B4M35KO, BE4M35KO
Practical Test lab no. 103 – Production planning with fixed costs

1 Test Assignment

Your task is to plan a production of $m = 11$ product types on $n = 10$ machines. Each machine is able to produce all the product types. The production of one piece of product type j on machine i costs $c_{i,j}$ dollars. Moreover there are the fixed costs F_i that must be payed if machine i is producing at least one product. The aim is to decide how many products of type j will be produced on machine i such that the overall costs are minimal and following constraints are satisfied:

a) The product of type j is produced at least p_j times

b) The number of produced products of type 6 must be a multiple of 5 (i.e., $0, 5, 10, 15, 20 \dots$)

c) The production of one product of type j on machine i consumes $t_{i,j}$ units of the machine capacity. The overall capacity of machine i is limited by T_i units.

d) The machine 1 and machine 3 are not allowed to be used together (if one of them produces at least one product of any type the second one is not allowed to produce anything)

The task is to implement an **Integer Linear Programming formulation in Gurobi Solver** of this problem and find an optimal solutions for the given set of test cases.

Your program will be called with two arguments: the first one is absolute path to input file and the second one is the absolute path to output file (the output file has to be created by your program).

1.1 Input File

The input file has the following form:

$$
\begin{array}{cccc}
F_1 & F_2 & \dots & F_{10} \\
T_1 & T_2 & \dots & T_{10} \\
p_1 & p_2 & \dots & p_{11} \\
c_{1,1} & c_{1,2} & \dots & c_{1,11} \\
\vdots & & \ddots & \vdots \\
c_{10,1} & c_{10,2} & \dots & c_{10,11} \\
t_{1,1} & t_{1,2} & \dots & t_{1,11} \\
\vdots & & \ddots & \vdots \\
t_{10,1} & t_{10,2} & \dots & t_{10,11}
\end{array}
$$

The first line of the input instance consists of vector of fixed costs F_i for each machine. The second line contains the vector of maximal machine capacity T_i. The requirements for minimal number of produced products p_j are in the third line. Lines 4 to 13 contains costs $c_{i,j}$. The rest of the input instance represents the matrix of machine-product capacity demands $t_{i,j}$. All the values are integers and space separated. The public instances can be found on the course page on CourseWare

1.2 Output File

The output file has the following form:

obj

$$\begin{matrix} x_{1,1} & x_{1,2} & \dots & x_{1,11} \\ \vdots & & \ddots & \vdots \\ x_{10,1} & x_{10,2} & \dots & x_{10,11} \end{matrix}$$

The first line of the output file contains the value of the criterion. The rest of the file contains the matrix X where $x_{i,j}$ represents the number of product of type j produced on machine i. In the case when there is no feasible solution the output file should consist of value -1 only. All the values must be integers and space separated.

Hint: Handle the resulting integer values carefully. Always round the value of integer variables!

2 Assignment Evaluation (max. 8 points)

Upload your code to the BRUTE (UploadSystem). If your program will be able to pass all the tests you will obtain full 8 points. Supported programming languages are C++, Java and Python (see `https://cw.fel.cvut.cz/wiki/courses/ko/start` for more details).