# Machine Learning - CS 7641 Assignment 2

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### Abstract

This paper first reviews three optimization problems using four different algorithms. The algorithms considered are Random Hill Climbing, Simulated Annealing, Genetic Algorithm and MIMIC. The Four Peaks problem highlights Genetic Algorithm, the K Colors problem highlights MIMIC and the Knapsack Problem highlights Simulated Annealing. The paper then reviews using Random Hill Climbing, Simulated Annealing, Genetic Algorithm for learning neural network weights for the MNIST image dataset and compares these results to using Back propagation.

## Introduction

The core library used in the experiments in this paper is mlrose [3]. This was developed by Georgia Tech students to support this class by providing a comprehensive tools set for reviewing randomized optimization. I used the mlrose-hiive [2] fork, which has had other students fix bugs and enhance functionality.

## Four Peaks

## Knapsack

## K Colors

## Neural Network Optimization

The data set is The MNIST Database of Handwritten Digits [2]. This consists of instances of 28 X 28 greyscale images of the digits 0-9. One transformation performed was that the values where scaled to 0 to 1, from 0 to 255. For all but the neural network algorithm, the images were flattened, creating 784 features, one for each pixel. There are 60,000 training instances and 10,000 test instances. I chose this because it is a good comparison to the first data set, with a very different type of data (images), which leads to significantly more features (784). In addition, each of the features can be thought of as related to each other, as they are all positional in a two dimensional grid, while the first data set features do not have any necessary relation between themselves ie: age is not related to sex.

Did use Pytorch, run. Switched over to mlrose

## References

1 The MNIST Database of Handwritten Digits. url: http://yann.lecun.com/exdb/mnist/.

2 Rollings, A. (2020). mlrose: Machine Learning, Randomized Optimization and SEarch package for Python, hiive extended remix. https://github.com/hiive/mlrose. Accessed: 2/11/2022

3 Hayes, G. (2019). mlrose: Machine Learning, Randomized Optimization and SEarch package for Python. https://github.com/gkhayes/mlrose. Accessed: 2/11/2022.