(AM) UECS2103 / (SE) UECS2403 / (ET) UECS2423 Operating Systems
Test 2 (Q&A)

Duration: 75 minutes

1.

a) Apply the **Banker's algorithm** to determine the system state. *State the **resources needed** by each process and **resources available** in every step performed*. (12 marks)

Needed			
R1	R2	R3	R4
5	**2**	**2**	**4**
2	**0**	**1**	**0**
6	**4**	**4**	**2**
3	**2**	**3**	**2**
8	**5**	**4**	**6**

Resources available: (8 7 6 8) – (6 6 5 7) = **2 1 1 1**
P2 completed, resources available: 2 1 1 1 + 1 2 2 1 = **3 3 3 2**
P4 completed, resources available: 3 3 3 2 + 2 1 1 2 = **5 4 4 4**
P1 completed, resources available: 5 4 4 4 + 2 1 0 1 = **7 5 4 5**
P3 completed, resources available: 7 5 4 5 + 1 1 0 2 = **8 6 4 7**
P5 can complete, thus the system state is **safe**.

b) Process P5 has requested for an additional unit of R2, determine whether the request should be granted by using banker's algorithm. Show the details of your calculation, including the resources needed by process P1 and the resources available. You may reuse the answer in part (a). (7 marks)

Answer:
Resources available after granted R2: 2 0 1 1
Resources needed by P5 after the request is granted: **8 4 4 6**
P2 completed, resources available: 2 0 1 1 + 1 2 2 1 = **3 2 3 2**
P4 completed, resources available: 3 2 3 2 + 2 1 1 2 = **5 3 4 4**
P1 completed, resources available: 5 3 4 4 + 2 1 0 1 = **7 4 4 5**
P3 completed, resources available: 7 4 4 5 + 1 1 0 2 = **8 5 4 7**
P5 can complete, the request should be granted.

2. Resolve the deadlock by **successively aborting deadlocked processes with the least amount of processor time consumed**. Show the resources available after each abortion in your workings. (6 marks)

Answer:
B is aborted, resources available: 0 0 1 1 + 2 1 2 1 = **2 1 3 2**
Deadlock still exists.
D is aborted, resources available = 2 1 3 2 + 2 3 3 2 = **4 4 6 4**
Sufficient resources for **A** and **C**, the deadlock is resolved.

3.

a) Memory requests in order 50KB, 110KB, 200KB, 10KB, 60KB and 100KB. (10 marks)

64	16	16	32	128	256	64	64	128	256
50	10			110	200	60		100	

b) Release the allocation to 10KB. (1 mark)

64	64	128	256	64	64	128	256
50		110	200	60		100	

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4. Apply the **Clock** replacement policy. (10 marks)
   Answer:

1	**2**	**6**	**7**	**2**	**4**	**5**	**7**	**4**	**6**	**5**	**2**	**1**
1’	1’	>1’	7’	7’	>7’	7	7’	7’	>7	>7	2’	2
>-	2’	2’	>2	>2’	2	5’	5’	5’	5	5’	>5’	1’
-	>-	6’	6	6	4’	>4’	>4’	>4’	6’	6’	6’	>6
F	F	F	F		F	F			F		F	F
			<---------- 1 mark per column ---------->									

5. Calculate the size of root page table in two-level scheme. Show all your calculations. (4 marks)
   Answer
   User page table size = 16GB / 8KB * 4 bytes = 8MB
   Root page table size = 8MB / 8KB * 4 bytes = 4KB

6. **Explain the process** of translating the virtual address **0000000100000110** to its corresponding real address. (8 marks)
   Answer
   Extract the segment number (1) and offset (6) from the virtual address.
   Get the starting address (N) and the length (Y) of the segment from segment table.
   If the offset is greater or equal to Y, the address is invalid.
   For valid address, real address is the combination of N and offset.

7.
   a) What is the term that refers to the wastage in dynamic partitioning? (1 mark)
      Answer: External fragmentation

   b) Explain how does this wastage happen in **1 or 2 sentences**. (3 marks)
      Answer
      After a series of swapping and reallocation, a large number of small unused partitions will be created.

8. Differentiate **direct** and **indirect** deadlock prevention. (2 marks)
   Answer
   Direct prevention prevents the occurrence of **circular wait**; whereas **indirect** prevention prevents the occurrence of **mutual exclusion, no-preemption or hold and wait conditions**.

9. Explain the importance of allocating adequate number of page frames to processes in **3 to 4 sentences**. (6 marks)
   Answer
   Smaller number of page frames allocated will lead to thrashing problem that decreases the system performance.
   Process swapping is required frequently if too many page frames are allocated.
   Thus, adequate number of page frames should be able to maintain the system performance with acceptable level of page fault rate.