B4M35KO, BE4M35KO
Practical Test – Production Planning

1 Test Assignment

Your task is to plan a production of $m = 13$ product types on $n = 4$ machines. Each machine is able to produce all the product types. The production of one piece of product type j on machine i takes $p_{i,j}$ hours and costs $c_{i,j}$ dollars. The aim is to decide how many products of each type j will be produced on each machine i such that:

a) The total cost of the production cannot be larger than C.

b) Each product of type $j \in \{1, \ldots, m\}$ is produced at least t_j times;

c) Machine $i = 4$ produces each product type in batches of 6, i.e., the number of produced products for every $j = 1, \ldots, m$ must be from a set $\{0, 6, 12, 18, 24, 30, \ldots\}$.

d) Sum of the production costs on machines $i = 2$ and $i = 4$ cannot be larger than value $C_{2,4}$.

e) The total number of products produced on each machine $i \in \{1, \ldots, n\}$ is at most e_i.

f) We are interested in optimal schedule which minimizes the absolute difference of the total production time on machines $i = 1$ and $i = 4$.

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:

C
$C_{2,4}$
$e_1 \quad e_2 \quad \cdots \quad e_n$
$t_1 \quad t_2 \quad \cdots \quad t_m$
$c_{1,1} \quad c_{1,2} \quad \cdots \quad c_{1,m}$
$c_{2,1} \quad c_{2,2} \quad \cdots \quad c_{2,m}$
$\vdots$
$c_{n,1} \quad c_{n,2} \quad \cdots \quad c_{n,m}$
$p_{1,1} \quad p_{1,2} \quad \cdots \quad p_{1,m}$
$p_{2,1} \quad p_{2,2} \quad \cdots \quad p_{2,m}$
$\vdots$
$p_{n,1} \quad p_{n,2} \quad \cdots \quad p_{n,m}$

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
$x_{1,1}$ $x_{1,2}$ $\cdots$ $x_{1,m}$
$x_{2,1}$ $x_{2,2}$ $\cdots$ $x_{2,m}$
$\vdots$
$x_{n,1}$ $x_{n,2}$ $\cdots$ $x_{n,m}$

The first line of the output file contains the value of the objective function. 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. 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).