

Métodos de Apoio à Decisão

Assignment 2: *Assignment problem*

João Pedro PEDROSO

DCC - FCUP, April 2025

In this assignment, questions will be based on the following statement. At the time of submission, during the practical classes from April 24 to May 2, there will be a set of questions in Codex, with the lab's computers configured as in previous classes. The AMPL textbook and the slides for this course will be available for reference.

Exercise 1

After completing your course, you and some of your colleagues decided to create a company called UBRbytes with the goal of bridging the gap between software companies and programmers. Your platform will advertise tasks that software companies want to complete in the next week, and programmers will advertise their availability to program the necessary components for these tasks. UBRbytes' mission is to assign programmers, based on their skills, to the skills required to complete each task. The margin between what software companies pay for completed tasks and what programmers charge will be your profit.

For example, you may have 3 programmers available, capable of programming C, Python, and web applications, as indicated in the following table, where 1 means compatible and "."/0 means incompatible.

	p1	p2	p3
c	1	.	1
py	1	1	.
web	1	1	1

Note that this table can be read as an AMPL data parameter by assigning a zero to ".", for example, if it is declared as:

```
param a {SKILLS, PROGRAMMERS} default 0;
```

Next week, each of them will be available for the following number of hours, at the following cost per hour:

	hours	cost/hour
p1	4	5
p2	10	5
p3	7	5

There are 5 tasks proposed by software companies for next week, at the following price:

t1	250
t2	150
t3	200
t4	100
t5	250

The number of hours required per programming skill are:

	c	py	web
t1	5	.	2
t2	.	3	.
t3	.	6	3
t4	3	3	3
t5	2	3	2

These tasks cannot be divided: a programmer can only be assigned to a task if they can complete all of its subtasks. For example, programmer p1 cannot use their 4 hours of C programming on task t1 because the task requires 5 hours of C programming plus 2 hours of web programming. They could, however, do task 2, which

only requires Python programming; in that case, they would have 1 hour left over, which could not be used on any other task because all of the other tasks require more than 1 hour.

The optimal solution in this case would be for p1 to do t2, p2 to do task t3 (they can program Python and web, and they have more than the 9 hours required available), and p3 to do task t1. Tasks t4, t5 are not covered. The optimal profit is 505 euros.

Exercício 1.1: Prepare a model, independent of the data (to make it easier to solve with different data), to solve this problem.

Exercise 2

To improve customer satisfaction, you have decided to track the ratings given by customers to each of the programmers. 5 is the best rating, 1 is the worst, 0 if there is no information available. For example, it could be:

	p1	p2	p3
c	5	.	5
py	5	3	.
web	1	5	1

Exercício 2.1: Solve the problem for the case where your company wants to maximize the rating of the programmers assigned to the tasks that will be completed, summed over all subtasks and all programmers. Consider the same constraints as in Exercise 1 and a constraint that imposes that the profit should not be less than that obtained in the optimal solution of Exercise 1.

Exercise 3

You have noticed that there is demand for tasks that require more programming hours than any one programmer can provide alone. Although ideally all tasks should be done by the same person, you can propose to some programmers to form a team next week and divide

Exercise 3.1: Solve the problem of maximizing profit in this situation.

Exercise 3.2: Solve the problem of minimizing the number of people on the team with the most elements (the largest team) subject to a profit at least as good as that determined in Exercise 3.1.

Note 1: You can use *glpsol* and/or the commercial software *AMPL* (<https://ampl.com>); a version licensed for this course is available at <https://www.dcc.fc.up.pt/~jpp/AMPL>.

Note 2: Please bring scratch paper; do not use any other materials or electronic devices during class.