

# Linear and Integer Optimization

## Programming Exercise 1

### Inofficial English Translation

Implement the `SIMPLEX ALGORITHM` to solve linear programs of the form  $\max\{c^t x \mid Ax = b, x \geq 0\}$ . Your program is to decide whether the instance is infeasible or unbounded. If it is bounded and feasible, your program is to output an optimal solution and its value. In particular, you must determine a starting solution yourself. You can set the pivot rules as you wish.

The program must be written in C or C++. It is recommended to use C++. You may include parts of the C++ standard library if necessary. Other external libraries may not be used. The program must work correctly and compile without error messages. The code must work on a common Linux system. Also make sure that you provide your program with sufficient comments.

The program is to be started by a command line call and read a text file whose name is passed to the program as an argument. The input format for the LP looks like this:

- The first line contains the number  $m$  of rows and  $n$  of columns of  $A$ .
- The second line contains  $n$  floating point numbers specifying  $c$ .
- The third line contains  $m$  floating point numbers specifying  $b$ .
- The next  $m$  lines contain the rows of  $A$ . Each line contains the  $n$  floating point numbers in the respective row.
- Entries in the same line are separated by blanks.

Example: The linear program

$$\begin{aligned} & \max(-2, 0, 8) \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} \\ \begin{pmatrix} 3.5 & -2 & 5 \\ 0 & 1 & -4 \end{pmatrix} \begin{pmatrix} x_1 \\ x_2 \\ x_3 \end{pmatrix} &= \begin{pmatrix} 3 \\ 0 \end{pmatrix} \\ & x_1, x_2, x_3 \geq 0 \end{aligned}$$

will be encoded as follows:

```
2 3
-2.0 0.0 8.0
3.0 0.0
3.5 -2.0 5.0
0.0 1.0 -4.0
```

Instances can be found on the web page of the exercises

[http://www.or.uni-bonn.de/lectures/ss22/lgo\\_uebung\\_ss22.html](http://www.or.uni-bonn.de/lectures/ss22/lgo_uebung_ss22.html)

(20 points)

**Due date:** Thursday, June 2, before the lecture. The submission is done via e-mail to your tutor.