Financial Machine Learning

Homework 8

Due at 07:00 pm (Korea Standard Time) on Sunday, November 6.

Submit one file: written solutions with executable Python code

Problem 1. Text book: Hands-on Machine Learning. Submit .ipynb file.

(a) Practice all the codes in the Text book Chapter 11. And show that they work well.

(b) Practice training a deep neural network on the CIFAR10 image dataset:

a. Build a DNN with 20 hidden layers of 100 neurons each (that's too many, but it's the point of this exercise). Use He initialization and the ELU activation function.

b. Using Nadam optimization and early stopping, train the network on the CIFAR10 dataset. You can load it with *keras.datasets.cifar10.load_ data()*. The dataset is composed of 60,000 32×32–pixel color images (50,000 for training, 10,000 for testing) with 10 classes, so you'll need a softmax output layer with 10 neurons. Remember to search for the right learning rate each time you change the model's architecture or hyperparameters.

c. Now try adding Batch Normalization and compare the learning curves: Is it converging faster than before? Does it produce a better model? How does it affect training speed?

d. Try replacing Batch Normalization with SELU, and make the necessary adjustments to ensure the network self-normalizes (i.e., standardize the input features, use LeCun normal initialization, make sure the DNN contains only a sequence of dense layers, etc.).

e. Try regularizing the model with alpha dropout. Then, without retraining your model, see if you can achieve better accuracy using MC Dropout.

f. Retrain your model using 1cycle scheduling and see if it improves training speed and model accuracy.

(c) Bias-variance Decomposition is known as theoretical base of regularization and ensemble method. Review and Proof Bias-variance Decomposition.

https://towardsdatascience.com/the-bias-variance-tradeoff-8818f41e39e9

Problem 2. Black Friday Sales EDA: Create a model that predicts purchasing power using artificial neural networks. And visualize them.

A retail company "ABC Private Limited" wants to understand the customer purchase behaviour (specifically, purchase amount) against various products of different categories. They have shared purchase summaries of various customers for selected high-volume products from last month.
The data set also contains customer demographics (age, gender, marital status, city type, stay in the current city), product details (productid and product category) and Total purchase amount from last month.

Now, they want to build a model to predict the purchase amount of customers against various products which will help them to create a personalized offer for customers against different products.

Tasks to perform

The purchase column is the Target Variable, perform Univariate Analysis and Bivariate Analysis w.r.t the Purchase.

Masked in the column description means already converted from categorical value to numerical column.

Below mentioned points are just given to get you started with the dataset, not mandatory to follow the same sequence.

Problem 3. Review under paper.

Dropout: A Simple Way to Prevent Neural Networks from Overfitting

https://www.cs.toronto.edu/~rsalakhu/papers/srivastava14a.pdf