Compulsory Assignment #3

Machine Learning and Deep Learning [KAN-CDSCO2004U]

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Deadline: {Refer Canvas Assignment for exact date and time}

Instructions

1. This compulsory assignment contains **three** questions. Answer all the questions.
2. You must upload your solutions before the deadline to the Canvas.
3. If your answers involve any math or report, please represent them using pdf format.
4. Use Python to answer the following questions whenever necessary. It is always a good practice to use comments extensively in your code so that it is easy for other people to understand it. The Python code to answer the questions must be submitted as one single *jupyter notebook*.

Question:01 - Fashion MNIST image classification using a custom model

In this question, you will use the Fashion MNIST dataset and build a custom model using custom training loops **(using a different optimizer with a different learning rate for the upper layers and the lower layers**) to tackle image classification in the Fashion MNIST dataset.

For example, you can use *Sequential model* [1] from *keras* to build your custom model. Please note that *Sequential model* is suitable for a simple stack of layers with the restriction that each layer can only support exactly one input tensor and one output tensor [1]. Alternatively, you can also use *Keras Functional API* [2], which allows you to create models that are more flexible than the models created using *Sequential model* [1]. Some hints are as follows:

1. Only use five epochs and 32 as batch size.
2. Only use softmax and ReLU activation functions.
3. Use SGD as the lower optimizer with the learning rate of 1e-4 and Nadam as upper optimizer with a learning rate as 1e-3.
4. Use *Nadam* optimizer [3] from Keras and also use *sparse categorical cross entropy* as a loss function.
5. Display the mean training loss and the mean accuracy over each epoch (updated at each iteration). Also display, validation loss, and accuracy at the end of each epoch.

Hint: The Fashion MNIST dataset is available in the Keras datasets and it can be loaded using below steps

Listing 1: Starting Code to upload MNIST data

```
import sys
import sklearn
import tensorflow as tf
from tensorflow import keras
import numpy as np
import os

#to make this notebook's output stable across runs
np.random.seed(42)
tf.random.set_seed(42)

(X_train_full, y_train_full), (X_test, y_test) = keras.datasets.fashion_mnist.load_data()
X_train_full = X_train_full.astype(np.float32) / 255.
X_valid, X_train = X_train_full[:5000], X_train_full[5000:]
y_valid, y_train = y_train_full[:5000], y_train_full[5000:]
X_test = X_test.astype(np.float32) / 255.
```

Question:02 - Fake news classification using bi-directional LSTM

Download two attached datasets (Fake.csv and True.csv), which contain real and fake news. In the given data set, there are a total of five columns. Now build a Bi-LSTM model to detect fake news using TensorFlow and other available libraries. Some hints are as follows:

1. You might preprocess both datasets.
2. You should also use Natural Language Toolkit (NLTK) library to handle "stopwords" in the dataset.
3. For a better model, remove stopwords and words with two or fewer characters and then split data into test and train sets.
4. You might also need to create a tokenizer to tokenize the words and sequences of tokenized words.
5. You can call Bi-Directional LSTM (from Keras library) and where fitting set Sigmoid and ReLU as activation function, Adam as an optimizer and Binary cross-entropy loss function should be used.
6. During training, set the batch size to 64 and the number of epochs to 2.
7. Finally, print the model accuracy. If the predicted value is greater than 0.5, then it is a piece of real news.

Question:03 - Convolutional Neural Network

The image **C** on the right was obtained by convolving image **I** on the left with a 2x2 kernel **H**. Fill in the four values of the kernel. You may want to briefly explain your reasoning if you are not sure of your answer.

Hint: If you are doing a lot of calculations, think again.

$$I = \begin{array}{|c|c|c|c|c|c|}\hline 1 & 0 & 5 & 0 & 2 & 0 \\ \hline 0 & 1 & 0 & 0 & 0 & 9 \\ \hline 0 & 7 & 0 & 3 & 0 & 0 \\ \hline 1 & 0 & 0 & 0 & 0 & 1 \\ \hline 2 & 0 & 2 & 0 & 6 & 0 \\ \hline \end{array} \qquad H = \begin{array}{|c|c|}\hline ? & ? \\ \hline ? & ? \\ \hline \end{array} \qquad C = \begin{array}{|c|c|c|c|c|}\hline 3 & 8 & 5 & 2 & 20 \\ \hline 15 & 22 & 6 & 9 & 9 \\ \hline 10 & 7 & 3 & 3 & 2 \\ \hline 7 & 4 & 6 & 12 & 19 \\ \hline \end{array}$$

References

[1] Keras, "The sequential model." https://keras.io/guides/sequential_model/.

[2] Keras, "The functional api." https://keras.io/guides/functional_api/.

[3] Keras, "Nadam optimizer." https://keras.io/api/optimizers/Nadam/.