

CarBrandMakes

October 7, 2024

```
[1]: import tensorflow as tf
import os
import cv2
import json
import numpy as np
from matplotlib import pyplot as plt
from keras.applications import InceptionResNetV2
from keras.models import Model
from keras.layers import Dense, GlobalAveragePooling2D
from keras.metrics import Precision, Recall, SparseCategoricalAccuracy

[2]: print("Num GPUs Available: ", len(tf.config.list_physical_devices('GPU')))
gpus = tf.config.experimental.list_physical_devices('GPU')
if gpus:
    try:
        for gpu in gpus:
            tf.config.experimental.set_memory_growth(gpu, True)
        logical_gpus = tf.config.experimental.list_logical_devices('GPU')
        print(len(gpus), "Physical GPUs,", len(logical_gpus), "Logical GPUs")
    except RuntimeError as e:
        print(e)
```

```
Num GPUs Available:  1
1 Physical GPUs, 1 Logical GPUs
```

```
[3]: base_dir = "Car Makes"
img_size = (224, 224)
batch_size = 16

data = tf.keras.utils.image_dataset_from_directory(
    base_dir,
    image_size=img_size,
    batch_size=batch_size,
    label_mode='int',
    interpolation='bilinear'
)

class_names = data.class_names
```

```
print("Class names:", class_names)
with open('CarBackend/mappings/CarBrandMake map.json', 'w') as f:
    json.dump(class_names, f)
```

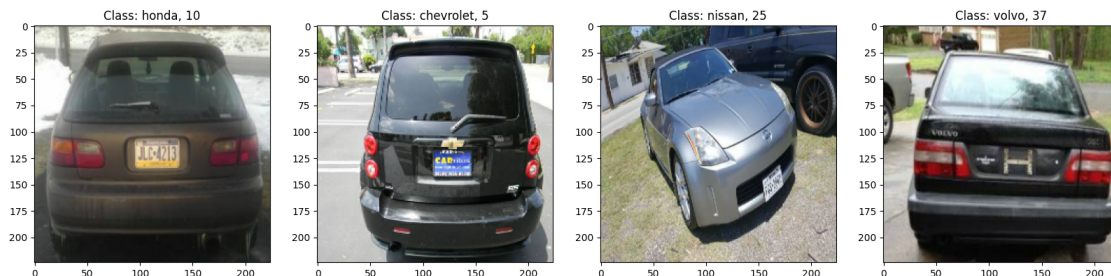
```
data_iterator = data.as_numpy_iterator()
```

Found 283317 files belonging to 38 classes.

Class names: ['acura', 'audi', 'bmw', 'buick', 'cadillac', 'chevrolet', 'chrysler', 'dodge', 'ford', 'gmc', 'honda', 'hyundai', 'infiniti', 'isuzu', 'jaguar', 'jeep', 'kia', 'landrover', 'lexus', 'lincoln', 'mazda', 'mercedes benz', 'mercury', 'mini', 'mitsubishi', 'nissan', 'oldsmobile', 'plymouth', 'pontiac', 'porsche', 'saab', 'saturn', 'scion', 'subaru', 'suzuki', 'toyota', 'volkswagen', 'volvo']

```
[4]: batch = data_iterator.next()
num_classes = len(class_names)
```

```
[5]: fig, ax = plt.subplots(ncols=4, figsize=(20,20))
for idx, img in enumerate(batch[0][:4]):
    ax[idx].imshow(img.astype(int))
    ax[idx].title.set_text(f"Class: {class_names[batch[1][idx]]}, \n
↪ {batch[1][idx]}")
```



```
[6]: train_size = int(len(data)*.7)
val_size = int(len(data)*.2)
test_size = int(len(data)*.1)
```

```
[7]: train = data.take(train_size)
val = data.skip(train_size).take(val_size)
test = data.skip(train_size+val_size).take(test_size)
```

```
[8]: base_model = InceptionResNetV2(
    weights='imagenet',
    include_top=False,
    input_shape=(224, 224, 3)
)
```

```
[9]: x = base_model.output
x = GlobalAveragePooling2D()(x)
output = Dense(num_classes, activation='softmax')(x)
model = Model(inputs=base_model.input, outputs=output)
model.compile(optimizer='adam',
              loss='sparse_categorical_crossentropy',
              metrics=['accuracy'])
tensorboard_callback = tf.keras.callbacks.TensorBoard(log_dir='logs')
hist = model.fit(train, epochs=20, validation_data=val,
               ↪callbacks=[tensorboard_callback])
```

Epoch 1/20

12395/12395 [=====] - 1239s 99ms/step - loss: 1.6397 - accuracy: 0.5432 - val_loss: 1.2935 - val_accuracy: 0.6473

Epoch 2/20

12395/12395 [=====] - 1209s 97ms/step - loss: 0.7519 - accuracy: 0.7834 - val_loss: 0.7386 - val_accuracy: 0.7885

Epoch 3/20

12395/12395 [=====] - 1207s 97ms/step - loss: 0.4837 - accuracy: 0.8568 - val_loss: 0.6533 - val_accuracy: 0.8195

Epoch 4/20

12395/12395 [=====] - 1205s 97ms/step - loss: 0.3388 - accuracy: 0.8976 - val_loss: 0.6287 - val_accuracy: 0.8319

Epoch 5/20

12395/12395 [=====] - 1207s 97ms/step - loss: 0.2492 - accuracy: 0.9231 - val_loss: 0.6889 - val_accuracy: 0.8309

Epoch 6/20

12395/12395 [=====] - 1209s 98ms/step - loss: 0.1908 - accuracy: 0.9398 - val_loss: 0.7188 - val_accuracy: 0.8317

Epoch 7/20

12395/12395 [=====] - 1218s 98ms/step - loss: 0.1505 - accuracy: 0.9517 - val_loss: 0.5632 - val_accuracy: 0.8667

Epoch 8/20

12395/12395 [=====] - 1314s 106ms/step - loss: 0.1248 - accuracy: 0.9592 - val_loss: 0.6076 - val_accuracy: 0.8658

Epoch 9/20

12395/12395 [=====] - 1412s 114ms/step - loss: 0.1052 - accuracy: 0.9661 - val_loss: 0.5848 - val_accuracy: 0.8686

Epoch 10/20

12395/12395 [=====] - 1300s 105ms/step - loss: 0.0916 - accuracy: 0.9704 - val_loss: 0.6121 - val_accuracy: 0.8738

Epoch 11/20

12395/12395 [=====] - 1250s 101ms/step - loss: 0.0807 - accuracy: 0.9737 - val_loss: 0.6049 - val_accuracy: 0.8700

Epoch 12/20

12395/12395 [=====] - 1212s 98ms/step - loss: 0.0745 - accuracy: 0.9760 - val_loss: 0.6533 - val_accuracy: 0.8668

Epoch 13/20

```

12395/12395 [=====] - 1213s 98ms/step - loss: 0.0680 -
accuracy: 0.9783 - val_loss: 0.7011 - val_accuracy: 0.8662
Epoch 14/20
12395/12395 [=====] - 1215s 98ms/step - loss: 0.0614 -
accuracy: 0.9800 - val_loss: 0.6260 - val_accuracy: 0.8821
Epoch 15/20
12395/12395 [=====] - 1293s 104ms/step - loss: 0.0566 -
accuracy: 0.9816 - val_loss: 0.6180 - val_accuracy: 0.8815
Epoch 16/20
12395/12395 [=====] - 1417s 114ms/step - loss: 0.0543 -
accuracy: 0.9825 - val_loss: 0.6828 - val_accuracy: 0.8790
Epoch 17/20
12395/12395 [=====] - 1282s 103ms/step - loss: 0.0496 -
accuracy: 0.9841 - val_loss: 0.8679 - val_accuracy: 0.8762
Epoch 18/20
12395/12395 [=====] - 1253s 101ms/step - loss: 0.0466 -
accuracy: 0.9852 - val_loss: 1.2681 - val_accuracy: 0.8750
Epoch 19/20
12395/12395 [=====] - 1251s 101ms/step - loss: 0.0437 -
accuracy: 0.9860 - val_loss: 0.8299 - val_accuracy: 0.8756
Epoch 20/20
12395/12395 [=====] - 1387s 112ms/step - loss: 0.0420 -
accuracy: 0.9865 - val_loss: 0.6710 - val_accuracy: 0.8842

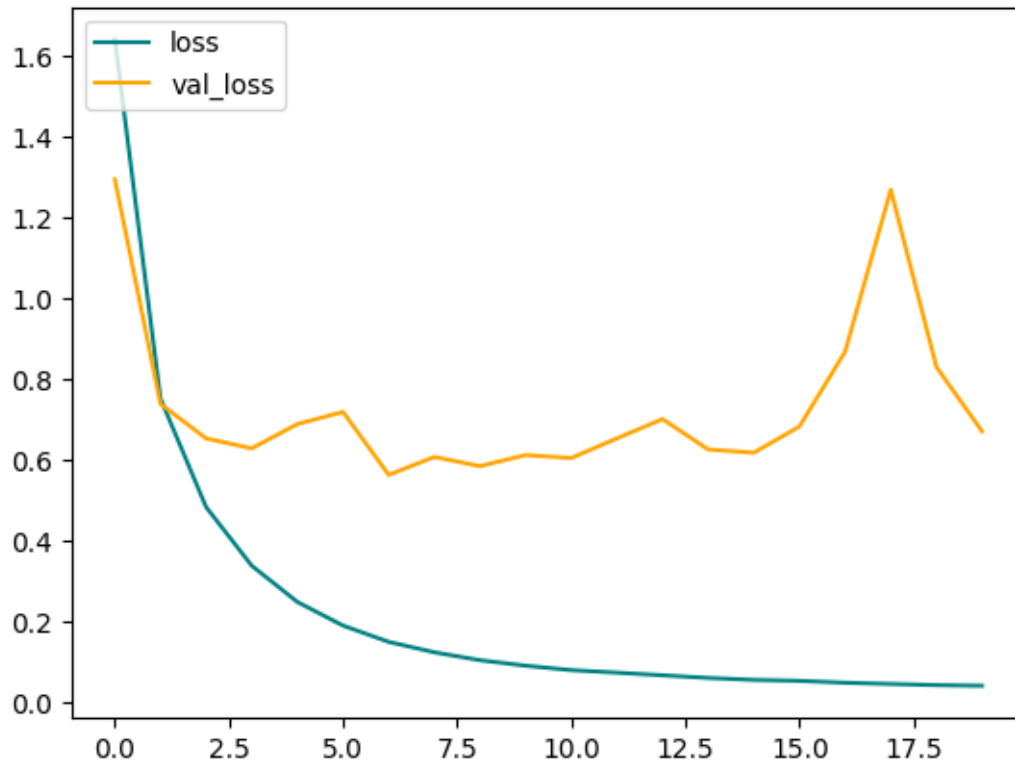
```

```

[10]: fig = plt.figure()
plt.plot(hist.history['loss'], color='teal', label='loss')
plt.plot(hist.history['val_loss'], color='orange', label='val_loss')
fig.suptitle('Loss', fontsize=20)
plt.legend(loc="upper left")
plt.show()

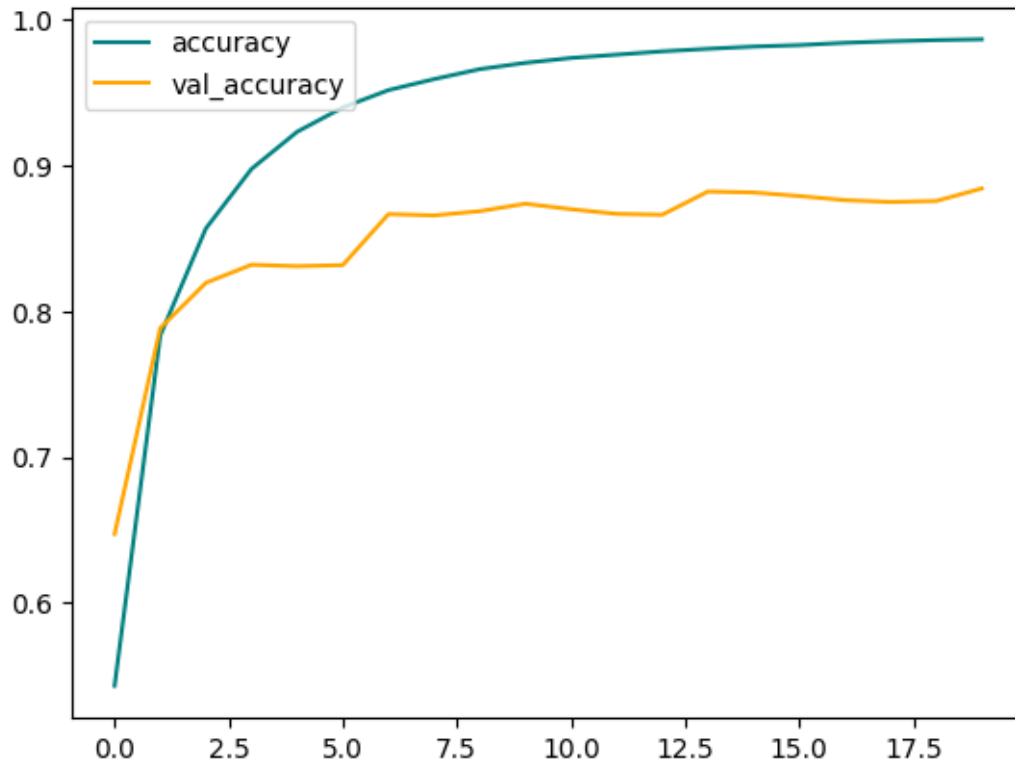
```

Loss



```
[11]: fig = plt.figure()
plt.plot(hist.history['accuracy'], color='teal', label='accuracy')
plt.plot(hist.history['val_accuracy'], color='orange', label='val_accuracy')
fig.suptitle('Accuracy', fontsize=20)
plt.legend(loc="upper left")
plt.show()
```

Accuracy



```
[12]: pre = Precision()
      re = Recall()
      acc = SparseCategoricalAccuracy()
```

```
[13]: for batch in test.as_numpy_iterator():
      X, y = batch
      yhat = model.predict(X)

      yhat_classes = tf.argmax(yhat, axis=1)

      pre.update_state(y, yhat_classes)
      re.update_state(y, yhat_classes)
      acc.update_state(y, yhat)
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```

[14]: print(f"Precision: {pre.result().numpy() * 100 : .2f}%")
      print(f"Recall: {re.result().numpy() * 100 : .2f}%")
      print(f"Accuracy: {acc.result().numpy() * 100 : .2f}%")

```

```

Precision: 99.82%
Recall: 99.62%
Accuracy: 88.76%

```

```

[15]: img = cv2.imread('Styles/test/Hatchback/8_jpg.rf.
      ↪c314c1d6777942876503fa1482c82240.jpg')

```

```

img_resized = cv2.resize(img, img_size)
img_expanded = np.expand_dims(img_resized, axis=0)

yhat = model.predict(img_expanded)
predicted_class = tf.argmax(yhat, axis=1).numpy()[0]

plt.imshow(img)
plt.title(f'Predicted class: {predicted_class}')
plt.axis('off')
plt.show()

```

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Predicted class: 35



```
[16]: print(f'Predicted class is: {class_names[predicted_class]}')
```

Predicted class is: toyota

```
[17]: model_file_name = f"CarBrandMakeModel{acc.result().numpy() * 100 : .2f}%_
      ↪ InceptionResNetV2.h5"
      model.save(os.path.join('CarBackEnd/models/CarBrandsMakes', model_file_name))
```

```
[ ]:
```