Inception_v3 Model

Action Classes - 5

```
In [1]:  from keras import models
         from keras.layers import Dense,Flatten
         from keras import backend as K
         import numpy as np
         import matplotlib.pyplot as plt

         from keras.applications import inception_v3
```

```
In [2]:  import tensorflow as tf
         print("Num GPUs Available: ", len(tf.config.list_physical_devices('GPU'))
```

Num GPUs Available: 1

2022-08-25 22:18:43.851617: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:43.964437: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:43.964736: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero

Dataset

```
In [3]:  from keras.preprocessing.image import ImageDataGenerator

         dataset_path = "./frames/"
         # will contain the categories in respective folders

         # Data generators
         train_datagen = ImageDataGenerator(rescale=1/255, validation_split=0.2)
```

In [4]:
```python
image_size = (299,299)
batch_size = 10

train_batches = train_datagen.flow_from_directory(
    dataset_path,
    target_size = image_size,
    batch_size = batch_size,
    class_mode = "categorical",
    subset = "training"
)

validation_batches = train_datagen.flow_from_directory(
    dataset_path,
    target_size = image_size,
    batch_size = batch_size,
    class_mode = "categorical",
    subset = "validation"
)

test_batches = train_datagen.flow_from_directory(
    dataset_path,
    target_size = image_size,
    batch_size = batch_size,
    class_mode = "categorical",
    subset = "validation"
)
```

```
Found 1546 images belonging to 5 classes.
Found 384 images belonging to 5 classes.
Found 384 images belonging to 5 classes.
```

In [5]:
```python
train_batches.class_indices
```

Out[5]:
```
{'ApplyLipstick': 0,
 'Biking': 1,
 'Kayaking': 2,
 'ShavingBeard': 3,
 'TennisSwing': 4}
```

In [6]:
```python
from matplotlib import pyplot as plt

def plot_images(images_arr):
    fig, axes = plt.subplots(1,10)
    axes = axes.flatten()
    for img, ax in zip(images_arr, axes):
        ax.imshow(img)
        ax.axis('off')
    plt.tight_layout()
    plt.show()
```

In [7]:
```python
imgs, labels = train_batches[0]
plot_images(imgs)
print(labels[:10])
```

```
[[0. 0. 0. 1. 0.]
 [0. 0. 1. 0. 0.]
 [1. 0. 0. 0. 0.]
 [0. 0. 1. 0. 0.]
 [0. 1. 0. 0. 0.]
 [0. 0. 0. 0. 1.]
 [0. 1. 0. 0. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 1. 0.]]
```

Initialize model

In [8]:
```python
inception_v3_model_top = inception_v3.InceptionV3(include_top=True,
                        input_shape=(299,299,3),
                        pooling='avg',
                        weights='imagenet')

for (i,layer) in enumerate(inception_v3_model_top.layers):
    print((i, layer.name, layer.output_shape))
```

```
2022-08-25 22:18:45.224999: I tensorflow/core/platform/cpu_feature_guard.
cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Netwo
rk Library (oneDNN) to use the following CPU instructions in performance-
critical operations:  AVX2 FMA
To enable them in other operations, rebuild TensorFlow with the appropria
te compiler flags.
2022-08-25 22:18:45.226429: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:45.226744: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:45.227002: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:46.263339: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:46.263538: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:46.263672: I tensorflow/stream_executor/cuda/cuda_gpu_ex
ecutor.cc:975] successful NUMA node read from SysFS had negative value (-
1), but there must be at least one NUMA node, so returning NUMA node zero
2022-08-25 22:18:46.263782: I tensorflow/core/common_runtime/gpu/gpu_devi
ce.cc:1532] Created device /job:localhost/replica:0/task:0/device:GPU:0 w
ith 3368 MB memory:  -> device: 0, name: NVIDIA GeForce GTX 1050 Ti, pci
bus id: 0000:01:00.0, compute capability: 6.1
```

```
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(39, 'activation_11', (None, 35, 35, 32))
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```

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```

```
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(306, 'activation_85', (None, 8, 8, 320))
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(308, 'concatenate_1', (None, 8, 8, 768))
(309, 'activation_93', (None, 8, 8, 192))
(310, 'mixed10', (None, 8, 8, 2048))
(311, 'avg_pool', (None, 2048))
(312, 'predictions', (None, 1000))
```

```
In [9]:  inception_v3_model = inception_v3.InceptionV3(include_top=False,
                                input_shape=(299,299,3),
                                pooling='avg',classes=5,
                                weights='imagenet')

         for (i,layer) in enumerate(inception_v3_model.layers):
             layer.trainable = False
             print((i, layer.name, layer.output_shape))
```

```
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(6, 'activation_95', (None, 147, 147, 32))
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```

```
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(311, 'global_average_pooling2d', (None, 2048))
```

In [10]:
```python
model = models.Sequential()

dense_layer_1 = Dense(32, activation='relu')
prediction_layer = Dense(5, activation='softmax')

model.add(inception_v3_model)
model.add(dense_layer_1)
model.add(prediction_layer)

model.summary()
```

Model: "sequential"

_____

Layer (type)	Output Shape	Param #
inception_v3 (Functional)	(None, 2048)	21802784
dense (Dense)	(None, 32)	65568
dense_1 (Dense)	(None, 5)	165

===
Total params: 21,868,517
Trainable params: 65,733
Non-trainable params: 21,802,784

_____

In [11]:
```python
model.compile(
    optimizer='adam',
    loss='categorical_crossentropy',
    metrics=['accuracy'],
)
```

In [12]:
```python
model.save("./models/action-class-05-inception_v3_model.h5")
```

In [13]:
```python
fit = model.fit(train_batches, epochs=20, validation_data=validation_batc
```

Epoch 1/20

2022-08-25 22:18:55.748471: I tensorflow/stream_executor/cuda/cuda_dnn.c
c:384] Loaded cuDNN version 8401
2022-08-25 22:18:57.202333: I tensorflow/core/platform/default/subproces
s.cc:304] Start cannot spawn child process: No such file or directory

```
155/155 [==============================] - 31s 153ms/step - loss: 0.2258
- accuracy: 0.9295 - val_loss: 0.1988 - val_accuracy: 0.9219
Epoch 2/20
155/155 [==============================] - 17s 111ms/step - loss: 0.0180
- accuracy: 0.9974 - val_loss: 0.0986 - val_accuracy: 0.9740
Epoch 3/20
155/155 [==============================] - 17s 112ms/step - loss: 0.0065
- accuracy: 1.0000 - val_loss: 0.1002 - val_accuracy: 0.9635
Epoch 4/20
155/155 [==============================] - 17s 112ms/step - loss: 0.0036
- accuracy: 1.0000 - val_loss: 0.1147 - val_accuracy: 0.9479
Epoch 5/20
155/155 [==============================] - 17s 112ms/step - loss: 0.0034
- accuracy: 1.0000 - val_loss: 0.1830 - val_accuracy: 0.9375
Epoch 6/20
155/155 [==============================] - 18s 113ms/step - loss: 0.0014
- accuracy: 1.0000 - val_loss: 0.1226 - val_accuracy: 0.9583
Epoch 7/20
155/155 [==============================] - 18s 115ms/step - loss: 9.3113e
-04 - accuracy: 1.0000 - val_loss: 0.1243 - val_accuracy: 0.9531
Epoch 8/20
155/155 [==============================] - 18s 118ms/step - loss: 7.5890e
-04 - accuracy: 1.0000 - val_loss: 0.1140 - val_accuracy: 0.9635
Epoch 9/20
155/155 [==============================] - 19s 121ms/step - loss: 6.1389e
-04 - accuracy: 1.0000 - val_loss: 0.1106 - val_accuracy: 0.9635
Epoch 10/20
155/155 [==============================] - 19s 123ms/step - loss: 4.9945e
-04 - accuracy: 1.0000 - val_loss: 0.1162 - val_accuracy: 0.9609
Epoch 11/20
155/155 [==============================] - 20s 127ms/step - loss: 4.0790e
-04 - accuracy: 1.0000 - val_loss: 0.1093 - val_accuracy: 0.9635
Epoch 12/20
155/155 [==============================] - 21s 134ms/step - loss: 3.4676e
-04 - accuracy: 1.0000 - val_loss: 0.1038 - val_accuracy: 0.9714
Epoch 13/20
155/155 [==============================] - 21s 138ms/step - loss: 2.9887e
-04 - accuracy: 1.0000 - val_loss: 0.1181 - val_accuracy: 0.9609
Epoch 14/20
155/155 [==============================] - 23s 148ms/step - loss: 2.5659e
-04 - accuracy: 1.0000 - val_loss: 0.1245 - val_accuracy: 0.9583
Epoch 15/20
155/155 [==============================] - 28s 183ms/step - loss: 2.2497e
-04 - accuracy: 1.0000 - val_loss: 0.1143 - val_accuracy: 0.9661
Epoch 16/20
155/155 [==============================] - 26s 168ms/step - loss: 1.9509e
-04 - accuracy: 1.0000 - val_loss: 0.1246 - val_accuracy: 0.9609
Epoch 17/20
155/155 [==============================] - 27s 173ms/step - loss: 1.7427e
-04 - accuracy: 1.0000 - val_loss: 0.1245 - val_accuracy: 0.9583
Epoch 18/20
155/155 [==============================] - 30s 196ms/step - loss: 1.5146e
-04 - accuracy: 1.0000 - val_loss: 0.1231 - val_accuracy: 0.9609
Epoch 19/20
155/155 [==============================] - 30s 192ms/step - loss: 1.3396e
-04 - accuracy: 1.0000 - val_loss: 0.1229 - val_accuracy: 0.9609
Epoch 20/20
155/155 [==============================] - 33s 210ms/step - loss: 1.1848e
-04 - accuracy: 1.0000 - val_loss: 0.1205 - val_accuracy: 0.9635
```

```
In [14]: model.save("./models/action-class-05-trained-inception_v3_model.h5")
```

Evaluate and Predict

In [15]:
```python
model = models.load_model("./models/action-class-05-trained-inception_v3_
model.summary()
```

```
Model: "sequential"
_____
 Layer (type)                Output Shape              Param #
=================================================================
 inception_v3 (Functional)   (None, 2048)              21802784

 dense (Dense)               (None, 32)                65568

 dense_1 (Dense)             (None, 5)                 165

=================================================================
Total params: 21,868,517
Trainable params: 65,733
Non-trainable params: 21,802,784
_____
```

In [16]:
```python
model.evaluate(test_batches)
```

```
39/39 [==============================] - 6s 109ms/step - loss: 0.1205 - a
ccuracy: 0.9635
```
Out[16]: [0.12051249295473099, 0.9635416865348816]

In [17]:
```python
plt.style.use("ggplot")
plt.figure()

plt.plot(np.arange(0, 20), fit.history["loss"], label="train_loss")
plt.plot(np.arange(0, 20), fit.history["val_loss"], label="val_loss")
plt.title("Training Loss")
plt.xlabel("Epoch #")
plt.ylabel("Loss")
plt.legend(loc="lower left")
plt.show()

plt.plot(np.arange(0, 20), fit.history["accuracy"], label="train_acc")
plt.plot(np.arange(0, 20), fit.history["val_accuracy"], label="val_acc")
plt.title("Accuracy")
plt.xlabel("Epoch #")
plt.ylabel("Accuracy")
plt.legend(loc="lower left")
plt.show()
```

Training Loss
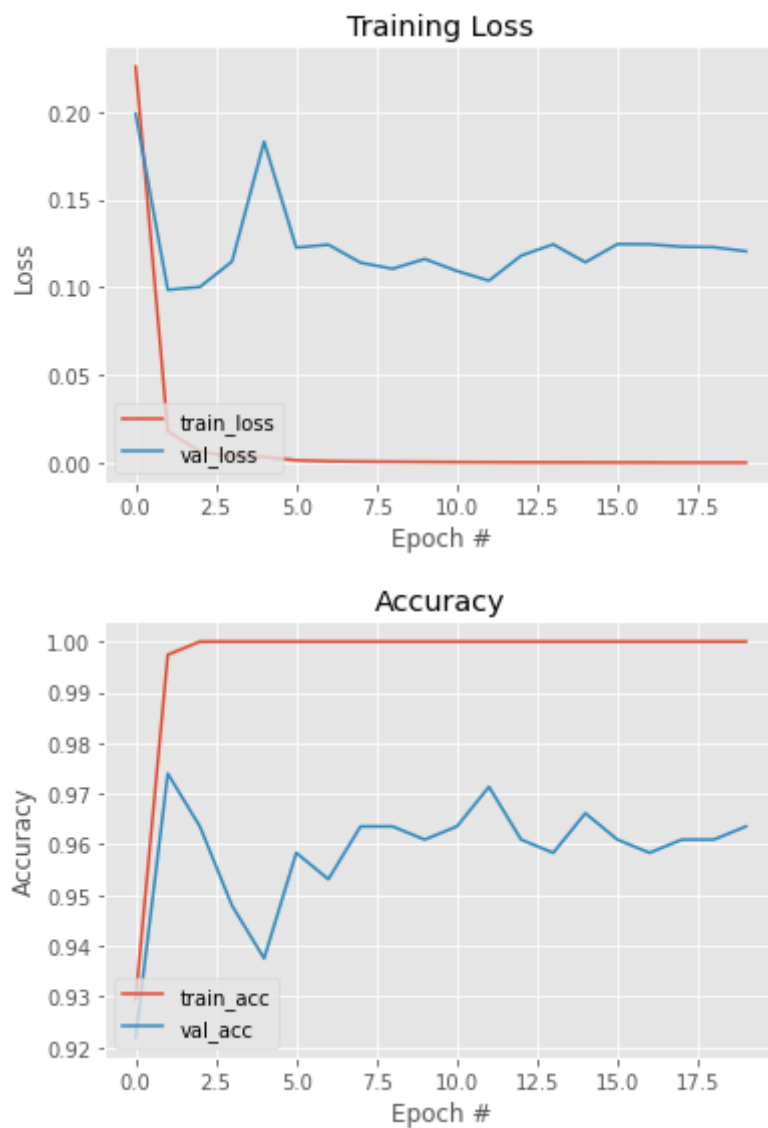
Accuracy


```
In [18]:  print("Avg Val Acc: " + str(sum(fit.history["val_accuracy"])/20*100))
          print("Avg Val Loss: " + str(sum(fit.history["val_loss"])/20*100))

          Avg Val Acc: 95.84635436534882
          Avg Val Loss: 12.343161031603813
```