Deep Learning laboratory Manual

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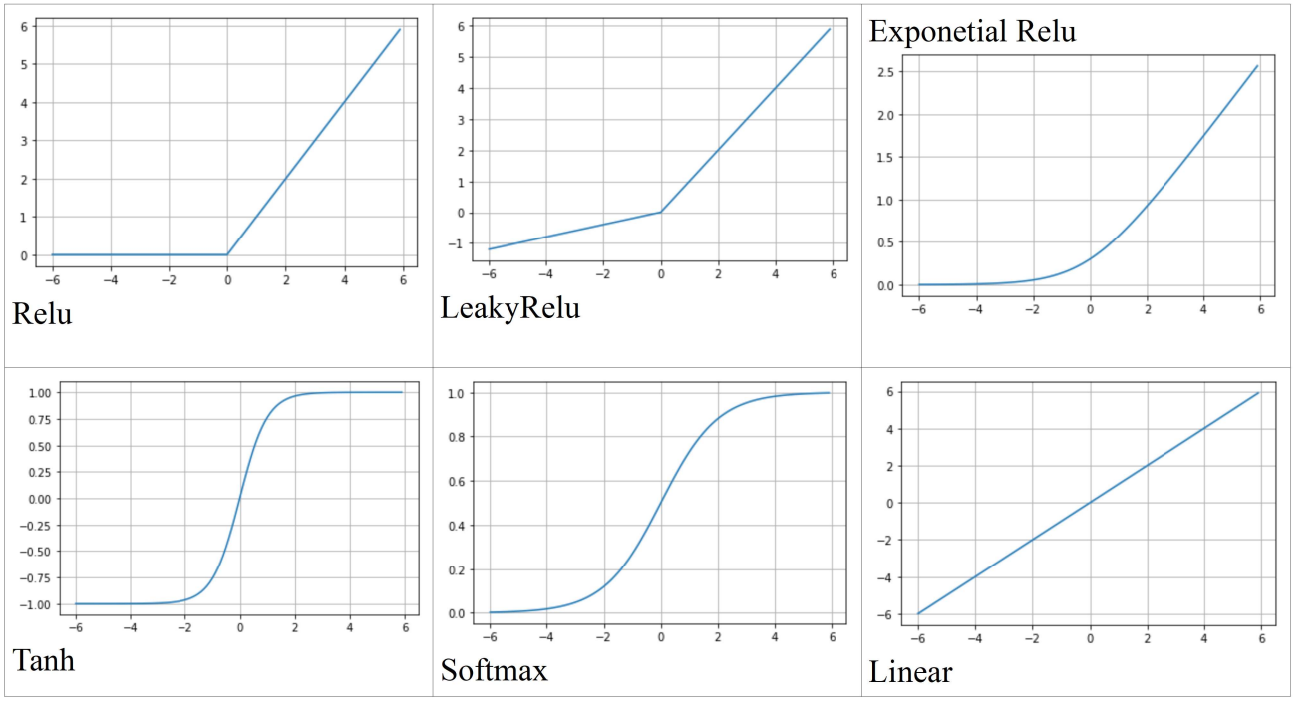
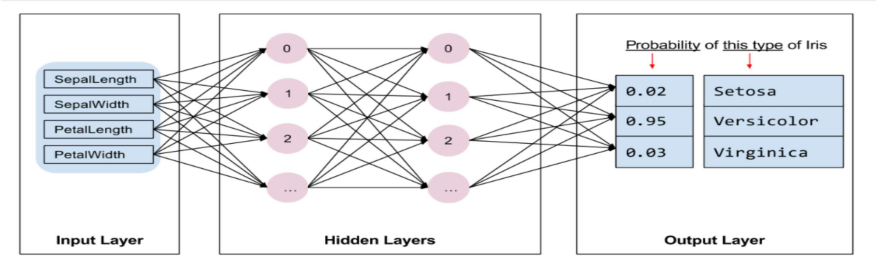
Steps for installation as Standalone Application:
Step-1: Install the Anaconda software.
Step2- In Anaconda, setup the environment for tensor flow and install the following packages: tensorflow, tensorflow-base, tensorflow-dataset, tensorflowboard, keras, numpy, pandas etc. All require software.
Step-3- Install any of the two GUI interface spider or jupiter.

Online through internet:
Step-1 We can directly run Google colab. For Google colab create the account and login.

Experiment 1: Simulation of Different Activation function



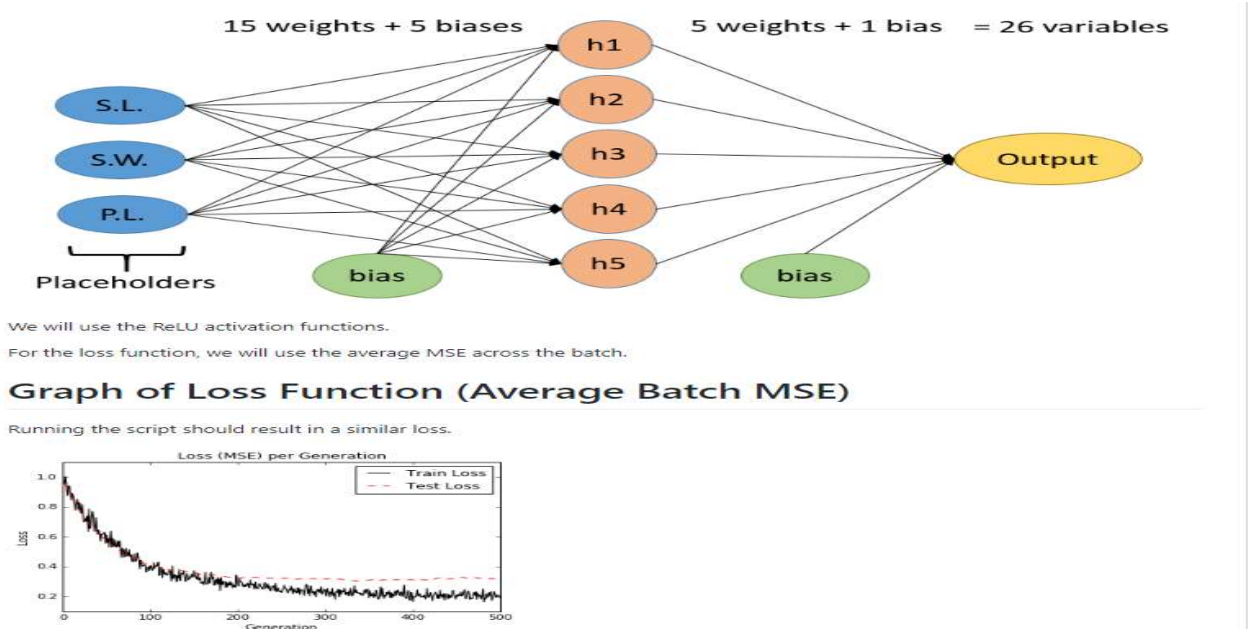
Experiment 2: Implement the Neural network for Fashion MNIST Data set.
Experiment 3: Design the Neural network for Iris dataset given below:



Experiment 4: Implementing a One Layer Neural Network for Iris dataset for given architecture:

We will use the Iris data for this exercise. We will build a one-hidden layer fully connected neural network to predict one of the flower attributes from the other three.

The four flower attributes are (1) sepal length, (2) sepal width, (3) pedal length, and (4) pedal width. We will use (1-3) to predict (4). The main purpose of this section is to illustrate how neural networks can implement regression just as easily as classification. Later on in this chapter, we will extend this model to have multiple hidden layers.



Experiment 5: CIFAR10 data set classification using CNN.
Experiment 6: MNIST data set as greyscale image classification using CNN.

Experiment 2:Solution

```
# -*- coding: utf-8 -*-
"""NN_Fashion.ipynb

Automatically generated by Colaboratory.

Original file is located at
    https://colab.research.google.com/drive/1JZ04Sx0ZIbFI_sEFiXB_TDF6yTWS82eH
"""

import tensorflow as tf
from tensorflow import keras

# Helper libraries
import numpy as np
import matplotlib.pyplot as plt

fashion_mnist = keras.datasets.fashion_mnist
```

```
(train_images, train_labels), (test_images, test_labels) = fashion_mnist.load_data()

class_names = ['T-shirt/top', 'Trouser', 'Pullover', 'Dress', 'Coat',
               'Sandal', 'Shirt', 'Sneaker', 'Bag', 'Ankle boot']

plt.figure()
plt.imshow(train_images[0])
plt.colorbar()
plt.grid(False)
plt.show()
train_images = train_images / 255.0

test_images = test_images / 255.0

plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i], cmap=plt.cm.binary)
    plt.xlabel(class_names[train_labels[i]])
plt.show()

model = keras.Sequential([
    keras.layers.Flatten(input_shape=(28, 28)),
    keras.layers.Dense(128, activation='relu'),
    keras.layers.Dense(10)
])
model.summary()

model.compile(optimizer='adam',
              loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
              metrics=['accuracy'])
model.fit(train_images, train_labels, epochs=10)

test_loss, test_acc = model.evaluate(test_images,  test_labels, verbose=2)

print('\nTest accuracy:', test_acc)

probability_model = tf.keras.Sequential([model,
                                         tf.keras.layers.Softmax()])
probability_model.summary()

predictions = probability_model.predict(test_images)
predictions[0]

np.argmax(predictions[0])

test_labels[0]

def plot_image(i, predictions_array, true_label, img):
```

```
  predictions_array, true_label, img = predictions_array, true_label[i], img[i]
  plt.grid(False)
  plt.xticks([])
  plt.yticks([])

  plt.imshow(img, cmap=plt.cm.binary)

  predicted_label = np.argmax(predictions_array)
  if predicted_label == true_label:
    color = 'blue'
  else:
    color = 'red'

  plt.xlabel("{} {:2.0f}% ({})".format(class_names[predicted_label],
                                100*np.max(predictions_array),
                                class_names[true_label]),
                                color=color)

def plot_value_array(i, predictions_array, true_label):
  predictions_array, true_label = predictions_array, true_label[i]
  plt.grid(False)
  plt.xticks(range(10))
  plt.yticks([])
  thisplot = plt.bar(range(10), predictions_array, color="#777777")
  plt.ylim([0, 1])
  predicted_label = np.argmax(predictions_array)

  thisplot[predicted_label].set_color('red')
  thisplot[true_label].set_color('blue')

i = 0
plt.figure(figsize=(6,3))
plt.subplot(1,2,1)
plot_image(i, predictions[i], test_labels, test_images)
plt.subplot(1,2,2)
plot_value_array(i, predictions[i],  test_labels)
plt.show()



i = 12
plt.figure(figsize=(6,3))
plt.subplot(1,2,1)
plot_image(i, predictions[i], test_labels, test_images)
plt.subplot(1,2,2)
plot_value_array(i, predictions[i],  test_labels)
plt.show()

num_rows = 5
num_cols = 3
num_images = num_rows*num_cols
plt.figure(figsize=(2*2*num_cols, 2*num_rows))
```

```
for i in range(num_images):
  plt.subplot(num_rows, 2*num_cols, 2*i+1)
  plot_image(i, predictions[i], test_labels, test_images)
  plt.subplot(num_rows, 2*num_cols, 2*i+2)
  plot_value_array(i, predictions[i], test_labels)
plt.tight_layout()
plt.show()

img = test_images[1]

print(img.shape)

img = (np.expand_dims(img,0))

print(img.shape)

predictions_single = probability_model.predict(img)

print(predictions_single)

plot_value_array(1, predictions_single[0], test_labels)
_ = plt.xticks(range(10), class_names, rotation=45)

np.argmax(predictions_single[0])

i =1
plt.figure(figsize=(6,3))
plt.subplot(1,2,1)
plot_image(i, predictions[i], test_labels, test_images)
plt.subplot(1,2,2)
plot_value_array(i, predictions[i],  test_labels)
plt.show()
```

Experiment 1: Solution

```
# -*- coding: utf-8 -*-
"""
Created on Mon Apr 13 16:01:05 2020

@author: vsemwal
"""


# -*- coding: utf-8 -*-
"""Different_Activation_Function.ipynb

"""

import math
```

```
import matplotlib.pyplot as plt
import numpy as np
x = np.arange(-6, 6, 0.1)

def linear(x):
    a = []
    for item in x:
        a.append(item)
    return a
y = linear(x)
plt.plot(x,y)
plt.grid()
plt.show()

def sigmoid(x):
    a = []
    for item in x:
        a.append(1/(1+math.exp(-item)))
    return a

y = sigmoid(x)
plt.plot(x,y)
plt.grid()
plt.show()

def tanh(x, derivative=False):
    if (derivative == True):
        return (1 - (x ** 2))
    return np.tanh(x)


y = tanh(x)

plt.plot(x,y)
plt.grid()
plt.show()

def relu(x):
    a = []
    for item in x:
        if item > 0:
            a.append(item)
        else:
            a.append(0)
    return a


y = relu(x)

plt.plot(x,y)
plt.grid()
plt.show()
```

```
def LeakyRelu(x):
    a = []
    for item in x:
        if item > 0:
            a.append(item)
        else:
            alpha=.2
            a.append((item*alpha))
    return a


y = LeakyRelu(x)

plt.plot(x,y)
plt.grid()
plt.show()

def SoftPlus(x):
    a = []
    for item in x:
        a.append(math.log10(math.exp(item)+1))
    return a


y = SoftPlus(x)

plt.plot(x,y)
plt.grid()
plt.show()

def ELU(x):
    a = []
    for item in x:
        if item > 0:
            a.append(item)
        else:
            alpha=.8
            a.append((alpha*(math.exp(item)-1)))
    return a


y = ELU(x)

plt.plot(x,y)
plt.grid()
plt.show()
```

Experiment 3:Solution

```
import os
import matplotlib.pyplot as plt
import tensorflow as tf
train_dataset_url = "https://storage.googleapis.com/download.tensorflow.org/data/iris_training.csv"

train_dataset_fp = tf.keras.utils.get_file(fname=os.path.basename(train_dataset_url),
                                           origin=train_dataset_url)

print("Local copy of the dataset file: {}".format(train_dataset_fp))
column_names = ['sepal_length', 'sepal_width', 'petal_length', 'petal_width', 'species']

feature_names = column_names[:-1]
label_name = column_names[-1]

print("Features: {}".format(feature_names))
print("Label: {}".format(label_name))
class_names = ['Iris setosa', 'Iris versicolor', 'Iris virginica']
batch_size = 32

train_dataset = tf.data.experimental.make_csv_dataset(
    train_dataset_fp,
    batch_size,
    column_names=column_names,
    label_name=label_name,
    num_epochs=1)
features, labels = next(iter(train_dataset))
print(features)
plt.scatter(features['petal_length'],
            features['sepal_length'],
            c=labels,
            cmap='viridis')

plt.xlabel("Petal length")
plt.ylabel("Sepal length")
plt.show()
def pack_features_vector(features, labels):
  """Pack the features into a single array."""
  features = tf.stack(list(features.values()), axis=1)
  return features, labels
train_dataset = train_dataset.map(pack_features_vector)
features, labels = next(iter(train_dataset))

print(features[:5])
model = tf.keras.Sequential([
  tf.keras.layers.Dense(10, activation=tf.nn.relu, input_shape=(4,)),  # input shape required
```

```
 tf.keras.layers.Dense(10, activation=tf.nn.relu),
 tf.keras.layers.Dense(3)
])
model.summary();
predictions = model(features)
predictions[:5]
tf.nn.softmax(predictions[:5])
print("Prediction: {}".format(tf.argmax(predictions, axis=1)))
print("    Labels: {}".format(labels))
```

Experiment 5: Solution

```
# -*- coding: utf-8 -*-
"""
Created on Thu Apr  9 21:17:39 2020

@author: Vijay Bhaskar Semwal & Neha Gaud, MANIT Bhopal
"""


import tensorflow as tf

from tensorflow.keras import datasets, layers, models
import matplotlib.pyplot as plt
(train_images, train_labels), (test_images, test_labels) = datasets.cifar10.load_data()

# Normalize pixel values to be between 0 and 1
train_images, test_images = train_images / 255.0, test_images / 255.0
class_names = ['airplane', 'automobile', 'bird', 'cat', 'deer',
               'dog', 'frog', 'horse', 'ship', 'truck']

plt.figure(figsize=(10,10))
for i in range(25):
    plt.subplot(5,5,i+1)
    plt.xticks([])
    plt.yticks([])
    plt.grid(False)
    plt.imshow(train_images[i], cmap=plt.cm.binary)
    # The CIFAR labels happen to be arrays,
    # which is why you need the extra index
    plt.xlabel(class_names[train_labels[i][0]])
plt.show()
model = models.Sequential()
model.add(layers.Conv2D(32, (3, 3), activation='relu', input_shape=(32, 32, 3)))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
model.add(layers.MaxPooling2D((2, 2)))
model.add(layers.Conv2D(64, (3, 3), activation='relu'))
```

```
model.summary()
model.add(layers.Flatten())
model.add(layers.Dense(64, activation='relu'))
model.add(layers.Dense(10))
model.summary()
model.compile(optimizer='adam',
              loss=tf.keras.losses.SparseCategoricalCrossentropy(from_logits=True),
              metrics=['accuracy'])
history = model.fit(train_images, train_labels, epochs=10,
                    validation_data=(test_images, test_labels))
plt.plot(history.history['accuracy'], label='accuracy')
plt.plot(history.history['val_accuracy'], label = 'val_accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.ylim([0.5, 1])
plt.legend(loc='lower right')

test_loss, test_acc = model.evaluate(test_images,  test_labels, verbose=2)
print(test_acc)
```

Experiment 6 :Solution

```
import keras
from keras.datasets import mnist

(train_images, train_labels), (test_images, test_labels) = mnist.load_data()
# the data, shuffled and split between train and test sets
(x_train, y_train), (x_test, y_test) = mnist.load_data()
x_train = train_images.reshape(60000, 784)
x_test = x_test.reshape(10000, 784)

x_train = x_train.astype('float32')
x_test = x_test.astype('float32')

x_train /= 255
x_test /= 255

from keras.utils import to_categorical

y_train = keras.utils.to_categorical(y_train, num_classes=10)
y_test = keras.utils.to_categorical(y_test, num_classes=10)

from keras.models import Sequential
from keras.layers import Dense
from keras.optimizers import sgd

model = Sequential()
model.add(Dense(10, activation='sigmoid', input_shape=(784,)))
model.add(Dense(10, activation='softmax'))
```

```
model.summary()

batch_size = 100
num_classes = 10
epochs=5

model.compile(loss='categorical_crossentropy',
              optimizer='sgd',
              metrics=['accuracy'])

model.fit(x_train, y_train,
          batch_size=batch_size,
          epochs=epochs,
          verbose=0
          )

test_loss, test_acc = model.evaluate(x_test, y_test)

print('Test loss:', test_loss)
print('Test accuracy:', test_acc)

#Relu
batch_size = 100
num_classes = 10
epochs=5

model2 = Sequential()
model2.add(Dense(10, activation='relu', input_shape=(784,)))
model2.add(Dense(10, activation='softmax'))


model2.summary()


model2.compile(loss='categorical_crossentropy',
              optimizer='sgd',
              metrics=['accuracy'])

model2.fit(x_train, y_train,
          batch_size=batch_size,
          epochs=epochs,
          verbose=0
          )

test_loss, test_acc = model2.evaluate(x_test, y_test)

print('Model2 - Test loss:', test_loss)
print('Model2 - Test accuracy:', test_acc)

model3 = Sequential()
model3.add(Dense(512, activation='relu', input_shape=(784,)))
model3.add(Dense(10, activation='softmax'))
```

```
model3.summary()

model3.compile(loss='categorical_crossentropy',
              optimizer='sgd',
              metrics=['accuracy'])

epochs = 10
model3.fit(x_train, y_train,
          batch_size=batch_size,
          epochs=epochs,
          verbose=0
          )

test_loss, test_acc = model3.evaluate(x_test, y_test)

print('Model3 - Test loss:', test_loss)
print('Model3 - Test accuracy:', test_acc)
```