vnyeoqtkh

June 19, 2024

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

[62]: import os, shutil

```
validation_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/validation'
      test_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/test'
[63]: 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)
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[64]: 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
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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)
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[65]: model.compile(
          optimizer='adam',
          loss='sparse_categorical_crossentropy',
          metrics=['accuracy']
      )
[66]: from keras.callbacks import ReduceLROnPlateau
      reduce_lr = ReduceLROnPlateau(
          monitor='val_loss',
          factor=0.2,
          patience=2,
          min_lr=0.001
      )
[67]: from keras.callbacks import EarlyStopping
```

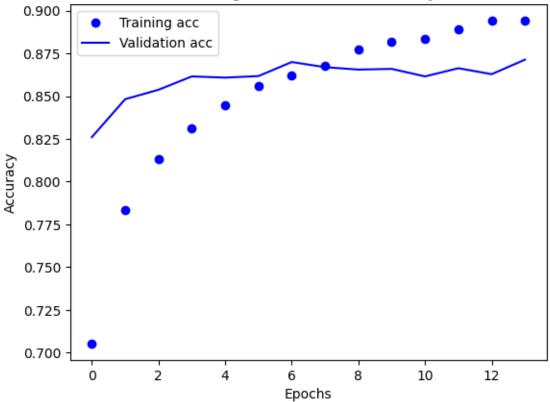
```
early_stopping = EarlyStopping(
          monitor='val_loss',
          patience=10,
          restore_best_weights=True
      )
[68]: from keras.callbacks import ModelCheckpoint
      model_checkpoint = ModelCheckpoint(
          filepath='C:/Users/flavi/Desktop/projetoClassificaoDeImagens/
       dl_project_2201707_2211044/ModelosT/ModelT_AdamOptimizer.keras',
          save_best_only=True,
          monitor='val loss'
      )
[69]: 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 9ms/step -
     accuracy: 0.6581 - loss: 1.8989 - val_accuracy: 0.8260 - val_loss: 0.5614 -
     learning_rate: 0.0010
     Epoch 2/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.7853 - loss: 0.6818 - val_accuracy: 0.8482 - val_loss: 0.5071 -
     learning_rate: 0.0010
     Epoch 3/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8136 - loss: 0.5970 - val_accuracy: 0.8537 - val_loss: 0.5188 -
     learning_rate: 0.0010
     Epoch 4/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8295 - loss: 0.5538 - val_accuracy: 0.8615 - val_loss: 0.5062 -
     learning_rate: 0.0010
     Epoch 5/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8498 - loss: 0.4878 - val_accuracy: 0.8608 - val_loss: 0.5268 -
     learning_rate: 0.0010
     Epoch 6/50
     1250/1250
                           11s 9ms/step -
```

```
learning_rate: 0.0010
     Epoch 7/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8637 - loss: 0.4486 - val accuracy: 0.8699 - val loss: 0.5655 -
     learning_rate: 0.0010
     Epoch 8/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8664 - loss: 0.4285 - val_accuracy: 0.8669 - val_loss: 0.5560 -
     learning_rate: 0.0010
     Epoch 9/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8770 - loss: 0.4154 - val_accuracy: 0.8655 - val_loss: 0.6262 -
     learning_rate: 0.0010
     Epoch 10/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8860 - loss: 0.3764 - val_accuracy: 0.8659 - val_loss: 0.6040 -
     learning_rate: 0.0010
     Epoch 11/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8843 - loss: 0.3936 - val_accuracy: 0.8615 - val_loss: 0.6686 -
     learning rate: 0.0010
     Epoch 12/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8922 - loss: 0.3617 - val_accuracy: 0.8663 - val_loss: 0.6486 -
     learning_rate: 0.0010
     Epoch 13/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8960 - loss: 0.3443 - val_accuracy: 0.8628 - val_loss: 0.6834 -
     learning_rate: 0.0010
     Epoch 14/50
     1250/1250
                           11s 9ms/step -
     accuracy: 0.8974 - loss: 0.3351 - val_accuracy: 0.8713 - val_loss: 0.7154 -
     learning_rate: 0.0010
[70]: 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')
```

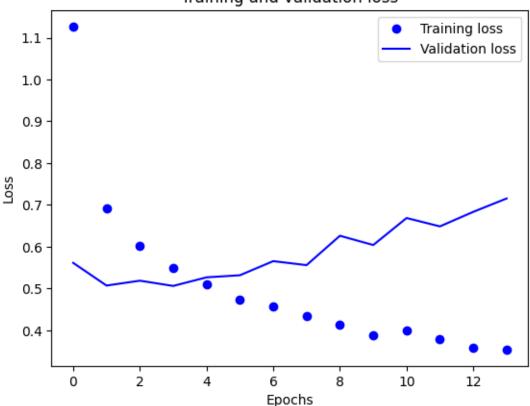
accuracy: 0.8555 - loss: 0.4678 - val_accuracy: 0.8617 - val_loss: 0.5317 -

```
plt.xlabel('Epochs')
plt.ylabel('Loss')
plt.legend()
plt.show()
```







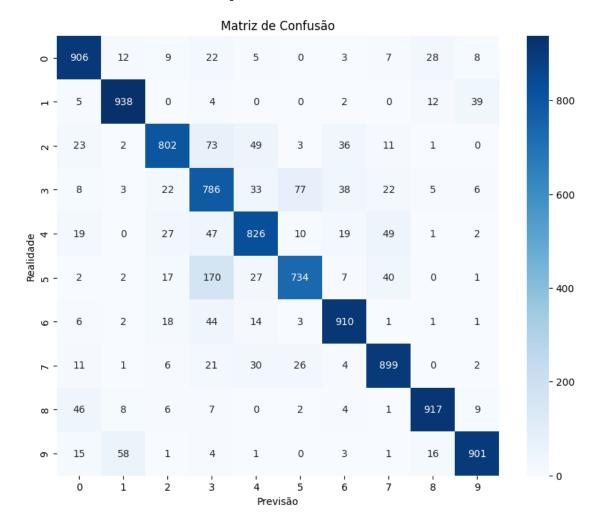


```
[71]: val_loss, val_acc = model.evaluate(val_features, val_labels)
      print('Validation Accuracy:', val_acc)
     313/313
                         0s 705us/step -
     accuracy: 0.8567 - loss: 0.5328
     Validation Accuracy: 0.8615000247955322
[72]: loss, accuracy = model.evaluate(test_features, test_labels)
      print(f"Loss: {loss}, Accuracy: {accuracy}")
     313/313
                         Os 697us/step -
     accuracy: 0.8589 - loss: 0.5111
     Loss: 0.4991396367549896, Accuracy: 0.8618999719619751
[73]: 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()
```

| | precision | recall | f1-score | support |
|---|-----------|--------|----------|---------|
| 0 | 0.87 | 0.91 | 0.89 | 1000 |
| 1 | 0.91 | 0.94 | 0.93 | 1000 |
| 2 | 0.88 | 0.80 | 0.84 | 1000 |
| 3 | 0.67 | 0.79 | 0.72 | 1000 |
| 4 | 0.84 | 0.83 | 0.83 | 1000 |

| 5 | 0.86 | 0.73 | 0.79 | 1000 |
|--------------|------|------|------|-------|
| 6 | 0.89 | 0.91 | 0.90 | 1000 |
| 7 | 0.87 | 0.90 | 0.89 | 1000 |
| 8 | 0.93 | 0.92 | 0.93 | 1000 |
| 9 | 0.93 | 0.90 | 0.92 | 1000 |
| | | | | |
| accuracy | | | 0.86 | 10000 |
| macro avg | 0.87 | 0.86 | 0.86 | 10000 |
| weighted avg | 0.87 | 0.86 | 0.86 | 10000 |

