Inception_v3 Model

Action Classes - 10

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 14:18:45.010869: 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 14:18:45.049175: 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 14:18:45.049479: 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]:
```
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 2734 images belonging to 10 classes.
Found 679 images belonging to 10 classes.
Found 679 images belonging to 10 classes.
```

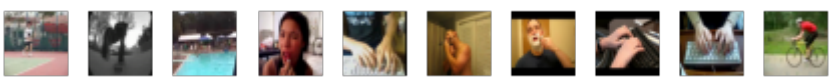
In [5]:
```
train_batches.class_indices
```

Out[5]:
```
{'ApplyLipstick': 0,
 'Archery': 1,
 'Biking': 2,
 'Diving': 3,
 'Kayaking': 4,
 'MilitaryParade': 5,
 'ShavingBeard': 6,
 'SkateBoarding': 7,
 'TennisSwing': 8,
 'Typing': 9}
```

In [6]:
```
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]:
```
imgs, labels = train_batches[0]
plot_images(imgs)
print(labels[:10])
```



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

Initialize model

In [8]:
```
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 14:18:45.849939: 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 14:18:45.850565: 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 14:18:45.850968: 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 14:18:45.851228: 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 14:18:46.244972: 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 14:18:46.245117: 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 14:18:46.245224: 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 14:18:46.245313: 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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(6, 'activation_1', (None, 147, 147, 32))
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(8, 'batch_normalization_2', (None, 147, 147, 64))
(9, 'activation_2', (None, 147, 147, 64))
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```

```
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```

```
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```

```
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```

```
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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=10,
                    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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```

```
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```

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

dense_layer_1 = Dense(32, activation='relu')
prediction_layer = Dense(10, 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, 10)                330

=================================================================
Total params: 21,868,682
Trainable params: 65,898
Non-trainable params: 21,802,784
_________________________________________________________________
```

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

In [12]:
```
model.save("./models/action-class-10-model-inception_v3_model.h5")
```

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

```
Epoch 1/20
2022-08-25 14:18:54.645255: I tensorflow/stream_executor/cuda/cuda_dnn.c
c:384] Loaded cuDNN version 8401
2022-08-25 14:18:55.037803: I tensorflow/core/platform/default/subproces
s.cc:304] Start cannot spawn child process: No such file or directory
```

```
274/274 [==============================] - 40s 125ms/step - loss: 0.3556
- accuracy: 0.9082 - val_loss: 0.2051 - val_accuracy: 0.9337
Epoch 2/20
274/274 [==============================] - 31s 113ms/step - loss: 0.0587
- accuracy: 0.9850 - val_loss: 0.2066 - val_accuracy: 0.9264
Epoch 3/20
274/274 [==============================] - 31s 114ms/step - loss: 0.0241
- accuracy: 0.9963 - val_loss: 0.2136 - val_accuracy: 0.9367
Epoch 4/20
274/274 [==============================] - 32s 118ms/step - loss: 0.0153
- accuracy: 0.9967 - val_loss: 0.1877 - val_accuracy: 0.9337
Epoch 5/20
274/274 [==============================] - 34s 126ms/step - loss: 0.0075
- accuracy: 0.9985 - val_loss: 0.1654 - val_accuracy: 0.9543
Epoch 6/20
274/274 [==============================] - 35s 128ms/step - loss: 0.0048
- accuracy: 1.0000 - val_loss: 0.1803 - val_accuracy: 0.9440
Epoch 7/20
274/274 [==============================] - 37s 135ms/step - loss: 0.0027
- accuracy: 1.0000 - val_loss: 0.1598 - val_accuracy: 0.9529
Epoch 8/20
274/274 [==============================] - 41s 148ms/step - loss: 0.0021
- accuracy: 1.0000 - val_loss: 0.1688 - val_accuracy: 0.9485
Epoch 9/20
274/274 [==============================] - 51s 186ms/step - loss: 0.0015
- accuracy: 1.0000 - val_loss: 0.1935 - val_accuracy: 0.9514
Epoch 10/20
274/274 [==============================] - 49s 177ms/step - loss: 0.0014
- accuracy: 1.0000 - val_loss: 0.1509 - val_accuracy: 0.9543
Epoch 11/20
274/274 [==============================] - 54s 198ms/step - loss: 0.0010
- accuracy: 1.0000 - val_loss: 0.1929 - val_accuracy: 0.9499
Epoch 12/20
274/274 [==============================] - 55s 201ms/step - loss: 8.3106e
-04 - accuracy: 1.0000 - val_loss: 0.1784 - val_accuracy: 0.9499
Epoch 13/20
274/274 [==============================] - 67s 243ms/step - loss: 6.6450e
-04 - accuracy: 1.0000 - val_loss: 0.1716 - val_accuracy: 0.9514
Epoch 14/20
274/274 [==============================] - 67s 244ms/step - loss: 5.5696e
-04 - accuracy: 1.0000 - val_loss: 0.1921 - val_accuracy: 0.9529
Epoch 15/20
274/274 [==============================] - 69s 251ms/step - loss: 4.6413e
-04 - accuracy: 1.0000 - val_loss: 0.1878 - val_accuracy: 0.9499
Epoch 16/20
274/274 [==============================] - 63s 229ms/step - loss: 3.8627e
-04 - accuracy: 1.0000 - val_loss: 0.2123 - val_accuracy: 0.9455
Epoch 17/20
274/274 [==============================] - 61s 224ms/step - loss: 3.3975e
-04 - accuracy: 1.0000 - val_loss: 0.1893 - val_accuracy: 0.9529
Epoch 18/20
274/274 [==============================] - 73s 265ms/step - loss: 2.7243e
-04 - accuracy: 1.0000 - val_loss: 0.2038 - val_accuracy: 0.9514
Epoch 19/20
274/274 [==============================] - 68s 248ms/step - loss: 2.2634e
-04 - accuracy: 1.0000 - val_loss: 0.2160 - val_accuracy: 0.9499
Epoch 20/20
274/274 [==============================] - 75s 275ms/step - loss: 2.1663e
-04 - accuracy: 1.0000 - val_loss: 0.1968 - val_accuracy: 0.9470
```

In [14]:
```
model.save("./models/action-class-10-trained-inception_v3_model.h5")
```

Evaluate and Predict

In [15]:
```
model = models.load_model("./models/action-class-10-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, 10)                330

=================================================================
Total params: 21,868,682
Trainable params: 65,898
Non-trainable params: 21,802,784
_________________________________________________________________
```

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

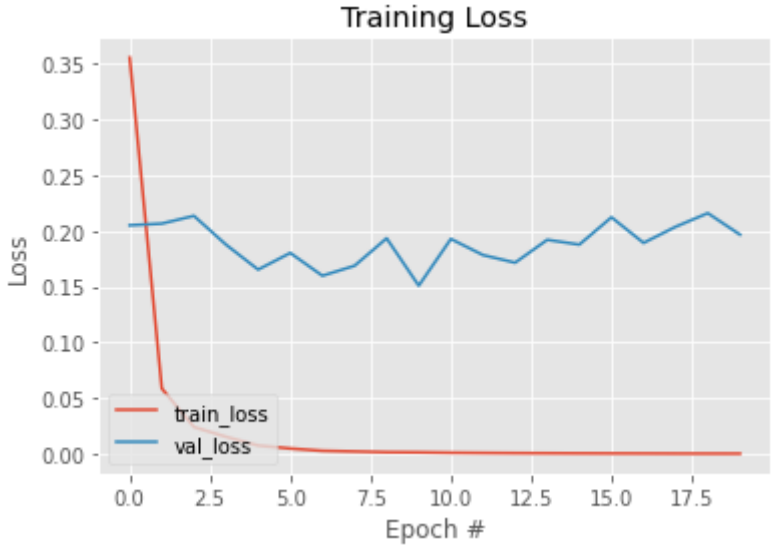
```
68/68 [==============================] - 9s 103ms/step - loss: 0.1968 - a
ccuracy: 0.9470
```

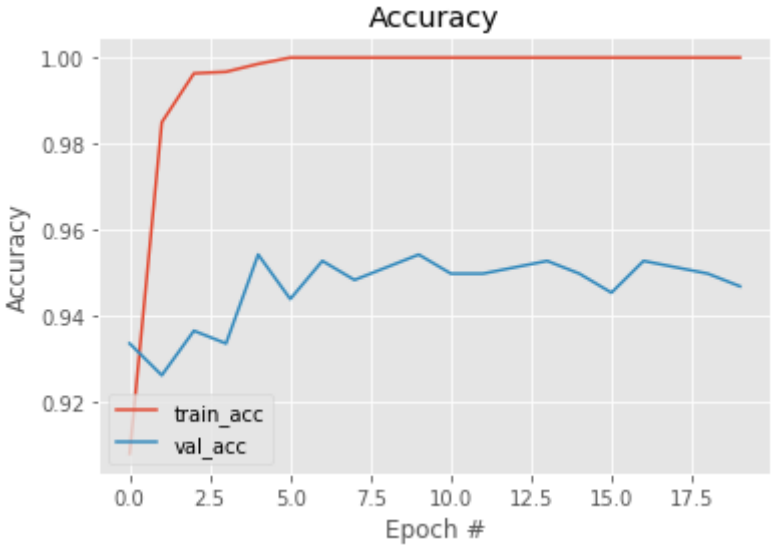
Out[16]:
```
[0.1967533826828003, 0.9469808340072632]
```

In [17]:
```
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
Loss
Epoch #
train_loss
val_loss
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5


Accuracy
Accuracy
Epoch #
train_acc
val_acc
1.00
0.98
0.96
0.94
0.92
0.0
2.5
5.0
7.5
10.0
12.5
15.0
17.5

In [ ]: