

CAAM Assignment: primal-dual interior-point method

Assignment:

Write a Matlab function to implement the primal-dual interior-point method (as outlined in the lecture notes) for solving the following linear programming problem

$$\begin{aligned} \min \quad & c^T x \\ \text{s.t.} \quad & Ax = b \\ & x \geq 0 \end{aligned}$$

The header of the function should be as follows:

```
function [x,y,z,iter] = pdipm(A,b,c,tol)
```

where

```
% INPUT:
%           A = constraint coefficient matrix
%           b = constraint right-hand side vector
%           c = objective coefficient vector
%           tol = tolerance
% OUTPUT:
%           x = final primal solution
%           y = final dual solution
%           z = final dual slacks
%           iter = iteration counter
```

Procedure:

1. Retrieve all the M-files and MAT-files (Matlab data files) from the assignment webpage into a directory of yours.
2. Write your interior-point function according to the specification. You must print out the following information on every iteration: iteration count, relative primal and dual residual norms and the relative duality gap, respectively,

$$\frac{\|Ax - b\|}{1 + \|b\|}, \quad \frac{\|A^T y + z - c\|}{1 + \|c\|}, \quad \frac{|c^T x - b^T y|}{1 + |b^T y|}$$

in the format shown below

```

iter 0: [primal dual gap] = [7.60e+03 3.72e+01 1.37e+03]
iter 1: [primal dual gap] = [4.61e+03 5.17e+00 4.37e+02]
iter 2: [primal dual gap] = [2.49e+03 1.95e+00 2.17e+02]
      o
      o
      o
iter 13: [primal dual gap] = [2.16e-09 1.18e-14 6.06e-05]
iter 14: [primal dual gap] = [5.94e-10 5.06e-15 8.77e-06]
iter 15: [primal dual gap] = [1.27e-12 3.81e-15 8.85e-07]

```

3. The stopping criterion should be

$$\frac{\|Ax - b\|}{1 + \|b\|} + \frac{\|A^T y + z - c\|}{1 + \|c\|} + \frac{|c^T x - b^T y|}{1 + |b^T y|} \leq \text{tol}.$$

4. Test your function first on individual problems, say `afiro`. After a problem (i.e., A, b, c) is loaded in memory (by command `load afiro`), run the program `runip`, which will call your function to solve the problem.
5. After debugging is done, run `test1` and `test2`, save the output from the sessions.
6. Download and run the instructors code `Zpdipm.p`. Try to obtain comparable performance with your code.