Project 2 for "Convex Optimization"

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1 Algorithms for ℓ_1 minimization

Consider the ℓ_1-regularized problem

$$\min_x \quad \frac{1}{2}\|Ax-b\|_2^2+\mu\|x\|_1, \tag{1.1}$$

where $A \in \mathbb{R}^{m\times n}$, $b \in \mathbb{R}^m$ and $\mu > 0$ are given. Test matrices:

```
n = 1024;
m = 512;
A = randn(m,n);
u = sprandn(n,1,0.1);
b = A*u;
mu = 1e-3;
```

See `http://bicmr.pku.edu.cn/~wenzw/courses/Test_l1_regularized_problems.m`

1. Read section 5 in the paper
   Kazufumi Ito, and Karl Kunisch, A variational approach to sparsity optimization based on Lagrange multiplier theory, Inverse Problems 30 (2014),
   `http://iopscience.iop.org/article/10.1088/0266-5611/30/1/015001`.
   Write down and implement a primal-dual active set method for solving (1.1).

2. Requirement:

   (a) The interface of each method should be written in the following format

   ```
   [x, out] = method_name(x0, A, b, mu, opts);
   ```

   Here, x0 is a given input initial solution, A, b and mu are given data, opts is a struct which stores the options of the algorithm, out is a struct which saves all other output information.

   (b) Compare the efficiency (cpu time) and accuracy (checking optimality condition) to what your have implemented in Homework 5 in the format as
   `http://bicmr.pku.edu.cn/~wenzw/courses/Test_l1_regularized_problems.m`

(c) Pack all of your codes in one file named as ”proj2-name-ID.zip” and send it to both me and TA:
wendouble@gmail.com
pkuopt@163.com

(d) If you get significant help from others on one routine, write down the source of references at the beginning of this routine.