SACRAMENTO STATE
COLLEGE OF ENGINEERING & COMPUTER SCIENCE

CSC 219 - Machine Learning

Project Proposal:
A Detail Performance Analysis Comparison
between different techniques on
Fashion-MNIST and CIFAR-10 dataset

By
Khoi Hoang

Problem Statement:

There are many different technique and models to solve the problem of image classification. It is important for students to fully understand the principles behind each model and its performance based on the dataset. The purpose of this project is to gain a deeper understanding of different classification models, and how they perform on the Fashion-MNIST and CIFAR-10 dataset. I will implement the model with various activation functions and optimizers, as well as using ensemble learning to boost the performance of the models.

Background:

Image classification is one of the most fundamental problems in Machine Learning. It is the core foundation for bigger problems such as Computer Vision, Face Recognition System, or Self-driving car. The Fashion-MNIST and CIFAR-10 are one of the most well-known datasets used for image classification. These data sets are proven to performed well on Deep Neural Network, with the accuracy of over 95% [1]. However, I want to take a closer look of the performance of simpler models, such as SVM, Logistic Regression, Random Forest, etc, and see how different they perform compare to Deep Neural Network. Since these two datasets are grayscale images and color images, some models may perform better than the other. I will also compare the performance of these models, long with various boosting techniques and ensemble learning to Deep Neural Network model. The highlights of this project is gaining knowledge, data preprocessing and the use of appropriate models to apply on different data.

Dataset:

Fashion-MNIST is developed to be "direct drop-in replacement for the original MNIST dataset for benchmarking machine learning algorithms". The data is extracted at:
https://github.com/zalandoresearch/fashion-mnist

The CIFAR-10 dataset consists of 60,000 color images in 10 classes. This is one of the most widely-used data in image classification. The data is extracted at:
https://www.cs.toronto.edu/~kriz/cifar.html

Methodology:

The Fashion-MNIST data set is a collection of grayscale images, while the CIFAR-10 dataset consists of color images. Since this is a classification problem, I will implement the following classification models:

1. SVM
2. Random Forest
3. Decision Tree
4. Logistic Regression
5. KNN
6. Naive Bayes
7. Neural Network Model
8. Ensemble learning using pretrained model

Evaluation Metrics: the following metrics will be used to evaluate and compare the performance of the models:

- F-1 score
- Accuracy
- Precision
- Recall

Software and Tools:

I will use the following tools to implement this project:

- R (for data visualization and graph)
- Python
- Jupyter Notebook
- Sklearn
- Tensorflow

Progress Milestone:

By week 11, I will complete the Data Preprocessing and Visualization part. I also expect to have the performance results of 3 or 4 models in the proposed methods.

References:

[1] Benjamin Graham, "Fractional Max-Pooling," 2015

[2] A. Krizhevsky and G. Hinton, "Learning multiple layers of features from tiny images," Technical report, University of Toronto, 2009.

[3] Han Xiao, Kashif Rasul, and Roland Vollgraf, "Fashion-MNIST: a Novel Image Dataset for Benchmarking Machine Learning Algorithms," 2017

[4] F. Agostinelli, M. Hoffman, P. Sadowski and P. Baldi, "Learning Activation Functions to Improve Deep Neural Networks," 2015