UNIVERSITY OF VICTORIA

Department of Electrical and Computer Engineering

ECE 403/503 Optimization for Machine Learning

LABORATORY REPORT

Experiment No: 03

Title: Predicting Energy Efficiency for Residential Buildings

Date of Experiment: 25 June, 2019

Report Submitted on: 2 July, 2019

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1 Introduction and Objectives

In this experiment, we investigate a technique for multi-category classification based on binary classifications. The technique is then applied to Fisher's 3-class datasets of Iris plants to demonstrate its effectiveness. The dataset of Iris plants to be used in this experiment was created and published in 1936 by R. A. Fisher [1]. Fisher's paper is a classic in the field and is referenced frequently to this day, as a matter of fact the dataset is arguably the best-known in the pattern recognition literature [2]. The dataset includes features of 150 Iris plants of 3 species known as Setosa, Versicolor, and Virginica, where each sample Iris is represented by a 4-dimensional vector in terms of lengths and widths of the sepal and petal of the flower.

2 Implementation Steps and Results

2.1 Implementation Steps

We strictly followed the implementation steps stated in the laboratory manual [3].

2.2 Code

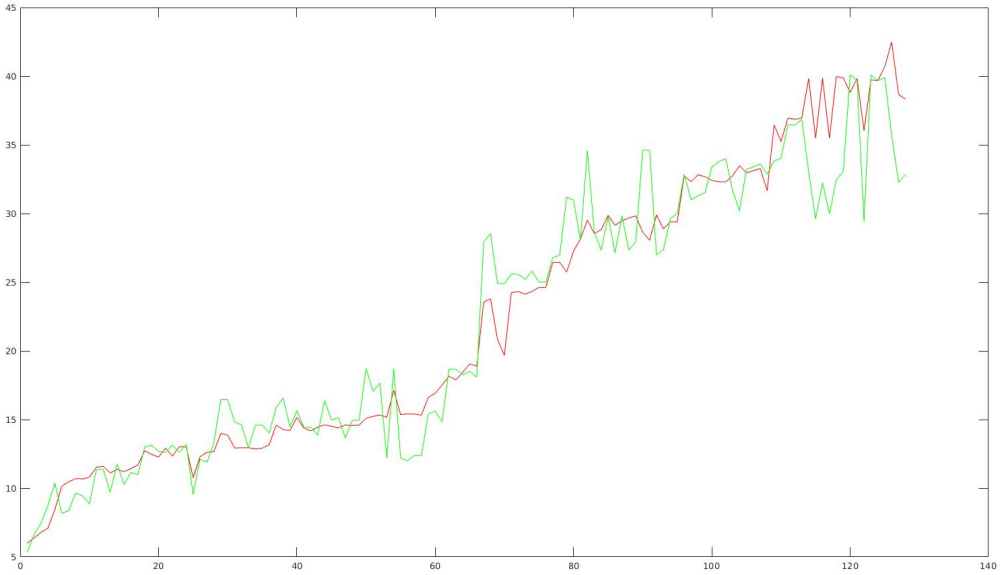
```
clc;
clear all;
close all;
D_tr = load('/home/alvi/Documents/courses/ece503/labs/3/data/D_build_tr.mat');
Xtr = D_tr.D_build_tr(1:8,:);
Ytr = D_tr.D_build_tr(9:10, :);
D_te = load('/home/alvi/Documents/courses/ece503/labs/3/data/D_build_te.mat');
Xte = D_te.D_build_te(1:8,:);
Yte = D_te.D_build_te(9:10, :);
Xtr = [Xtr' ones(640, 1)];
I = eye(9);
W_B = pinv(Xtr' * Xtr + 0.01 * I) * Xtr' * Ytr';
W = [W_B(1:8, 1) W_B(1:8, 2)];
b = W_B(9, :)';
e_p = double.empty();
Y = double.empty();
for i=1:128
y = W' * Xte(:, i) + b;
Y = [Y, y];
end
e_p = norm(Yte - Y, 'fro') / norm(Yte, 'fro');
disp(e_p);
I = 1:128;
plot(I, Yte(1, I), 'r', I, Y(1, I), 'g');
plot(I, Yte(2, I), 'r', I, Y(2, I), 'g');
```

2.3 Result

3 Discussion

4 Conclusion

From our analysis we can see that Linear Binary Classifier works really well for multi-category classification. Calculating the optimal parameters of linear function $f(x, w, b) = w^T x + b$ that best

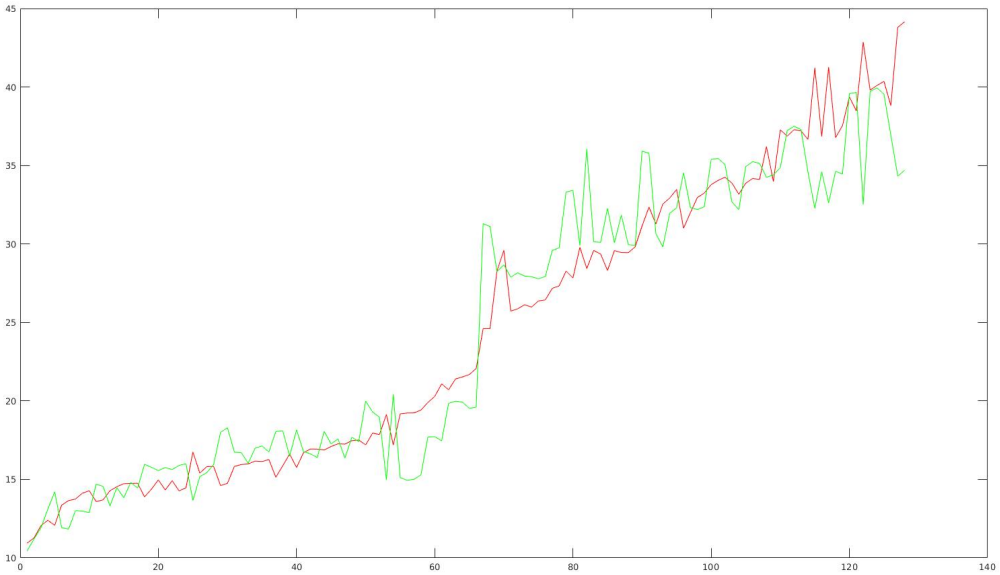


Figuur 1: First row of Yte and first row of $Y^{(p)}$

separate class P from class N using the solution of linear equation $\hat{X}^T\hat{X}\hat{w} = \hat{X}^T y$ really increase the speed of the calculation rather than using "for" loops. Although the result was very promising, the experiment was conducted in controlled dataset thus limiting our assumption of performance with variety of other datasets. The performance of other classification techniques such as SVN is also worth exploring.

5 References

[1] A. Tsanas and A. Xifara, Accurate quantitative estimation of energy performance of residential buildings using statistical machine learning tools, Energy and Buildings, vol. 49, pp. 560-567, 2012.
[2] UCI Machine Learning, http://archive.ics.uci.edu/ml, University of California Irvine, School of Information and Computer Science.
[3] LABORATORY MANUAL, ECE 403/503 - OPTIMIZATION for MACHINE LEARNING, Prepared by: Wu-Sheng Lu, Department of Electrical and Computer Engineering, University of Victoria.



Figuur 2: Second row of Yte and second row of $Y^{(p)}$