference string of pages {7→0→1→2→0→3→0→4→2→4→1→2→4}, please illustrate the page replacement and the queue of (1) FIFO algorithm and (2) LRU algorithm.

Answer:

(1) (8%)

7	7	7	2	2	2	2	4	4	4	4	4	4
	0	0	0	0	3	3	3	2	2	2	2	2
		1	1	1	1	0	0	0	0	1	1	1
7	0	1	2	2	3	0	4	2	2	1	1	1
	7	0	1	1	2	3	0	4	4	2	2	2
		7	0	0	1	2	3	0	0	4	4	4

← The pages in the three frames

← The victim is here

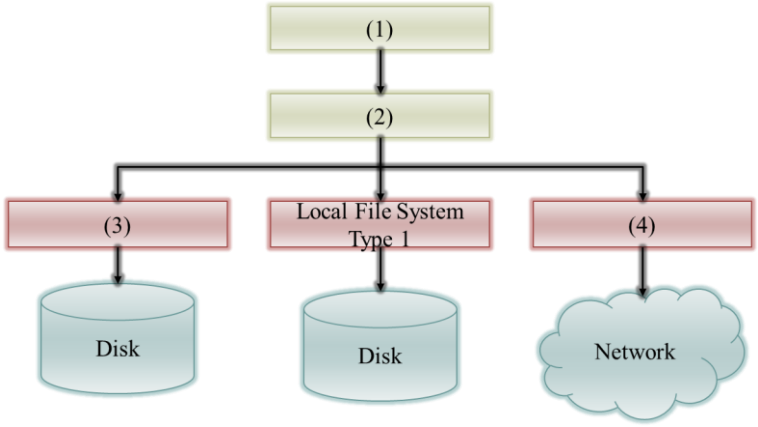
(2) (8%)

7	7	7	2	2	2	2	4	4	4	4	4	4
	0	0	0	0	0	0	0	0	0	1	1	1
		1	1	1	3	3	3	2	2	2	2	2
7	0	1	2	0	3	0	4	2	4	1	2	4
	7	0	1	2	0	3	0	4	2	4	1	2
		7	0	1	2	2	3	0	0	2	4	1

← The pages in the three frames

← The victim is here

9. (12%) There are a lot of file systems supported by various operating systems. In order to provide unified file-system interface, the concept of the virtual file system is proposed. Thus, in the following figure, please list what are (1), (2), (3), and (4). Hint: they could be Local File System Type 2, Remote File System Type 1, File-System Interface, and Virtual-File-System Interface



Answer: (1) (3%) File-System Interface, (2) (3%) Virtual-File-System Interface, (3) (3%) Local File System Type 2, (4) (3%) Remote File System Type 1