oftj94fdx

June 19, 2024

train_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/train'

[9]: import os, shutil

```
validation_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/validation'
      test_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/test'
[10]: from keras.utils import image_dataset_from_directory
      IMG_SIZE = 150
      train_dataset = image_dataset_from_directory(
      train_dir,
      image_size=(IMG_SIZE, IMG_SIZE),
      batch_size=32)
      validation_dataset = image_dataset_from_directory(
      validation_dir,
      image_size=(IMG_SIZE, IMG_SIZE),
      batch_size=32)
      test_dataset = image_dataset_from_directory(
      test_dir,
      image_size=(IMG_SIZE, IMG_SIZE),
      batch_size=32)
     Found 40000 files belonging to 10 classes.
     Found 10000 files belonging to 10 classes.
     Found 10000 files belonging to 10 classes.
[11]: from tensorflow import keras
      from tensorflow.keras import layers
      from tensorflow.keras.preprocessing import image
      import numpy as np
      import tensorflow as tf # Import TensorFlow explicitly
      from tensorflow.keras.applications import VGG16 # Correct import statement for
       →VGG16
      conv_base = VGG16(weights='imagenet', include top=False, input_shape=(IMG_SIZE,__
       →IMG_SIZE, 3))
      # Função para extrair características e rótulos dos datasets
```

```
def get_features_and_labels(dataset):
    all features = []
    all_labels = []
    for images, labels in dataset:
        preprocessed_images = keras.applications.vgg16.preprocess_input(images)
        features = conv_base.predict(preprocessed_images)
        all features.append(features)
        all_labels.append(labels)
    return np.concatenate(all features), np.concatenate(all labels)
# Extrair características dos datasets de treino, validação e teste
train_features, train_labels = get_features_and_labels(train_dataset)
val features, val labels = get features and labels(validation_dataset)
test_features, test_labels = get_features_and_labels(test_dataset)
# Definição do modelo denso a partir das características extraídas
inputs = keras.Input(shape=(4, 4, 512))
x = layers.Flatten()(inputs)
x = layers.Dense(256, activation='relu')(x)
x = layers.Dropout(0.5)(x)
outputs = layers.Dense(10, activation="softmax")(x)
model = keras.Model(inputs, outputs)
1/1
               1s 596ms/step
               1s 536ms/step
               1s 528ms/step
```

```
1/1
1/1
1/1
                1s 508ms/step
1/1
                0s 485ms/step
1/1
                1s 526ms/step
1/1
                1s 525ms/step
1/1
                1s 504ms/step
1/1
                1s 512ms/step
1/1
                Os 495ms/step
1/1
                1s 530ms/step
1/1
                1s 517ms/step
1/1
                Os 493ms/step
1/1
                1s 529ms/step
1/1
                1s 501ms/step
1/1
                1s 512ms/step
1/1
                0s 486ms/step
1/1
                Os 466ms/step
1/1
                0s 469ms/step
1/1
                0s 498ms/step
1/1
                0s 495ms/step
1/1
                0s 481ms/step
1/1
                Os 497ms/step
```

1/1	1s	505ms/step
1/1	1s	503ms/step
1/1	0s	474ms/step
1/1	0s	490ms/step
1/1	0s	_
1/1	0s	495ms/step
1/1	1s	537ms/step
1/1	0s	-
1/1	0s	-
1/1	0s	466ms/step
1/1	0s	489ms/step
1/1	0s	_
1/1	0s	-
1/1		483ms/step
1/1		510ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	434ms/step
1/1	0s	488ms/step
1/1	0s	488ms/step
1/1	0s	-
1/1		440ms/step
1/1	1s	-
1/1	0s	479ms/step
1/1	0s	_
1/1	0s	-
	1s	500ms/step
1/1		517ms/step
1/1	0s	-
1/1	0s	
1/1		476ms/step
1/1	1s	
1/1	1s	
1/1	0s	497ms/step
1/1	1s	518ms/step
1/1	0s	494ms/step
1/1	0s	
1/1		465ms/step
1/1		491ms/step
1/1	0s	487ms/step
1/1	1s	500ms/step
1/1	1s	507ms/step
1/1	1s	508ms/step
1/1	0s	473ms/step
1/1		475ms/step
1/1		518ms/step
1/1	0s	-
1/1	1s	506ms/step
1/1	0s	478ms/step

1/1	1s	502ms/step
1/1	1s	502ms/step
1/1	1s	505ms/step
1/1	1s	502ms/step
1/1	0s	485ms/step
1/1	0s	484ms/step
1/1	0s	494ms/step
1/1	1s	507ms/step
1/1	0s	486ms/step
1/1	0s	487ms/step
1/1	1s	507ms/step
1/1	0s	492ms/step
1/1	1s	_
1/1	0s	-
1/1	0s	475ms/step
1/1	0s	473ms/step
1/1	0s	_
1/1	0s	474ms/step
1/1	0s	467ms/step
1/1	0s	484ms/step
1/1	0s	-
1/1	0s	470ms/step
1/1	0s	469ms/step
1/1	0s	474ms/step
1/1	0s	_
1/1	0s	471ms/step
1/1	0s	468ms/step
1/1	0s	478ms/step
1/1	0s	
1/1	0s	476ms/step
1/1	1s	519ms/step
	0s	_
1/1		459ms/step
1/1	0s	461ms/step
1/1	0s	461ms/step
1/1	0s	455ms/step
1/1	0s	
1/1		458ms/step
1/1	0s	462ms/step
1/1	0s	460ms/step
1/1	0s	462ms/step
1/1	0s	498ms/step
1/1	0s	472ms/step
1/1	0s	463ms/step
1/1		459ms/step
1/1		468ms/step
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1	0s	451ms/step

1/1	0s	460ms/step
1/1	0s	459ms/step
1/1	0s	462ms/step
1/1	0s	464ms/step
1/1	0s	468ms/step
1/1	0s	460ms/step
1/1	0s	457ms/step
1/1	0s	459ms/step
1/1	0s	468ms/step
1/1	0s	459ms/step
1/1	0s	465ms/step
1/1	0s	466ms/step
1/1	0s	462ms/step
1/1	0s	458ms/step
1/1	0s	458ms/step
1/1	0s	472ms/step
1/1	0s	459ms/step
1/1	0s	465ms/step
1/1	0s	487ms/step
1/1	0s	465ms/step
1/1	0s	461ms/step
1/1	0s	462ms/step
1/1	0s	460ms/step
1/1	0s	458ms/step
1/1	0s	461ms/step
1/1	0s	459ms/step
1/1	0s	486ms/step
1/1	0s	478ms/step
1/1	0s	489ms/step
1/1	0s	470ms/step
1/1	0s	472ms/step
1/1	0s	469ms/step
1/1	0s	477ms/step
1/1	0s	482ms/step
1/1	0s	480ms/step
1/1	0s	491ms/step
1/1	0s	471ms/step
1/1	0s	482ms/step
1/1	0s	465ms/step
1/1	0s	489ms/step
1/1	0s	469ms/step
1/1	0s	470ms/step
1/1	0s	469ms/step
1/1	0s	469ms/step
1/1	0s	482ms/step
1/1	0s	469ms/step
1/1	0s	469ms/step
1/1	0s	466ms/step
±/ ±	OB	100mb/ brep

1/1	0s	465ms/step
1/1	0s	467ms/step
1/1	0s	465ms/step
1/1	0s	461ms/step
1/1	0s	463ms/step
1/1	0s	463ms/step
1/1	0s	460ms/step
1/1	0s	460ms/step
1/1	0s	462ms/step
1/1	0s	459ms/step
1/1	0s	466ms/step
1/1	0s	463ms/step
1/1	0s	499ms/step
1/1	0s	458ms/step
1/1	0s	466ms/step
	0s	-
1/1		461ms/step
1/1	0s	468ms/step
1/1	0s	458ms/step
1/1	0s	459ms/step
1/1	0s	464ms/step
1/1	0s	466ms/step
1/1	0s	464ms/step
1/1	0s	458ms/step
1/1	0s	460ms/step
1/1	0s	465ms/step
1/1	0s	468ms/step
1/1	0s	468ms/step
1/1	0s	468ms/step
1/1	0s	460ms/step
1/1	0s	500ms/step
1/1	0s	475ms/step
1/1	0s	460ms/step
1/1	0s	465ms/step
1/1	0s	463ms/step
1/1	0s	465ms/step
1/1	0s	462ms/step
1/1	0s	458ms/step
1/1	0s	460ms/step
1/1	0s	464ms/step
1/1	0s	463ms/step
1/1	0s	467ms/step
1/1	0s	461ms/step
		-
1/1	0s	463ms/step
1/1	0s	465ms/step
1/1	0s	464ms/step
1/1	a0	466ms/step
1/1	0s	458ms/step
1/1	0s	458ms/step

1/1	0s	459ms/step
1/1	0s	468ms/step
1/1	0s	465ms/step
1/1	0s	458ms/step
1/1	0s	462ms/step
1/1	0s	458ms/step
1/1	0s	464ms/step
1/1	0s	462ms/step
1/1	0s	474ms/step
1/1	0s	476ms/step
1/1	0s	467ms/step
1/1	0s	459ms/step
1/1	0s	462ms/step
1/1	0s	466ms/step
1/1		467ms/step
1/1		468ms/step
1/1		457ms/step
1/1		465ms/step
1/1		471ms/step
1/1		460ms/step
1/1		487ms/step
1/1		457ms/step
1/1		465ms/step
1/1		460ms/step
1/1	0s	_
1/1	0s	464ms/step
1/1		470ms/step
1/1		461ms/step
1/1		461ms/step
1/1		480ms/step
1/1		465ms/step
1/1		458ms/step
1/1	0s	459ms/step
1/1	0s	457ms/step
1/1	0s	467ms/step
1/1		458ms/step
1/1	0s	_
1/1		462ms/step
1/1		_
1/1	0s 0s	450ms/step 460ms/step
		466ms/step
1/1	0s	_
1/1		461ms/step
1/1		457ms/step
1/1		466ms/step
1/1		457ms/step
1/1		465ms/step
1/1		463ms/step
1/1	0s	465ms/step

1/1	0s	458ms/step
1/1		461ms/step
1/1		461ms/step
1/1		463ms/step
1/1	0s	-
1/1	0s	_
1/1	0s	-
1/1		466ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	465ms/step
1/1	0s	462ms/step
1/1	0s	_
1/1		458ms/step
		_
1/1		461ms/step
1/1		459ms/step
1/1		463ms/step
1/1	0s	-
1/1	0s	460ms/step
1/1	0s	
1/1	0s	462ms/step
1/1	0s	
1/1	0s	
1/1	0s	482ms/step
1/1	0s	457ms/step
1/1	0s	469ms/step
1/1	0s	461ms/step
1/1	0s	467ms/step
1/1	0s	461ms/step
1/1	0s	471ms/step
1/1	0s	465ms/step
1/1	0s	465ms/step
1/1	0s	457ms/step
1/1	0s	466ms/step
1/1	0s	477ms/step
1/1	0s	466ms/step
1/1	0s	
1/1	0s	494ms/step
1/1	0s	466ms/step
1/1	0s	465ms/step
1/1	0s	460ms/step
1/1	0s	462ms/step
1/1	0s	456ms/step
1/1	0s	466ms/step
1/1		459ms/step
1/1	0s	468ms/step
1/1	0s 0s	458ms/step
1/1	0s 0s	
1/1	US	458ms/step

1/1	0s	458ms/step
1/1	0s	463ms/step
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1	0s	463ms/step
1/1	0s	472ms/step
1/1	0s	467ms/step
1/1	0s	_
1/1	0s	471ms/step
1/1	0s	
1/1	0s	462ms/step
1/1	0s	-
1/1	0s	466ms/step
1/1		458ms/step
1/1		458ms/step
1/1		464ms/step
1/1		465ms/step
1/1	0s	461ms/step
1/1	0s	482ms/step
1/1	0s	-
1/1	0s	-
1/1		468ms/step
1/1		488ms/step
1/1	0s	457ms/step
1/1	0s	
1/1	0s	465ms/step
1/1	0s	471ms/step
1/1	0s	
1/1		462ms/step
1/1		460ms/step
1/1	0s	
1/1	0s	-
1/1	1s	500ms/step
1/1	0s	464ms/step
1/1	0s	458ms/step
1/1		458ms/step
1/1		462ms/step
1/1		460ms/step
1/1	0s	463ms/step
1/1	0s	460ms/step
1/1	0s	465ms/step
1/1	0s	465ms/step
1/1	0s 0s	_
1/1		460ms/step 462ms/step
1/1		462ms/step 460ms/step
1/1		460ms/step 465ms/step
1/1	os 0s	_
1/1	os 0s	482ms/step
1/1	υS	459ms/step

1/1	0s	465ms/step
1/1		465ms/step
1/1		461ms/step
1/1		465ms/step
1/1		462ms/step
1/1		465ms/step
1/1		463ms/step
1/1		466ms/step
1/1		464ms/step
1/1		460ms/step
1/1		459ms/step
		_
1/1		462ms/step
1/1		457ms/step
1/1		458ms/step
1/1		477ms/step
1/1		459ms/step
1/1		463ms/step
1/1		461ms/step
1/1		467ms/step
1/1	0s	458ms/step
1/1	0s	465ms/step
1/1	0s	470ms/step
1/1	0s	461ms/step
1/1	0s	461ms/step
1/1		501ms/step
1/1		464ms/step
1/1		465ms/step
1/1		463ms/step
1/1		463ms/step
1/1		466ms/step
1/1		474ms/step
1/1		462ms/step
1/1		459ms/step
1/1	0s	466ms/step
1/1	0s	_
		467ms/step
1/1		457ms/step
1/1	a0	476ms/step
1/1	0s	464ms/step
1/1	0s	463ms/step
1/1	0s	472ms/step
1/1	0s	464ms/step
1/1	0s	466ms/step
1/1	0s	460ms/step
1/1	0s	465ms/step
1/1	0s	463ms/step
1/1	0s	466ms/step
1/1	0s	476ms/step
1/1	0s	457ms/step
		. 1

1/1	0s	465ms/step
1/1	0s	485ms/step
1/1	0s	459ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	466ms/step
1/1	0s	_
1/1		461ms/step
1/1	0s	_
1/1		463ms/step
1/1	0s	-
1/1		465ms/step
1/1		489ms/step
1/1		459ms/step
1/1		477ms/step
1/1		477ms/step 468ms/step
		463ms/step
1/1		-
1/1	0s	-
1/1	0s	
1/1		469ms/step
1/1		461ms/step
1/1		460ms/step
1/1	0s	462ms/step
1/1	0s	-
1/1	0s	462ms/step
1/1	0s	462ms/step
1/1	0s	459ms/step
1/1	0s	461ms/step
1/1	0s	469ms/step
1/1	0s	474ms/step
1/1	0s	466ms/step
1/1	0s	470ms/step
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1	0s	466ms/step
1/1	0s	460ms/step
1/1	0s	465ms/step
1/1	0s	467ms/step
1/1	0s	461ms/step
1/1	0s	465ms/step
1/1	0s	458ms/step
1/1	0s	463ms/step
1/1	0s	-
1/1	0s	474ms/step
1/1	0s	458ms/step
1/1	1s	502ms/step
1/1	0s	-
		462ms/step
1/1	0s	460ms/step

1/1	0s	459ms/step
1/1	0s	460ms/step
1/1	0s	460ms/step
1/1	0s	461ms/step
1/1	0s	460ms/step
1/1	0s	466ms/step
1/1	0s	463ms/step
1/1	0s	461ms/step
1/1	0s	_
1/1	0s	476ms/step
1/1	0s	464ms/step
1/1	0s	458ms/step
1/1	0s	-
1/1	0s	-
1/1		459ms/step
1/1	0s	_
1/1		466ms/step
1/1	0s	465ms/step
1/1	0s	472ms/step
1/1	1s	511ms/step
1/1	0s	-
1/1	0s	-
1/1	0s	465ms/step
1/1	0s	462ms/step
1/1	0s	459ms/step
1/1	0s	461ms/step
		-
1/1	0s	461ms/step
1/1	0s	460ms/step
1/1	0s	
1/1	0s	
1/1	0s	457ms/step
1/1	0s	485ms/step
1/1	0s	467ms/step
1/1	0s	458ms/step
1/1	0s	465ms/step
1/1	0s	
1/1		456ms/step
1/1	0ຮ	462ms/step
1/1	0s	460ms/step
1/1	0s	491ms/step
1/1	0s	458ms/step
1/1	0s	463ms/step
1/1	0s	465ms/step
1/1	0s	459ms/step
1/1	0s	462ms/step
1/1	0s	462ms/step
1/1	0s	465ms/step
1/1	0s	466ms/step

1/1	0s	466ms/step
1/1	0s	463ms/step
1/1	0s	461ms/step
1/1	0s	460ms/step
1/1	0s	461ms/step
1/1	0s	458ms/step
1/1	0s	465ms/step
1/1	0s	464ms/step
1/1	0s	459ms/step
1/1	0s	468ms/step
1/1	0s	461ms/step
1/1	1s	510ms/step
1/1	0s	-
1/1	0s	-
1/1		463ms/step
1/1	0s	470ms/step
1/1	0s	_
1/1	0s	460ms/step
1/1	0s	460ms/step
1/1	0s	462ms/step
1/1	0s	
1/1	0s	458ms/step
1/1	0s	466ms/step
1/1	0s	461ms/step
1/1	0s	469ms/step
1/1	0s	469ms/step
1/1	0s	462ms/step
1/1	0s	470ms/step
1/1	0s	
1/1	0s	
1/1	0s	-
	0s 0s	
1/1		486ms/step
1/1	0s	465ms/step
1/1	0s	464ms/step
1/1	0s	465ms/step
1/1	0s	
1/1		459ms/step
1/1	0s	468ms/step
1/1	0s	464ms/step
1/1	0s	473ms/step
1/1	0s	459ms/step
1/1	0s	461ms/step
1/1	0s	460ms/step
1/1		458ms/step
1/1		474ms/step
1/1	0s	468ms/step
1/1	0s	461ms/step
1/1	0s	467ms/step

1/1	0s	459ms/step
1/1	0s	494ms/step
1/1	0s	-
1/1	0s	-
1/1	0s	
1/1	0s	-
1/1	0s	-
1/1	0s	_
	0s	-
1/1		-
1/1	0s	462ms/step
1/1	0s	-
1/1	0s	
1/1		462ms/step
1/1	0s	_
1/1	0s	465ms/step
1/1	0s	458ms/step
1/1	0s	463ms/step
1/1	0s	462ms/step
1/1	0s	458ms/step
1/1	0s	467ms/step
1/1	0s	471ms/step
1/1	0s	_
1/1	0s	_
1/1	0s	467ms/step
1/1	0s	468ms/step
1/1	0s	463ms/step
1/1	0s	-
1/1	0s	_
1/1		465ms/step
1/1		462ms/step
		_
1/1		471ms/step
1/1		479ms/step
1/1	0s	
1/1	0s	471ms/step
1/1	0s	475ms/step
1/1	0ຮ	463ms/step
1/1	0s	468ms/step
1/1	0s	477ms/step
1/1	0s	475ms/step
1/1	0s	467ms/step
1/1	0s	461ms/step
1/1	0s	469ms/step
1/1	0s	465ms/step
1/1	0s	464ms/step
1/1	0s	465ms/step
1/1	0s	473ms/step
1/1	0s	465ms/step
1/1	0s	465ms/step
±/ ±	VS	TOOMS/ Steb

1/1	0s	465ms/step
1/1	0s	461ms/step
1/1	0s	469ms/step
1/1	0s	464ms/step
1/1	0s	454ms/step
1/1	1s	506ms/step
1/1	0s	460ms/step
1/1	0s	471ms/step
1/1	0s	463ms/step
1/1	0s	469ms/step
1/1	0s	461ms/step
1/1	0s	460ms/step
1/1	0s	-
1/1	0s	-
1/1	0s	470ms/step
1/1	0s	459ms/step
1/1	0s	_
1/1	0s	493ms/step
1/1	0s	474ms/step
1/1	0s	479ms/step
1/1	0s	
1/1	0s	471ms/step
1/1	0s	498ms/step
1/1	0s	482ms/step
1/1	0s	458ms/step
1/1	0s	462ms/step
1/1	0s	461ms/step
1/1	0s	458ms/step
1/1	0s	
1/1	0s	
1/1	0s	483ms/step
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1	0s	469ms/step
1/1	0s	455ms/step
1/1	0s	-
1/1	0s	460ms/step
1/1	0s	459ms/step
1/1	0s	466ms/step
1/1	0s	456ms/step
1/1	0s	461ms/step
1/1	0s 0s	453ms/step
	0s 0s	_
1/1 1/1		464ms/step 497ms/step
		_
1/1	a0 a0	468ms/step
1/1		465ms/step
1/1	a0	465ms/step
1/1	0s	458ms/step

1/1	0s	467ms/step
1/1	0s	479ms/step
1/1	0s	465ms/step
1/1	0s	467ms/step
1/1	0s	467ms/step
1/1	0s	461ms/step
1/1	0s	473ms/step
1/1	0s	466ms/step
1/1	0s	465ms/step
1/1	0s	464ms/step
1/1	0s	467ms/step
1/1	0s	494ms/step
1/1	0s	463ms/step
1/1	0s	
1/1	0s	458ms/step
1/1	0s	476ms/step
1/1	0s	458ms/step
1/1	0s	484ms/step
1/1	0s	463ms/step
1/1	0s	462ms/step
1/1	0s	466ms/step
1/1	0s	
1/1	0s	467ms/step
1/1	0s	459ms/step
1/1	0s	460ms/step
1/1	0s	458ms/step
1/1	0s	460ms/step
1/1	0s	480ms/step
1/1	0s	459ms/step
1/1	0s	
1/1	0s	490ms/step
1/1	0s	459ms/step
1/1	0s	468ms/step
1/1	0s	460ms/step
1/1	0s	459ms/step
1/1	0s	461ms/step
1/1	0s	
1/1	0s	459ms/step
1/1	0s	466ms/step
1/1	0s	_
	0s 0s	460ms/step
1/1		464ms/step
1/1	0s	472ms/step
1/1	0s	464ms/step
1/1	0s	500ms/step
1/1	0s	-
1/1	0s	463ms/step
1/1	0s	473ms/step
1/1	0s	472ms/step

1/1	0s	465ms/step
1/1	0s	462ms/step
1/1	0s	475ms/step
1/1	0s	464ms/step
1/1	0s	-
1/1	0s	459ms/step
1/1		457ms/step
1/1		460ms/step
1/1	0s	_
1/1		460ms/step
1/1	0s	-
1/1		478ms/step
1/1		459ms/step
1/1		462ms/step
1/1		467ms/step
1/1		488ms/step
		_
1/1		458ms/step
1/1		479ms/step
1/1	0s	
1/1	0s	
1/1		463ms/step
1/1		465ms/step
1/1	0s	-
1/1	0s	-
1/1	0s	473ms/step
1/1	0s	458ms/step
1/1	0s	461ms/step
1/1	0s	484ms/step
1/1	0s	468ms/step
1/1	0s	462ms/step
1/1	0s	464ms/step
1/1	0s	469ms/step
1/1	0s	477ms/step
1/1	0s	462ms/step
1/1	0s	472ms/step
1/1	0s	461ms/step
1/1	0s	454ms/step
1/1	0s	463ms/step
1/1	0s	465ms/step
1/1	0s	461ms/step
1/1	0s	475ms/step
1/1	0s	465ms/step
1/1	0s	-
1/1	0s	465ms/step
1/1	0s	473ms/step
1/1	0s	462ms/step
1/1	0s 0s	465ms/step
		-
1/1	0s	464ms/step

1/1	0s	468ms/step
1/1	0s	460ms/step
1/1	0s	461ms/step
1/1	0s	466ms/step
1/1	0s	_
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1	0s	_
1/1		459ms/step
1/1	0s	_
1/1	0s	459ms/step
1/1	0s	-
1/1		480ms/step
1/1		471ms/step
1/1		460ms/step
1/1		463ms/step
1/1		465ms/step
1/1	0s	468ms/step
1/1	0s	462ms/step
1/1	0s	-
1/1	0s	-
1/1		460ms/step
1/1	0s	-
1/1	0s	465ms/step
1/1	0s 0s	_
1/1	0s	-
	os 1s	459ms/step
1/1		
1/1		459ms/step
1/1		459ms/step
1/1		461ms/step
1/1	0s	
1/1		466ms/step
1/1	0s	464ms/step
1/1	0s	459ms/step
1/1	0s	460ms/step
1/1		469ms/step
1/1		462ms/step
1/1		468ms/step
1/1	0s	465ms/step
1/1	0s	484ms/step
1/1	0s	471ms/step
1/1	0s	472ms/step
1/1	0s	467ms/step
1/1	0s	463ms/step
1/1	0s	458ms/step
1/1	0s	465ms/step
1/1	0s	461ms/step
1/1	0s	474ms/step

1/1	0s	464ms/step
1/1	0s	463ms/step
1/1	0s	459ms/step
1/1	0s	465ms/step
1/1	0s	-
1/1	0s	-
1/1		499ms/step
1/1	0s	_
1/1		473ms/step
1/1	1s	_
1/1		470ms/step
1/1		470ms/step 462ms/step
		-
1/1		461ms/step
1/1		460ms/step
1/1		453ms/step
1/1		458ms/step
1/1		465ms/step
1/1	0s	-
1/1		458ms/step
1/1		465ms/step
1/1	0s	470ms/step
1/1	0s	493ms/step
1/1	0s	466ms/step
1/1	0s	468ms/step
1/1	0s	468ms/step
1/1	0s	463ms/step
1/1	0s	461ms/step
1/1	0s	464ms/step
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1		459ms/step
1/1		460ms/step
1/1	0s	
1/1	0s	461ms/step
1/1	0s	466ms/step
1/1	0s	472ms/step
1/1	0s	483ms/step
1/1	0s	471ms/step
1/1	0s	458ms/step
1/1	0s	460ms/step
1/1	0s	-
		465ms/step
1/1	0s	465ms/step
1/1	0s	461ms/step
1/1	0s	462ms/step
1/1	0s	465ms/step
1/1	0s	472ms/step
1/1	0s	465ms/step
1/1	0s	469ms/step

1/1	0s	467ms/step
1/1	0s	485ms/step
1/1	0s	463ms/step
1/1	0s	464ms/step
1/1	0s	460ms/step
1/1	0s	457ms/step
1/1	0s	464ms/step
1/1	0s	_
1/1	0s	479ms/step
1/1	0s	-
1/1	0s	462ms/step
1/1	0s	462ms/step
1/1	0s	462ms/step
1/1		461ms/step
1/1		496ms/step
1/1		465ms/step
1/1		475ms/step
1/1	0s	465ms/step
1/1	0s	475ms/step
1/1	0s	-
1/1	0s	
1/1		461ms/step
1/1	0s	-
1/1	0s	465ms/step
1/1	0s	
1/1	0s	459ms/step
1/1	0s	456ms/step
1/1	0s	
1/1		469ms/step
1/1		466ms/step
1/1	0s	
1/1		463ms/step
1/1	1s	572ms/step
1/1	1s	529ms/step
1/1	0s	469ms/step
1/1		467ms/step
1/1		472ms/step
1/1		464ms/step
1/1	0s	492ms/step
1/1	0s	460ms/step
1/1	0s	467ms/step
	0s	_
1/1 1/1	os os	463ms/step
		466ms/step
1/1		500ms/step
1/1		511ms/step
1/1		461ms/step
1/1	0s	474ms/step
1/1	0s	479ms/step

1/1	0s	467ms/step
1/1	0s	497ms/step
1/1	1s	508ms/step
1/1	0s	465ms/step
1/1	0s	472ms/step
1/1	0s	460ms/step
1/1	0s	465ms/step
1/1	0s	468ms/step
1/1	0s	468ms/step
1/1	0s	466ms/step
1/1	0s	464ms/step
1/1	0s	466ms/step
1/1	0s	463ms/step
1/1	0s	
1/1	0s	472ms/step
1/1	0s	_
1/1	0s	488ms/step
1/1	0s	_
1/1	0s	463ms/step
1/1	0s	461ms/step
1/1	0s	460ms/step
1/1	0s	
1/1	0s	467ms/step
1/1	0s	461ms/step
1/1	0s	464ms/step
1/1	0s	467ms/step
1/1	0s	479ms/step
1/1	0s	467ms/step
1/1	0s	493ms/step
1/1	0s	
1/1	0s	
1/1	0s	461ms/step
1/1	0s	459ms/step
1/1	0s	463ms/step
1/1	0s	459ms/step
1/1	0s	459ms/step
1/1	0s	468ms/step
1/1	0s	458ms/step
1/1	0s	459ms/step
1/1	0s	493ms/step
1/1	0s	498ms/step
1/1	0s	469ms/step
1/1	1s	-
		557ms/step
1/1	1s	512ms/step
1/1	1s	-
1/1	1s	-
1/1	1s	563ms/step
1/1	1s	521ms/step

1s	557ms/step
1s	527ms/step
1s	562ms/step
1s	518ms/step
1s	557ms/step
1s	527ms/step
1s	517ms/step
1s	522ms/step
0s	483ms/step
0s	463ms/step
0s	464ms/step
0s	_
0s	
0s	466ms/step
	467ms/step
	464ms/step
	464ms/step
	461ms/step
	465ms/step
	-
	457ms/step
	542ms/step
	461ms/step
	_
	458ms/step
	462ms/step
	_
	474ms/step
	468ms/step
	461ms/step
	496ms/step
	460ms/step
	465ms/step
	-
	467ms/step
	461ms/step
	465ms/step
	469ms/step
	467ms/step
	502ms/step
	479ms/step
	472ms/step
	497ms/step
US	481ms/step
	1s 1

1/1	0s	481ms/step
1/1	1s	516ms/step
1/1	0s	487ms/step
1/1	0s	483ms/step
1/1	1s	505ms/step
1/1	0s	489ms/step
1/1	0s	486ms/step
1/1	0s	466ms/step
1/1	1s	_
1/1	0s	486ms/step
1/1	0s	497ms/step
1/1	0s	494ms/step
1/1	0s	
1/1	0s	-
1/1	0s	-
1/1	0s	
1/1	0s	-
1/1	1s	_
1/1	0s	475ms/step
1/1	0s	475ms/step
1/1	0s	
1/1	0s	471ms/step
1/1	0s	479ms/step
	0s 0s	_
1/1		474ms/step
1/1	0s	481ms/step
1/1	0s	477ms/step
1/1	0s	476ms/step
1/1	0s	491ms/step
1/1	0s	-
1/1	0s	473ms/step
1/1	0s	475ms/step
1/1	0s	466ms/step
1/1	0s	480ms/step
1/1	0s	479ms/step
1/1	0s	482ms/step
1/1	0s	465ms/step
1/1	1s	519ms/step
1/1	0s	490ms/step
1/1	0s	480ms/step
1/1	0s	469ms/step
1/1	1s	500ms/step
1/1	0s	472ms/step
1/1	0s	475ms/step
1/1	0s	470ms/step
1/1		476ms/step
1/1	0s	463ms/step
1/1	1s	506ms/step
1/1	0s	_
• –		,op

1/1	0s	468ms/step
1/1	0s	469ms/step
1/1	0s	470ms/step
1/1	0s	478ms/step
1/1	0s	475ms/step
1/1	0s	468ms/step
1/1	0s	484ms/step
1/1	0s	_
1/1	1s	-
1/1	0s	_
1/1	0s	470ms/step
1/1	0s	-
1/1	0s	474ms/step
1/1		469ms/step
1/1		472ms/step
1/1		473ms/step
1/1		471ms/step
1/1	0s	476ms/step
1/1	0s	475ms/step
1/1	1s	
1/1	0s	-
1/1	0s	-
1/1	0s	
	0s 0s	-
1/1		464ms/step
1/1	0s	463ms/step
1/1	0s	470ms/step
1/1	0s	475ms/step
1/1	0s	
1/1		472ms/step
1/1		516ms/step
1/1	0s	
1/1		481ms/step
1/1	0s	480ms/step
1/1	0s	461ms/step
1/1	0s	479ms/step
1/1	0s	471ms/step
1/1	0s	470ms/step
1/1	0s	476ms/step
1/1	0s	467ms/step
1/1	0s	493ms/step
1/1	0s	468ms/step
1/1	0s	475ms/step
1/1	0s	466ms/step
1/1	0s	478ms/step
1/1		466ms/step
1/1		466ms/step
1/1	0s	471ms/step
1/1	0s	465ms/step
• =		,p

1/1	0s	472ms/step
1/1	0s	499ms/step
1/1	0s	469ms/step
1/1	0s	481ms/step
1/1	0s	470ms/step
1/1	0s	471ms/step
1/1	0s	466ms/step
1/1	0s	_
1/1	0s	470ms/step
1/1	0s	474ms/step
1/1	0s	468ms/step
1/1	1s	
1/1	0s	470ms/step
1/1		494ms/step
1/1		465ms/step
1/1		477ms/step
1/1		474ms/step
1/1	0s	476ms/step
1/1	0s	469ms/step
1/1	0s	470ms/step
1/1	0s	-
1/1	0s	499ms/step
1/1	0s	470ms/step
1/1	0s	469ms/step
1/1	0s	485ms/step
1/1	0s	469ms/step
1/1	0s	483ms/step
1/1	0s	
1/1		470ms/step
1/1		476ms/step
1/1	0s	
1/1	0s	_
1/1	0s	469ms/step
1/1	0s	475ms/step
1/1	0s	475ms/step
1/1		476ms/step
1/1		474ms/step
1/1		485ms/step
1/1	0s	468ms/step
1/1	0s	475ms/step
1/1	0s	474ms/step
	0s	_
1/1 1/1	os 0s	498ms/step
		469ms/step 468ms/step
1/1		-
1/1		500ms/step
1/1		471ms/step
1/1	0s	485ms/step
1/1	0s	470ms/step

1/1	0s	471ms/step
1/1	0s	468ms/step
1/1	0s	470ms/step
1/1	0s	487ms/step
1/1	0s	_
1/1	0s	469ms/step
1/1	0s	473ms/step
1/1	0s	_
1/1		484ms/step
1/1	0s	479ms/step
1/1	0s	475ms/step
1/1	0s	-
1/1	0s	-
1/1		493ms/step
1/1		484ms/step
1/1		469ms/step
1/1		472ms/step
1/1	0s	468ms/step
1/1	0s	471ms/step
1/1	0s	_
1/1	0s	
1/1		468ms/step
1/1		472ms/step
1/1	1s	
1/1	0s	
		-
1/1	0s	487ms/step
1/1	0s	476ms/step
1/1	0s	
1/1		473ms/step
1/1		475ms/step
1/1	0s	
1/1		467ms/step
1/1	0s	471ms/step
1/1	0s	493ms/step
1/1	0s	470ms/step
1/1		468ms/step
1/1		470ms/step
1/1		470ms/step
1/1	0s	473ms/step
1/1	0s	468ms/step
1/1	0s	470ms/step
1/1	0s	466ms/step
1/1	1s	514ms/step
1/1	0s	474ms/step
1/1	0s	491ms/step
1/1	0s	492ms/step
1/1	0s	468ms/step
1/1	0s	465ms/step
		_

1/1	0s	472ms/step
1/1	0s	478ms/step
1/1	0s	473ms/step
1/1	1s	536ms/step
1/1	0s	465ms/step
1/1	0s	488ms/step
1/1	0s	480ms/step
1/1	0s	_
1/1		467ms/step
1/1	0s	481ms/step
1/1	0s	466ms/step
1/1	0s	_
1/1		493ms/step
1/1		472ms/step
1/1		475ms/step
1/1		472ms/step
1/1		472ms/step
1/1	0s	491ms/step
1/1	0s	_
1/1	0s	-
1/1		476ms/step
1/1		501ms/step
1/1	0s	
	0s 0s	_
1/1		472ms/step
1/1	0s	-
1/1	0s	481ms/step
1/1	0s	467ms/step
1/1	0s	
1/1		469ms/step
1/1	0s	
1/1	0s	
1/1		470ms/step
1/1	0s	469ms/step
1/1	0s	475ms/step
1/1	0s	475ms/step
1/1	1s	501ms/step
1/1	0s	483ms/step
1/1	0s	483ms/step
1/1	0s	477ms/step
1/1	0s	484ms/step
1/1	1s	560ms/step
1/1	1s	606ms/step
1/1	0s	479ms/step
1/1	0s	468ms/step
1/1		470ms/step
1/1		493ms/step
1/1	0s	473ms/step
1/1	0s	
		•

1/1	0s	472ms/step
1/1	0s	_
1/1	0s	473ms/step
1/1	0s	-
1/1	0s	
1/1	0s	-
1/1	0s	-
1/1	0s	
1/1	0s	474ms/step
1/1	0s	_
1/1	0s	. •
1/1	0s	-
1/1		467ms/step
1/1		513ms/step
1/1		474ms/step
1/1		474ms/step 467ms/step
		_
1/1		469ms/step
1/1		478ms/step
1/1		480ms/step
1/1	0s	
1/1		486ms/step
1/1	1s	
1/1		463ms/step
1/1	0s	466ms/step
1/1	0s	479ms/step
1/1	0s	469ms/step
1/1	0s	473ms/step
1/1	0s	467ms/step
1/1	0s	482ms/step
1/1	0s	472ms/step
1/1	0s	492ms/step
1/1	0s	465ms/step
1/1	0s	475ms/step
1/1	0s	478ms/step
1/1	0s	469ms/step
1/1	0s	490ms/step
1/1	0s	_
1/1	0s	475ms/step
1/1		470ms/step
1/1		470ms/step
1/1	0s	_
1/1	0s	470ms/step
1/1	1s	504ms/step
1/1	0s	468ms/step
1/1	0s	496ms/step
1/1		474ms/step
1/1		474ms/step 484ms/step
		_
1/1	0ຮ	475ms/step

1/1	0s	472ms/step
1/1	0s	486ms/step
1/1	0s	-
1/1	0s	466ms/step
1/1		476ms/step
1/1	1s	_
1/1	0s	-
1/1	0s	. •
	0s 0s	-
1/1		
1/1		469ms/step
1/1		467ms/step
1/1		497ms/step
1/1		498ms/step
1/1		482ms/step
1/1		470ms/step
1/1	0s	469ms/step
1/1	0s	475ms/step
1/1	0s	479ms/step
1/1	0s	470ms/step
1/1	0s	489ms/step
1/1	0s	482ms/step
1/1	0s	486ms/step
1/1	0s	473ms/step
1/1	0s	470ms/step
1/1	0s	_
1/1	0s	470ms/step
1/1	1s	_
1/1		476ms/step
1/1		465ms/step
1/1		471ms/step
1/1		471ms/step
1/1		475ms/step
1/1	0s	_
1/1		490ms/step
		_
1/1		473ms/step
1/1		476ms/step
1/1		495ms/step
1/1		477ms/step
1/1	0s	472ms/step
1/1	0s	480ms/step
1/1	0s	493ms/step
1/1	0s	
1/1		486ms/step
1/1	0s	467ms/step
1/1	0s	479ms/step

1/1	0s	463ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	_
1/1	0s	-
1/1		481ms/step
1/1		472ms/step
1/1		471ms/step
		_
1/1		482ms/step
1/1	0s	
1/1	0s	-
1/1		473ms/step
1/1		470ms/step
1/1		465ms/step
1/1	0s	467ms/step
1/1	0s	472ms/step
1/1	1s	513ms/step
1/1	0s	477ms/step
1/1	0s	476ms/step
1/1	0s	469ms/step
1/1	0s	469ms/step
1/1		471ms/step
1/1	0s	_
1/1	0s	496ms/step
1/1	1s	500ms/step
1/1	0s	475ms/step
1/1	0s	-
1/1		486ms/step
1/1		471ms/step
1/1		479ms/step
		_
1/1		491ms/step
1/1		480ms/step
1/1	0s	
1/1	0s	476ms/step
1/1	0s	479ms/step
1/1	0s	467ms/step
1/1	0s	467ms/step
1/1	1s	501ms/step
1/1	0s	476ms/step
1/1	0s	470ms/step
1/1	0s	495ms/step
1/1	0s	467ms/step
1/1	0s	475ms/step
1/1	0s	469ms/step
1/1	0s	494ms/step
1/1	0s	470ms/step
1/1	0s	479ms/step
1/1	0s	470ms/step
-, -	0.0	1, omp, poeb

1/1	0s	469ms/step
1/1	0s	477ms/step
1/1	0s	470ms/step
1/1	0s	496ms/step
1/1	0s	_
1/1	0s	472ms/step
1/1	0s	471ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	472ms/step
1/1	1s	512ms/step
1/1	0s	478ms/step
1/1		481ms/step
1/1		474ms/step
1/1		490ms/step
1/1	0s	_
1/1		470ms/step
1/1	1s	_
1/1	0s	483ms/step
1/1	0s	473ms/step
1/1	0s	-
1/1		480ms/step
1/1		466ms/step
1/1	0s 0s	489ms/step
1/1	0s 0s	
		487ms/step
1/1	0s	472ms/step
1/1	0s	478ms/step
1/1	0s	
1/1		470ms/step
1/1		467ms/step
1/1	0s	-
1/1	1s	
1/1	0s	470ms/step
1/1	0s	470ms/step
1/1	0s	476ms/step
1/1		470ms/step
1/1		470ms/step
1/1		470ms/step
1/1	0s	494ms/step
1/1	0s	483ms/step
1/1	0s	467ms/step
1/1	0s	477ms/step
1/1	0s	470ms/step
1/1	0s	465ms/step
1/1	0s	477ms/step
1/1	0s	500ms/step
1/1	0s	483ms/step
1/1	0s	470ms/step
		_

1/1	0s	475ms/step
1/1	0s	475ms/step
1/1	0s	466ms/step
1/1	0s	485ms/step
1/1	0s	496ms/step
1/1	0s	-
1/1		474ms/step
1/1	0s	_
1/1		474ms/step
1/1	0s	477ms/step
1/1		474ms/step
1/1		502ms/step
1/1		472ms/step
1/1		471ms/step
1/1		471ms/step 469ms/step
		_
1/1		467ms/step
1/1		470ms/step
1/1	1s	-
1/1		504ms/step
1/1	0s	
1/1		473ms/step
1/1		471ms/step
1/1	0s	
1/1	0s	477ms/step
1/1	0s	486ms/step
1/1	0s	475ms/step
1/1	0s	485ms/step
1/1	0s	472ms/step
1/1	0s	483ms/step
1/1	0s	486ms/step
1/1	0s	481ms/step
1/1	1s	501ms/step
1/1	0s	471ms/step
1/1	0s	477ms/step
1/1	0s	482ms/step
1/1	0s	471ms/step
1/1	0s	480ms/step
1/1	0s	484ms/step
1/1	1s	510ms/step
1/1	0s	470ms/step
1/1	0s	477ms/step
1/1	0s	492ms/step
1/1	0s	469ms/step
1/1	0s	472ms/step
1/1	0s	469ms/step
1/1	1s	510ms/step
	0s	-
1/1		471ms/step
1/1	0s	477ms/step

1/1	0s	477ms/step
1/1	0s	473ms/step
1/1	0s	483ms/step
1/1	0s	469ms/step
1/1	0s	496ms/step
1/1	0s	465ms/step
1/1	0s	481ms/step
1/1	0s	477ms/step
1/1	0s	468ms/step
1/1	0s	483ms/step
1/1	0s	499ms/step
1/1	0s	497ms/step
1/1	0s	484ms/step
1/1	0s	472ms/step
1/1	0s	477ms/step
1/1	0s	471ms/step
1/1	0s	469ms/step
1/1	0s	472ms/step
1/1	1s	500ms/step
1/1	0s	467ms/step
1/1	0s	468ms/step
1/1	0s	473ms/step
1/1	0s	472ms/step
1/1	0s	467ms/step
1/1	0s	470ms/step
1/1	1s	_
1/1	0s	474ms/step
1/1	0s	473ms/step
1/1	0s	469ms/step
1/1	0s	
1/1	0s	469ms/step
1/1	0s	472ms/step
1/1	0s	489ms/step
1/1	0s	482ms/step
1/1	0s	472ms/step
1/1	0s	468ms/step
1/1	0s	479ms/step
1/1	0s	477ms/step
1/1	0s	469ms/step
1/1	1s	517ms/step
1/1	0s	470ms/step
1/1	0s	470ms/step
1/1	0s	478ms/step
1/1	0s	484ms/step
1/1	0s	-
1/1	0s	471ms/step
1/1	0s	498ms/step
1/1	0s	467ms/step
= , =		,,p

1/1	0s	477ms/step
1/1	0s	472ms/step
1/1	0s	487ms/step
1/1	0s	476ms/step
1/1	0s	484ms/step
1/1	0s	497ms/step
1/1	0s	469ms/step
1/1	0s	494ms/step
1/1	0s	488ms/step
1/1	0s	468ms/step
1/1	0s	468ms/step
1/1	0s	470ms/step
1/1	0s	-
1/1	0s	-
1/1	0s	473ms/step
1/1	0s	470ms/step
1/1	0s	_
1/1	0s	470ms/step
1/1	0s	477ms/step
1/1	0s	499ms/step
1/1	0s	-
1/1	0s	-
	0s	471ms/step
1/1		496ms/step
1/1	0s	468ms/step
1/1	0s	462ms/step
1/1	0s	477ms/step
1/1	1s	512ms/step
1/1	0s	467ms/step
1/1	0s	-
1/1	0s	478ms/step
1/1	0s	470ms/step
1/1	0s	467ms/step
1/1	1s	504ms/step
1/1	0s	489ms/step
1/1	0s	469ms/step
1/1	0s	472ms/step
1/1	0s	475ms/step
1/1	0s	472ms/step
1/1	0s	473ms/step
1/1	0s	479ms/step
1/1	1s	537ms/step
1/1	0s	458ms/step
1/1	0s	477ms/step
1/1		464ms/step
1/1	0s	469ms/step
1/1	0s	467ms/step
1/1	0s	475ms/step
1/1	1s	_
-, -	13	512mb/ 50ep

1/1	0s	475ms/step
1/1	0s	474ms/step
1/1	0s	470ms/step
1/1	0s	313ms/step
1/1	1s	560ms/step
1/1	0s	491ms/step
1/1	0s	496ms/step
1/1	0s	466ms/step
1/1	0s	469ms/step
1/1	0s	481ms/step
1/1	0s	487ms/step
1/1	0s	469ms/step
1/1	0s	469ms/step
1/1	0s	
1/1	0s	477ms/step
1/1	0s	473ms/step
1/1	0s	465ms/step
1/1	0s	
1/1	0s	469ms/step
1/1	0s	471ms/step
1/1	0s	490ms/step
1/1	0s	
1/1	0s	467ms/step
1/1	0s	475ms/step
1/1	0s	472ms/step
1/1	0s	470ms/step
1/1	0s	468ms/step
1/1	1s	503ms/step
1/1	0s	471ms/step
1/1	0s	
1/1	0s	
1/1	0s	469ms/step
1/1	0s	494ms/step
1/1	0s	488ms/step
1/1	0s	500ms/step
1/1	0s	467ms/step
1/1	0s	467ms/step
1/1	0s	469ms/step
1/1	0s	472ms/step
1/1	0s	470ms/step
1/1	0s	472ms/step
1/1	0s	499ms/step
1/1	0s	480ms/step
1/1	0s	465ms/step
1/1	0s	-
1/1	0s	466ms/step
1/1	0s	476ms/step
1/1	0s 0s	461ms/step
1/ 1	US	-torms/sreb

1/1	1s	500ms/step
1/1	0s	469ms/step
1/1	0s	470ms/step
1/1	0s	469ms/step
1/1	0s	470ms/step
1/1	0s	477ms/step
1/1	0s	472ms/step
1/1	0s	491ms/step
1/1	0s	466ms/step
1/1	0s	469ms/step
1/1	0s	472ms/step
1/1	0s	480ms/step
1/1	1s	501ms/step
1/1	0s	476ms/step
1/1	1s	500ms/step
1/1	0s	467ms/step
1/1	0s	474ms/step
1/1	0s	472ms/step
1/1	0s	467ms/step
1/1	0s	463ms/step
1/1	0s	471ms/step
1/1	1s	503ms/step
1/1	0s	476ms/step
1/1	0s	476ms/step
1/1	0s	475ms/step
1/1	0s	477ms/step
1/1	0s	472ms/step
1/1	0s	474ms/step
1/1	0s	483ms/step
1/1	0s	470ms/step
1/1	0s	479ms/step
1/1	0s	470ms/step
1/1	0s	471ms/step
1/1	0s	458ms/step
1/1	0s	488ms/step
1/1	0s	491ms/step
1/1	0s	474ms/step
1/1	0s	471ms/step
1/1	0s	474ms/step
1/1	0s	465ms/step
1/1	0s	469ms/step
1/1	1s	515ms/step
1/1	0s	472ms/step
1/1	0s	468ms/step
1/1	0s	467ms/step
1/1	0s	477ms/step
1/1	0s	464ms/step
1/1	1s	510ms/step

1/1	0s	473ms/step
1/1	0s	460ms/step
1/1	0s	488ms/step
1/1	0s	500ms/step
1/1	1s	513ms/step
1/1	0s	488ms/step
1/1	0s	480ms/step
1/1	0s	468ms/step
1/1	0s	491ms/step
1/1	1s	532ms/step
1/1	1s	512ms/step
1/1	0s	496ms/step
1/1	1s	-
1/1	0s	-
1/1	0s	-
1/1	0s	486ms/step
1/1	0s	-
1/1	1s	-
1/1	1s	504ms/step
1/1	0s	483ms/step
1/1	0s	
1/1	0s	478ms/step
1/1	0s	469ms/step
1/1	0s	488ms/step
1/1	0s	488ms/step
1/1	1s	531ms/step
1/1	1s	556ms/step
1/1	1s	514ms/step
1/1	1s	
1/1	1s	
1/1	1s	_
	1s	568ms/step
1/1		603ms/step
1/1	1s	569ms/step
1/1	1s	574ms/step
1/1	1s	623ms/step
1/1	1s	
1/1	1s	
1/1	1s	577ms/step
1/1	1s	569ms/step
1/1	0s	495ms/step
1/1	0s	482ms/step
1/1	0s	498ms/step
1/1	1s	642ms/step
1/1	1s	-
1/1	1s	-
1/1	0s	483ms/step
1/1	0s	463ms/step
1/1	0s	464ms/step

1/1	0s	461ms/step
1/1	1s	503ms/step
1/1	0s	475ms/step
1/1	0s	475ms/step
1/1	0s	_
1/1	0s	465ms/step
1/1	0s	-
1/1	0s	480ms/step
1/1	0s	_
1/1	0s	460ms/step
1/1	0s	468ms/step
1/1	1s	
1/1	1s	-
1/1	0s	-
1/1		462ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	475ms/step
1/1	0s	460ms/step
1/1	1s	504ms/step
1/1	0s	
1/1	0s	465ms/step
1/1	0s	470ms/step
	0s 0s	_
1/1		463ms/step
1/1	0s	460ms/step
1/1	0s	484ms/step
1/1	0s	464ms/step
1/1	0s	462ms/step
1/1	0s	-
1/1	0s	
1/1	1s	
1/1	1s	
1/1	0ຣ	467ms/step
1/1	0s	462ms/step
1/1	0s	460ms/step
1/1	0s	480ms/step
1/1	0s	485ms/step
1/1	1s	501ms/step
1/1	0s	467ms/step
1/1	0s	463ms/step
1/1	0s	480ms/step
1/1	0s	463ms/step
1/1	0s	465ms/step
1/1	0s	483ms/step
1/1		470ms/step
1/1	0s	470ms/step
1/1	0s	493ms/step
1/1	0s	497ms/step
• –		, 200p

1/1	0s	462ms/step
1/1	0s	_
1/1	0s	-
1/1		459ms/step
1/1		463ms/step
1/1	0s	-
1/1		462ms/step
1/1		515ms/step
		_
1/1		468ms/step
1/1	0s	
1/1		463ms/step
1/1		461ms/step
1/1		464ms/step
1/1		492ms/step
1/1		466ms/step
1/1	0s	466ms/step
1/1	0s	462ms/step
1/1	0s	463ms/step
1/1	0s	468ms/step
1/1	1s	515ms/step
1/1	0s	466ms/step
1/1		468ms/step
1/1		466ms/step
1/1		471ms/step
1/1	0s	462ms/step
1/1	1s	_
1/1	0s	-
1/1		461ms/step
1/1		462ms/step
1/1		466ms/step
		_
1/1		469ms/step
1/1	_	535ms/step
1/1	0s	1
1/1	0s	464ms/step
1/1	0s	468ms/step
1/1	0s	463ms/step
1/1	0ຮ	462ms/step
1/1	0s	491ms/step
1/1	0s	465ms/step
1/1	0s	465ms/step
1/1	0s	463ms/step
1/1	0s	469ms/step
1/1	0s	475ms/step
1/1	1s	530ms/step
1/1	0s	471ms/step
1/1	0s	463ms/step
1/1	0s	470ms/step
1/1	0s	465ms/step
±/ ±	VS	TOOMS/ Steb

1/1	0s	490ms/step
1/1	0s	464ms/step
1/1	0s	471ms/step
1/1	0s	_
1/1	0s	-
1/1	0s	-
1/1	1s	
	1s	
1/1	1s	-
1/1		
1/1	1s	536ms/step
1/1	1s	
1/1	1s	
1/1	1s	
1/1	1s	-
1/1		476ms/step
1/1	1s	_
1/1	0s	498ms/step
1/1	1s	558ms/step
1/1	1s	579ms/step
1/1	1s	518ms/step
1/1	1s	513ms/step
1/1	1s	555ms/step
1/1	1s	535ms/step
1/1	1s	
1/1	1s	570ms/step
1/1	1s	512ms/step
1/1	1s	-
1/1	1s	-
1/1	0s	
1/1		494ms/step
1/1	1s	
1/1		476ms/step
1/1	0s	
•	0s	489ms/step
1/1 1/1		471ms/step
	20 0a	-
1/1	0s	473ms/step
1/1	1s	518ms/step
1/1	0s	494ms/step
1/1	0s	474ms/step
1/1	1s	509ms/step
1/1	0s	475ms/step
1/1	0s	489ms/step
1/1	0s	473ms/step
1/1	0s	472ms/step
1/1	1s	519ms/step
1/1	1s	520ms/step
1/1	1s	530ms/step
1/1	0s	493ms/step
		-

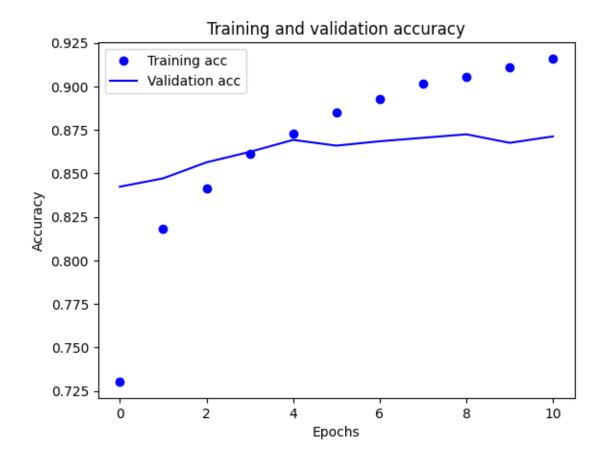
```
1/1
                     Os 499ms/step
     1/1
                     1s 517ms/step
                     1s 565ms/step
     1/1
     1/1
                     1s 577ms/step
     1/1
                     1s 551ms/step
     1/1
                     1s 547ms/step
     1/1
                     1s 551ms/step
     1/1
                     1s 541ms/step
     1/1
                     1s 572ms/step
     1/1
                     1s 531ms/step
     1/1
                     1s 546ms/step
     1/1
                     1s 538ms/step
     1/1
                     1s 544ms/step
     1/1
                     1s 562ms/step
     1/1
                     1s 525ms/step
     1/1
                     1s 533ms/step
     1/1
                     1s 544ms/step
     1/1
                     1s 558ms/step
     1/1
                     1s 577ms/step
     1/1
                     1s 537ms/step
     1/1
                     1s 529ms/step
     1/1
                     1s 531ms/step
     1/1
                     1s 551ms/step
     1/1
                     1s 557ms/step
     1/1
                     1s 571ms/step
     1/1
                     1s 550ms/step
     1/1
                     1s 534ms/step
     1/1
                     1s 519ms/step
     1/1
                     Os 305ms/step
[12]: from tensorflow.keras.optimizers import RMSprop
      model.compile(
          optimizer=RMSprop(), # Use RMSprop optimizer
          loss='sparse_categorical_crossentropy',
          metrics=['accuracy']
      )
[13]: from keras.callbacks import ReduceLROnPlateau
      reduce_lr = ReduceLROnPlateau(
          monitor='val_loss',
          factor=0.2,
          patience=2,
          min_lr=0.001
```

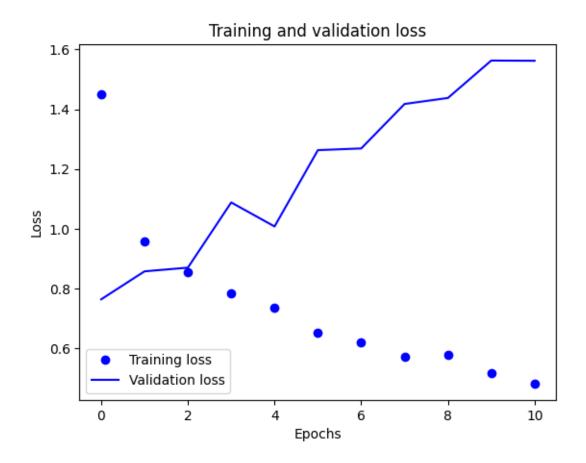
```
[14]: from keras.callbacks import EarlyStopping
      early_stopping = EarlyStopping(
          monitor='val_loss',
          patience=10,
          restore_best_weights=True
      )
[15]: from keras.callbacks import ModelCheckpoint
      model_checkpoint = ModelCheckpoint(
          filepath='C:/Users/flavi/Desktop/projetoClassificaoDeImagens/

¬dl_project_2201707_2211044/ModelosT/ModelT_RMSpropOptimizer.keras',
          save_best_only=True,
          monitor='val loss'
[16]: callbacks = [reduce_lr, early_stopping, model_checkpoint]
      # Train the model using the extracted features
      history = model.fit(
          train_features, train_labels,
          epochs=50,
          validation_data=(val_features, val_labels),
          callbacks=callbacks
      )
     Epoch 1/50
     1250/1250
                           12s 10ms/step -
     accuracy: 0.6706 - loss: 2.5303 - val_accuracy: 0.8424 - val_loss: 0.7643 -
     learning_rate: 0.0010
     Epoch 2/50
                           11s 9ms/step -
     1250/1250
     accuracy: 0.8164 - loss: 0.9273 - val_accuracy: 0.8472 - val_loss: 0.8579 -
     learning_rate: 0.0010
     Epoch 3/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8437 - loss: 0.8118 - val_accuracy: 0.8564 - val_loss: 0.8702 -
     learning_rate: 0.0010
     Epoch 4/50
     1250/1250
                           11s 8ms/step -
     accuracy: 0.8638 - loss: 0.7647 - val_accuracy: 0.8624 - val_loss: 1.0881 -
     learning_rate: 0.0010
     Epoch 5/50
     1250/1250
                           10s 8ms/step -
     accuracy: 0.8746 - loss: 0.7093 - val_accuracy: 0.8693 - val_loss: 1.0080 -
     learning_rate: 0.0010
```

```
1250/1250
                           10s 8ms/step -
     accuracy: 0.8878 - loss: 0.6249 - val accuracy: 0.8660 - val loss: 1.2631 -
     learning_rate: 0.0010
     Epoch 7/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8947 - loss: 0.6161 - val accuracy: 0.8685 - val loss: 1.2688 -
     learning_rate: 0.0010
     Epoch 8/50
                           10s 8ms/step -
     1250/1250
     accuracy: 0.9049 - loss: 0.5503 - val accuracy: 0.8705 - val loss: 1.4174 -
     learning_rate: 0.0010
     Epoch 9/50
     1250/1250
                           10s 8ms/step -
     accuracy: 0.9079 - loss: 0.5438 - val_accuracy: 0.8725 - val_loss: 1.4375 -
     learning_rate: 0.0010
     Epoch 10/50
     1250/1250
                           10s 8ms/step -
     accuracy: 0.9138 - loss: 0.4806 - val_accuracy: 0.8676 - val_loss: 1.5626 -
     learning rate: 0.0010
     Epoch 11/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.9182 - loss: 0.4605 - val_accuracy: 0.8713 - val_loss: 1.5619 -
     learning rate: 0.0010
[17]: import matplotlib.pyplot as plt
      plt.plot(history.history['accuracy'], 'bo', label='Training acc')
      plt.plot(history.history['val_accuracy'], 'b', label='Validation acc')
      plt.title('Training and validation accuracy')
      plt.xlabel('Epochs')
      plt.ylabel('Accuracy')
      plt.legend()
      plt.show()
      plt.plot(history.history['loss'], 'bo', label='Training loss')
      plt.plot(history.history['val_loss'], 'b', label='Validation loss')
      plt.title('Training and validation loss')
      plt.xlabel('Epochs')
      plt.ylabel('Loss')
      plt.legend()
      plt.show()
```

Epoch 6/50





```
[18]: val_loss, val_acc = model.evaluate(val_features, val_labels)
      print('Validation Accuracy:', val_acc)
     313/313
                         0s 816us/step -
     accuracy: 0.8458 - loss: 0.7600
     Validation Accuracy: 0.8424000144004822
[19]: loss, accuracy = model.evaluate(test_features, test_labels)
      print(f"Loss: {loss}, Accuracy: {accuracy}")
     313/313
                         0s 851us/step -
     accuracy: 0.8454 - loss: 0.7394
     Loss: 0.736763596534729, Accuracy: 0.8446999788284302
[20]: import numpy as np
      from sklearn.metrics import confusion_matrix, classification_report
      import seaborn as sns
      import matplotlib.pyplot as plt
      def evaluate_model(model, features, labels):
```

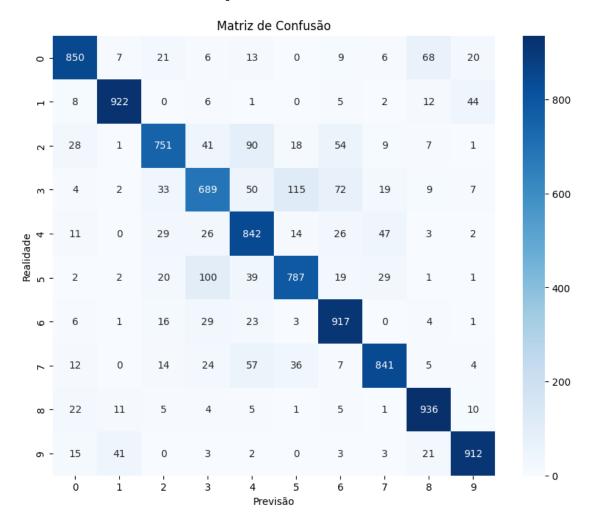
```
predictions = model.predict(features)
    predicted_labels = np.argmax(predictions, axis=1) # Convert probabilities_
 ⇔to class labels
    return labels, predicted_labels # Return true labels and predicted labels
# Obter previsões e rótulos reais para o conjunto de testes
true_labels, predicted_labels = evaluate_model(model, test_features,_
 →test labels)
# Compute the confusion matrix
conf_matrix = confusion_matrix(true_labels, predicted_labels)
# Plot the confusion matrix
plt.figure(figsize=(10, 8))
sns.heatmap(conf_matrix, annot=True, fmt="d", cmap="Blues",_
 →xticklabels=range(10), yticklabels=range(10))
plt.title('Matriz de Confusão')
plt.xlabel('Previsão')
plt.ylabel('Realidade')
plt.show()
# Print classification report
class_names = [str(i) for i in range(10)] # Define class names based on your_
 \rightarrow dataset
print(classification_report(true_labels, predicted_labels,__
 →target_names=class_names))
# Plot precision, recall, and F1-score
report = classification_report(true_labels, predicted_labels,_
 starget_names=class_names, output_dict=True)
metrics = {'precision': [], 'recall': [], 'f1-score': []}
for cls in class_names:
    metrics['precision'].append(report[cls]['precision'])
    metrics['recall'].append(report[cls]['recall'])
    metrics['f1-score'].append(report[cls]['f1-score'])
plt.figure(figsize=(10, 6))
bar width = 0.2
index = np.arange(len(class_names))
plt.bar(index, metrics['precision'], bar_width, label='Precision')
plt.bar(index + bar_width, metrics['recall'], bar_width, label='Recall')
plt.bar(index + 2*bar_width, metrics['f1-score'], bar_width, label='F1-score')
plt.xlabel('Class')
```

```
plt.ylabel('Scores')
plt.title('Precision, Recall e F1-score para cada classe')
plt.xticks(index + bar_width, class_names)
plt.legend()

plt.tight_layout()
plt.show()
```

313/313

Os 751us/step



	precision	recall	f1-score	support
0	0.89	0.85	0.87	1000
1	0.93	0.92	0.93	1000
2	0.84	0.75	0.80	1000
3	0.74	0.69	0.71	1000
4	0.75	0.84	0.79	1000

5	0.81	0.79	0.80	1000
6	0.82	0.92	0.87	1000
7	0.88	0.84	0.86	1000
8	0.88	0.94	0.91	1000
9	0.91	0.91	0.91	1000
accuracy			0.84	10000
macro avg	0.85	0.84	0.84	10000
weighted avg	0.85	0.84	0.84	10000

