MATH 319 Final Project

Project Description: You will work in a group of up to 2 individuals to research a topic in optimization or solve an applied problem using the tools we developed in this class. Here is what you should produce:

1. An 8-10 minute presentation that demonstrates a solid understanding of the topic. You should sate theoretical results (guarantees of convergence, etc.) and, where applicable, implement code and run computational experiments.
2. You may choose a theoretical slant or a computational slant.
3. If you choose a theoretical slant, you should submit a write-up (preferably latex), of a proof or derivation.
4. If you choose a computational slant, you should submit an `R` notebook of the code that you developed.

Potential Topics: You can choose to research a topic in optimization or solve an applied problem. You will meet with me to discuss your choice of topic. I have listed several suitable topics below:

1. **Efficient Global Optimization (EGO) Algorithm** - use statistical modeling tools to sparsely sample a black-box function and avoid local solutions.
2. **Nelder-Mead Algorithm** - an optimization algorithm that does not use derivatives, but uses simplices to choose search directions.
3. **Stochastic Gradient Algorithm** - popular algorithm for minimizing functions that are large sums.
4. **Automatic Differentiation** - a technique for approximating derivatives.
5. **Proximal Operator in Optimization** - a way to regularize non-differentiable functions.
6. **Robust Optimization** - when the constants in the optimization problem are not really constants.
7. **Multi-Objective Optimization** - how to minimize multiple objective functions at the same time, e.g., maximize your GPA and having fun.
8. **Dijkstra's Shortest Path Algorithm** - the basis of the Google Maps algorithm.
9. **Alternating Projections in Optimization** - reduce your optimization problem to finding the intersection of 2 sets, then do lots of projections.
10. **Network Flow Problems** - optimization problems on directed graphs.
11. **Ellipsoid Method for LP** - the polynomial time algorithm for linear programming.