Deep Learning With Computer Vision And Advanced NLP (DL_CV_NLP)

Implementation of ANN using Keras:

In [ ]:
```
# Importing Libraries
import tensorflow as tf
import matplotlib.pyplot as plt
import numpy as np
import pandas as pd
import seaborn as sns
import os
```

In [ ]:
```
# Checking version of Tensorflow ans Keras
print(f"Tensorflow Version {tf.__version__}")
print(f"Keras Version {tf.keras.__version__}")
```

```
Tensorflow Version 2.5.0
Keras Version 2.5.0
```

In [ ]:
```
# Changing directory to my drive
ROOT = "/content/drive/MyDrive/DL-CV-NLP/Revision "
os.chdir(ROOT)
```

In [ ]:
```
os.getcwd()
```

Out[5]:
```
'/content/drive/My Drive/DL-CV-NLP/Revision '
```

GPU / CPU Check

In [ ]:
```
tf.config.list_physical_devices("GPU")
```

Out[6]:
```
[PhysicalDevice(name='/physical_device:GPU:0', device_type='GPU')]
```

In [ ]:
```
tf.config.list_physical_devices("CPU")
```

Out[7]:
```
[PhysicalDevice(name='/physical_device:CPU:0', device_type='CPU')]
```

In [ ]:
```
check_list = ['GPU','CPU']

for device in check_list:
  out = tf.config.list_physical_devices(device)
  if len(out) > 0:
    print(f"{device} is available!")
    print(f"Details >> {out}")
  else:
    print(f"{device} isn't available!")
```

```
GPU is available!
Details >> [PhysicalDevice(name='/physical_device:GPU:0', device_type='GPU')]
CPU is available!
Details >> [PhysicalDevice(name='/physical_device:CPU:0', device_type='CPU')]
```

#Creating a simple classifier using keras on MNIST data

In [ ]:
```
mnist = tf.keras.datasets.mnist
(X_train_full, y_train_full), (X_test, y_test) = mnist.load_data()
```

```
Downloading data from https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnis
t.npz (https://storage.googleapis.com/tensorflow/tf-keras-datasets/mnist.npz)
11493376/11490434 [==============================] - 0s 0us/step
```

In [ ]:
```
print(f"data type of X_train_full: {X_train_full.dtype},\n shape of X_train_full: {X_tra
```

```
data type of X_train_full: uint8,
 shape of X_train_full: (60000, 28, 28)
```

In [ ]:
```
X_test.shape
```

Out[11]:
```
(10000, 28, 28)
```

In [ ]:
```
len(X_test[1][0])
```

Out[12]:
```
28
```

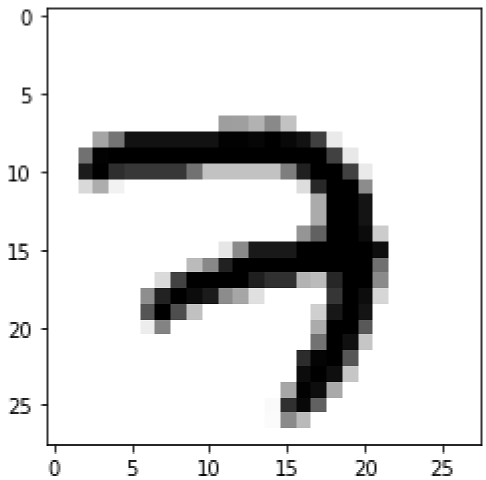
In [ ]:
```
# create a validation data set from the full training data
# Scale the data between 0 to 1 by dividing it by 255. as its an unsigned data between 0
X_valid, X_train = X_train_full[:5000] / 255., X_train_full[5000:] / 255.
y_valid, y_train = y_train_full[:5000], y_train_full[5000:]

# scale the test set as well
X_test = X_test / 255.
```

In [ ]:
```
len(X_train_full[5000:] )
```

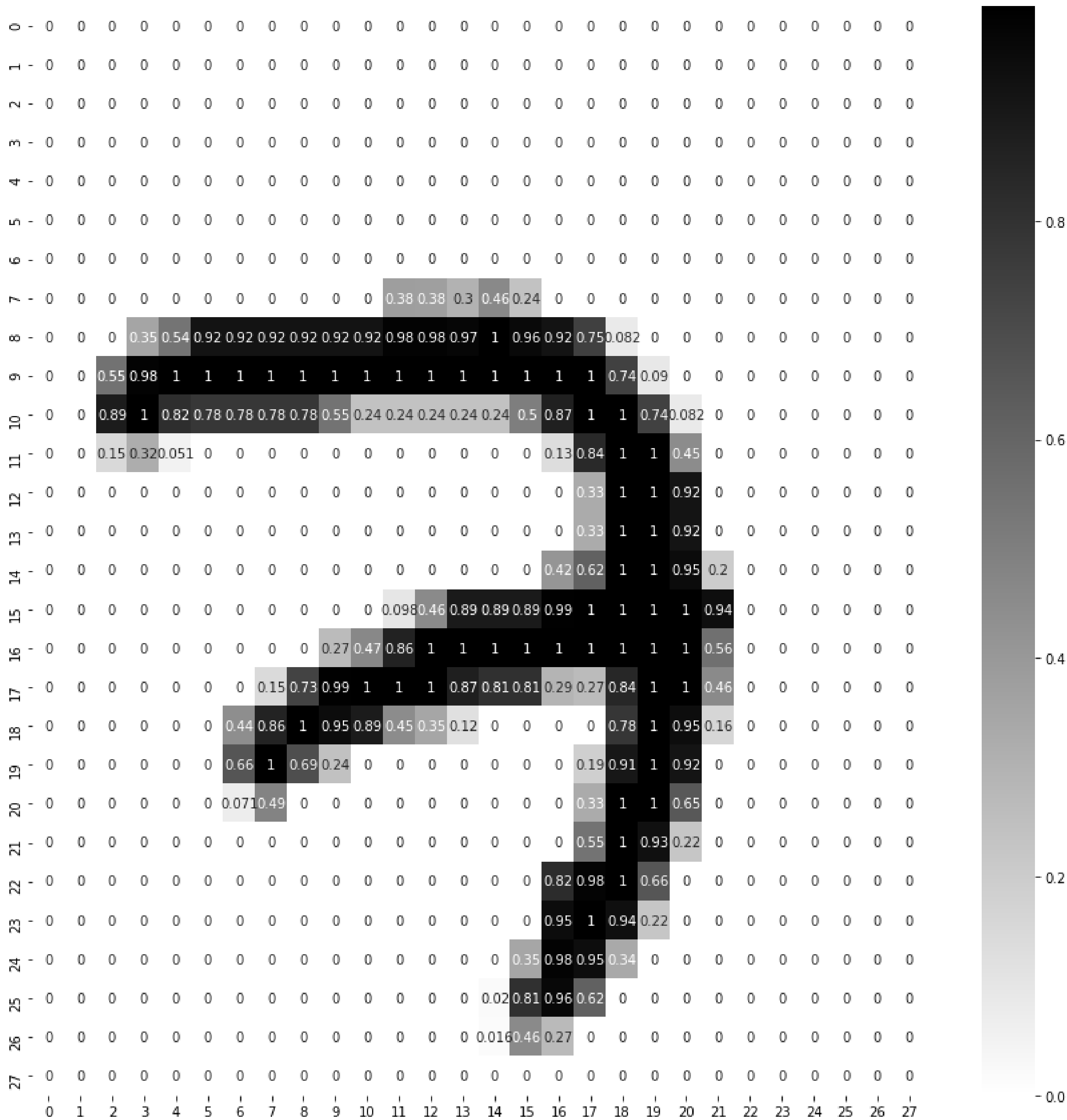
Out[14]:
```
55000
```

In [ ]:
```
# Lets view some data
plt.imshow(X_train[0], cmap="binary")
plt.show()
```

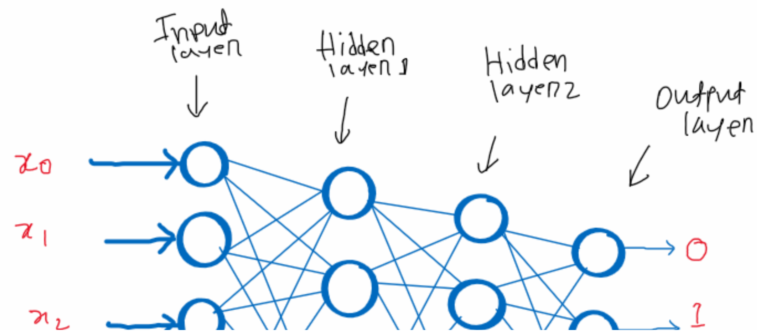


```
In [ ]: plt.figure(figsize=(15,15))
        sns.heatmap(X_train[0], annot=True, cmap="binary")
```

```
Out[16]: <matplotlib.axes._subplots.AxesSubplot at 0x7fb350107390>
```



Architechture Used:



In [ ]:
```python
# Creating layers of ANN
LAYERS = [tf.keras.layers.Flatten(input_shape=[28, 28], name="inputLayer"),
          tf.keras.layers.Dense(300, activation="relu", name="hiddenLayer1"),
          tf.keras.layers.Dense(100, activation="relu", name="hiddenLayer2"),
          tf.keras.layers.Dense(10, activation="softmax", name="outputLayer")] ## We use

model_clf = tf.keras.models.Sequential(LAYERS)
```

In [ ]:
```python
model_clf.layers
```

Out[18]:
```
[<tensorflow.python.keras.layers.core.Flatten at 0x7fb3140a3910>,
 <tensorflow.python.keras.layers.core.Dense at 0x7fb3140a3810>,
 <tensorflow.python.keras.layers.core.Dense at 0x7fb313a90450>,
 <tensorflow.python.keras.layers.core.Dense at 0x7fb313a90850>]
```

In [ ]:
```python
model_clf.summary()
```

```
Model: "sequential"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
inputLayer (Flatten)         (None, 784)               0
_________________________________________________________________
hiddenLayer1 (Dense)         (None, 300)               235500
_________________________________________________________________
hiddenLayer2 (Dense)         (None, 100)               30100
_________________________________________________________________
outputLayer (Dense)          (None, 10)                1010
=================================================================
Total params: 266,610
Trainable params: 266,610
Non-trainable params: 0
_________________________________________________________________
```

In [ ]:
```python
# firsLayer * secondLayer + bias
784*300 + 300, 300*100+100, 100*10+10
```

Out[20]:
```
(235500, 30100, 1010)
```

In [ ]:
```python
# Total parameters to be trained
sum((235500, 30100, 1010))
```

Out[21]:
```
266610
```

In [ ]:
```
hidden1 = model_clf.layers[1]
hidden1.name
```

Out[22]:
```
'hiddenLayer1'
```

In [ ]:
```
len(hidden1.get_weights()[1])
```

Out[23]:
```
300
```

In [ ]:
```
hidden1.get_weights()
```

Out[24]:
```
[array([[-0.04071231,  0.02368394, -0.04371588, ...,  0.03490927,
          0.04804594, -0.04025941],
        [ 0.07241748,  0.04408754,  0.04216108, ...,  0.03603031,
          0.03906497, -0.07369931],
        [-0.05971236,  0.06530608, -0.03200042, ..., -0.00993332,
          0.06796919, -0.05723395],
        ...,
        [ 0.05587782,  0.03816801, -0.04787287, ...,  0.01242442,
          0.02829525, -0.04116471],
        [-0.03556294,  0.06861447,  0.0311735 , ...,  0.05164792,
         -0.00438299, -0.0568511 ],
        [-0.00249385, -0.05429724, -0.03027862, ...,  0.05772662,
          0.03096132, -0.02140954]], dtype=float32),
 array([0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.,
        0., 0., 0., 0., 0., 0., 0., 0., 0., 0., 0.], dtype=float32)]
```

In [ ]:
```
weights, biases = hidden1.get_weights()
```

In [ ]:
```
print("shape\n",weights.shape, "\n")
weights
```

```
shape
 (784, 300)
```

Out[26]:
```
array([[-0.04071231,  0.02368394, -0.04371588, ...,  0.03490927,
         0.04804594, -0.04025941],
       [ 0.07241748,  0.04408754,  0.04216108, ...,  0.03603031,
         0.03906497, -0.07369931],
       [-0.05971236,  0.06530608, -0.03200042, ..., -0.00993332,
         0.06796919, -0.05723395],
       ...,
       [ 0.05587782,  0.03816801, -0.04787287, ...,  0.01242442,
         0.02829525, -0.04116471],
       [-0.03556294,  0.06861447,  0.0311735 , ...,  0.05164792,
        -0.00438299, -0.0568511 ],
       [-0.00249385, -0.05429724, -0.03027862, ...,  0.05772662,
         0.03096132, -0.02140954]], dtype=float32)
```

In [ ]:
```
print("shape\n", biases.shape)
```

```
shape
 (300,)
```

In [ ]:
```
LOSS_FUNCTION = "sparse_categorical_crossentropy" # use => tf.losses.sparse_categorical_
OPTIMIZER = "SGD" # or use with custom learning rate=> tf.keras.optimizers.SGD(0.02)
METRICS = ["accuracy"]

model_clf.compile(loss=LOSS_FUNCTION,
              optimizer=OPTIMIZER,
              metrics=METRICS)
```

In [ ]:

```
# training

EPOCHS = 30
VALIDATION_SET = (X_valid, y_valid)

history = model_clf.fit(X_train, y_train, epochs=EPOCHS,
                    validation_data=VALIDATION_SET, batch_size=32)
```

```
Epoch 1/30
1719/1719 [==============================] - 6s 2ms/step - loss: 0.6108 - accuracy: 0.8
404 - val_loss: 0.3050 - val_accuracy: 0.9118
Epoch 2/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.2860 - accuracy: 0.9
187 - val_loss: 0.2445 - val_accuracy: 0.9314
Epoch 3/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.2347 - accuracy: 0.9
329 - val_loss: 0.2028 - val_accuracy: 0.9444
Epoch 4/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.2007 - accuracy: 0.9
434 - val_loss: 0.1808 - val_accuracy: 0.9494
Epoch 5/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.1753 - accuracy: 0.9
501 - val_loss: 0.1614 - val_accuracy: 0.9562
Epoch 6/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.1554 - accuracy: 0.9
560 - val_loss: 0.1473 - val_accuracy: 0.9606
Epoch 7/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.1391 - accuracy: 0.9
606 - val_loss: 0.1357 - val_accuracy: 0.9632
Epoch 8/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.1257 - accuracy: 0.9
645 - val_loss: 0.1261 - val_accuracy: 0.9656
Epoch 9/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.1146 - accuracy: 0.9
678 - val_loss: 0.1165 - val_accuracy: 0.9680
Epoch 10/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.1053 - accuracy: 0.9
704 - val_loss: 0.1101 - val_accuracy: 0.9688
Epoch 11/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0968 - accuracy: 0.9
729 - val_loss: 0.1042 - val_accuracy: 0.9708
Epoch 12/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0892 - accuracy: 0.9
751 - val_loss: 0.0988 - val_accuracy: 0.9724
Epoch 13/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0827 - accuracy: 0.9
769 - val_loss: 0.0967 - val_accuracy: 0.9722
Epoch 14/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0767 - accuracy: 0.9
788 - val_loss: 0.0947 - val_accuracy: 0.9724
Epoch 15/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0717 - accuracy: 0.9
800 - val_loss: 0.0878 - val_accuracy: 0.9750
Epoch 16/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0668 - accuracy: 0.9
816 - val_loss: 0.0854 - val_accuracy: 0.9750
Epoch 17/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0623 - accuracy: 0.9
832 - val_loss: 0.0854 - val_accuracy: 0.9762
Epoch 18/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0587 - accuracy: 0.9
838 - val_loss: 0.0834 - val_accuracy: 0.9754
Epoch 19/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0547 - accuracy: 0.9
853 - val_loss: 0.0790 - val_accuracy: 0.9764
Epoch 20/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0513 - accuracy: 0.9
```

```
862 - val_loss: 0.0782 - val_accuracy: 0.9760
Epoch 21/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0484 - accuracy: 0.9
872 - val_loss: 0.0764 - val_accuracy: 0.9776
Epoch 22/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0456 - accuracy: 0.9
879 - val_loss: 0.0755 - val_accuracy: 0.9760
Epoch 23/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0427 - accuracy: 0.9
889 - val_loss: 0.0738 - val_accuracy: 0.9766
Epoch 24/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0404 - accuracy: 0.9
897 - val_loss: 0.0720 - val_accuracy: 0.9778
Epoch 25/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0382 - accuracy: 0.9
907 - val_loss: 0.0717 - val_accuracy: 0.9768
Epoch 26/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0357 - accuracy: 0.9
909 - val_loss: 0.0704 - val_accuracy: 0.9776
Epoch 27/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0341 - accuracy: 0.9
918 - val_loss: 0.0731 - val_accuracy: 0.9774
Epoch 28/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0320 - accuracy: 0.9
921 - val_loss: 0.0715 - val_accuracy: 0.9782
Epoch 29/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0303 - accuracy: 0.9
927 - val_loss: 0.0700 - val_accuracy: 0.9790
Epoch 30/30
1719/1719 [==============================] - 3s 2ms/step - loss: 0.0288 - accuracy: 0.9
931 - val_loss: 0.0667 - val_accuracy: 0.9784
```

In [ ]:

```
history.params
```

Out[30]:

```
{'epochs': 30, 'steps': 1719, 'verbose': 1}
```

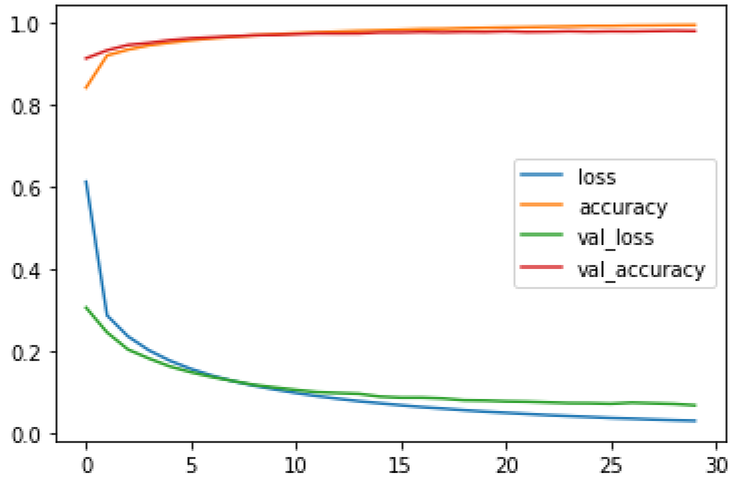
In [ ]:
```
pd.DataFrame(history.history)
```

Out[31]:

	loss	accuracy	val_loss	val_accuracy
0	0.610783	0.840400	0.304987	0.9118
1	0.285988	0.918727	0.244523	0.9314
2	0.234710	0.932945	0.202774	0.9444
3	0.200725	0.943436	0.180845	0.9494
4	0.175329	0.950091	0.161418	0.9562
5	0.155363	0.955982	0.147345	0.9606
6	0.139052	0.960618	0.135747	0.9632
7	0.125705	0.964527	0.126051	0.9656
8	0.114648	0.967818	0.116540	0.9680
9	0.105304	0.970418	0.110109	0.9688
10	0.096849	0.972945	0.104200	0.9708
11	0.089239	0.975055	0.098834	0.9724
12	0.082732	0.976909	0.096679	0.9722
13	0.076676	0.978764	0.094740	0.9724
14	0.071677	0.979964	0.087841	0.9750
15	0.066792	0.981600	0.085419	0.9750
16	0.062317	0.983236	0.085411	0.9762
17	0.058702	0.983764	0.083373	0.9754
18	0.054696	0.985291	0.078985	0.9764
19	0.051254	0.986236	0.078202	0.9760
20	0.048405	0.987182	0.076363	0.9776
21	0.045569	0.987909	0.075493	0.9760
22	0.042715	0.988855	0.073792	0.9766
23	0.040419	0.989673	0.072045	0.9778
24	0.038164	0.990745	0.071726	0.9768
25	0.035741	0.990891	0.070450	0.9776
26	0.034124	0.991782	0.073145	0.9774
27	0.032035	0.992091	0.071539	0.9782
28	0.030310	0.992745	0.070034	0.9790
29	0.028805	0.993127	0.066688	0.9784

In [ ]:
```
pd.DataFrame(history.history).plot()
```

Out[32]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7fb30c471810>
```



In [ ]:
```
model_clf.evaluate(X_test, y_test)
```

```
313/313 [==============================] - 0s 1ms/step - loss: 0.0713 - accuracy: 0.977
7
```

Out[33]:
```
[0.07131989300251007, 0.9776999950408936]
```

In [ ]:
```
x_new = X_test[:3]
# x_new
```

In [ ]:
```
actual = y_test[:3]
actual
```

Out[35]:
```
array([7, 2, 1], dtype=uint8)
```

In [ ]:
```
y_prob = model_clf.predict(x_new)
y_prob.round(3)
```

Out[36]:
```
array([[0.   , 0.   , 0.   , 0.001, 0.   , 0.   , 0.   , 0.999, 0.   ,
        0.   ],
       [0.   , 0.   , 1.   , 0.   , 0.   , 0.   , 0.   , 0.   , 0.   ,
        0.   ],
       [0.   , 0.997, 0.   , 0.   , 0.   , 0.   , 0.   , 0.001, 0.001,
        0.   ]], dtype=float32)
```

In [ ]:
```
y_prob
```

Out[37]:
```
array([[1.26814825e-06, 4.46078133e-07, 1.07542524e-04, 1.11021555e-03,
        8.08912104e-10, 6.93279389e-07, 2.99566656e-11, 9.98763442e-01,
        2.68553026e-06, 1.37673715e-05],
       [1.36328981e-05, 2.90468706e-05, 9.99673128e-01, 1.67828388e-04,
        4.09359916e-12, 2.81948644e-07, 2.40973009e-06, 2.80236584e-10,
        1.13638853e-04, 7.04005257e-11],
       [8.51472032e-06, 9.97284412e-01, 3.58027231e-04, 7.38601229e-05,
        4.06352337e-04, 9.29948001e-05, 1.49637301e-04, 9.27356305e-04,
        6.85796491e-04, 1.29904947e-05]], dtype=float32)
```

In [ ]:
```
y_pred = np.argmax(y_prob, axis = -1)
```

In [ ]:
```
y_pred
```

Out[39]:
```
array([7, 2, 1])
```

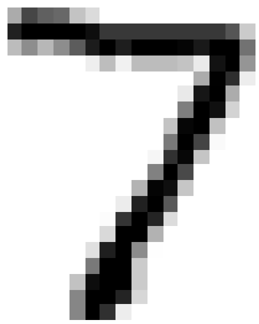
In [ ]:
```
actual
```

Out[40]:
```
array([7, 2, 1], dtype=uint8)
```

In [ ]:

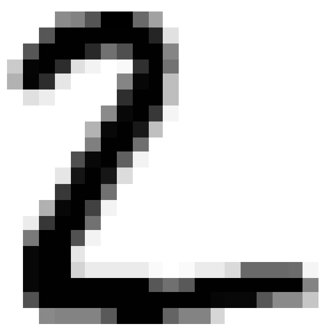
```
# plot
for data, pred, actual_data in zip(x_new, y_pred, actual):
  plt.imshow(data, cmap="binary")
  plt.title(f"Predicted {pred} and Actual {actual_data}")
  plt.axis("off")
  plt.show()
  print("######################")
```

Predicted 7 and Actual 7



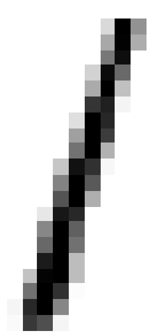
```
######################
```

Predicted 2 and Actual 2



```
######################
```

Predicted 1 and Actual 1



```
######################
```

```
In [ ]:
```