Project Proposal

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1 Objective

Our objective is to write code which implements James Renegar's framework for transforming convex conic optimization problems into simpler convex formulations to solve with subgradient methods. This framework could be useful for solving many problems more easily, but as of yet, it has not been implemented in any coding language.
We plan on incorporating the framework into Python. If time permits, we will possibly work on comparable implementations for Julia and/or Matlab. Python includes a package which implements subgradient methods, called Subgradient-PY. We hope to use this to solve the transformed problems. That way, in order to provide a useful result, we need only to write code to provide a transformed version of the problem understandable to Subgradient-PY.

2 Current Situation

Currently, convex conic optimization problems are solved with interior point methods. Interior point methods work fine for low-dimensional problems, but struggle with high-dimensional problems. This happens because their spacial complexities do not scale well with high dimensions.

3 Impact

While subgradient methods are not generally faster than interior point methods, they can be faster in the case of particularly high-dimensional problems. They also lend themselves to parellelism, which could be helpful when the infrastructure for parallel computing is available.
If we can use subgradient methods to solve convex conic problems, we have another tool in the toolbox. Not all convex conic problems would be better solved via our transformation. But some would, and just having the option would be useful.

4 Risks

Subgradient-PY was written as a final project for EE364B at Stanford, by Maurizio Calo and Jaehyun Park. The package has not been maintained since it was written in 2011. We hope that we can use this package to do the solving, after we have transformed the problem into a proper form. However, because of its age and lack of maintenance, we are unsure if the package will perform acceptably. If it does not, we will provide our own implementation of a subgradient method.

5 Checkpoints

We have five checkpoints for our progress.
1) We understand the theories behind subgradient methods, convex conic optimization, and Renegar's tranformation method
2) We have code which can recognize a convex conic optimization problem
3) We have code which can reliably transform convex conic optimization problems into the form specified by Renegar's framework
4) We have code which can return a solution for convex conic optimization problems
5) We have thoroughly tested the code, documented it, and provided examples.