Assignment#1

Multi-Layer Perceptron

1-Home value prediction using MLP network: A regression problem

 A. Download the housing data set from the link below and import it into the program environment using <u>pandas</u> library
https://archive.ics.uci.edu/ml/machine-learning-databases/housing/

 B. Separate the last column of data as the target.

 C. Consider 80% of the data as training and 20% as testing.

 D. Normalize the data so that the mean of the features is set to zero and the standard deviation is set to one. (You should obtain the mean and standard deviation on the training data and obtain the normalized training and normalized test data based on the mean and standard deviation calculated on the training data.).

 E. Design an MLP network with three hidden layers and the number of neurons are 256, 64 and 16 respectively. In the output layer, consider the number of neurons as 1 without activation function. Consider loss function as MSE and metric as MAE. Consider a <u>Design model</u> function that performs network architecture and compilation. (Write a function that performs the architecture and then the compilation of the network.)

 F. Because you have so few data points, the best practice is to use K-fold cross-validation. In this example, use 5-fold cross validation and report the MAE values of validation data in 5 folds.(You can use KFold from sklearn.model_selection library)

 G. Finally, evaluate the loss and metric of test data.

2-Breast cancer prediction using MLP network: A classification problem

 A. Download the Breast Cancer data set from the link below and import it into the program environment using <u>pandas</u> library.
https://drive.google.com/file/d/1M5-pLxF7IFWzcjmB0amhVXA7EPnF2R6D/view?usp=share_link

 B. Delete the first column that specifies the patients ID.

 C. Separate the last column of data as the target and change their values to 1 and 0.

 D. Import the train_test_split function From the sklearn.model_selection library and consider 0.33 of the dataset as test data.

 E. Repeat step D of part 1 (Normalize the data).

 F. Design an MLP neural network with four hidden layers with the number of 256 neurons in the first layer and 64 neurons in the second layer and 16 neurons in the third layer and 16 neurons in the fourth layer. Use the ReLU activation function for all hidden layers. Train this network using the SGD optimizer with a learning rate of 0.008 and the Cross Entropy cost function and the number of epochs is 55. Use 0.33 of the

total data as the test data and consider the number of 200 data from the training data as the validation data set.

G. Display plots of loss and accuracy on training and validation data. Determine the best epoch for this problem.

H. In the next step, use the weight regularization of l1 with $\lambda=0.001$ and report results and plot.

I. In both parts 1 and 2, consider the batch size =1.

3- For which inputs the following functions lead to vanishing gradients?

(A) ReLU

(B) Tanh

(C) Leaky ReLU