資訊網路與多媒體研究所

資格考試科目：高等作業系統

96. 10. 5

Instructions: There are **five** questions each of which counts 20 points. Each question may have several sub-questions. Please read the questions carefully before answering the questions.

1. (20 pts) There are two general approaches to deal with deadlocks. Please answer the following questions.
   A. One general approach is called deadlock prevention, which prevents deadlock from occurring. What is the other general approach to deal with deadlocks?
   B. Please define starvation and give an example.
   C. How do you ensure that starvation will not occur when dealing with deadlocks.
   D. Bob designed a resource synchronization protocol. In his protocol, each program has a unique program ID and each resource also has a unique resource ID which is the greatest program ID among that for the programs may request the same resource. Bob's protocol is the following: A process can lock a resource if and only if its program ID is ***greater*** than the resource ID of other resources already locked by other processes. Bob claims that his protocol can avoid deadlock. Is Bob correct? If yes, please prove that there is no deadlock. If no, please use a counter example to prove that Bob's protocol cannot avoid deadlock.

2. (20 pts) Disk I/O has been a critical overhead in the operating systems. FCFS Scheduling, SSTF Scheduling, SCAN scheduling C-SCAN scheduling, and LOOK scheduling algorithms are five common disk-scheduling algorithms. Please answer the following questions.
   a. (10 points) In time-sharing systems, fairness is an important metric. Which of the above algorithms are not fair? Please explain your answer.
   a. (10 points) Under different system workload patterns, we may have to choose different disk scheduling algorithms. Please choose a best scheduling algorithm for the following two workload patterns.
      i. Lightly loaded system that has occasional burst of disk IO accesses.
      ii. Heavily loaded system which rarely has an empty disk IO request queue.

3. (20 pts) In distributed systems, it is very often that a coordinator is needed to synchronize the work among the processes in the systems. Election algorithms such as bully and ring-based algorithms are designed to determine which process is the coordinator process. Assume that there are *n* processes in the system and each

process has a unique label. Please answer the following questions:

A. (10 pts) In the conventional ring-based election algorithm, a unidirectional ring is used. What is the number of messages needed in worst case and in average to elect a new coordinator when only the coordinator process fails?

B. (10 pts) In order to reduce the size of sent messages, Bob decides to include only the largest process ID in the message, rather than all the IDs for the processes receiving election messages. Can Bob's algorithm still work? Please explain your answer.

4. Context switches for processes can be classified as voluntary or involuntary. Voluntary context switches for a process means that a process voluntarily gives up its CPU execution. One example for voluntary context switches is that a process makes a blocking system call. Please provide two different examples for voluntary context switches and two different examples for involuntary context switches (20pts).

5. (20 pts Shared Memory) When the multi-core processors are used in a system and the physical memory are shared all the cores, the operating system has to assure that the data are consistent all the time. One general approach is to organize all the memory in memory pages and lock the memory page when used. However, one drawback for this approach is *false sharing*. Please answer the following questions.

   A. Please define false sharing for shared memory.

   B. Please describe the condition that false sharing may occur more frequently.

   C. How can we avoid the false sharing?