You have until the end of class for this exam. The exam is closed book. All answers should be written on the exam paper. Anything that we can’t read or understand won’t get credit. Any question for which you give no answer at all will receive 25% partial credit. Please answer in standard English; illiterate or illegible answers to essay questions will lose credit. Please watch the front board for corrections and other informations. This exam has 6 questions on 7 pages and is in two parts.

Problem #1
The state of a system is as shown. (There are 3 processes, A, B and C. There are two resources.)

<table>
<thead>
<tr>
<th>process</th>
<th>Allocated</th>
<th>Max_need</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>B</td>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>C</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>available:</td>
<td>15</td>
<td>30</td>
</tr>
</tbody>
</table>

Determine if this system is in a safe state. Show your work (12)

Problem #2
Assume that the arrival times and run times of jobs are as follows:

<table>
<thead>
<tr>
<th>job</th>
<th>arrival-time</th>
<th>run-time</th>
</tr>
</thead>
</table>


Problem #2

Suppose C is augmented with P,V, and Conditional-P. Conditional P tries to decrement the semaphore, if it is not legal (i.e. Sem = 0), then it returns FALSE, if it is legal, it does it and returns TRUE.

a) What is useful about Conditional-P? (6)

b) Can it be used to avoid deadlocks in all cases? (Why/Why not, be careful to state your assumption). (6)

Problem #4

Assume a Coca-Cola machine exists. Assume there are many people who drink Coca-Cola and many people who stock the machine with Coca-Cola (21).

Write functions for the 'Stockers' and the 'Drinkers', using P() and V().

Properly synchronize your code so that only *one* stocker or drinker can have access to the coke machine at
a given time.

Correctness constraints:
1) Drinkers can only drink if there is a coke in the machine.
2) Stockers only stock the machine when it is completely empty.

Assume there are NUMCOKE number of coke slots in the machine.

Semaphore mutex = 1; Semaphore emptySem = 0; Semaphore fullSem = NUMCOKES;

Problem #5
Under what circumstances is FIFO a better scheduling algorithm than SET? Explain (10).

Problem #6
The following "solutions" to the deadlock problem were described in class. Explain the disadvantages to each (15):

a. deadlock detection and recovery

b. make all processes obtain their resources in the same order

c. banker's algorithm