Name:

CIS 586 Midterm
March 6th, 2008

Answer all questions in the space provided. You may write on the back if you need more room. Closed book, closed notes, closed neighbor. Please write your name on each page.

Question 1	/10 pts
Question 2	/5 pts
Question 3	/10 pts
Question 4	/15 pts
Question 5	/15 pts
Question 6	/15 pts
Question 7	/20 pts
Question 8	/10 pts
Total	/ pts

Question 1) a) (5) Why are modern systems split into user mode and kernel mode?

b) (5) What do system calls, exceptions and interrupts have in common?

Question 2) (5) Explain what happens in a context switch and what language requirements a context switch has.

Question 3) (10) What are the main differences between user level threads and kernel level threads?

Question 4) (15) The below code synchronizes cars passing over a bridge. The bridge is only wide enough for one-way traffic, and can only support 5 cars a time. While traffic is passing from one-side the traffic on the other side has to wait.

```
Semaphore mutex = new Semaphore(1);
Semaphore load = new Semaphore(5);
Semaphore bridge = new Semaphore(1);
Integer east_count = 0;
Integer west_count = 0;
```

Car East thread

```
mutex.P();
east_count = east_count +1;
if east_count == 1 then
  bridge.P();
end if
mutex.V();
load.P();
bathroom code
load.V();
mutex.P();
east_count = east_count -1;
if east_count == 0 then
  bridge.V();
end if
mutex.V();
```

Car West thread

```
mutex.P();
west_count = west_count +1;
if west_count == 1 then
  bridge.P();
end if
mutex.V();
load.P();
bathroom code
load.V();
mutex.P();
west_count = west_count -1;
if west_count == 0 then
  bridge.V();
end if
```

Are there any synchronization issues with this code? Does it successfully synchronize cars as described above? (We are not asking for any improvements, simply point out any errors.)

(intentionally blank)

Question 5) (10) What purpose do condition variables play in monitors, and why do monitors not need any mutexes?

Question 6) (15) Explain how a lottery scheduler chooses the next process to run? Are lottery schedulers good for real-time systems?

Question 7) **(Read the entire question before answering)**
(20) There are 5 processes and 5 resources, resources are currently allocated according to:

$$C = \begin{pmatrix} 2 & 1 & 1 & 1 & 2 \\ 0 & 0 & 3 & 0 & 0 \\ 0 & 2 & 1 & 0 & 1 \\ 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 1 & 0 \end{pmatrix}$$

$$E =< 4, 5, 5, 4, 3 >$$

$$A =< 0, 1, 0, 2, 0 >$$

The resources each process still need to finish is given by:

$$R = \begin{pmatrix} 2 & 2 & 3 & 0 & 1 \\ 1 & 1 & 0 & 2 & 0 \\ 2 & 0 & 3 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \\ 1 & 1 & 2 & 2 & 0 \end{pmatrix}$$

(a) (15) Use the Banker's algorithm to see if a deadlock recovery mechanism would raise a flag here.

(b) (5) What could the deadlock recovery mechanism do to recover from a deadlock if it is here?

Question 8) (10) Explain two of the four different methods for preventing deadlocks by attacking the four conditions necessary for deadlock (mutual exclusion, hold and wait, no pre-emption, circular dependency) ?