

# ÜBUNGEN ZU Numerische Verfahren der restringierten Optimierung

<http://www.math.uni-konstanz.de/numerik/personen/volkwein/teaching/>

**Submission: 26.11.2012, 9:45 o'clock**  
**Codes by E-Mail and Reports together with the Homework**

## Program 1

(6 Points)

Program the Predictor-Corrector Algorithm (Mehrotra, Algorithm 2.16) in MATLAB. Test your code on the linear programming problem

$$\min c^\top x, \quad \text{subject to } Ax = b, x \geq 0$$

and corresponding dual problem

$$\max b^\top \lambda, \quad \text{subject to } A^\top \lambda + \mu = c, \mu \geq 0$$

generated by choosing the matrix  $A \in \mathbb{R}^{m \times n}$  randomly ( $m < n$ ), and then setting  $x, c, \mu \in \mathbb{R}^n$  and  $b, \lambda \in \mathbb{R}^m$  as follows:

$$\begin{aligned} x_i &= \begin{cases} \text{random positive number} & i = 1, 2, \dots, m, \\ 0 & i = m + 1, m + 2, \dots, n, \end{cases} \\ \mu_i &= \begin{cases} \text{random positive number} & i = m + 1, m + 2, \dots, n, \\ 0 & i = 1, 2, \dots, m, \end{cases} \\ \lambda &= \text{random vector}, \\ c &= A^\top \lambda + \mu, \\ b &= Ax. \end{aligned}$$

Choose the starting point  $(x^0, \lambda^0, \mu^0)$  with the components of  $x^0$  and  $\mu^0$  set to large positive values.

Compare the computed numerical solution obtained by the algorithm with the exact solution used to generate the examples to verify the correctness of your code. Try different values for  $m, n$  and the tolerance  $\varepsilon$  (`tol`), for example  $n = 30, m = 20$  and `tol` =  $10^{-12}$ .

Use the provided template `mylinprog.m` as a guideline for the implementation of your algorithm. Check dimensions of input arguments and give corresponding error messages. Stop the algorithm if `maxiter` is reached and provide the user with a corresponding note. Additionally submit a script file to run the above generated example.

Listing 1: Template for the MATLAB routine mylinprog.m

```

1 function [x,lambda,mu] = mylinprog(c,A,b,tol,maxiter, ...
2                                     x0,lambda0,mu0)
3 %MYLINPROG Linear programming
4 % [x,lambda,mu] = MYLINPROG(c,A,b,tol,maxiter,x0,lambda0,mu0)
5 % attempts to solve the linear programming problem utilizing
6 % the predictor corrector algorithm (Mehrotra):
7 %
8 %          min c'*x      subject to      A*x = b, x >= 0
9 %
10 % Input : c ..... vector of dimension nx1
11 %         A ..... matrix of dimension mxn
12 %         b ..... vector of dimension mx1
13 %         tol ..... tolerance for the stopping criteria
14 %         maxiter ... maximum number of allowed iterations
15 %         x0 ..... initial guess for the solution x
16 %                  (dimension nx1)
17 %         lambda0 ... initial guess for the Lagrange
18 %                  multiplier lambda (dimension mx1)
19 %         mu0 ..... initial guess for the Lagrange
20 %                  multiplier mu (dimension nx1)
21 %
22 % Output: x ..... numerical solution for x
23 %         lambda .... numerical solution for Lagrange
24 %                  multiplier lambda
25 %         mu ..... numerical solution for Lagrange
26 %                  multiplier mu
27 %
28
29 % Authors : Vorname1 Nachname1, Vorname2 Nachname2
30 % Email   : my.1.email@address.com, my.2.email@address.com
31
32 % !!! Enter Code Here !!!

```