# MTL103 Programming Assignment

## Problem Statement

You are given an Integer Linear Programming problem of the form

$$\begin{aligned}
\max \quad & c^T x \\
\text{s.t.} \quad & Ax \leq b \\
& x \geq 0 \\
& x_i \in Z \ \forall \, i \in [n]
\end{aligned}$$

Here $x$ is $n$ dimensional, $A$ is a $m \times n$ matrix, $c$ is $n$ dimensional, $b$ is $m$ dimensional. All entries of $A, b, c$ are integers.

Implement the Gomory cutting plane technique to solve the ILP and output the optimal solution.

## Constraints

$$\begin{aligned}
n &\leq 18 \\
m &\leq 18 \\
-1000 \leq a_{i,j} &\leq 1000 \\
-1000 \leq b_i &\leq 1000 \\
-1000 \leq c_j &\leq 1000 \\
a_{i,j}, b_i, c_j &\in \mathbf{Z}
\end{aligned}$$

## Input format

The first line of input contains two space separated integers $n$ and $m$ - The dimensions of $c$ and $b$ respectively.
Second line has $m$ space separated integers - $b_1, b_2, ..., b_m$
Third line has $n$ space separated integers - $c_1, c_2, ..., c_n$
The $i^{th}$ line of the next $m$ lines contains $n$ space separated integers $a_{i,1}, a_{i,2}, ..., a_{i,n}$

## Output format

Output the answer as an array of $n$ integers $x_1^*, x_2^*, ..., x_n^*$ - where $x^*$ is the solution to the given ILP.

## Submission Details

1. The deadline for submission of the assignment is **11:59 PM, 29th April, 2023**.

2. This assigment can be done in groups of at most 2.

3. You will need to code the assignment in Python. You need to create a file called `ilp.py` and create this function inside `ilp.py`

```
def gomory(string filename)
    # Take input from file "filename"
    return x # an array of n integers
```

4. `filename` is the file containing the input in the input format specified above. This function reads the input from the file and returns the answer (array of integers containing the optimal solution to the ILP).

5. Create a file `README.md` and list all team members' name and entry number here.

6. You can create other files and functions if needed. Make sure to put all necessary files inside a folder called `MTL103_Assignment`, zip it and submit in Gradescope.

7. One of the team members needs to submit the assignment. While submitting, make sure to include the other team member's name as part of the submission.