

# Tutorial

## Discrete Optimization - Centrale Supélec

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Here is a collection of problems in integer and binary programming.

### 1 A young couple

A young couple, Alice et Benoît, constantly argue with respect to domestic chores (and they don't even have children yet!). In order to solve the problem, as good mathematicians, they try to find the most equitable way to share the chores. After a lot of research, they draw the following tableau:

	Groceries	Cooking	Dishwashing	Laundry
Alice	4.5h	7.8	3.6	2.9
Benoît	4.9h	7.2	4.3	3.1

They decide to each only take care of two tasks, which cannot be shared. In order to both minimize their working hours.

1. Formulate this problem as an IP.
2. Solve the LP relaxation
3. Solve the IP with Excel / OpenOffice
4. What if they had decided that they should have the most *equitable* workload irrespective of efficiency, how would you formulate and solve the problem ?

### 2 Processors

A processor manufacturer wants to reinvent their product line. To help with their product line decision, the following tableau is given:

	Product 1	Product 2	Product 3	Product 4
Starting costs	€50 000	€40 000	€70 000	€60 000
Revenue/unit	€70	€60	€90	€80

Denoting  $x_i$  is the production of  $i$ , we want to maximize the profit (i.e. revenues - costs), knowing that:

- At most two products can be fabricated.
- Product 3 or 4 require the production of one of product 1 or 2.
- There exist production limits, expressed thus:

$$\begin{array}{rclcl} 5x_1 & + & 3x_2 & + & 6x_3 & + & 4x_4 & \leq & 6000 & \text{or} \\ 4x_1 & + & 6x_2 & + & 3x_3 & + & 5x_4 & \leq & 6000 \end{array}$$

1. Model the problem as a mixed linear-integer program.
2. Solve the problem with a spreadsheet program

### 3 The textbooks

Company WSP sells textbooks. This company has two sale representatives to best cover a region split into zones. The number of students in each zone is given in figure 1:

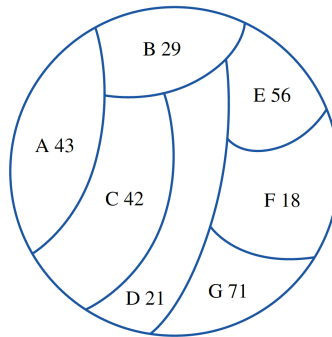


Figure 1: Régions

Each representative must be associated to two adjacent zones, for instance one rep can be affected to zones A and B but not A and D.

- a Propose a formulation allowing WSP to maximize the number of students reached by the two representatives.
- b Solve the problem with a spreadsheet program. Write the solution on your exam sheet and submit your spreadsheet on icampus like for the first question. You can use a single file for both questions.