1. Instalasi Kaggle API

Kode Perintah:

```
!pip install kaggle
```

Hasil: Output status reiqurement already satisfied yang dimana kaggle telah di install dalam library python

```
!pip install kaggle

Requirement already satisfied: kaggle in
/usr/local/lib/python3.12/dist-packages (1.7.4.5)
Requirement already satisfied: bleach in
/usr/local/lib/python3.12/dist-packages (from kaggle) (6.3.0)
Requirement already satisfied: certifi>=14.05.14 in
/usr/local/lib/python3.12/dist-packages (from kaggle) (2025.11.12)
Requirement already satisfied: charset-normalizer in
/usr/local/lib/python3.12/dist-packages (from kaggle) (3.4.4)
Requirement already satisfied: idna in /usr/local/lib/python3.12/dist-
packages (from kaggle) (3.11)
Requirement already satisfied: protobuf in
/usr/local/lib/python3.12/dist-packages (from kaggle) (5.29.5)
Requirement already satisfied: python-dateutil>=2.5.3 in
/usr/local/lib/python3.12/dist-packages (from kaggle) (2.9.0.post0)
Requirement already satisfied: python-slugify in
/usr/local/lib/python3.12/dist-packages (from kaggle) (8.0.4)
Requirement already satisfied: requests in
/usr/local/lib/python3.12/dist-packages (from kaggle) (2.32.4)
Requirement already satisfied: setuptools>=21.0.0 in
/usr/local/lib/python3.12/dist-packages (from kaggle) (75.2.0)
Requirement already satisfied: six>=1.10 in
/usr/local/lib/python3.12/dist-packages (from kaggle) (1.17.0)
Requirement already satisfied: text-unidecode in
/usr/local/lib/python3.12/dist-packages (from kaggle) (1.3)
Requirement already satisfied: tqdm in /usr/local/lib/python3.12/dist-
packages (from kaggle) (4.67.1)
Requirement already satisfied: urllib3>=1.15.1 in
/usr/local/lib/python3.12/dist-packages (from kaggle) (2.5.0)
Requirement already satisfied: webencodings in
/usr/local/lib/python3.12/dist-packages (from kaggle) (0.5.1)
```

2. Konfigurasi Kaggle API Key

```
from google.colab import files
files.upload()
#mengunggah file kaggle.json ke lingkungan Google Colab sebagai
autentikasi untuk mengakses dataset Kaggle.
```

```
<IPython.core.display.HTML object>

Saving kaggle.json to kaggle.json

{'kaggle.json':
b'{"username":"riansatriapermana","key":"1ca20d9be657c2d5a9f9497b4609b
23d"}'}
```

```
import os
os.makedirs('/root/.kaggle', exist_ok=True)
os.rename('kaggle.json', '/root/.kaggle/kaggle.json')
os.chmod('/root/.kaggle/kaggle.json', 600)
```

Mengonfigurasi Kaggle API agar dapat digunakan oleh sistem.

- os.makedirs() membuat folder .kaggle.
- os.rename() memindahkan file kaggle.json ke direktori yang sesuai.
- os.chmod(600) mengatur hak akses file agar aman.

```
!kaggle datasets download -d hojjatk/mnist-dataset

Dataset URL: https://www.kaggle.com/datasets/hojjatk/mnist-dataset
License(s): copyright-authors
Downloading mnist-dataset.zip to /content
  0% 0.00/22.0M [00:00<?, ?B/s]
100% 22.0M/22.0M [00:00<00:00, 981MB/s]
```

Mengunduh dataset MNIST dari Kaggle dalam format file ZIP.

- Dataset berisi citra angka tulisan tangan (0–9).
- Dataset akan digunakan sebagai data latih dan data uji.

bertujuan untuk mengunzip file mnist-dataset

```
!unzip mnist-dataset.zip

Archive:  mnist-dataset.zip
  inflating: t10k-images-idx3-ubyte/t10k-images-idx3-ubyte
  inflating: t10k-images.idx3-ubyte
  inflating: t10k-labels-idx1-ubyte/t10k-labels-idx1-ubyte
  inflating: t10k-labels.idx1-ubyte
  inflating: train-images-idx3-ubyte/train-images-idx3-ubyte
  inflating: train-images.idx3-ubyte
  inflating: train-labels-idx1-ubyte/train-labels-idx1-ubyte
  inflating: train-labels.idx1-ubyte
```

Menginstal library idx2numpy untuk membaca file MNIST berformat IDX.

```
!pip install idx2numpy
```

```
Collecting idx2numpy
  Downloading idx2numpy-1.2.3.tar.gz (6.8 kB)
  Preparing metadata (setup.py) ... ent already satisfied: numpy in
/usr/local/lib/python3.12/dist-packages (from idx2numpy) (2.0.2)
Requirement already satisfied: six in /usr/local/lib/python3.12/dist-
packages (from idx2numpy) (1.17.0)
Building wheels for collected packages: idx2numpy
  Building wheel for idx2numpy (setup.py) ... py: filename=idx2numpy-
1.2.3-py3-none-any.whl size=7903
sha256=83e783975a6290bea024e05a32512be7fad76a9f36ff5d36e3a47253b4b536b
d
  Stored in directory:
/root/.cache/pip/wheels/f7/48/00/ae031c97d62f39e1c3c4daa00426c09a65eb2
9ae5753a189ee
Successfully built idx2numpy
Installing collected packages: idx2numpy
Successfully installed idx2numpy-1.2.3
```

Load DATASET MNIST

```
import idx2numpy

x_train = idx2numpy.convert_from_file('train-images.idx3-ubyte')
y_train = idx2numpy.convert_from_file('train-labels.idx1-ubyte')
x_test = idx2numpy.convert_from_file('t10k-images.idx3-ubyte')
y_test = idx2numpy.convert_from_file('t10k-labels.idx1-ubyte')

print(x_train.shape)
print(y_train.shape)
print(x_test.shape)
print(y_test.shape)
```

```
(60000, 28, 28)
(60000,)
(10000, 28, 28)
(10000,)
```

```
# Normalisasi
x_train = x_train / 255.0
x_test = x_test / 255.0

# One-hot encoding
from tensorflow.keras.utils import to_categorical
y_train = to_categorical(y_train, 10)
y_test = to_categorical(y_test, 10)
```

Membangun model MLPP (ANN)

```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.optimizers import Adam

model = Sequential()
model.add(Flatten(input_shape=(28, 28)))
model.add(Dense(128, activation='relu'))
model.add(Dense(64, activation='relu'))
model.add(Dense(10, activation='softmax'))
```

```
/usr/local/lib/python3.12/dist-packages/keras/src/layers/reshaping/
flatten.py:37: UserWarning: Do not pass an `input_shape`/`input_dim`
argument to a layer. When using Sequential models, prefer using an
`Input(shape)` object as the first layer in the model instead.
  super().__init__(**kwargs)
```

```
model.compile(
    optimizer=Adam(learning_rate=0.001),
    loss='categorical_crossentropy',
    metrics=['accuracy']
)

model.summary()
```

```
Model: "sequential"
```

```
┏━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━━━━━━━━━━┳━━━━━━━━━━━━━━━┓
┃ Layer (type)                    ┃ Output Shape           ┃       Param # ┃
┡━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━━━━━━━━━━╇━━━━━━━━━━━━━━━┩
│ flatten (Flatten)               │ (None, 784)            │             0 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ dense (Dense)                   │ (None, 128)            │       100,480 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ dense_1 (Dense)                 │ (None, 64)             │         8,256 │
├─────────────────────────────────┼────────────────────────┼───────────────┤
│ dense_2 (Dense)                 │ (None, 10)             │           650 │
└─────────────────────────────────┴────────────────────────┴───────────────┘
```

```
 Total params: 109,386 (427.29 KB)

 Trainable params: 109,386 (427.29 KB)

 Non-trainable params: 0 (0.00 B)
```

```
history = model.fit(
    x_train,
    y_train,
    epochs=10,
    batch_size=128,
    validation_split=0.2
)
```

```
Epoch 1/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 4s 7ms/step - accuracy: 0.7969 - loss:
0.6964 - val_accuracy: 0.9470 - val_loss: 0.1882
Epoch 2/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - accuracy: 0.9518 - loss:
0.1667 - val_accuracy: 0.9632 - val_loss: 0.1317
Epoch 3/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 3s 9ms/step - accuracy: 0.9680 - loss:
0.1104 - val_accuracy: 0.9669 - val_loss: 0.1113
Epoch 4/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 3s 7ms/step - accuracy: 0.9760 - loss:
0.0822 - val_accuracy: 0.9678 - val_loss: 0.1080
Epoch 5/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - accuracy: 0.9823 - loss:
0.0622 - val_accuracy: 0.9680 - val_loss: 0.1112
Epoch 6/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 3s 7ms/step - accuracy: 0.9855 - loss:
0.0501 - val_accuracy: 0.9710 - val_loss: 0.0969
Epoch 7/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - accuracy: 0.9876 - loss:
0.0422 - val_accuracy: 0.9707 - val_loss: 0.1029
Epoch 8/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 4s 10ms/step - accuracy: 0.9909 - loss:
0.0309 - val_accuracy: 0.9744 - val_loss: 0.0945
Epoch 9/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - accuracy: 0.9928 - loss:
0.0267 - val_accuracy: 0.9736 - val_loss: 0.0965
Epoch 10/10
375/375 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - accuracy: 0.9933 - loss:
0.0220 - val_accuracy: 0.9710 - val_loss: 0.1102
```

Evaluasi Model

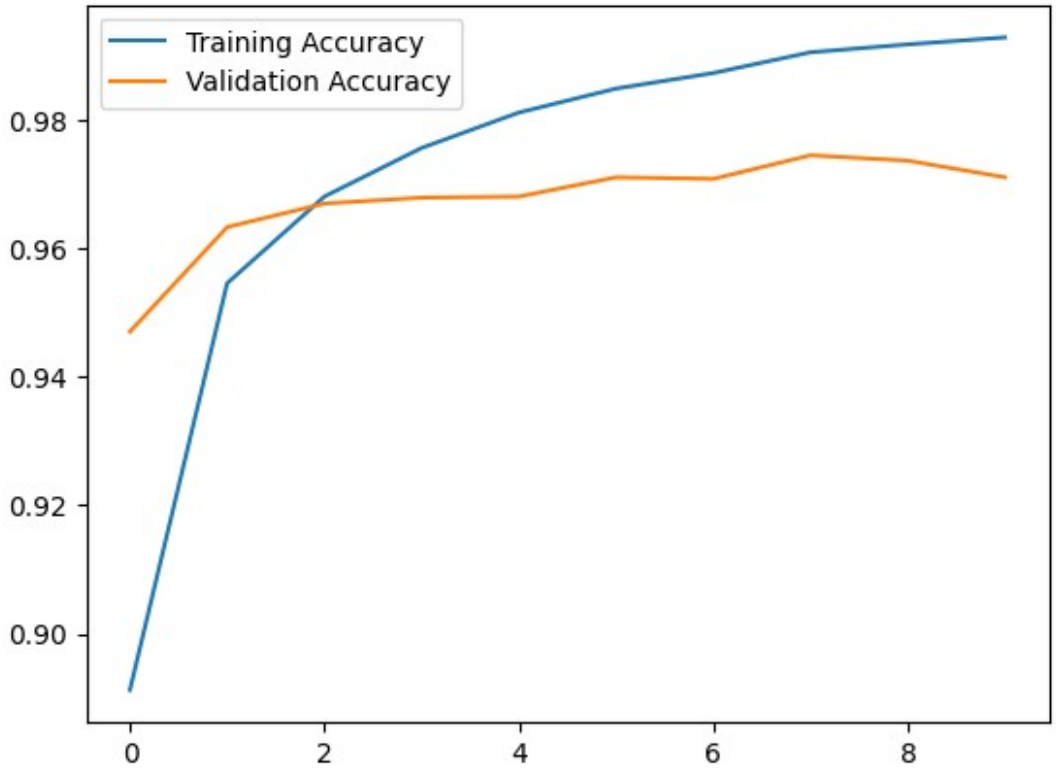
```
loss, accuracy = model.evaluate(x_test, y_test)
print("Test Loss:", loss)
print("Test Accuracy:", accuracy)
```

```
313/313 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - accuracy: 0.9631 - loss: 0.1313
Test Loss: 0.11139214783906937
Test Accuracy: 0.9696999788284302
```

Visualisasi Model

```
import matplotlib.pyplot as plt

plt.plot(history.history['accuracy'], label='Training Accuracy')
plt.plot(history.history['val_accuracy'], label='Validation Accuracy')
plt.legend()
plt.show()
```



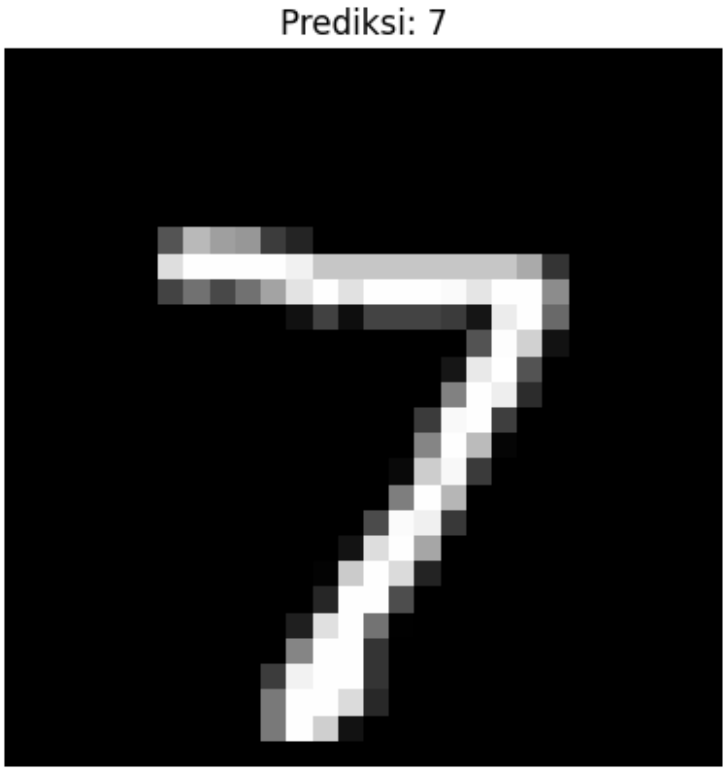
Prediksi Hasil

```
import numpy as np

predictions = model.predict(x_test)

plt.imshow(x_test[0], cmap='gray')
plt.title(f"Prediksi: {np.argmax(predictions[0])}")
plt.axis('off')
plt.show()
```

```
313/313 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step
```




```

```