

Inception_v3 Model

Action Classes - 15

```
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 16:11:23.973814: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:24.010132: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:24.010439: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 3767 images belonging to 15 classes.
Found 934 images belonging to 15 classes.
Found 934 images belonging to 15 classes.

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

```
Out[5]: {'ApplyLipstick': 0,
        'Archery': 1,
        'BabyCrawling': 2,
        'Biking': 3,
        'Diving': 4,
        'Fencing': 5,
        'Kayaking': 6,
        'MilitaryParade': 7,
        'PizzaTossing': 8,
        'ShavingBeard': 9,
        'SkateBoarding': 10,
        'SumoWrestling': 11,
        'TennisSwing': 12,
        'Typing': 13,
        'WritingOnBoard': 14}
```

```
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. 0. 0. 0. 0. 0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 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. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 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. 0. 0. 0. 0. 1. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 0. 0. 0. 0. 0. 0.]
 [0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 1. 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 16:11:24.816508: I tensorflow/core/platform/cpu_feature_guard.cc:193] This TensorFlow binary is optimized with oneAPI Deep Neural Network Library (oneDNN) to use the following CPU instructions in performance-critical operations: AVX2 FMA

To enable them in other operations, rebuild TensorFlow with the appropriate compiler flags.

2022-08-25 16:11:24.817331: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:24.817682: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:24.817988: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:25.196198: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:25.196336: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:25.196437: I tensorflow/stream_executor/cuda/cuda_gpu_executor.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 16:11:25.196523: I tensorflow/core/common_runtime/gpu/gpu_device.cc:1532] Created device /job:localhost/replica:0/task:0/device:GPU:0 with 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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```

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(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=15,
              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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```

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

dense_layer_1 = Dense(32, activation='relu')
prediction_layer = Dense(15, 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, 15)	495
Total params: 21,868,847		
Trainable params: 66,063		
Non-trainable params: 21,802,784		

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

```
In [12]: model.save("./models/action-class-15-model-inception_v3_model.h5")
```

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

Epoch 1/20

2022-08-25 16:11:33.853346: I tensorflow/stream_executor/cuda/cuda_dnn.cc:384] Loaded cuDNN version 8401

2022-08-25 16:11:34.221907: I tensorflow/core/platform/default/subprocess.cc:304] Start cannot spawn child process: No such file or directory

```
377/377 [=====] - 55s 133ms/step - loss: 0.8889
- accuracy: 0.7709 - val_loss: 0.3456 - val_accuracy: 0.9154
Epoch 2/20
377/377 [=====] - 47s 124ms/step - loss: 0.1768
- accuracy: 0.9604 - val_loss: 0.2401 - val_accuracy: 0.9304
Epoch 3/20
377/377 [=====] - 47s 125ms/step - loss: 0.0913
- accuracy: 0.9817 - val_loss: 0.2020 - val_accuracy: 0.9347
Epoch 4/20
377/377 [=====] - 49s 131ms/step - loss: 0.0556
- accuracy: 0.9907 - val_loss: 0.1878 - val_accuracy: 0.9433
Epoch 5/20
377/377 [=====] - 58s 155ms/step - loss: 0.0360
- accuracy: 0.9944 - val_loss: 0.2217 - val_accuracy: 0.9229
Epoch 6/20
377/377 [=====] - 73s 193ms/step - loss: 0.0241
- accuracy: 0.9968 - val_loss: 0.2060 - val_accuracy: 0.9304
Epoch 7/20
377/377 [=====] - 77s 205ms/step - loss: 0.0145
- accuracy: 0.9995 - val_loss: 0.1852 - val_accuracy: 0.9411
Epoch 8/20
377/377 [=====] - 85s 226ms/step - loss: 0.0105
- accuracy: 0.9997 - val_loss: 0.1987 - val_accuracy: 0.9411
Epoch 9/20
377/377 [=====] - 90s 239ms/step - loss: 0.0071
- accuracy: 1.0000 - val_loss: 0.2081 - val_accuracy: 0.9390
Epoch 10/20
377/377 [=====] - 93s 246ms/step - loss: 0.0054
- accuracy: 1.0000 - val_loss: 0.2015 - val_accuracy: 0.9400
Epoch 11/20
377/377 [=====] - 89s 235ms/step - loss: 0.0039
- accuracy: 1.0000 - val_loss: 0.1914 - val_accuracy: 0.9465
Epoch 12/20
377/377 [=====] - 101s 268ms/step - loss: 0.0029
- accuracy: 1.0000 - val_loss: 0.2185 - val_accuracy: 0.9368
Epoch 13/20
377/377 [=====] - 98s 259ms/step - loss: 0.0025
- accuracy: 1.0000 - val_loss: 0.2026 - val_accuracy: 0.9411
Epoch 14/20
377/377 [=====] - 99s 261ms/step - loss: 0.0021
- accuracy: 1.0000 - val_loss: 0.2029 - val_accuracy: 0.9422
Epoch 15/20
377/377 [=====] - 85s 224ms/step - loss: 0.0014
- accuracy: 1.0000 - val_loss: 0.2052 - val_accuracy: 0.9475
Epoch 16/20
377/377 [=====] - 97s 257ms/step - loss: 0.0011
- accuracy: 1.0000 - val_loss: 0.2245 - val_accuracy: 0.9465
Epoch 17/20
377/377 [=====] - 93s 246ms/step - loss: 0.0011
- accuracy: 1.0000 - val_loss: 0.2504 - val_accuracy: 0.9325
Epoch 18/20
377/377 [=====] - 96s 255ms/step - loss: 0.0382
- accuracy: 0.9875 - val_loss: 0.2758 - val_accuracy: 0.9315
Epoch 19/20
377/377 [=====] - 97s 257ms/step - loss: 0.0020
- accuracy: 1.0000 - val_loss: 0.3937 - val_accuracy: 0.9111
Epoch 20/20
377/377 [=====] - 92s 243ms/step - loss: 7.8810e
-04 - accuracy: 1.0000 - val_loss: 0.2655 - val_accuracy: 0.9379
```

```
In [14]: model.save("./models/action-class-15-trained-inception_v3_model.h5")
```


Evaluate and Predict

```
In [15]: model = models.load_model("./models/action-class-15-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, 15)	495

```
=====
Total params: 21,868,847
Trainable params: 66,063
Non-trainable params: 21,802,784
=====
```

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

```
94/94 [=====] - 12s 109ms/step - loss: 0.2655 -
accuracy: 0.9379
```

```
Out[16]: [0.265487939119339, 0.937901496887207]
```

```
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()
```



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

```
Avg Val Acc: 0.9355995684862137  
Avg Val Loss: 0.23134735822677613
```