Some of the answers to these questions can be found using the lecture slides, the recommended textbooks or other sources (question marked with *). Some questions may have more than one possible answer, or be more or less open for discussion. Note that no answers (solutions) will be given to these questions, but if help is needed the assistants will be available to answer questions. The concepts marked with yellow are important and should be fully understood.

Deadlocks

1. Which conditions need to hold for mutual exclusion? Provide *accurate* definitions.
2. Describe the four necessary conditions which need to hold simultaneously such that a deadlock can occur.
3. Which are the four classes of deadlock mitigation strategies? Can you give a definition or an example for each of them?
4. Resource allocation planning
   (a) Give an example for resource allocation graphs. Which vertex types exist and which relations between them?
   (b) Describe the following data structures used to model resource allocations in deadlock detection and avoidance schemes:
      i. Availability vector
      ii. (Maximum) request matrix
      iii. Current allocation matrix
      iv. (Current) need matrix
   (c) Let's assume there exist five processes P_0 through P_4 and the following set of data structures:

Process	**Allocation**			**Maximum**			**Available**		
	A	B	C	A	B	C			
P_0	0	1	0	7	5	3			
P_1	2	0	0	3	2	2	A	B	C
P_2	3	0	2	9	0	2	3	3	2
P_3	2	1	1	2	2	2			
P_4	0	0	2	4	3	3			

      i. Is the sequence P_3, P_4, P_2, P_0, P_1 satisfiable? Provide the need matrix and the development of the availability vector alongside your solution.
      ii. Is the sequence P_1, P_3, P_4, P_2, P_0 satisfiable? Provide the need matrix and the development of the availability vector alongside your solution.

iii. Is the modeled system state safe?