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Concepts and Algorithms of Optimization – Series 4

www.math.uni-magdeburg.de/institute/imo/teaching/wise17/cao/

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Exercise 1

The department manager of a successful consultant agency has to decide about how to assign five available employees to five upcoming projects. The projects are characterized by the main aspects they cover. There are two projects focusing on credit issues, two projects mainly dealing with insurance matters and one composite project involving problems of both types.

Considering the personnel, there are two employees specialized on credits, whereby one of them can also manage composite projects. Similarly, there are two employees specialized on insurances of which one can also manage a composite project. The fifth employee is qualified to work on all types of projects.

The employees receive a project- and qualification-dependent salary. The credit specialists earns 400 € per project and the insurance specialists earn 500 € per project. The allround employee receives 800 € per project. If one of the specialists is assigned to the composite project, he or she will receive extra 200 €, whereby the allround employee will receive 300 € in addition in this case.

The department manager is willing to assign the employees to the projects so that the total costs of personnel are minimal.

(a) Give a graph-based representation of the situation and formulate the problem of the department manager.

(b) The assignment problem is extended by the facts that employees can work on different projects for certain amounts of their total working hours, projects require certain amounts of working time and can be assigned to more than one employee.

Each employee is available for 8 h per day and the given salary is paid per hour. The credit-related projects require 6 h and 4 h of working time and the insurance-related projects need 5 h and 3 h, respectively. For the composite project, there are 15 h of working time required.

To which theoretical problem formulation (defined on a network) does this extension of the assignment problem correspond? Give a graphical representation.

(c) Determine a linear programming formulation for the problem given in (b).

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

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?

(c) State a specific integer programming model for the given problem.

(d) Determine a general integer programming formulation for problems of this type.