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Concepts and Algorithms of Optimization – Series 5

www.math.uni-magdeburg.de/institute/imo/teaching/wise19/cao/

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Exercise 1

In the shop floor of the *H2O Chemicals Corp.*, there are several tasks to be operated and scheduled for the next day. Each of these tasks has a duration of 1 hour and some of them cannot be operated simultaneously.
The tasks are: unloading (U) and loading a truck (L), storing test tubes (S), picking (I) and packing (A) orders, mixing pesticides (M), heating (H), cooling (C) and vaporization (V) of other chemicals.
Since there is only one loading dock, the processes unloading and loading cannot take place at the same time. The mixing machine is located next to the loading dock, so that it cannot be used while any process is operated there. Storing and picking tasks involve the same vehicle, so they can only be executed after another. There are two employees working in the storage and dispatching area, each of which can only do one task at a time. One employee is responsible for unloading and storing items, while the other employee is in charge of picking and loading processes. Furthermore, cooling and heating require the same workplace, so that these tasks cannot be done simultaneously. Vaporization is one of the most dangerous processes in the shop floor. Therefore, the loading dock and the mixing workplace are the only areas, which may be used during this process.

Considering the given restrictions, the shop floor manager is willing to know, what is the maximum number of tasks, which can be operated simultaneously.

Additionally, the CEO of the *H2O Chemicals Corp.* is highly interested in optimal workflow and minimum working time. What is the minimum amount of time needed to finish all the given tasks?

State the underlying graph-based problems regarding the questions of the shop floor manager and the CEO.

Please turn the page!

Exercise 2

Congratulations! Your company *SofTech Inc* has become one of the leading software engineering start-ups in Germany! You hired two new colleagues last month and you are going to move to a new office building with an amazing view over the city.
There are six employees working for you, namely Amy, Barry, Carl, Daniel, Emily and Freddy. The new building offers three offices with two workplaces each. As the manager, it is up to you to decide about the assignment of pairs of employees to the new offices. Almost all pairings of people are possible with two exceptions: the two girls do not like each other that much, so they should not share an office, and Barry, Carl and Freddy had a big argument during a project last month, so there should be no office sharing among these three.
Additionally, you have noticed that neighboring workplaces have an effect on the productivity of certain pairs of employees. You came up with the following productivity scoring:

least productive	0	Amy and Barry
	1	Amy and Freddy
	2	Daniel and Emily
	3	Barry and Daniel, Amy and Carl, Barry and Emily, Carl and Daniel, Daniel and Freddy
	4	Carl and Emily
most productive	5	Emily and Freddy, Amy and Daniel

Your goal is to find an assignment of pairs of employees to offices, which leads to the maximum total productivity.

(a) Give a graph-based problem formulation.

(b) Consider the feasible pairing: Amy and Barry, Carl and Daniel, Emily and Freddy. How is it possible to construct another feasible pairing from the given one? Among the pairings constructed this way, does there exist another one with higher total productivity?