In [1]:
```
pip install tensorflow
```

```
Defaulting to user installation because normal site-packages is not writeable
Note: you may need to restart the kernel to use updated packages.


Requirement already satisfied: tensorflow in c:\users\sakshi's pc\appdata\roa
ming\python\python311\site-packages (2.15.0)
Requirement already satisfied: tensorflow-intel==2.15.0 in c:\users\sakshi's
pc\appdata\roaming\python\python311\site-packages (from tensorflow) (2.15.0)
Requirement already satisfied: absl-py>=1.0.0 in c:\users\sakshi's pc\appdata
\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->tenso
rflow) (2.0.0)
Requirement already satisfied: astunparse>=1.6.0 in c:\users\sakshi's pc\appd
ata\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->te
nsorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=23.5.26 in c:\users\sakshi's pc\a
ppdata\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0-
>tensorflow) (23.5.26)
Requirement already satisfied: gast!=0.5.0,!=0.5.1,!=0.5.2,>=0.2.1 in c:\user
s\sakshi's pc\appdata\roaming\python\python311\site-packages (from tensorflow
-intel==2.15.0->tensorflow) (0.5.4)
Requirement already satisfied: google-pasta>=0.1.1 in c:\users\sakshi's pc\ap
pdata\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->
tensorflow) (0.2.0)
Requirement already satisfied: h5py>=2.9.0 in c:\programdata\anaconda3\lib\si
te-packages (from tensorflow-intel==2.15.0->tensorflow) (3.9.0)
Requirement already satisfied: libclang>=13.0.0 in c:\users\sakshi's pc\appda
ta\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->ten
sorflow) (16.0.6)
Requirement already satisfied: ml-dtypes~=0.2.0 in c:\users\sakshi's pc\appda
ta\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->ten
sorflow) (0.2.0)
Requirement already satisfied: numpy<2.0.0,>=1.23.5 in c:\programdata\anacond
a3\lib\site-packages (from tensorflow-intel==2.15.0->tensorflow) (1.24.3)
Requirement already satisfied: opt-einsum>=2.3.2 in c:\users\sakshi's pc\appd
ata\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->te
nsorflow) (3.3.0)
Requirement already satisfied: packaging in c:\programdata\anaconda3\lib\site
-packages (from tensorflow-intel==2.15.0->tensorflow) (23.1)
Requirement already satisfied: protobuf!=4.21.0,!=4.21.1,!=4.21.2,!=4.21.3,!=
4.21.4,!=4.21.5,<5.0.0dev,>=3.20.3 in c:\users\sakshi's pc\appdata\roaming\py
thon\python311\site-packages (from tensorflow-intel==2.15.0->tensorflow) (4.2
3.4)
Requirement already satisfied: setuptools in c:\programdata\anaconda3\lib\sit
e-packages (from tensorflow-intel==2.15.0->tensorflow) (68.0.0)
Requirement already satisfied: six>=1.12.0 in c:\programdata\anaconda3\lib\si
te-packages (from tensorflow-intel==2.15.0->tensorflow) (1.16.0)
Requirement already satisfied: termcolor>=1.1.0 in c:\users\sakshi's pc\appda
ta\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->ten
sorflow) (2.3.0)
Requirement already satisfied: typing-extensions>=3.6.6 in c:\programdata\ana
conda3\lib\site-packages (from tensorflow-intel==2.15.0->tensorflow) (4.7.1)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in c:\programdata\anaconda
3\lib\site-packages (from tensorflow-intel==2.15.0->tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in c:\use
rs\sakshi's pc\appdata\roaming\python\python311\site-packages (from tensorflo
w-intel==2.15.0->tensorflow) (0.31.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in c:\users\sakshi's pc\ap
pdata\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->
```

```
tensorflow) (1.59.3)
Requirement already satisfied: tensorboard<2.16,>=2.15 in c:\users\sakshi's p
c\appdata\roaming\python\python311\site-packages (from tensorflow-intel==2.1
5.0->tensorflow) (2.15.1)
Requirement already satisfied: tensorflow-estimator<2.16,>=2.15.0 in c:\users
\sakshi's pc\appdata\roaming\python\python311\site-packages (from tensorflow-
intel==2.15.0->tensorflow) (2.15.0)
Requirement already satisfied: keras<2.16,>=2.15.0 in c:\users\sakshi's pc\ap
pdata\roaming\python\python311\site-packages (from tensorflow-intel==2.15.0->
tensorflow) (2.15.0)
Requirement already satisfied: wheel<1.0,>=0.23.0 in c:\programdata\anaconda3
\lib\site-packages (from astunparse>=1.6.0->tensorflow-intel==2.15.0->tensorf
low) (0.38.4)
Requirement already satisfied: google-auth<3,>=1.6.3 in c:\users\sakshi's pc
\appdata\roaming\python\python311\site-packages (from tensorboard<2.16,>=2.15
->tensorflow-intel==2.15.0->tensorflow) (2.23.4)
Requirement already satisfied: google-auth-oauthlib<2,>=0.5 in c:\users\saksh
i's pc\appdata\roaming\python\python311\site-packages (from tensorboard<2.16,
>=2.15->tensorflow-intel==2.15.0->tensorflow) (1.1.0)
Requirement already satisfied: markdown>=2.6.8 in c:\programdata\anaconda3\li
b\site-packages (from tensorboard<2.16,>=2.15->tensorflow-intel==2.15.0->tens
orflow) (3.4.1)
Requirement already satisfied: requests<3,>=2.21.0 in c:\programdata\anaconda
3\lib\site-packages (from tensorboard<2.16,>=2.15->tensorflow-intel==2.15.0->
tensorflow) (2.31.0)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in c:\us
ers\sakshi's pc\appdata\roaming\python\python311\site-packages (from tensorbo
ard<2.16,>=2.15->tensorflow-intel==2.15.0->tensorflow) (0.7.2)
Requirement already satisfied: werkzeug>=1.0.1 in c:\programdata\anaconda3\li
b\site-packages (from tensorboard<2.16,>=2.15->tensorflow-intel==2.15.0->tens
orflow) (2.2.3)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in c:\users\sakshi's pc
\appdata\roaming\python\python311\site-packages (from google-auth<3,>=1.6.3->
tensorboard<2.16,>=2.15->tensorflow-intel==2.15.0->tensorflow) (5.3.2)
Requirement already satisfied: pyasn1-modules>=0.2.1 in c:\programdata\anacon
da3\lib\site-packages (from google-auth<3,>=1.6.3->tensorboard<2.16,>=2.15->t
ensorflow-intel==2.15.0->tensorflow) (0.2.8)
Requirement already satisfied: rsa<5,>=3.1.4 in c:\users\sakshi's pc\appdata
\roaming\python\python311\site-packages (from google-auth<3,>=1.6.3->tensorbo
ard<2.16,>=2.15->tensorflow-intel==2.15.0->tensorflow) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in c:\users\sakshi's
pc\appdata\roaming\python\python311\site-packages (from google-auth-oauthlib<
2,>=0.5->tensorboard<2.16,>=2.15->tensorflow-intel==2.15.0->tensorflow) (1.3.
1)
Requirement already satisfied: charset-normalizer<4,>=2 in c:\programdata\ana
conda3\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->
tensorflow-intel==2.15.0->tensorflow) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in c:\programdata\anaconda3\lib\s
ite-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensorflow-i
ntel==2.15.0->tensorflow) (3.4)
Requirement already satisfied: urllib3<3,>=1.21.1 in c:\programdata\anaconda3
\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensor
flow-intel==2.15.0->tensorflow) (1.26.16)
Requirement already satisfied: certifi>=2017.4.17 in c:\programdata\anaconda3
\lib\site-packages (from requests<3,>=2.21.0->tensorboard<2.16,>=2.15->tensor
flow-intel==2.15.0->tensorflow) (2023.7.22)
Requirement already satisfied: MarkupSafe>=2.1.1 in c:\programdata\anaconda3
```

```
\lib\site-packages (from werkzeug>=1.0.1->tensorboard<2.16,>=2.15->tensorflow
-intel==2.15.0->tensorflow) (2.1.1)
Requirement already satisfied: pyasn1<0.5.0,>=0.4.6 in c:\programdata\anacond
a3\lib\site-packages (from pyasn1-modules>=0.2.1->google-auth<3,>=1.6.3->tens
orboard<2.16,>=2.15->tensorflow-intel==2.15.0->tensorflow) (0.4.8)
Requirement already satisfied: oauthlib>=3.0.0 in c:\users\sakshi's pc\appdat
a\roaming\python\python311\site-packages (from requests-oauthlib>=0.7.0->goog
le-auth-oauthlib<2,>=0.5->tensorboard<2.16,>=2.15->tensorflow-intel==2.15.0->
tensorflow) (3.2.2)
```

In [2]:
```
pip install keras
```

```
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: keras in c:\users\sakshi's pc\appdata\roaming
\python\python311\site-packages (2.15.0)
Note: you may need to restart the kernel to use updated packages.
```

In [3]:
```python
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.utils import to_categorical
```

```
WARNING:tensorflow:From C:\Users\Sakshi's PC\AppData\Roaming\Python\Python311
\site-packages\keras\src\losses.py:2976: The name tf.losses.sparse_softmax_cr
oss_entropy is deprecated. Please use tf.compat.v1.losses.sparse_softmax_cros
s_entropy instead.
```

In [4]:
```python
url = "https://archive.ics.uci.edu/ml/machine-learning-databases/letter-recogn
columns = ['letter', 'x-box', 'y-box', 'width', 'height', 'onpix', 'x-bar', 'y
data = pd.read_csv(url, names=columns)
```

In [5]:
```python
label_encoder = LabelEncoder()
data['letter'] = label_encoder.fit_transform(data['letter'])
```

In [6]:
```python
X = data.drop('letter', axis=1).values
y = to_categorical(data['letter'].values)    # One-hot encoding of labels

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, rando
```

In [7]:
```python
model = Sequential([
    Dense(128, input_shape=(16,), activation='relu'),
    Dense(64, activation='relu'),
    Dense(26, activation='softmax')  # 26 output units for 26 letters
])
```

WARNING:tensorflow:From C:\Users\Sakshi's PC\AppData\Roaming\Python\Python311
\site-packages\keras\src\backend.py:873: The name tf.get_default_graph is dep
recated. Please use tf.compat.v1.get_default_graph instead.

In [8]:
```python
model.compile(optimizer='adam', loss='categorical_crossentropy', metrics=['acc
```

WARNING:tensorflow:From C:\Users\Sakshi's PC\AppData\Roaming\Python\Python311
\site-packages\keras\src\optimizers__init__.py:309: The name tf.train.Optimi
zer is deprecated. Please use tf.compat.v1.train.Optimizer instead.

In [9]:
```python
model.fit(X_train, y_train, epochs=50, batch_size=32, validation_split=0.2)
```

```
Epoch 1/50
WARNING:tensorflow:From C:\Users\Sakshi's PC\AppData\Roaming\Python\Python
311\site-packages\keras\src\utils\tf_utils.py:492: The name tf.ragged.Ragg
edTensorValue is deprecated. Please use tf.compat.v1.ragged.RaggedTensorVa
lue instead.

WARNING:tensorflow:From C:\Users\Sakshi's PC\AppData\Roaming\Python\Python
311\site-packages\keras\src\engine\base_layer_utils.py:384: The name tf.ex
ecuting_eagerly_outside_functions is deprecated. Please use tf.compat.v1.e
xecuting_eagerly_outside_functions instead.

400/400 [==============================] - 2s 3ms/step - loss: 1.7790 - ac
curacy: 0.5056 - val_loss: 1.1560 - val_accuracy: 0.6837
Epoch 2/50
400/400 [==============================] - 1s 3ms/step - loss: 1.0002 - ac
curacy: 0.7180 - val_loss: 0.9405 - val_accuracy: 0.7331
Epoch 3/50
400/400 [==============================] - 1s 2ms/step - loss: 0.8074 - ac
curacy: 0.7710 - val_loss: 0.7646 - val_accuracy: 0.7897
```

In [10]:
```python
loss, accuracy = model.evaluate(X_test, y_test)
print(f"Test Accuracy: {accuracy*100:.2f}%")
```

```
125/125 [==============================] - 0s 2ms/step - loss: 0.1939 - accur
acy: 0.9377
Test Accuracy: 93.77%
```

In [12]:
```python
pred = model.predict(X_test)
pred
```

```
125/125 [==============================] - 0s 2ms/step
```

Out[12]:
```
array([[2.1889560e-11, 3.3557399e-08, 1.3694292e-08, ..., 2.6282030e-01,
        1.4941163e-06, 3.0130900e-02],
       [1.6559906e-04, 5.9961501e-08, 7.1185779e-05, ..., 1.7011902e-06,
        1.1779878e-08, 4.7514347e-14],
       [1.0000000e+00, 6.1382838e-14, 9.5652218e-21, ..., 9.5359541e-16,
        1.9236000e-21, 1.0235353e-14],
       ...,
       [2.8822982e-18, 1.9710142e-19, 1.6709896e-07, ..., 1.0897102e-12,
        2.2320210e-19, 8.6262394e-13],
       [3.2257176e-08, 1.3980318e-12, 4.3752035e-13, ..., 8.9267829e-08,
        9.9995780e-01, 2.9342933e-05],
       [7.4276807e-11, 4.1154737e-22, 4.3930024e-20, ..., 9.9763145e-07,
        9.9992430e-01, 5.1801445e-31]], dtype=float32)
```

In [ ]:

In [ ]:

In [ ]: