NNDL_ICP6

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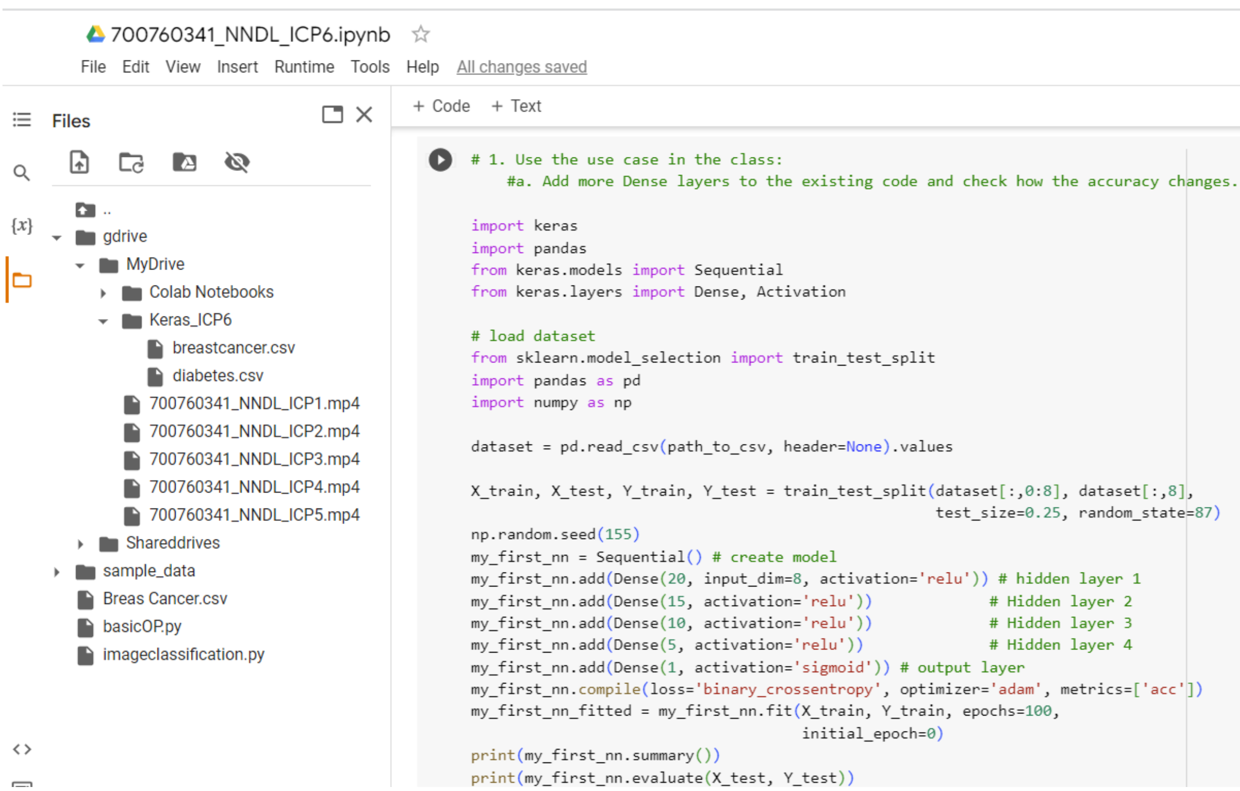
Student Number:700760431

GitHub Link: https://github.com/neeraj4944/NNDL_ICP6

Video Link:
https://drive.google.com/file/d/1DSYlGnHxMTZUmFhqa6u1QH9zIWyqAYDx/view?usp=sharing



700760341_NNDL_ICP6.ipynb

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Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
    - 700760341_NNDL_ICP3.mp4
    - 700760341_NNDL_ICP4.mp4
    - 700760341_NNDL_ICP5.mp4
  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

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[14]

```
Epoch 83/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5456 - acc: 0.7274
Epoch 84/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5573 - acc: 0.7153
Epoch 85/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5524 - acc: 0.7135
Epoch 86/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5456 - acc: 0.7309
Epoch 87/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5406 - acc: 0.7292
Epoch 88/100
18/18 [==============================] - 0s 4ms/step - loss: 0.5344 - acc: 0.7465
Epoch 89/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5374 - acc: 0.7465
Epoch 90/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5498 - acc: 0.7188
Epoch 91/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5410 - acc: 0.7344
Epoch 92/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5407 - acc: 0.7274
Epoch 93/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5473 - acc: 0.7135
Epoch 94/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5484 - acc: 0.7257
Epoch 95/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5317 - acc: 0.7604
Epoch 96/100
18/18 [==============================] - 0s 6ms/step - loss: 0.5352 - acc: 0.7274
Epoch 97/100
18/18 [==============================] - 0s 6ms/step - loss: 0.5592 - acc: 0.7205
Epoch 98/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5443 - acc: 0.7274
Epoch 99/100
18/18 [==============================] - 0s 5ms/step - loss: 0.5426 - acc: 0.7396
Epoch 100/100
18/18 [==============================] - 0s 4ms/step - loss: 0.5310 - acc: 0.7517
```

700760341_NNDL_ICP6.ipynb

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- ..
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      - diabetes.csv
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    - 700760341_NNDL_ICP3.mp4
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    - 700760341_NNDL_ICP5.mp4
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- imageclassification.py

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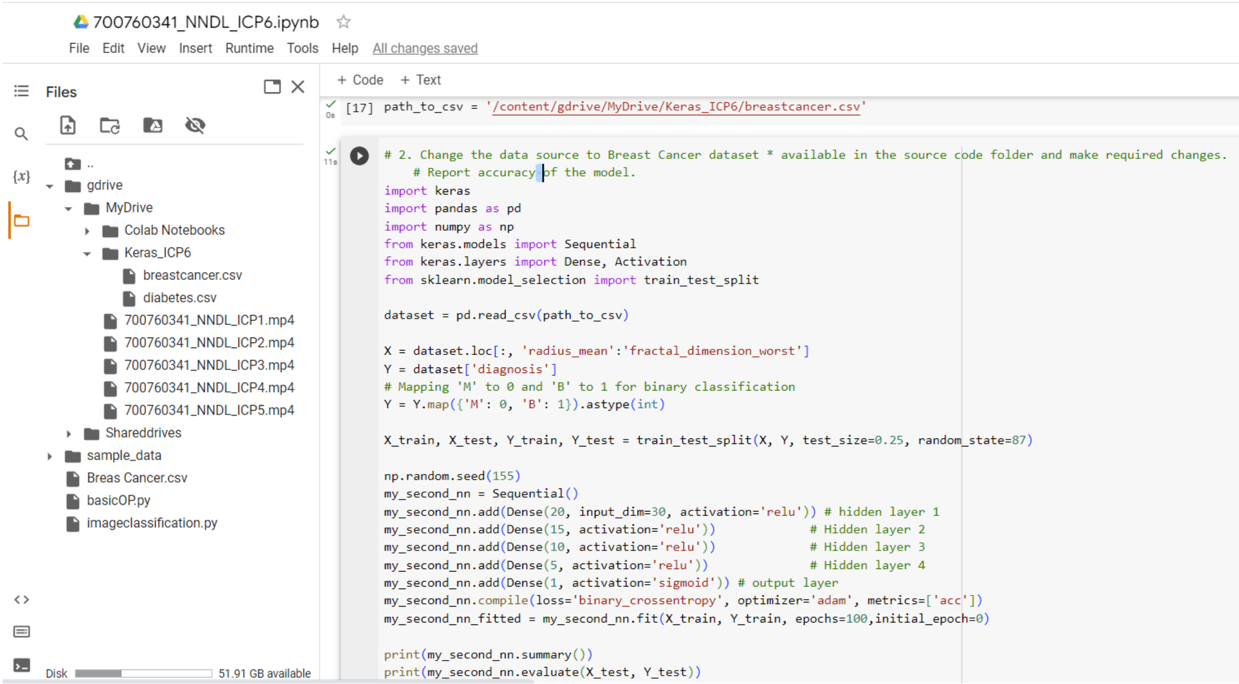
[14]

```
Model: "sequential_3"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_11 (Dense)            (None, 20)                180

 dense_12 (Dense)            (None, 15)                315

 dense_13 (Dense)            (None, 10)                160

 dense_14 (Dense)            (None, 5)                 55

 dense_15 (Dense)            (None, 1)                 6

=================================================================
Total params: 716 (2.80 KB)
Trainable params: 716 (2.80 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
None
6/6 [==============================] - 0s 6ms/step - loss: 0.5611 - acc: 0.6823
[0.5610950589179993, 0.6822916865348816]
```

Adding more Dense layers to our existing neural network model resulted in increased accuracy levels below are the results.

WITH 1 DENSE LAYER: 6/6 [==============================] - 0s 3ms/step - loss: 0.6898 - acc: 0.6458 [0.6897628903388977, 0.6458333134651184]

WITH 4 DENSE LAYER: 6/6 [==============================] - 0s 5ms/step - loss: 0.5770 - acc: 0.7083 [0.5769844055175781, 0.7083333134651184]



700760341_NNDL_ICP6.ipynb

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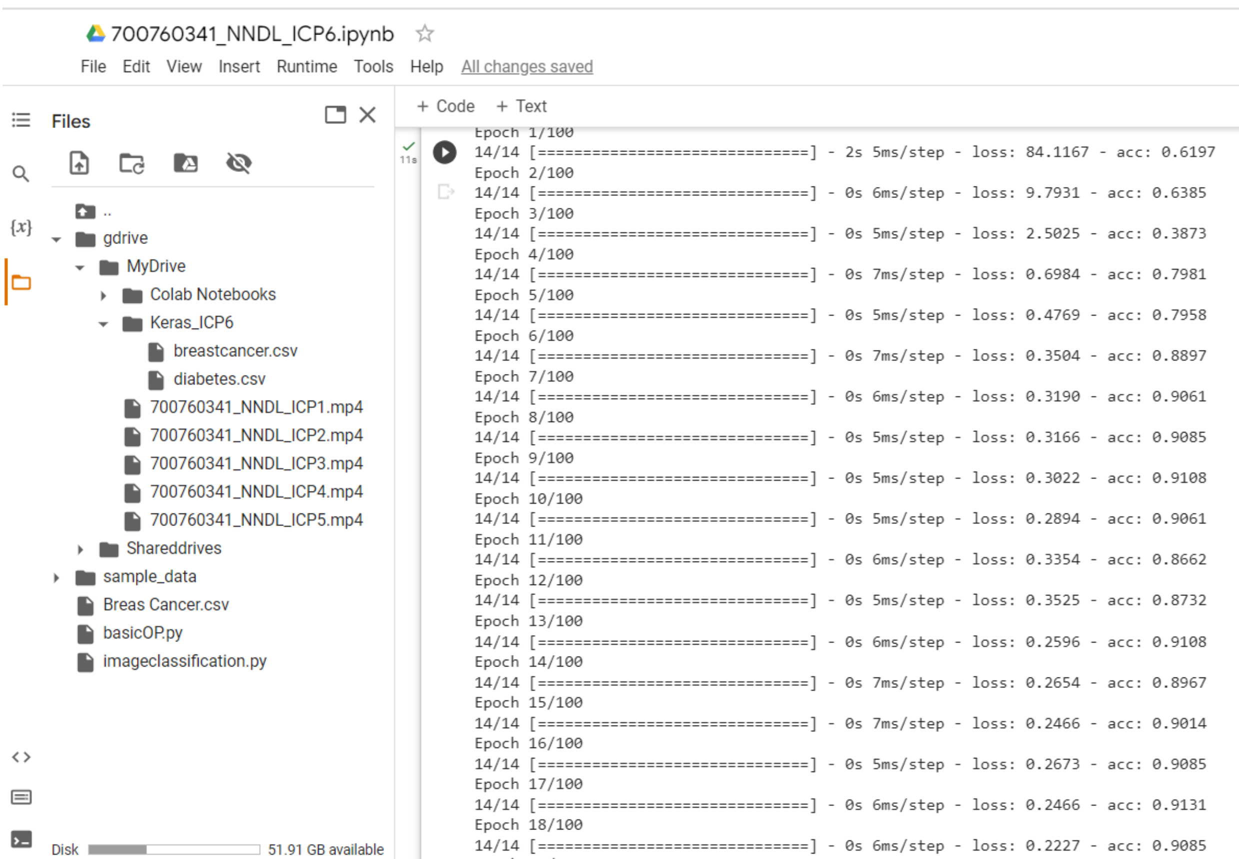
```
[17] path_to_csv = '/content/gdrive/MyDrive/Keras_ICP6/breastcancer.csv'
```

```
# 2. Change the data source to Breast Cancer dataset * available in the source code folder and make required changes.
    # Report accuracy of the model.
import keras
import pandas as pd
import numpy as np
from keras.models import Sequential
from keras.layers import Dense, Activation
from sklearn.model_selection import train_test_split

dataset = pd.read_csv(path_to_csv)

X = dataset.loc[:, 'radius_mean':'fractal_dimension_worst']
Y = dataset['diagnosis']
# Mapping 'M' to 0 and 'B' to 1 for binary classification
Y = Y.map({'M': 0, 'B': 1}).astype(int)

X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.25, random_state=87)

np.random.seed(155)
my_second_nn = Sequential()
my_second_nn.add(Dense(20, input_dim=30, activation='relu')) # hidden layer 1
my_second_nn.add(Dense(15, activation='relu'))            # Hidden layer 2
my_second_nn.add(Dense(10, activation='relu'))            # Hidden layer 3
my_second_nn.add(Dense(5, activation='relu'))             # Hidden layer 4
my_second_nn.add(Dense(1, activation='sigmoid')) # output layer
my_second_nn.compile(loss='binary_crossentropy', optimizer='adam', metrics=['acc'])
my_second_nn_fitted = my_second_nn.fit(X_train, Y_train, epochs=100,initial_epoch=0)

print(my_second_nn.summary())
print(my_second_nn.evaluate(X_test, Y_test))
```



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```
Epoch 1/100
14/14 [==============================] - 2s 5ms/step - loss: 84.1167 - acc: 0.6197
Epoch 2/100
14/14 [==============================] - 0s 6ms/step - loss: 9.7931 - acc: 0.6385
Epoch 3/100
14/14 [==============================] - 0s 5ms/step - loss: 2.5025 - acc: 0.3873
Epoch 4/100
14/14 [==============================] - 0s 7ms/step - loss: 0.6984 - acc: 0.7981
Epoch 5/100
14/14 [==============================] - 0s 5ms/step - loss: 0.4769 - acc: 0.7958
Epoch 6/100
14/14 [==============================] - 0s 7ms/step - loss: 0.3504 - acc: 0.8897
Epoch 7/100
14/14 [==============================] - 0s 6ms/step - loss: 0.3190 - acc: 0.9061
Epoch 8/100
14/14 [==============================] - 0s 5ms/step - loss: 0.3166 - acc: 0.9085
Epoch 9/100
14/14 [==============================] - 0s 5ms/step - loss: 0.3022 - acc: 0.9108
Epoch 10/100
14/14 [==============================] - 0s 5ms/step - loss: 0.2894 - acc: 0.9061
Epoch 11/100
14/14 [==============================] - 0s 6ms/step - loss: 0.3354 - acc: 0.8662
Epoch 12/100
14/14 [==============================] - 0s 5ms/step - loss: 0.3525 - acc: 0.8732
Epoch 13/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2596 - acc: 0.9108
Epoch 14/100
14/14 [==============================] - 0s 7ms/step - loss: 0.2654 - acc: 0.8967
Epoch 15/100
14/14 [==============================] - 0s 7ms/step - loss: 0.2466 - acc: 0.9014
Epoch 16/100
14/14 [==============================] - 0s 5ms/step - loss: 0.2673 - acc: 0.9085
Epoch 17/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2466 - acc: 0.9131
Epoch 18/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2227 - acc: 0.9085
```

700760341_NNDL_ICP6.ipynb

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- ..
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    - Keras_ICP6
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      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
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```
14/14 [==============================] - 0s 5ms/step - loss: 0.2225 - acc: 0.9178
Epoch 21/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2155 - acc: 0.9272
Epoch 22/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2133 - acc: 0.9155
Epoch 23/100
14/14 [==============================] - 0s 7ms/step - loss: 0.2081 - acc: 0.9178
Epoch 24/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2098 - acc: 0.9249
Epoch 25/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2115 - acc: 0.9202
Epoch 26/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2100 - acc: 0.9225
Epoch 27/100
14/14 [==============================] - 0s 7ms/step - loss: 0.2031 - acc: 0.9296
Epoch 28/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2152 - acc: 0.9178
Epoch 29/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2079 - acc: 0.9296
Epoch 30/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2037 - acc: 0.9225
Epoch 31/100
14/14 [==============================] - 0s 5ms/step - loss: 0.2127 - acc: 0.9178
Epoch 32/100
14/14 [==============================] - 0s 7ms/step - loss: 0.1973 - acc: 0.9296
Epoch 33/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2136 - acc: 0.9131
Epoch 34/100
14/14 [==============================] - 0s 7ms/step - loss: 0.2072 - acc: 0.9202
Epoch 35/100
14/14 [==============================] - 0s 7ms/step - loss: 0.1917 - acc: 0.9296
Epoch 36/100
14/14 [==============================] - 0s 6ms/step - loss: 0.2605 - acc: 0.9202
Epoch 37/100
14/14 [==============================] - 0s 7ms/step - loss: 0.2332 - acc: 0.9155
Epoch 38/100
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
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    - 700760341_NNDL_ICP1.mp4
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- Breas Cancer.csv
- basicOP.py
- imageclassification.py

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```
14/14 [==============================] - 0s 5ms/step - loss: 0.1801 - acc: 0.9296
Epoch 96/100
14/14 [==============================] - 0s 5ms/step - loss: 0.1784 - acc: 0.9249
Epoch 97/100
14/14 [==============================] - 0s 4ms/step - loss: 0.1748 - acc: 0.9319
Epoch 98/100
14/14 [==============================] - 0s 4ms/step - loss: 0.1685 - acc: 0.9366
Epoch 99/100
14/14 [==============================] - 0s 4ms/step - loss: 0.1639 - acc: 0.9319
Epoch 100/100
14/14 [==============================] - 0s 4ms/step - loss: 0.1646 - acc: 0.9366
Model: "sequential_4"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_16 (Dense)            (None, 20)                620

 dense_17 (Dense)            (None, 15)                315

 dense_18 (Dense)            (None, 10)                160

 dense_19 (Dense)            (None, 5)                 55

 dense_20 (Dense)            (None, 1)                 6

=================================================================
Total params: 1156 (4.52 KB)
Trainable params: 1156 (4.52 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
None
5/5 [==============================] - 0s 4ms/step - loss: 0.3036 - acc: 0.8881
[0.3035851716995239, 0.8881118893623352]
```

700760341_NNDL_ICP6.ipynb

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```
[19] # 3. Normalize the data before feeding the data to the model and check how the normalization change your accuracy (code given below).
        # from sklearn.preprocessing import StandardScaler
        # sc = StandardScaler()
import keras
import pandas as pd
import numpy as np
from keras.models import Sequential
from keras.layers import Dense, Activation
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler

dataset = pd.read_csv(path_to_csv)

X = dataset.loc[:, 'radius_mean':'fractal_dimension_worst']
Y = dataset['diagnosis']
# Map 'M' to 0 and 'B' to 1 for binary classification
Y = Y.map({'M': 0, 'B': 1}).astype(int)

X_train, X_test, Y_train, Y_test = train_test_split(X, Y, test_size=0.25, random_state=87)
np.random.seed(155)

sc = StandardScaler()
normalized_Xtrain = sc.fit_transform(X_train)
normalized_Xtest = sc.transform(X_test)

my_third_nn = Sequential()
my_third_nn.add(Dense(20, input_dim=30, activation='relu')) # hidden layer 1
my_third_nn.add(Dense(15, activation='relu'))             # Hidden layer 2
my_third_nn.add(Dense(10, activation='relu'))             # Hidden layer 3
my_third_nn.add(Dense(5, activation='relu'))              # Hidden layer 4
my_third_nn.add(Dense(1, activation='sigmoid'))
my_third_nn.compile(loss='binary_crossentropy', optimizer='adam', metrics=['acc'])
```

700760341_NNDL_ICP6.ipynb

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```
my_third_nn.compile(loss='binary_crossentropy', optimizer='adam', metrics=['acc'])
my_third_nn_fitted = my_third_nn.fit(normalized_Xtrain, Y_train, epochs=100,initial_epoch=0

print(my_third_nn.summary())
print(my_third_nn.evaluate(normalized_Xtest, Y_test))
```

```
Epoch 83/100
14/14 [==============================] - 0s 7ms/step - loss: 0.0014 - acc: 1.0000
Epoch 84/100
14/14 [==============================] - 0s 5ms/step - loss: 0.0014 - acc: 1.0000
Epoch 85/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0014 - acc: 1.0000
Epoch 86/100
14/14 [==============================] - 0s 5ms/step - loss: 0.0014 - acc: 1.0000
Epoch 87/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0013 - acc: 1.0000
Epoch 88/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0012 - acc: 1.0000
Epoch 89/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0011 - acc: 1.0000
Epoch 90/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0011 - acc: 1.0000
Epoch 91/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0011 - acc: 1.0000
Epoch 92/100
14/14 [==============================] - 0s 6ms/step - loss: 0.0010 - acc: 1.0000
Epoch 93/100
14/14 [==============================] - 0s 6ms/step - loss: 9.8459e-04 - acc: 1.0000
Epoch 94/100
14/14 [==============================] - 0s 6ms/step - loss: 9.4301e-04 - acc: 1.0000
Epoch 95/100
14/14 [==============================] - 0s 7ms/step - loss: 9.1617e-04 - acc: 1.0000
Epoch 96/100
14/14 [==============================] - 0s 6ms/step - loss: 8.8701e-04 - acc: 1.0000
Epoch 97/100
```

700760341_NNDL_ICP6.ipynb

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- ..
- gdrive
  - MyDrive
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    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
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    - 700760341_NNDL_ICP5.mp4
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- sample_data
- Breas Cancer.csv
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- imageclassification.py

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[19]

```
Epoch 96/100
14/14 [==============================] - 0s 6ms/step - loss: 8.8701e-04 - acc: 1.0000
Epoch 97/100
14/14 [==============================] - 0s 7ms/step - loss: 8.7539e-04 - acc: 1.0000
Epoch 98/100
14/14 [==============================] - 0s 7ms/step - loss: 8.4345e-04 - acc: 1.0000
Epoch 99/100
14/14 [==============================] - 0s 7ms/step - loss: 8.6043e-04 - acc: 1.0000
Epoch 100/100
14/14 [==============================] - 0s 7ms/step - loss: 7.8228e-04 - acc: 1.0000
Model: "sequential_5"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 dense_21 (Dense)            (None, 20)                620

 dense_22 (Dense)            (None, 15)                315

 dense_23 (Dense)            (None, 10)                160

 dense_24 (Dense)            (None, 5)                 55

 dense_25 (Dense)            (None, 1)                 6

=================================================================
Total params: 1156 (4.52 KB)
Trainable params: 1156 (4.52 KB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
None
5/5 [==============================] - 0s 6ms/step - loss: 0.3978 - acc: 0.9650
[0.39780929684638977, 0.9650349617004395]
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

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    - 700760341_NNDL_ICP1.mp4
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```python
# Use Image Classification on the hand written digits data set (mnist)
# 1. Plot the loss and accuracy for both training data and validation data using the history object in the sourcecode.
# 2. Plot one of the images in the test data, and then do inferencing to check what is the prediction of the model
   # on that single image.

from keras import Sequential
from keras.datasets import mnist
import numpy as np
from keras.layers import Dense
from keras.utils import to_categorical
import matplotlib.pyplot as plt

(train_images,train_labels),(test_images, test_labels) = mnist.load_data()

print(train_images.shape[1:])
#process the data
#1. convert each image of shape 28*28 to 784 dimensional which will be fed to the network as a single feature
dimData = np.prod(train_images.shape[1:])
print(dimData)
train_data = train_images.reshape(train_images.shape[0],dimData)
test_data = test_images.reshape(test_images.shape[0],dimData)

#convert data to float and scale values between 0 and 1
train_data = train_data.astype('float')
test_data = test_data.astype('float')
#scale data
train_data /=255.0
test_data /=255.0
#change the labels frominteger to one-hot encoding. to_categorical is doing the same thing as LabelEncoder()
train_labels_one_hot = to_categorical(train_labels)
test_labels_one_hot = to_categorical(test_labels)

#creating network
```

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700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

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    - 700760341_NNDL_ICP5.mp4
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```
#creating network
model = Sequential()
model.add(Dense(512, activation='relu', input_shape=(dimData,)))
model.add(Dense(512, activation='relu'))
model.add(Dense(10, activation='softmax'))

model.compile(optimizer='rmsprop', loss='categorical_crossentropy', metrics=['accuracy'])
history = model.fit(train_data, train_labels_one_hot, batch_size=256, epochs=10, verbose=1,
                    validation_data=(test_data, test_labels_one_hot))

# Extract training history
training_loss = history.history['loss']
training_accuracy = history.history['accuracy']
validation_loss = history.history['val_loss']
validation_accuracy = history.history['val_accuracy']

# Plot loss
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(training_loss, label='Training Loss')
plt.plot(validation_loss, label='Validation Loss')
plt.title('Loss')
plt.xlabel('Epoch')
plt.legend()

# Plot accuracy
plt.subplot(1, 2, 2)
plt.plot(training_accuracy, label='Training Accuracy')
plt.plot(validation_accuracy, label='Validation Accuracy')
plt.title('Accuracy')
plt.xlabel('Epoch')
plt.legend()
```


700760341_NNDL_ICP6.ipynb

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  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

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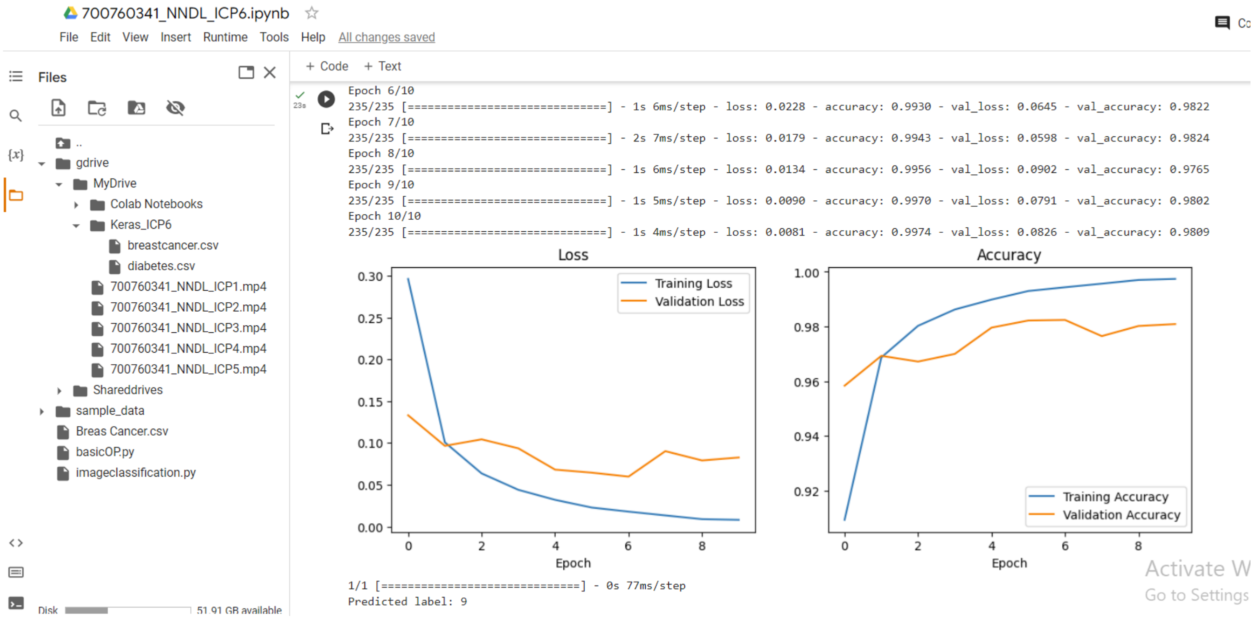
```
plt.show()

# select a random image from the test data
idx = np.random.randint(test_data.shape[0])
image = test_data[idx].reshape(28, 28)

# plot the selected image
plt.figure()
plt.imshow(image, cmap='gray')
plt.axis('off')
plt.title('Selected Image')

# do inferencing to check the model prediction on the selected image
prediction = model.predict(image.reshape(1, 784))
prediction = np.argmax(prediction)

# print the predicted label
print('Predicted label:', prediction)
```

```
(28, 28)
784
Epoch 1/10
235/235 [==============================] - 2s 6ms/step - loss: 0.2961 - accuracy: 0.9094 - val_loss: 0.1331 - val_accuracy: 0.9584
Epoch 2/10
235/235 [==============================] - 1s 5ms/step - loss: 0.1008 - accuracy: 0.9687 - val_loss: 0.0966 - val_accuracy: 0.9693
Epoch 3/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0636 - accuracy: 0.9803 - val_loss: 0.1044 - val_accuracy: 0.9672
Epoch 4/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0440 - accuracy: 0.9862 - val_loss: 0.0936 - val_accuracy: 0.9700
Epoch 5/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0320 - accuracy: 0.9898 - val_loss: 0.0681 - val_accuracy: 0.9796
Epoch 6/10
```


700760341_NNDL_ICP6.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Files
gdrive
MyDrive
Colab Notebooks
Keras_ICP6
breastcancer.csv
diabetes.csv
700760341_NNDL_ICP1.mp4
700760341_NNDL_ICP2.mp4
700760341_NNDL_ICP3.mp4
700760341_NNDL_ICP4.mp4
700760341_NNDL_ICP5.mp4
Shareddrives
sample_data
Breas Cancer.csv
basicOP.py
imageclassification.py
Disk 51.91 GB available
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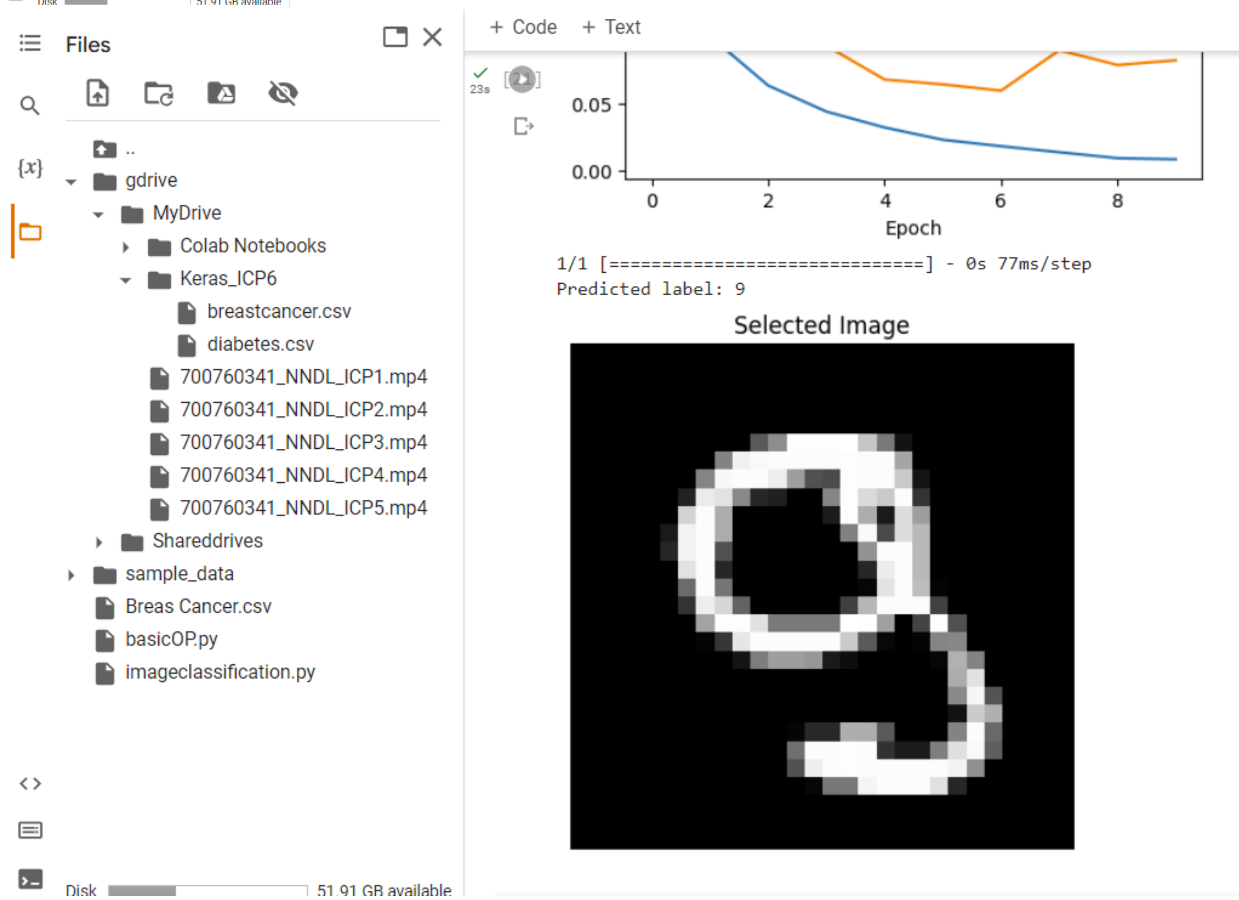
Epoch 6/10
235/235 [==============================] - 1s 6ms/step - loss: 0.0228 - accuracy: 0.9930 - val_loss: 0.0645 - val_accuracy: 0.9822
Epoch 7/10
235/235 [==============================] - 2s 7ms/step - loss: 0.0179 - accuracy: 0.9943 - val_loss: 0.0598 - val_accuracy: 0.9824
Epoch 8/10
235/235 [==============================] - 1s 6ms/step - loss: 0.0134 - accuracy: 0.9956 - val_loss: 0.0902 - val_accuracy: 0.9765
Epoch 9/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0090 - accuracy: 0.9970 - val_loss: 0.0791 - val_accuracy: 0.9802
Epoch 10/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0081 - accuracy: 0.9974 - val_loss: 0.0826 - val_accuracy: 0.9809
Loss
Training Loss
Validation Loss
Epoch
Accuracy
Training Accuracy
Validation Accuracy
Epoch
1/1 [==============================] - 0s 77ms/step
Predicted label: 9
Activate W
Go to Settings


Files
gdrive
MyDrive
Colab Notebooks
Keras_ICP6
breastcancer.csv
diabetes.csv
700760341_NNDL_ICP1.mp4
700760341_NNDL_ICP2.mp4
700760341_NNDL_ICP3.mp4
700760341_NNDL_ICP4.mp4
700760341_NNDL_ICP5.mp4
Shareddrives
sample_data
Breas Cancer.csv
basicOP.py
imageclassification.py
Disk 51.91 GB available
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Epoch
1/1 [==============================] - 0s 77ms/step
Predicted label: 9
Selected Image

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
    - 700760341_NNDL_ICP3.mp4
    - 700760341_NNDL_ICP4.mp4
    - 700760341_NNDL_ICP5.mp4
  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

Disk 51.91 GB available

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```python
# 3. We had used 2 hidden layers and Relu activation. Try to change the number of hidden layer and the
    #activation to tanh or sigmoid and see what happens.

from keras import Sequential
from keras.datasets import mnist
import numpy as np
from keras.layers import Dense
from keras.utils import to_categorical
import matplotlib.pyplot as plt

(train_images,train_labels),(test_images, test_labels) = mnist.load_data()

print(train_images.shape[1:])
#process the data
#1. convert each image of shape 28*28 to 784 dimensional which will be fed to the network as a single feature
dimData = np.prod(train_images.shape[1:])
print(dimData)
train_data = train_images.reshape(train_images.shape[0],dimData)
test_data = test_images.reshape(test_images.shape[0],dimData)

#convert data to float and scale values between 0 and 1
train_data = train_data.astype('float')
test_data = test_data.astype('float')
#scale data
train_data /=255.0
test_data /=255.0
#change the labels frominteger to one-hot encoding. to_categorical is doing the same thing as LabelEncoder()
train_labels_one_hot = to_categorical(train_labels)
test_labels_one_hot = to_categorical(test_labels)

#creating network
model = Sequential()
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
    - 700760341_NNDL_ICP3.mp4
    - 700760341_NNDL_ICP4.mp4
    - 700760341_NNDL_ICP5.mp4
  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

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```python
#creating network
model = Sequential()
model.add(Dense(512, activation='tanh', input_shape=(dimData,)))
model.add(Dense(256, activation='tanh'))
model.add(Dense(128, activation='tanh'))
model.add(Dense(10, activation='softmax'))

model.compile(optimizer='rmsprop', loss='categorical_crossentropy', metrics=['accuracy'])
history = model.fit(train_data, train_labels_one_hot, batch_size=256, epochs=10, verbose=1,
                    validation_data=(test_data, test_labels_one_hot))

# Extract training history
training_loss = history.history['loss']
training_accuracy = history.history['accuracy']
validation_loss = history.history['val_loss']
validation_accuracy = history.history['val_accuracy']

# Plot loss
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(training_loss, label='Training Loss')
plt.plot(validation_loss, label='Validation Loss')
plt.title('Loss')
plt.xlabel('Epoch')
plt.legend()

# Plot accuracy
plt.subplot(1, 2, 2)
plt.plot(training_accuracy, label='Training Accuracy')
plt.plot(validation_accuracy, label='Validation Accuracy')
plt.title('Accuracy')
plt.xlabel('Epoch')
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

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Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
    - 700760341_NNDL_ICP3.mp4
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    - 700760341_NNDL_ICP5.mp4
  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

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```python
# Plot accuracy
plt.subplot(1, 2, 2)
plt.plot(training_accuracy, label='Training Accuracy')
plt.plot(validation_accuracy, label='Validation Accuracy')
plt.title('Accuracy')
plt.xlabel('Epoch')
plt.legend()

plt.show()
```

```
(28, 28)
784
Epoch 1/10
235/235 [==============================] - 3s 7ms/step - loss: 0.3371 - accuracy: 0.8975 - val_loss: 0.2093 - val_accuracy: 0.9364
Epoch 2/10
235/235 [==============================] - 1s 6ms/step - loss: 0.1501 - accuracy: 0.9546 - val_loss: 0.1524 - val_accuracy: 0.9547
Epoch 3/10
235/235 [==============================] - 1s 6ms/step - loss: 0.1001 - accuracy: 0.9699 - val_loss: 0.1192 - val_accuracy: 0.9629
Epoch 4/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0716 - accuracy: 0.9781 - val_loss: 0.1782 - val_accuracy: 0.9437
Epoch 5/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0543 - accuracy: 0.9830 - val_loss: 0.0720 - val_accuracy: 0.9765
Epoch 6/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0417 - accuracy: 0.9869 - val_loss: 0.1045 - val_accuracy: 0.9669
Epoch 7/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0314 - accuracy: 0.9905 - val_loss: 0.0646 - val_accuracy: 0.9790
Epoch 8/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0232 - accuracy: 0.9930 - val_loss: 0.0619 - val_accuracy: 0.9800
Epoch 9/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0178 - accuracy: 0.9949 - val_loss: 0.0636 - val_accuracy: 0.9802
Epoch 10/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0134 - accuracy: 0.9962 - val_loss: 0.0645 - val_accuracy: 0.9811
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

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Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
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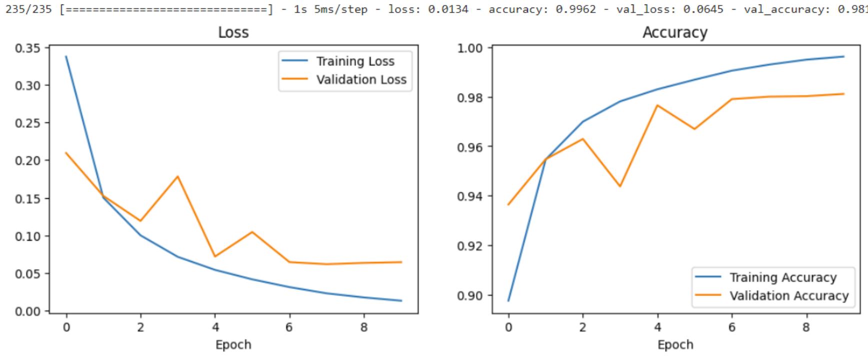
```
235/235 [==============================] - 1s 5ms/step - loss: 0.0314 - accuracy: 0.9905 - val_loss: 0.0646 - val_accuracy: 0.9790
Epoch 8/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0232 - accuracy: 0.9930 - val_loss: 0.0619 - val_accuracy: 0.9800
Epoch 9/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0178 - accuracy: 0.9949 - val_loss: 0.0636 - val_accuracy: 0.9802
Epoch 10/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0134 - accuracy: 0.9962 - val_loss: 0.0645 - val_accuracy: 0.9811
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
    - 700760341_NNDL_ICP3.mp4
    - 700760341_NNDL_ICP4.mp4
    - 700760341_NNDL_ICP5.mp4
  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

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```python
# 4. Run the same code without scaling the images and check the performance?

import matplotlib.pyplot as plt
from keras import Sequential
from keras.datasets import mnist
import numpy as np
from keras.layers import Dense
from keras.utils import to_categorical

(train_images, train_labels), (test_images, test_labels) = mnist.load_data()

print(train_images.shape[1:])
# Process the data
# 1. Convert each image of shape 28*28 to 784 dimensional which will be fed to the network as a single feature
dimData = np.prod(train_images.shape[1:])
print(dimData)
train_data = train_images.reshape(train_images.shape[0], dimData)
test_data = test_images.reshape(test_images.shape[0], dimData)

# Convert data to float (no scaling)
train_data = train_data.astype('float')
test_data = test_data.astype('float')

# Change the labels from integer to one-hot encoding. to_categorical is doing the same thing as LabelEncoder()
train_labels_one_hot = to_categorical(train_labels)
test_labels_one_hot = to_categorical(test_labels)

# Creating network
model = Sequential()
model.add(Dense(512, activation='tanh', input_shape=(dimData,)))
model.add(Dense(256, activation='tanh'))
model.add(Dense(128, activation='tanh'))
model.add(Dense(10, activation='softmax'))
```

700760341_NNDL_ICP6.ipynb

File Edit View Insert Runtime Tools Help All changes saved

Files

- ..
- gdrive
  - MyDrive
    - Colab Notebooks
    - Keras_ICP6
      - breastcancer.csv
      - diabetes.csv
    - 700760341_NNDL_ICP1.mp4
    - 700760341_NNDL_ICP2.mp4
    - 700760341_NNDL_ICP3.mp4
    - 700760341_NNDL_ICP4.mp4
    - 700760341_NNDL_ICP5.mp4
  - Shareddrives
- sample_data
- Breas Cancer.csv
- basicOP.py
- imageclassification.py

+ Code + Text

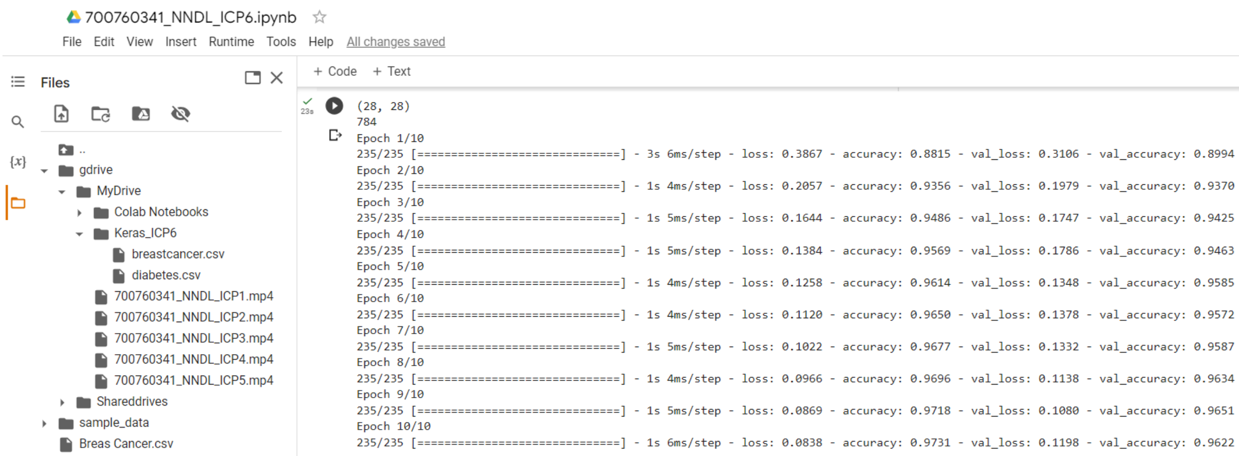
```python
model.compile(optimizer='rmsprop', loss='categorical_crossentropy', metrics=['accuracy'])
history = model.fit(train_data, train_labels_one_hot, batch_size=256, epochs=10, verbose=1,
                    validation_data=(test_data, test_labels_one_hot))

# Extract training history
training_loss = history.history['loss']
training_accuracy = history.history['accuracy']
validation_loss = history.history['val_loss']
validation_accuracy = history.history['val_accuracy']

# Plot loss
plt.figure(figsize=(12, 4))
plt.subplot(1, 2, 1)
plt.plot(training_loss, label='Training Loss')
plt.plot(validation_loss, label='Validation Loss')
plt.title('Loss')
plt.xlabel('Epoch')
plt.legend()

# Plot accuracy
plt.subplot(1, 2, 2)
plt.plot(training_accuracy, label='Training Accuracy')
plt.plot(validation_accuracy, label='Validation Accuracy')
plt.title('Accuracy')
plt.xlabel('Epoch')
plt.legend()

plt.show()
```


700760341_NNDL_ICP6.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Files
+ Code + Text
gdrive
MyDrive
Colab Notebooks
Keras_ICP6
breastcancer.csv
diabetes.csv
700760341_NNDL_ICP1.mp4
700760341_NNDL_ICP2.mp4
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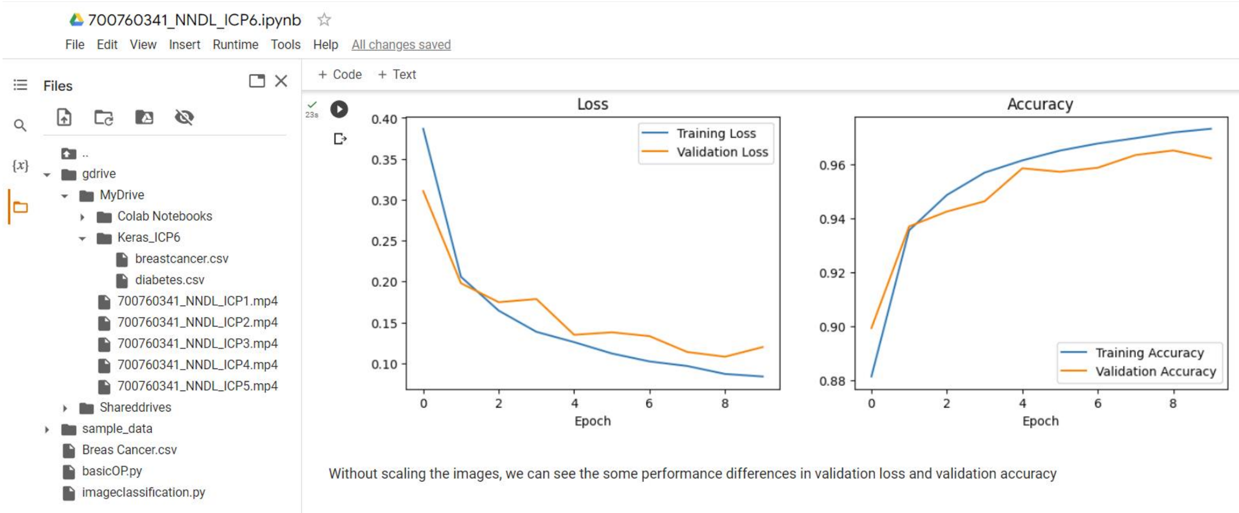
700760341_NNDL_ICP4.mp4
700760341_NNDL_ICP5.mp4
Shareddrives
sample_data
Breas Cancer.csv
(28, 28)
784
Epoch 1/10
235/235 [==============================] - 3s 6ms/step - loss: 0.3867 - accuracy: 0.8815 - val_loss: 0.3106 - val_accuracy: 0.8994
Epoch 2/10
235/235 [==============================] - 1s 4ms/step - loss: 0.2057 - accuracy: 0.9356 - val_loss: 0.1979 - val_accuracy: 0.9370
Epoch 3/10
235/235 [==============================] - 1s 5ms/step - loss: 0.1644 - accuracy: 0.9486 - val_loss: 0.1747 - val_accuracy: 0.9425
Epoch 4/10
235/235 [==============================] - 1s 5ms/step - loss: 0.1384 - accuracy: 0.9569 - val_loss: 0.1786 - val_accuracy: 0.9463
Epoch 5/10
235/235 [==============================] - 1s 4ms/step - loss: 0.1258 - accuracy: 0.9614 - val_loss: 0.1348 - val_accuracy: 0.9585
Epoch 6/10
235/235 [==============================] - 1s 4ms/step - loss: 0.1120 - accuracy: 0.9650 - val_loss: 0.1378 - val_accuracy: 0.9572
Epoch 7/10
235/235 [==============================] - 1s 5ms/step - loss: 0.1022 - accuracy: 0.9677 - val_loss: 0.1332 - val_accuracy: 0.9587
Epoch 8/10
235/235 [==============================] - 1s 4ms/step - loss: 0.0966 - accuracy: 0.9696 - val_loss: 0.1138 - val_accuracy: 0.9634
Epoch 9/10
235/235 [==============================] - 1s 5ms/step - loss: 0.0869 - accuracy: 0.9718 - val_loss: 0.1080 - val_accuracy: 0.9651
Epoch 10/10
235/235 [==============================] - 1s 6ms/step - loss: 0.0838 - accuracy: 0.9731 - val_loss: 0.1198 - val_accuracy: 0.9622


700760341_NNDL_ICP6.ipynb
File Edit View Insert Runtime Tools Help All changes saved
Files
+ Code + Text
gdrive
MyDrive
Colab Notebooks
Keras_ICP6
breastcancer.csv
diabetes.csv
700760341_NNDL_ICP1.mp4
700760341_NNDL_ICP2.mp4
700760341_NNDL_ICP3.mp4
700760341_NNDL_ICP4.mp4
700760341_NNDL_ICP5.mp4
Shareddrives
sample_data
Breas Cancer.csv
basicOP.py
imageclassification.py
Loss
Training Loss
Validation Loss
Epoch
Accuracy
Training Accuracy
Validation Accuracy
Epoch
Without scaling the images, we can see the some performance differences in validation loss and validation accuracy