nqnzbeasz

June 19, 2024

[1]:
```
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'
```

[2]:
```
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.
```

[3]:
```
from tensorflow import keras
from keras import layers
from keras import models
from keras.preprocessing import image

data_augmentation = keras.Sequential(
    [
    layers.RandomFlip("horizontal_and_vertical"),
    layers.RandomRotation(0.1),
    layers.RandomZoom(0.2),
    ]
)

inputs = keras.Input(shape=(IMG_SIZE, IMG_SIZE, 3))
```

```python
x = data_augmentation(inputs)
x = layers.Rescaling(1./255)(inputs)

x = layers.Conv2D(filters=32, kernel_size=3, activation="relu",␣
↪padding='same')(x)
x = layers.BatchNormalization()(x)
x = layers.MaxPooling2D(pool_size=2)(x)

x = layers.Conv2D(filters=64, kernel_size=3, activation="relu",␣
↪padding='same')(x)
x = layers.BatchNormalization()(x)
x = layers.MaxPooling2D(pool_size=2)(x)

x = layers.Conv2D(filters=128, kernel_size=3, activation="relu",␣
↪padding='same')(x)
x = layers.BatchNormalization()(x)
x = layers.MaxPooling2D(pool_size=2)(x)

x = layers.Flatten()(x)
x = layers.Dropout(0.5)(x)
x = layers.Dense(512, activation="relu")(x)
outputs = layers.Dense(10, activation="softmax")(x)
model = keras.Model(inputs=inputs, outputs=outputs)
```

[4]:
```python
model.compile(
    optimizer='adam',
    loss='sparse_categorical_crossentropy',
    metrics=['accuracy']
)
```

[5]:
```python
from keras.callbacks import ReduceLROnPlateau

reduce_lr = ReduceLROnPlateau(
    monitor='val_loss',
    factor=0.2,
    patience=2,
    min_lr=0.001
)
```

[6]:
```python
from keras.callbacks import EarlyStopping

early_stopping = EarlyStopping(
    monitor='val_loss',
    patience=5,
    restore_best_weights=True
)
```

[7]:
```
from keras.callbacks import ModelCheckpoint

model_checkpoint = ModelCheckpoint(
    filepath='C:/Users/flavi/Desktop/projetoClassificaoDeImagens/
 ↪dl_project_2201707_2211044/ModelosS/ModelS_AdamOptimizerComData.keras',
    save_best_only=True,
    monitor='val_loss'
)
```

[8]:
```
callbacks = [reduce_lr, early_stopping, model_checkpoint]
history = model.fit(
    train_dataset,
    epochs=30,
    validation_data=validation_dataset,
    callbacks=callbacks
)
```

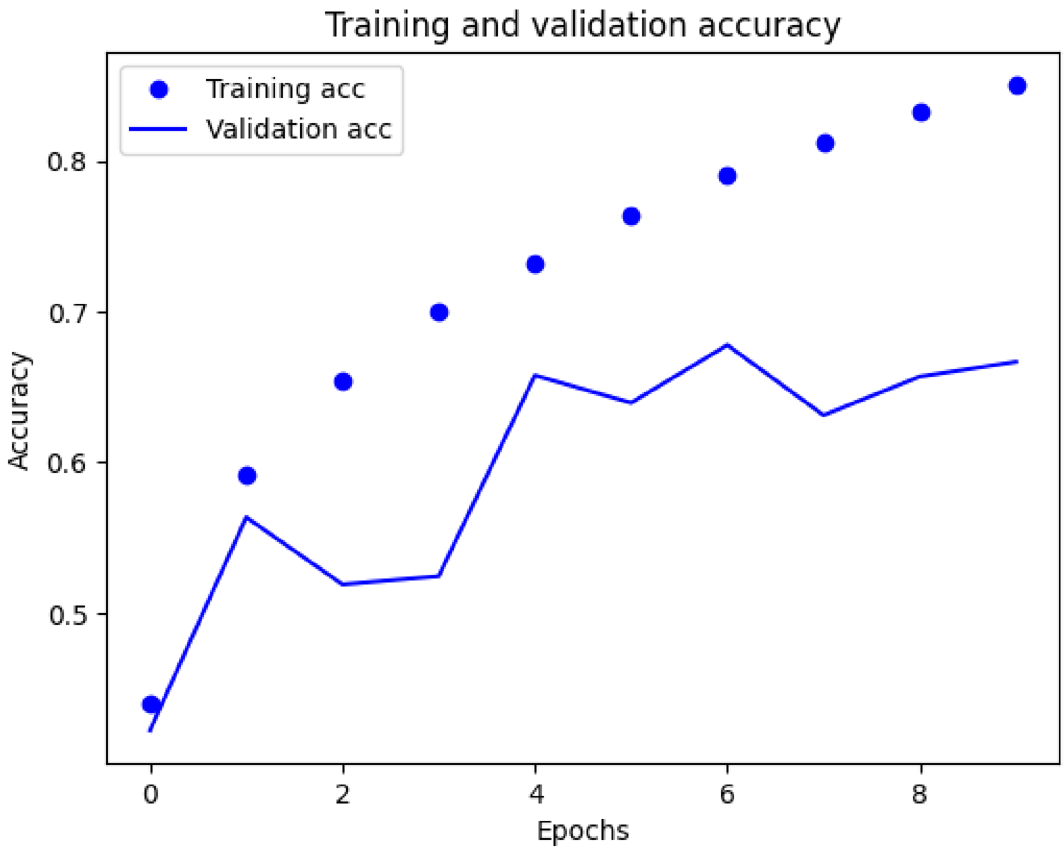
```
Epoch 1/30
1250/1250             1441s 1s/step -
accuracy: 0.3599 - loss: 2.6228 - val_accuracy: 0.4222 - val_loss: 1.5588 -
learning_rate: 0.0010
Epoch 2/30
1250/1250             1221s
977ms/step - accuracy: 0.5683 - loss: 1.2108 - val_accuracy: 0.5635 - val_loss:
1.2211 - learning_rate: 0.0010
Epoch 3/30
1250/1250             752s 601ms/step
- accuracy: 0.6369 - loss: 1.0144 - val_accuracy: 0.5190 - val_loss: 1.3985 -
learning_rate: 0.0010
Epoch 4/30
1250/1250             680s 544ms/step
- accuracy: 0.6869 - loss: 0.8906 - val_accuracy: 0.5244 - val_loss: 1.5803 -
learning_rate: 0.0010
Epoch 5/30
1250/1250             1091s
873ms/step - accuracy: 0.7235 - loss: 0.7926 - val_accuracy: 0.6576 - val_loss:
1.0033 - learning_rate: 0.0010
Epoch 6/30
1250/1250             1241s
993ms/step - accuracy: 0.7566 - loss: 0.6982 - val_accuracy: 0.6394 - val_loss:
1.0638 - learning_rate: 0.0010
Epoch 7/30
1250/1250             1244s
995ms/step - accuracy: 0.7805 - loss: 0.6307 - val_accuracy: 0.6777 - val_loss:
1.0417 - learning_rate: 0.0010
Epoch 8/30
1250/1250             1240s
```

```
992ms/step - accuracy: 0.8055 - loss: 0.5612 - val_accuracy: 0.6312 - val_loss:
1.2235 - learning_rate: 0.0010
Epoch 9/30
1250/1250          1227s
982ms/step - accuracy: 0.8270 - loss: 0.5035 - val_accuracy: 0.6568 - val_loss:
1.1859 - learning_rate: 0.0010
Epoch 10/30
1250/1250          1244s
995ms/step - accuracy: 0.8421 - loss: 0.4559 - val_accuracy: 0.6666 - val_loss:
1.1801 - learning_rate: 0.0010
```

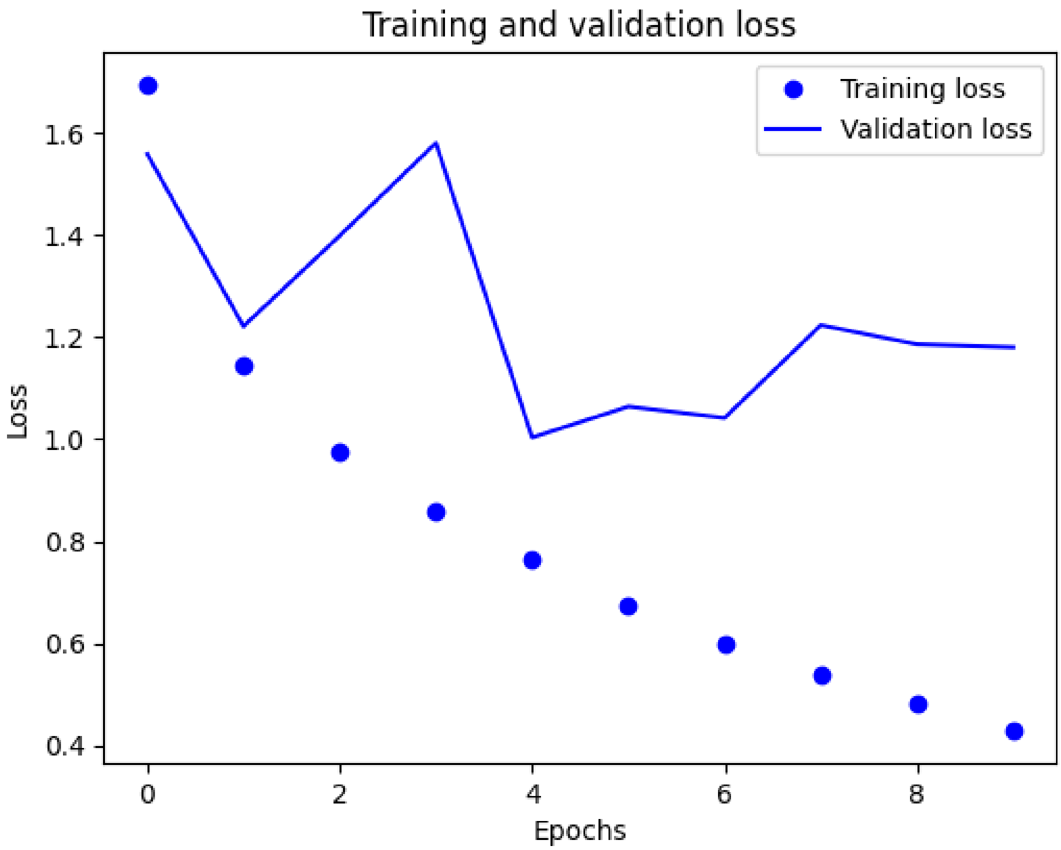
[9]:

```
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()
```



Training and validation accuracy
Training acc
Validation acc
Accuracy
0.5
0.6
0.7
0.8
0
2
4
6
8
Epochs



[10]:
```
val_loss, val_acc = model.evaluate(validation_dataset)
print('Validation Accuracy:', val_acc)
```

```
313/313                52s 166ms/step -
accuracy: 0.6562 - loss: 0.9955
Validation Accuracy: 0.6575999855995178
```

[11]:
```
loss, accuracy = model.evaluate(test_dataset)
print(f"Loss: {loss}, Accuracy: {accuracy}")
```

```
313/313                52s 166ms/step -
accuracy: 0.6516 - loss: 1.0232
Loss: 1.0121647119522095, Accuracy: 0.6565999984741211
```

[12]:
```
import numpy as np
from sklearn.metrics import confusion_matrix, classification_report
import seaborn as sns
import matplotlib.pyplot as plt

# Function to evaluate the model and get true and predicted labels
```

```python
def evaluate_model(model, dataset):
    all_labels = []
    all_predictions = []

    for images, labels in dataset:
        predictions = model.predict(images)
        predicted_labels = np.argmax(predictions, axis=1)
        true_labels = labels.numpy()  # Convert to numpy array if not already

        all_labels.extend(true_labels)
        all_predictions.extend(predicted_labels)

    return np.array(all_labels), np.array(all_predictions)

# Get true and predicted labels for the test dataset
true_labels, predicted_labels = evaluate_model(model, test_dataset)

# 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))

# Extract precision, recall, and F1-score for each class from classification␣
 ↪report
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'])

# Plot precision, recall, and F1-score
```

```python
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()
```

```
1/1              1s 685ms/step
1/1              0s 209ms/step
1/1              0s 248ms/step
1/1              0s 261ms/step
1/1              0s 219ms/step
1/1              0s 169ms/step
1/1              0s 227ms/step
1/1              0s 286ms/step
1/1              0s 218ms/step
1/1              0s 194ms/step
1/1              0s 222ms/step
1/1              0s 293ms/step
1/1              0s 228ms/step
1/1              0s 222ms/step
1/1              0s 227ms/step
1/1              0s 305ms/step
1/1              0s 323ms/step
1/1              0s 269ms/step
1/1              0s 217ms/step
1/1              0s 190ms/step
1/1              0s 231ms/step
1/1              0s 284ms/step
1/1              0s 299ms/step
1/1              0s 244ms/step
1/1              0s 180ms/step
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1/1          0s 244ms/step
1/1          0s 229ms/step
1/1          0s 249ms/step
1/1          0s 226ms/step
1/1          0s 203ms/step
1/1          0s 173ms/step
1/1          0s 264ms/step
1/1          0s 239ms/step
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1/1          0s 235ms/step
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1/1          0s 216ms/step
1/1          0s 210ms/step
1/1          0s 181ms/step
1/1          0s 172ms/step
1/1          0s 283ms/step
1/1          0s 375ms/step
1/1          0s 308ms/step
1/1          0s 295ms/step
1/1          0s 239ms/step
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1/1          0s 208ms/step
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1/1          0s 251ms/step
1/1          0s 260ms/step
1/1          0s 205ms/step
1/1          0s 211ms/step
1/1          0s 297ms/step
1/1          0s 347ms/step
1/1          0s 284ms/step
```

```
1/1            0s 205ms/step
1/1            0s 177ms/step
1/1            0s 175ms/step
1/1            0s 232ms/step
1/1            0s 226ms/step
1/1            0s 195ms/step
1/1            0s 218ms/step
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1/1            0s 223ms/step
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1/1            0s 188ms/step
1/1            0s 241ms/step
1/1            0s 330ms/step
1/1            0s 293ms/step
1/1            0s 231ms/step
1/1            0s 216ms/step
1/1            0s 250ms/step
1/1            0s 149ms/step
1/1            0s 244ms/step
1/1            0s 187ms/step
1/1            0s 173ms/step
1/1            0s 174ms/step
1/1            0s 222ms/step
1/1            0s 280ms/step
1/1            0s 249ms/step
1/1            0s 257ms/step
1/1            0s 173ms/step
1/1            0s 172ms/step
1/1            0s 231ms/step
1/1            0s 228ms/step
1/1            0s 266ms/step
1/1            1s 525ms/step
```
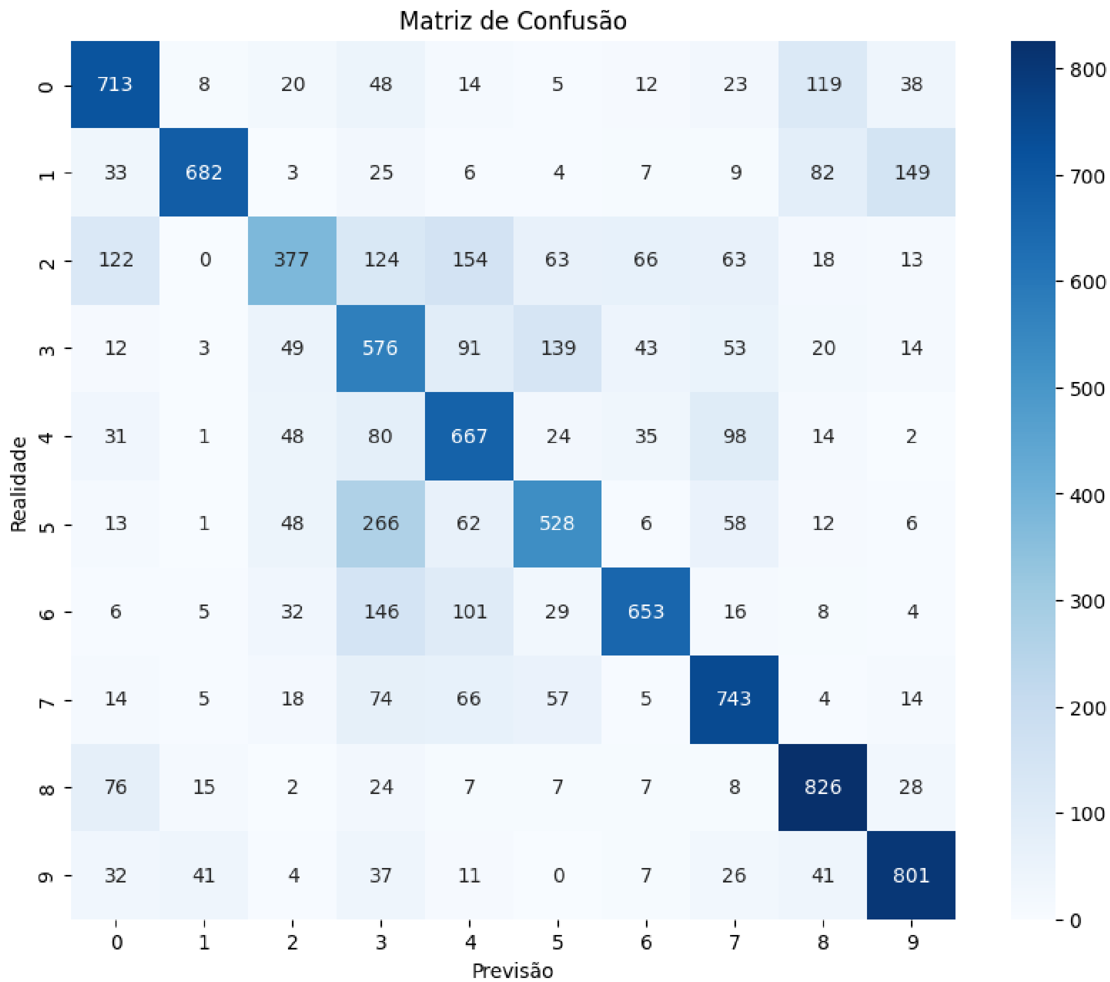
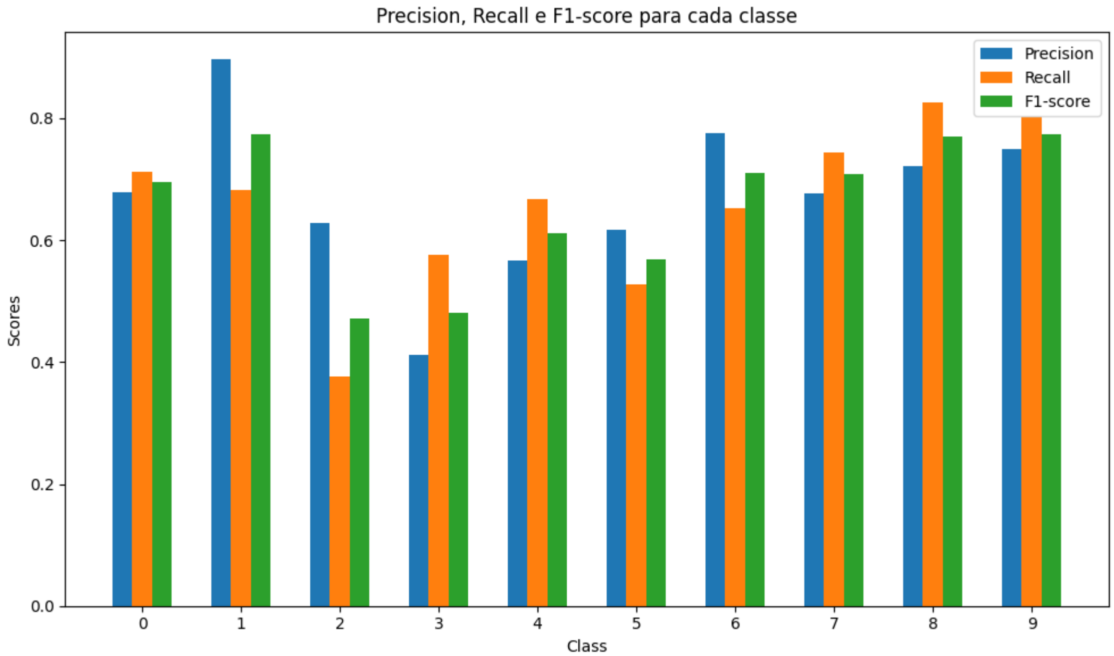



	precision	recall	f1-score	support
0	0.68	0.71	0.69	1000
1	0.90	0.68	0.77	1000
2	0.63	0.38	0.47	1000
3	0.41	0.58	0.48	1000
4	0.57	0.67	0.61	1000
5	0.62	0.53	0.57	1000
6	0.78	0.65	0.71	1000
7	0.68	0.74	0.71	1000
8	0.72	0.83	0.77	1000
9	0.75	0.80	0.77	1000
accuracy			0.66	10000
macro avg	0.67	0.66	0.66	10000
weighted avg	0.67	0.66	0.66	10000


Precision, Recall e F1-score para cada classe
Precision
Recall
F1-score
Scores
0.0
0.2
0.4
0.6
0.8
Class
0
1
2
3
4
5
6
7
8
9