CSc33200: Operating Systems, CS-CCNY, Fall 2003

Midterm Exam

October 22, 2003

NAME: ....

ID: ....

NOTE:

- This midterm exam is due on **11/10/2003** before the class on the day is dismissed.
- It is a take-home exam and hence you may refer to any book or materials; however no discussion is allowed.
- Write your answer only within the given space using a readable text with normal size font. Note that the spaces given do not necessarily reflect how difficult the problems are.
- Don't guess! You get 20% of the value if you leave the answer blank. You get no points for a wrong answer.

Problem	Part	Maximum Points	Your Points
1	-	10	
2	-	15	
3	a	20	
	b	20	
4	a	10	
	b	25	
5	a	15	
	b	15	
	c	35	
6	-	35	
Total		200	

Good Luck!

1. The Pumpkin Computer uses a segmented addressing scheme in which individual bytes are accessed by combining a 16-bit segment paragraph and a 16-bit relative offset. SR is 16-bit register that points to the beginning of a 16-byte paragraph that is evenly divisible by 16. The segment paragraph is treated as if it were shifted left by four bits. SI is a 16-bit segment index register that contains a relative offset from the segment paragraph specified in SR. What will be the actual memory address accessed if the contents of SR are 1234H and the contents of SI are 4392H?

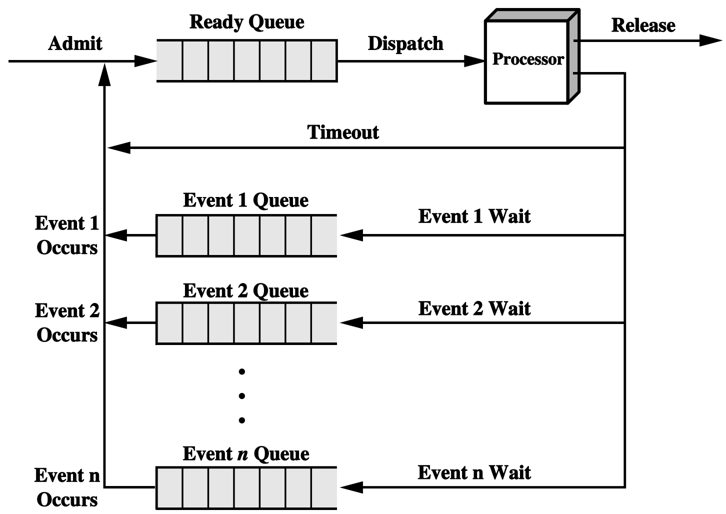
2. As a deadlock prevention strategy, the *hold-and-wait* condition may be prevented. If you are allowed to use semaphores, how would you use this strategy to regulate the requests for resources so that deadlock is prevented? Give a skeleton of the program in the same style as the first example regarding the two processes, P and Q, on 10/22's notes.

3. Prove the correctness of Dekker's algorithm in the following aspects:

(a) Prove that mutual exclusion is enforced.

(b) Prove that a process requiring access to its critical section will not be delayed indefinitely. That is to show there is no starvation.

4. The following figure illustrates that a process may be blocked and placed into the corresponding event queue due to waiting for an event of a specific type, but it suggests that a process can only be in one event queue at a time.



(a) Is it possible that you would want to allow a process to wait on more than one event at the same time? Provide an example.

(b) In that case, how would you modify the queuing structure of the figure to support this new feature? Give the definition of the structures in C/C++ and illustrate it in a picture.

5. Do the followings regarding message passing.

   (a) Describe how mutual exclusion and synchronization are supported with message passing.

   (b) Give the solution to the producer/consumer problem with an infinite buffer using message passing.

(c) Give a fair solution to the barbershop problem using message passing in a different way from the solution given in the textbook. (*Hint: You may assign a unique number to each barber chair instead of each customer.*)

6. Use semaphores to solve the following problem:

> You have been hired by Greenpeace Organization to help the environment. Because unscrupulous commercial interests have dangerously lowered the whale population, whales are having synchronization problems in finding a mate. The trick is that in order to have children, `three` whales are needed, one male, one female, and one to play matchmaker – literally, to push the other two whales together (I'm not making this up!). Your job is to write the three procedures `Male()`, `Female()`, and `Matchmaker()`. Each whale is represented by a separate process. A male whale calls `Male()`, which waits until there is a waiting female and matchmaker; similarly, a female whale must wait until a male whale and a matchmaker are present. Once all three are present, all three return.