

### Quiz Sheet #3

**Problem 3.1:** *scheduling*

(1+1 = 2 points)

Please mark whether the following two statements are true or false. Hint: read carefully.

- a) The period of time for which a process is allowed to run in a preemptive multitasking system is generally called the time slice.
- b) A multilevel feedback queue scheduler assigns processes to different queues based on their priorities. Processes can transition between queues when their priority is adjusted.

**Solution:**

- a) True
- b) True

**Problem 3.2: deadlocks**

(3+3+2 = 8 points)

$P$  is a set of processes and  $R$  is a set of resource types. The resource requests and resource assignments is defined by the set  $Q$ :

$$P = \{P_1, P_2, P_3\}$$

$$R = \{R_1, R_2, R_3\}$$

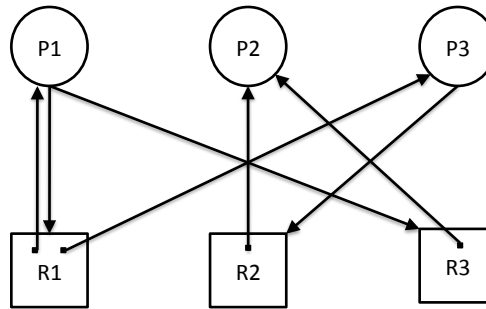
$$Q = \{P_1 \rightarrow R_1, P_1 \rightarrow R_3, P_3 \rightarrow R_2, R_1 \rightarrow P_1, R_1 \rightarrow P_3, R_3 \rightarrow P_2, R_2 \rightarrow P_2\}$$

Resource type  $R_1$  has two instances; resource types  $R_2$  and  $R_3$  have one instance each.

- Draw a resource allocation graph using the above information.
- Write down the resource allocation and resource request matrices.
- Is the system in a deadlock state? Which processes are deadlocked and which are not? Explain.

**Solution:**

- The resource allocation graph:



- Allocation and request matrices:

$$Alloc = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 0 \end{pmatrix} \quad Request = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix}$$

- The resource allocation graph makes it clear that there exists the cycle,  $P_1 \rightarrow R_1 \rightarrow P_1$ . However, this cycle does not necessarily lead to a deadlock since  $P_1$  can receive the resource it requests:  $P_2$  has the resources  $(R_2, R_3)$  it needs in order to finish. Once the process  $P_2$  leaves the system, it releases the resources  $(R_2, R_3)$  and  $P_3$  can then finish as it acquires  $R_2$ . Similarly,  $P_1$  can acquire  $R_3$  and finish as well. As such, there exists no deadlock in the system.