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Term Project
Subgradient Methods Applied to LASSO Regression

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1 Team Members

This project will be completed as a solo endeavor, by myself, Kasey Tian.

2 Scope

This project will explore subgradient methods in convex optimization problems. Then these methods will be applied to a practical problem, training a LASSO linear regression model to predict life expectancy from various factors using World Health Organization (WHO) data.

2.1 Subgradient Methods

First, research will be done into the nature of subgradients and subgradient methods. This will involve a proof of convergent behavior. After the nature of the algorithm is understood I will implement subgradient methods in Python. Particularly, I would like to implement a number of different step size choosing methods as well as the basic algorithm. Subgradient methods will be drawn primarily from [1], along with supplementary sources [2], [3], and [4].

2.2 LASSO regression

In order to apply subgradient methods in a real world application, I will train a LASSO linear regression model, which is not fully differentiable. This makes it a suitable candidate for using subgradient methods as opposed to more common gradient descent methods. The LASSO method will be drawn primarily from [5], supplemented by [4].

2.3 Application

Linear regression is one of the primary applications of the LASSO method, so predicting life expectancy from other factors should be a task it is well suited for. I will be utilizing a data set from WHO [6] to train and test my resulting model.

References

[1] S. Boyd and J. Park, "Subgradient Methods", 2014, Available: `https://web.stanford.edu/class/ee364b/lectures/subgrad_method_notes.pdf`

[2] S. Boyd, L. Xiao, A. Mutapcic, "Subgradient Methods", 2003, Available: `https://web.mit.edu/6.976/www/notes/subgrad_method.pdf`

[3] W.-K. Ma, "Subgradient Methods", Available: `http://dsp.ee.cuhk.edu.hk/eleg5481/Lecture%20notes/14-%20subgradient/subgrad.pdf`

[4] M. Gormley, "Lecture 10: Subgradients / The Subgradient Method", 2023, Available: `https://www.cs.cmu.edu/~mgormley/courses/10425/slides/lecture10-subgrad.pdf`

[5] R. Tibshirani, "Regression Shrinkage and Selection via the Lasso", *Journal of the Royal Statistical Society*, vol. 59, iss. 1, pg. 267-288, 1996, Available: `doi.org/10.1111/j.2517-6161.1996.tb02080.x`

[6] KUMARRAJARASHI, "Life Expectancy (WHO)", Available: `https://www.kaggle.com/datasets/kumarajarshi/life-expectancy-who/data`