

```
!pip install -q kaggle
```

```
from google.colab import files
files.upload()
```

Choose Files

No file chosen

Upload widget is only available when the cell has been

executed in the current browser session. Please rerun this cell to enable.

Saving kaggle.json to kaggle (1).json

```
{'kaggle.json': ...}
```

```
!mkdir ~/.kaggle
```

```
mkdir: cannot create directory '/root/.kaggle': File exists
```

```
!cp kaggle.json ~/.kaggle/
```

```
!chmod 600 ~/.kaggle/kaggle.json
```

```
!kaggle datasets list
```

ref	title	size	lastUpd
arnabchaki/data-science-salaries-2023	Data Science Salaries 2023	25KB	2023-04
asahu40/walmart-data-analysis-and-forecasting	Walmart Data Analysis and Forecasting	122KB	2023-04
ahmedshahriarsakib/usa-real-estate-dataset	USA Real Estate Dataset	1MB	2023-04
iammustafatz/diabetes-prediction-dataset	Diabetes prediction dataset	734KB	2023-04
desalegngeb/students-exam-scores	Students Exam Scores: Extended Dataset	695KB	2023-04
sougatapramanick/happiness-index-2018-2019	Happiness Index 2018-2019	15KB	2023-04
salvatorerastelli/spotify-and-youtube	Spotify and Youtube	9MB	2023-03
rajkumarpandey02/list-of-epidemics-and-pandemics-in-world-history	List of Epidemics and Pandemics in World History	10KB	2023-05
nadyinky/sephora-products-and-skincare-reviews	Sephora Products and Skincare Reviews	175MB	2023-04
rishabhgupta/best-movies-on-netflix	Top 100 Movies on Netflix	32KB	2023-04
thabresh/2023-countries-by-population	2023 Countries by Population	17KB	2023-04
harshghadiya/covid-19-country-statistics-dataset	Covid-19-country-statistics-dataset	13KB	2023-04
mohamedafsal007/house-price-dataset-of-india	House Price dataset of India	480KB	2023-03
023	Indian Restaurants 2023	139KB	2023-04
Amazon Products Sales Dataset 2023	Amazon Products Sales Dataset 2023	80MB	2023-03
Motor Vehicle Collisions	Motor Vehicle Collisions	78MB	2023-04
bilalwaseer/all-time-worldwide-box-office-for-action-movies	All Time Worldwide Box Office for Action Movies	51KB	2023-04
erdentaha/cancer-data	Cancer Data	49KB	2023-03
tayyarhussain/best-selling-video-games-of-all-time	Best-Selling Video Games of All Time	2KB	2023-04
dansbecker/melbourne-housing-snapshot	Melbourne Housing Snapshot	451KB	2018-06

Saved successfully!

```
!kaggle datasets download "suvoov/hindi-character-recognition"
```

```
hindi-character-recognition.zip: Skipping, found more recently modified local copy (use --force to force download)
```

```
!unzip hindi-character-recognition.zip
```

```
Archive: hindi-character-recognition.zip
```

```
replace DevanagariHandwrittenCharacterDataset/Test/character_10_yna/10544.png? [y]es, [n]o, [A]ll, [N]one, [r]ename:
```

```
!pip install tensorflow
```

```
Looking in indexes: https://pypi.org/simple, https://us-python.pkg.dev/colab-wheels/public/simple/
Requirement already satisfied: tensorflow in /usr/local/lib/python3.10/dist-packages (2.12.0)
Requirement already satisfied: absl-py>=1.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.4.0)
Requirement already satisfied: astunparse>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.6.3)
Requirement already satisfied: flatbuffers>=2.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (23.3.3)
Requirement already satisfied: gast<=0.4.0,>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.0)
Requirement already satisfied: google-pasta>=0.1.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.2.0)
Requirement already satisfied: grpcio<2.0,>=1.24.3 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.54.0)
Requirement already satisfied: h5py>=2.9.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.8.0)
Requirement already satisfied: jax>=0.3.15 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0.4.8)
Requirement already satisfied: keras<2.13,>=2.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.0)
Requirement already satisfied: libclang>=13.0.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (16.0.0)
Requirement already satisfied: numpy<1.24,>=1.22 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.22.4)
Requirement already satisfied: opt-einsum>=2.3.2 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (3.3.0)
Requirement already satisfied: packaging in /usr/local/lib/python3.10/dist-packages (from 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 /usr/local/lib/p
Requirement already satisfied: setuptools in /usr/local/lib/python3.10/dist-packages (from tensorflow) (67.7.2)
Requirement already satisfied: six>=1.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.16.0)
Requirement already satisfied: tensorboard<2.13,>=2.12 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.12.2)
Requirement already satisfied: tensorflow-estimator<2.13,>=2.12.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.1
Requirement already satisfied: termcolor>=1.1.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (2.3.0)
Requirement already satisfied: typing-extensions>=3.6.6 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (4.5.0)
Requirement already satisfied: wrapt<1.15,>=1.11.0 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (1.14.1)
Requirement already satisfied: tensorflow-io-gcs-filesystem>=0.23.1 in /usr/local/lib/python3.10/dist-packages (from tensorflow) (0
Requirement already satisfied: wheel<1.0,>=0.23.0 in /usr/local/lib/python3.10/dist-packages (from astunparse>=1.6.0->tensorflow) (
Requirement already satisfied: ml-dtypes>=0.0.3 in /usr/local/lib/python3.10/dist-packages (from jax>=0.3.15->tensorflow) (0.1.0)
```

```
Requirement already satisfied: scipy>=1.7 in /usr/local/lib/python3.10/dist-packages (from jax>=0.3.15->tensorflow) (1.10.1)
Requirement already satisfied: google-auth<3,>=1.6.3 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (2.21.0)
Requirement already satisfied: google-auth-oauthlib<1.1,>=0.5 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (0.7.0)
Requirement already satisfied: markdown>=2.6.8 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (3.4.1)
Requirement already satisfied: requests<3,>=2.21.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (2.28.1)
Requirement already satisfied: tensorboard-data-server<0.8.0,>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (0.7.0)
Requirement already satisfied: tensorboard-plugin-wit>=1.6.0 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (1.8.1)
Requirement already satisfied: werkzeug>=1.0.1 in /usr/local/lib/python3.10/dist-packages (from tensorboard<2.13,>=2.12->tensorboard) (2.3.7)
Requirement already satisfied: cachetools<6.0,>=2.0.0 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard) (5.3.1)
Requirement already satisfied: pyasn1-modules>=0.2.1 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard) (0.3.1)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.10/dist-packages (from google-auth<3,>=1.6.3->tensorboard) (4.9)
Requirement already satisfied: requests-oauthlib>=0.7.0 in /usr/local/lib/python3.10/dist-packages (from google-auth-oauthlib<1.1,>=0.5->tensorboard) (1.3.1)
Requirement already satisfied: urllib3<1.27,>=1.21.1 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard) (2.0.4)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard) (2023.7.22)
Requirement already satisfied: charset-normalizer~=2.0.0 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.10/dist-packages (from requests<3,>=2.21.0->tensorboard) (3.4)
Requirement already satisfied: MarkupSafe>=2.1.1 in /usr/local/lib/python3.10/dist-packages (from werkzeug>=1.0.1->tensorboard) (2.1.3)
Requirement already satisfied: pyasn1<0.6.0,>=0.4.6 in /usr/local/lib/python3.10/dist-packages (from pyasn1-modules>=0.2.1->google-auth) (0.5.1)
Requirement already satisfied: oauthlib>=3.0.0 in /usr/local/lib/python3.10/dist-packages (from requests-oauthlib>=0.7.0->google-auth) (3.2.2)
```

```
import numpy as np
import tensorflow as tf
from tensorflow.keras import layers
from tensorflow.keras.models import Sequential
from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
img_width, img_height = 32, 32
num_classes = 46
```

```
train_dir = r"/content/DevanagariHandwrittenCharacterDataset/Train"
test_dir = r"/content/DevanagariHandwrittenCharacterDataset/Test"
```

```
train_datagen = ImageDataGenerator(rescale=1./255)
test_datagen = ImageDataGenerator(rescale=1./255)
```

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```
train_generator = train_datagen.flow_from_directory(
    train_dir,
    target_size=(img_width, img_height),
    batch_size=32,
    color_mode='grayscale',
    class_mode='categorical')

test_generator = test_datagen.flow_from_directory(
    test_dir,
    target_size=(img_width, img_height),
    batch_size=32,
    color_mode='grayscale',
    class_mode='categorical')
```

```
Found 78200 images belonging to 46 classes.
Found 13800 images belonging to 46 classes.
```

```
model = Sequential([
    layers.Conv2D(32, (3, 3), activation='relu', input_shape=(img_width, img_height, 1)),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(64, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Conv2D(128, (3, 3), activation='relu'),
    layers.MaxPooling2D((2, 2)),
    layers.Flatten(),
    layers.Dense(128, activation='relu'),
    layers.Dense(num_classes, activation='softmax')
])
```

```
# Compile the model
model.compile(optimizer='adam',
              loss='categorical_crossentropy',
              metrics=['accuracy'])
```

```
history = model.fit(
    train_generator,
    epochs=50,
    validation_data=test_generator)
```

```
Epoch 1/50
2444/2444 [=====] - 116s 18ms/step - loss: 0.5311 - accuracy: 0.8473 - val_loss: 0.1766 - val_accuracy
Epoch 2/50
```

```

2444/2444 [=====] - 44s 18ms/step - loss: 0.1355 - accuracy: 0.9579 - val_loss: 0.1370 - val_accuracy:
Epoch 3/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0846 - accuracy: 0.9736 - val_loss: 0.1101 - val_accuracy:
Epoch 4/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0627 - accuracy: 0.9798 - val_loss: 0.0881 - val_accuracy:
Epoch 5/50
2444/2444 [=====] - 48s 20ms/step - loss: 0.0482 - accuracy: 0.9842 - val_loss: 0.0829 - val_accuracy:
Epoch 6/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0375 - accuracy: 0.9881 - val_loss: 0.0811 - val_accuracy:
Epoch 7/50
2444/2444 [=====] - 48s 20ms/step - loss: 0.0329 - accuracy: 0.9892 - val_loss: 0.0900 - val_accuracy:
Epoch 8/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0281 - accuracy: 0.9909 - val_loss: 0.1284 - val_accuracy:
Epoch 9/50
2444/2444 [=====] - 48s 20ms/step - loss: 0.0240 - accuracy: 0.9922 - val_loss: 0.0902 - val_accuracy:
Epoch 10/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0229 - accuracy: 0.9925 - val_loss: 0.0894 - val_accuracy:
Epoch 11/50
2444/2444 [=====] - 49s 20ms/step - loss: 0.0222 - accuracy: 0.9928 - val_loss: 0.1026 - val_accuracy:
Epoch 12/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0187 - accuracy: 0.9939 - val_loss: 0.1109 - val_accuracy:
Epoch 13/50
2444/2444 [=====] - 44s 18ms/step - loss: 0.0171 - accuracy: 0.9944 - val_loss: 0.0954 - val_accuracy:
Epoch 14/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0158 - accuracy: 0.9949 - val_loss: 0.1068 - val_accuracy:
Epoch 15/50
2444/2444 [=====] - 48s 20ms/step - loss: 0.0176 - accuracy: 0.9946 - val_loss: 0.1136 - val_accuracy:
Epoch 16/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0143 - accuracy: 0.9958 - val_loss: 0.1136 - val_accuracy:
Epoch 17/50
2444/2444 [=====] - 48s 20ms/step - loss: 0.0153 - accuracy: 0.9950 - val_loss: 0.1120 - val_accuracy:
Epoch 18/50
2444/2444 [=====] - 42s 17ms/step - loss: 0.0143 - accuracy: 0.9955 - val_loss: 0.0940 - val_accuracy:
Epoch 19/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0117 - accuracy: 0.9963 - val_loss: 0.1071 - val_accuracy:
Epoch 20/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0150 - accuracy: 0.9956 - val_loss: 0.1240 - val_accuracy:
Epoch 21/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0126 - accuracy: 0.9962 - val_loss: 0.1094 - val_accuracy:
Epoch 22/50
2444/2444 [=====] - 44s 18ms/step - loss: 0.0121 - accuracy: 0.9964 - val_loss: 0.1216 - val_accuracy:
Epoch 23/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0125 - accuracy: 0.9963 - val_loss: 0.1206 - val_accuracy:
Epoch 24/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0137 - accuracy: 0.9958 - val_loss: 0.1100 - val_accuracy:
Epoch 25/50
2444/2444 [=====] - 44s 18ms/step - loss: 0.0105 - accuracy: 0.9970 - val_loss: 0.1275 - val_accuracy:
Epoch 26/50
2444/2444 [=====] - 43s 18ms/step - loss: 0.0123 - accuracy: 0.9966 - val_loss: 0.1347 - val_accuracy:
Epoch 27/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0121 - accuracy: 0.9964 - val_loss: 0.1170 - val_accuracy:
Epoch 28/50
2444/2444 [=====] - 43s 17ms/step - loss: 0.0104 - accuracy: 0.9970 - val_loss: 0.1321 - val_accuracy:

```

Saved successfully!

```
import tensorflow as tf
```

```
print(tf.config.list_physical_devices('GPU'))
```

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

```
print(tf.config.list_physical_devices('GPU'))
```

```
print(tf.config.experimental.list_physical_devices('GPU'))
```

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

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

```
import os
```

```
os.environ['CUDA_VISIBLE_DEVICES'] = '0'
```

```
# Evaluate the model on the testing dataset
```

```
test_loss, test_acc = model.evaluate(test_generator)
```

```
print('Test accuracy:', test_acc)
```

```
432/432 [=====] - 7s 15ms/step - loss: 0.1694 - accuracy: 0.9838
```

```
Test accuracy: 0.9838405847549438
```

```
img_path = r"/content/DevanagariHandwrittenCharacterDataset/Test/character_11_taamatar/10592.png"
```

```
img = tf.keras.preprocessing.image.load_img(img_path, target_size=(img_width, img_height), color_mode='grayscale')
```

```
# Preprocess the input image
```

```
x = tf.keras.preprocessing.image.img_to_array(img)
```

```
x = np.expand_dims(x, axis=0)
```

```
x /= 255.  
  
# Classify the input image using the trained model  
prediction = model.predict(x)  
  
# Get the predicted class label  
predicted_class = np.argmax(prediction)  
  
# Get the folder name of the predicted class  
class_dict = train_generator.class_indices  
folder_name = [k for k, v in class_dict.items() if v == predicted_class][0]  
  
print('Predicted folder name:', folder_name)  
  
1/1 [=====] - 0s 185ms/step  
Predicted folder name: character_11_taamatar  
  
import matplotlib.pyplot as plt  
plt.imshow(img, cmap='gray')  
plt.axis('off')  
plt.show()
```

