Operating Systems - Week 5 Tutorial

(These questions are based on weeks 3 and 4 lectures.)

Q 1 Suppose 3 processes A, B, C require 3 resources R, S, T and they are requested in the following order:

1. A requests R
2. B requests S
3. C requests T
4. A requests S
5. B requests T
6. C requests R.

Model this with 2 directed graphs - lecture notes Show 1 to 3 on the first graph and 1 to 6 on the next. The second graph indicates a deadlock cycle!

Could this be avoided by adapting a different ordering after 1? (Hint: try linking C to T next!)

Q 2. Look at the bankers algorithm (notes). Suppose process D asks for one more unit - does this lead to a safe state or an unsafe state? What happens if the request comes from C instead of D?

Q 3. [From Tanenbaum] A University Hall of Residence has only one bathroom. Since the Hall is mixed, the following rules apply to bathroom use by different sexes. If a woman is in the bathroom, other women may enter, but no men (and vice-versa). A sign with a sliding marker on the door of the bathroom indicates which of three possible states it is in.

- Empty
- Women Present
- Men present.

In pseudo-code, write the following procedures: \texttt{woman\_wants\_to\_enter}, \texttt{man\_wants\_to\_enter}, \texttt{woman\_leaves}, \texttt{man\_leaves}. You may use whatever counters and synchronisation techniques you like.

Q 4 [based on 2003 exam question] Two owners of a joint bank account (A and B) have equal access to the account. The following sequence of events results in them having an incorrect bank balance:

A withdraws £a, resulting in process A copying the current balance (in the DB record of the joint account) to variable \texttt{curr\_Acct\_A};
Process A reduces \texttt{curr\_Acct\_A} by \texttt{a};
B withdraws £b resulting in Process B copying the current balance in the DB record to variable \texttt{curr\_Acct\_B};
Process A copies \texttt{curr\_Acct\_A} to the DB record of the balance;
Process B reduces \texttt{curr\_Acct\_B} by \texttt{b};
Process B copies \texttt{curr\_Acct\_B} to the DB record of the balance;
Figure 1: Producer/Consumer Problem

(a) How could the mistake arise?
(b) Rewrite the sequence of events, producing a list of events for process A and a list of events for Process B, inserting semaphores in both lists, thus showing how semaphores could be used to prevent the miscalculation. Q 5

Consider the following snapshot of a system at T0, where A, B, C, D are resource classes, P0, P1, P2, P3, P4 are processes, and where ‘Available’ means ‘available at T0’:

<table>
<thead>
<tr>
<th>Allocation</th>
<th>Max</th>
<th>Available</th>
</tr>
</thead>
<tbody>
<tr>
<td>A B C D</td>
<td>A B C D</td>
<td>A B C D</td>
</tr>
<tr>
<td>P0</td>
<td>0 0 1 2</td>
<td>0 0 1 2</td>
</tr>
<tr>
<td>P1</td>
<td>1 0 0 0</td>
<td>1 7 5 0</td>
</tr>
<tr>
<td>P2</td>
<td>1 3 5 4</td>
<td>2 3 5 6</td>
</tr>
<tr>
<td>P3</td>
<td>0 6 3 2</td>
<td>0 6 5 2</td>
</tr>
<tr>
<td>P4</td>
<td>0 0 1 4</td>
<td>0 6 5 6</td>
</tr>
</tbody>
</table>

Answer the following questions using the bankers algorithm:
(a) What is the content of the needs matrix R ( = Max – Allocation)
(b) Is the system in a safe state?
(c) If a request from P1 arrives for (0,4,2,0) can it be granted immediately?

Q 6 Producer Consumer problem: Simulate the use of semaphores for one producer and one consumer with two people sitting across a table. A card with a 0 on one side and a 1 on the other can represent a semaphore. The diagram (Figure 1) can represent the buffer. NextIn and NextOut can be simulated by index fingers. You should find that no matter how the processes interleave their actions, they cannot be putting into and taking out of the same slot in the buffer at the same time.