TRANSP-OR

Optimization and simulation
Spring 2015

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Project 2: Interior point methods

Objective:
The aim of this project is to implement the interior point methods (short-step, predictor-corrector and long-step) and compare them with the simplex method.

Requirements:
The student will implement algorithm 19.2,19.3 and 19.4 to the following problems (Klee & Minty, 1972):

a)

$$
\begin{aligned}
min & -\sum_{i=1}^{n} 2^{n-i} x_i \\
& x_1 \leq 5 \\
& 4x_1 + x_2 \leq 25 \\
& 8x_1 + 4x_2 + x_3 \leq 125 \\
& \quad . \\
& \quad . \\
& \quad . \\
& 2^n x_1 + 2^{n-1} x_2 + ... + 4x_{n-1} + x_n \leq 5^n \\
& x_1, x_2, ..., x_n \geq 0
\end{aligned}
$$

Use the starting point $(1, 1, ..., 1)^T$. The solution of this problem is $x^* = (0, 0, ..., 0, 5^n)^T$.
b)

$$
\begin{aligned}
min & -x_n \\
& \epsilon \leq x_1 \leq 1 \\
& \epsilon x_{i-1} \leq x_i \leq 1 - \epsilon x_{i-1} \quad \forall i = 2, .., n
\end{aligned}
$$

Use the starting point

$$
\begin{aligned}
x_1 &= \frac{1+\epsilon}{2} \\
x_i &= \frac{1}{2} \quad \forall i = 2, ..., n.
\end{aligned}
$$

with $0 \leq \epsilon \leq 0.5$ (we suggest $\epsilon = 0.4$). The value of the optimum is -1.

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The student will compare the performance of interior point methods to the simplex method for different values of n (e.g. 5,10,50). We suggest to test the following variants of algorithms:

Algorithm 19.2 $\theta = 0.1, 0.4, 0.8$.

Algorithm 19.3 $\theta_{pred} = 0.1, 0.5, 0.9$ and $\theta_{corr} = \theta_{pred}/2$.

Algorithm 19.4 $\gamma = 10^{-5}, 10^{-3}, 1$ and $\sigma = 0.1, 0.5, 0.9$.

Remark If the starting point doesn't belong to the neighborhood of a specific algorithm, apply some "centering" iterations ($\sigma = 1$) in order to get a point in the neighborhood.

Implementation

- Algorithms 19.2, 19.3, 19.4.

You do not need to implement the simplex method; use the Matlab function linprog with options '*LargeScale=off*' and '*Simplex=on*'.