vnyeoqtkh

June 19, 2024

[62]:
```python
import os, shutil
train_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/train'
validation_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/validation'
test_dir = 'C:/Users/flavi/Desktop/Projeto-20240530/test'
```

[63]:
```python
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.
```

[64]:
```python
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
```

```python
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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1/1             0s 473ms/step
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1/1             0s 475ms/step
1/1             1s 517ms/step
1/1             0s 474ms/step
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1/1                 0s 485ms/step
1/1                 0s 486ms/step
1/1                 0s 480ms/step
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1/1                0s 476ms/step
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1/1          0s 483ms/step
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1/1                0s 485ms/step
1/1                1s 503ms/step
1/1                0s 472ms/step
1/1                0s 472ms/step
1/1                0s 476ms/step
1/1                0s 482ms/step
1/1                0s 473ms/step
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1/1                0s 472ms/step
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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
)
```

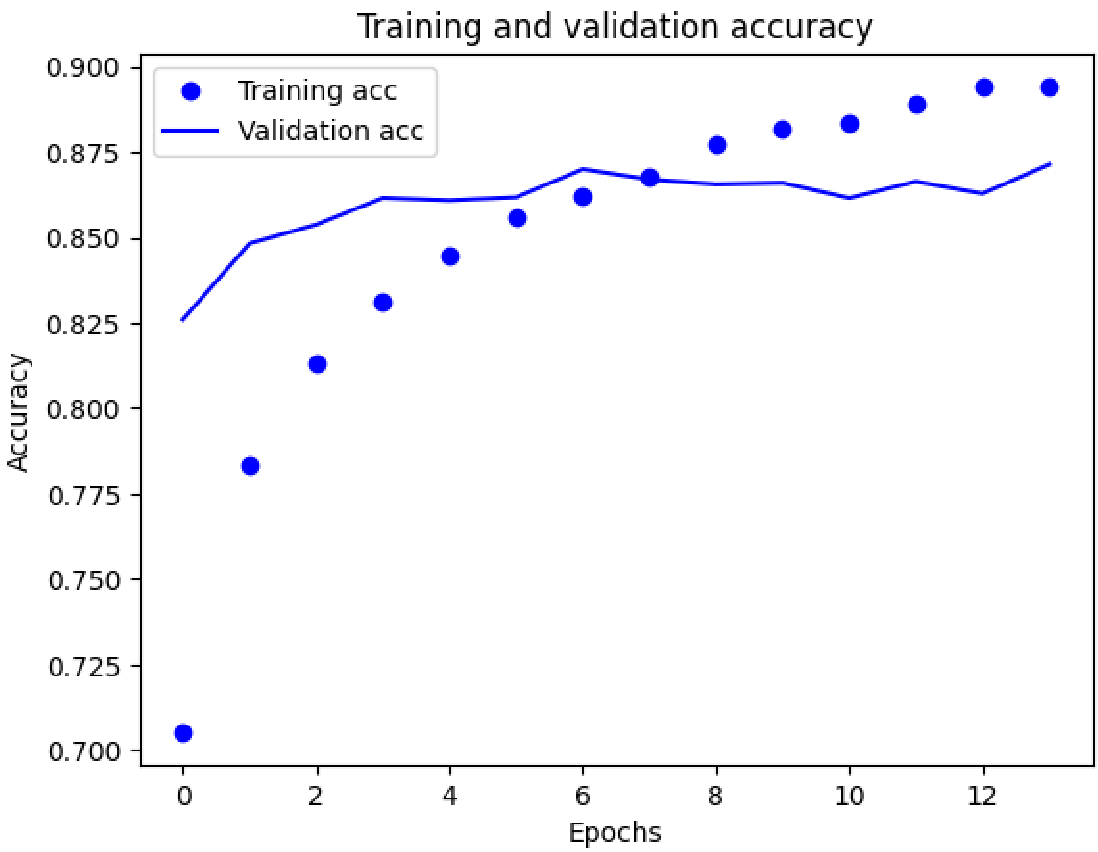
```
Epoch 1/50
1250/1250            12s 9ms/step -
accuracy: 0.6581 - loss: 1.8989 - val_accuracy: 0.8260 - val_loss: 0.5614 -
learning_rate: 0.0010
Epoch 2/50
1250/1250            11s 9ms/step -
accuracy: 0.7853 - loss: 0.6818 - val_accuracy: 0.8482 - val_loss: 0.5071 -
learning_rate: 0.0010
Epoch 3/50
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 -
```

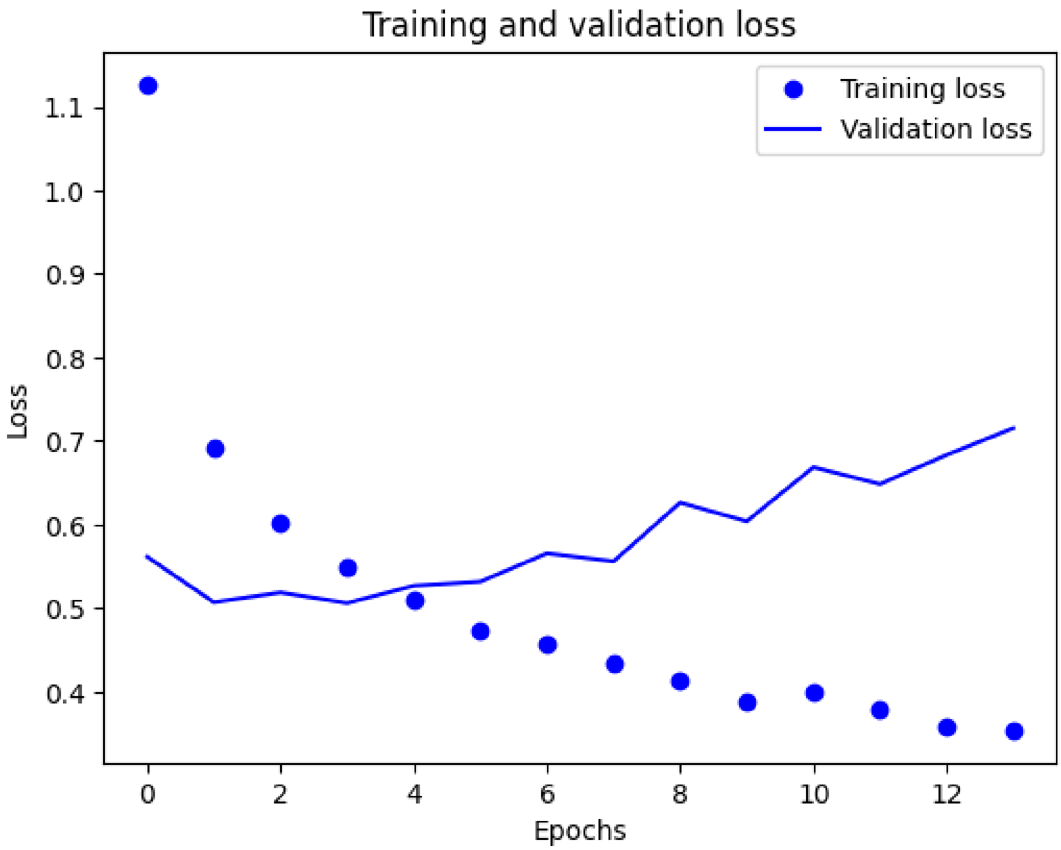
```
accuracy: 0.8555 - loss: 0.4678 - val_accuracy: 0.8617 - val_loss: 0.5317 -
learning_rate: 0.0010
Epoch 7/50
1250/1250            11s 9ms/step -
accuracy: 0.8637 - loss: 0.4486 - val_accuracy: 0.8699 - val_loss: 0.5655 -
learning_rate: 0.0010
Epoch 8/50
1250/1250            11s 9ms/step -
accuracy: 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]:

```python
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()
```





[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}")
```

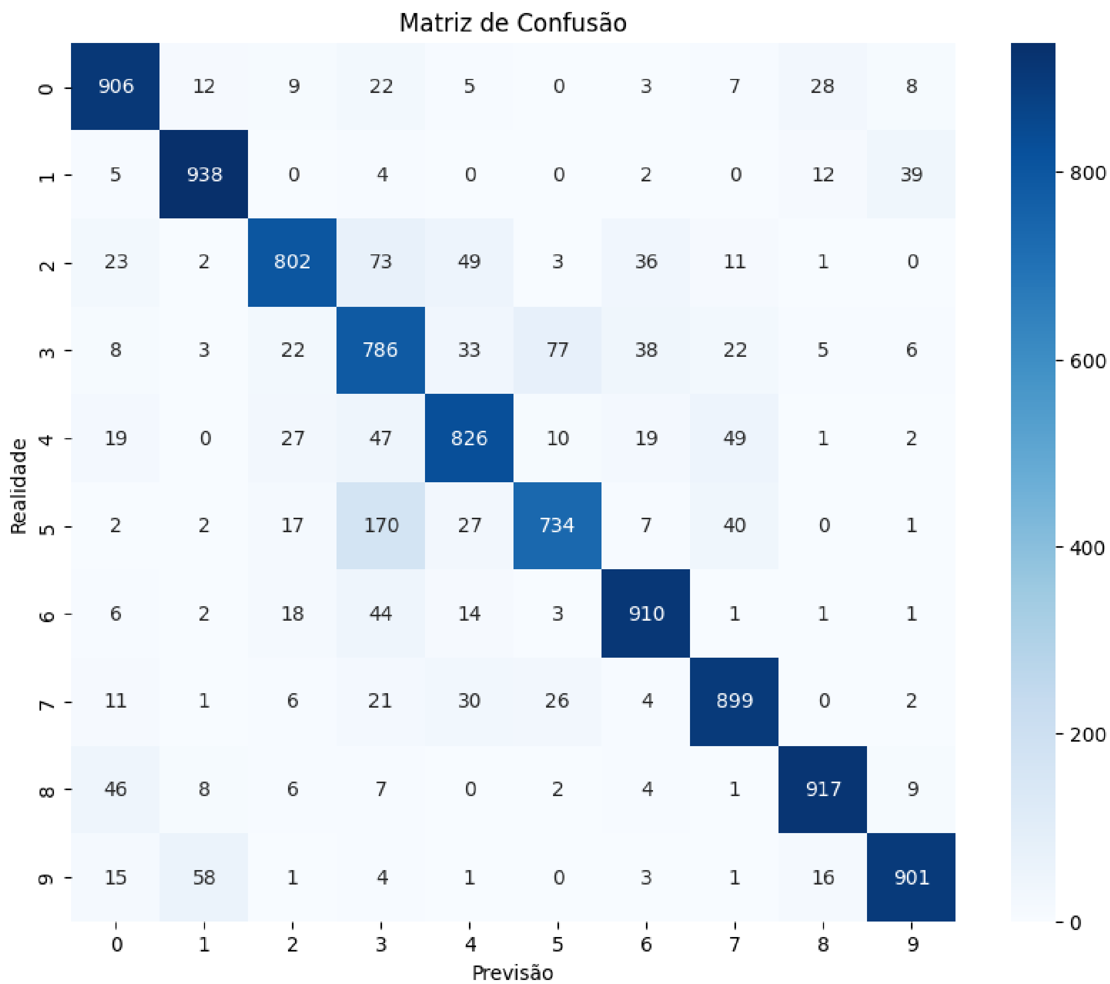
```
313/313              0s 697us/step -
accuracy: 0.8589 - loss: 0.5111
Loss: 0.4991396367549896, Accuracy: 0.8618999719619751
```

[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):
```

```python
    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␣
 ↪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,␣
 ↪target_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')
```

```python
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              0s 802us/step
```




```
         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