DEEP LEARNING LAB 1 REPORT

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importing the needed libraries

```
[1]  import numpy as np

     import tensorflow as tf

     from tensorflow.keras.preprocessing.image import ImageDataGenerator
```

```
[2]  !git clone https://github.com/nickmccullum/cats-and-dogs.git
```

```
Cloning into 'cats-and-dogs'...
remote: Enumerating objects: 10016, done.
remote: Counting objects: 100% (2/2), done.
remote: Compressing objects: 100% (2/2), done.
remote: Total 10016 (delta 0), reused 0 (delta 0), pack-reused 10014
Receiving objects: 100% (10016/10016), 216.39 MiB | 33.52 MiB/s, done.
Resolving deltas: 100% (3/3), done.
Updating files: 100% (10008/10008), done.
```

Preprocessing the Training Data

```
[3]  training_generator = ImageDataGenerator(
                              rescale = 1/255,
                              shear_range = 0.2,
                              zoom_range = 0.2,
                              horizontal_flip = True)
```

```
[4]  training_set = training_generator.flow_from_directory('/content/cats-and-dogs/training_data',
                                                           target_size = (64, 64),
                                                           batch_size = 32,
                                                           class_mode = 'binary')
```

```
Found 8000 images belonging to 2 classes.
```

```
[7]  print('The training set is = ',training_set)
```

```
The training set is =  <keras.src.preprocessing.image.DirectoryIterator object at 0x7c525a208bb0>
```

Please print the output of training_generator.flow_from_directory as an image here [1 Mark]

```
import matplotlib.pyplot as plt

# Retrieve a batch of images and labels from the generator
images, labels = next(training_set)

# Plot the images
fig, axes = plt.subplots(4, 8, figsize=(10, 10))  # will display 4*8 images = 32 images =batch size=32
axes = axes.ravel()

for i in range(len(images)):
    axes[i].imshow(images[i])
    axes[i].axis('off')

plt.show()
```

preprocessing test set

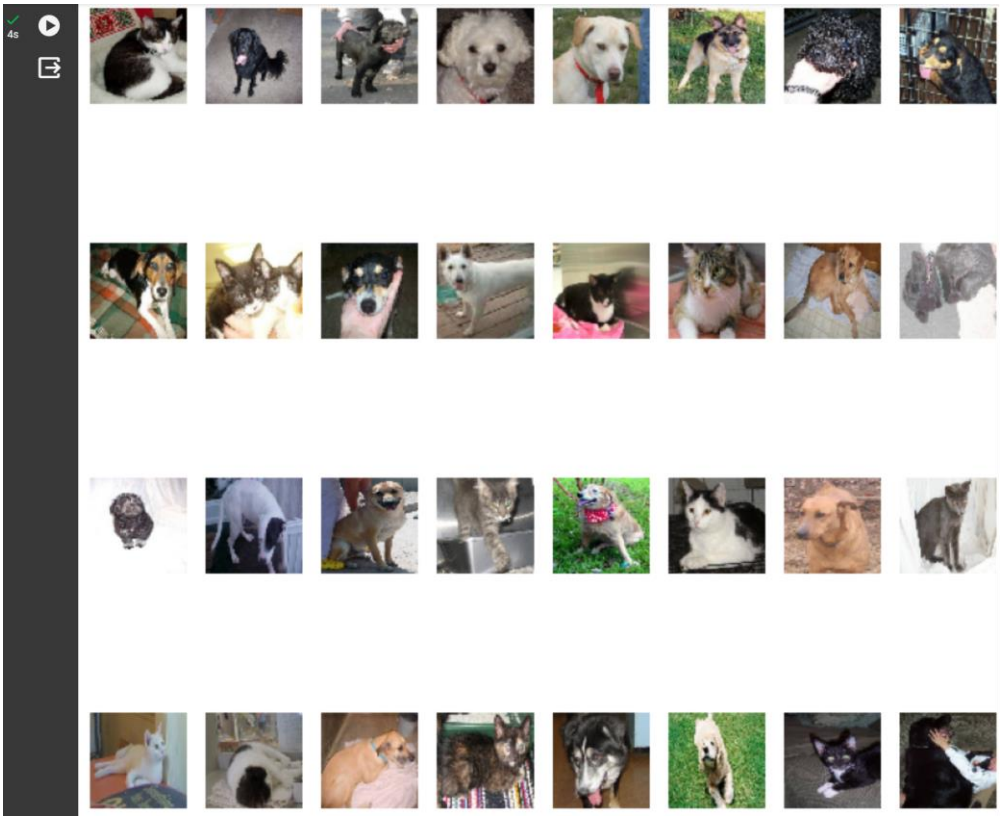
```
[17] test_generator = ImageDataGenerator(rescale = 1./255)

     test_set = test_generator.flow_from_directory('/content/cats-and-dogs/test_data',
                                                   target_size = (64, 64),
                                                   batch_size = 32,
                                                   class_mode = 'binary')
```

```
Found 2000 images belonging to 2 classes.
```

Please print the output of test_generator.flow_from_directory as an image here [1 Mark]

```
# Print the output
print('Found', test_set.samples, 'images belonging to', test_set.num_classes, 'classes.')

# Retrieve a batch of images and labels from the generator
images, labels = next(test_set)

# Plot the images
fig, axes = plt.subplots(4, 8, figsize=(10, 10))
axes = axes.ravel()

for i in range(len(images)):
    axes[i].imshow(images[i])
    axes[i].axis('off')

plt.show()
```

```
Found 2000 images belonging to 2 classes.
```



preprocessing is complete^^

Building Our Convolutional Neural Network

```
preprocessing is complete

Building Our Convolutional Neural Network

[21] cnn = tf.keras.models.Sequential()

Adding Our Convolutional Layer

[23] cnn.add(tf.keras.layers.Conv2D(filters=32, kernel_size=3, activation='relu', input_shape=[64, 64, 3]))
```

What will be the add command if we wanted to have 64 feature detectors, with a kernel size of 5x5 [2 Marks]

```
[25] cnn.add(tf.keras.layers.Conv2D(filters=64, kernel_size=5, activation='relu')) #relu is the default activation function
```

Adding Our Max Pooling Layer

```
Adding Our Max Pooling Layer

[27] cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))
```

What will be the add command if we wanted to have a max pooling layer which reduces the size of the image by a factor of 4 ? [2 Marks]

```
What will be the add command if we wanted to have a max pooling layer which reduces the size of the image by a factor of 4 ?

[28] cnn.add(tf.keras.layers.MaxPool2D(pool_size=4, strides=4))
```

Adding Another Convolutional Layer and Pooling Layer

```
Adding Another Convolutional Layer and Pooling Layer

[48] cnn.add(tf.keras.layers.Conv2D(filters=32, kernel_size=3, activation='relu'))

     cnn.add(tf.keras.layers.MaxPool2D(pool_size=2, strides=2))
```

Adding The Flattening Layer To Our Convolutional Neural Network

Adding The Flattening Layer To Our Convolutional Neural Network

```
[49] cnn.add(tf.keras.layers.Flatten())
```

Adding The Full Connection Layer To Our Convolutional Neural Network

Adding The Full Connection Layer To Our Convolutional Neural Network

```
[51] cnn.add(tf.keras.layers.Dense(units=128, activation='relu'))
```

Adding The Output Layer To Our Convolutional Neural Network

Adding The Output Layer To Our Convolutional Neural Network

```
[52] cnn.add(tf.keras.layers.Dense(units=1, activation='sigmoid'))
```

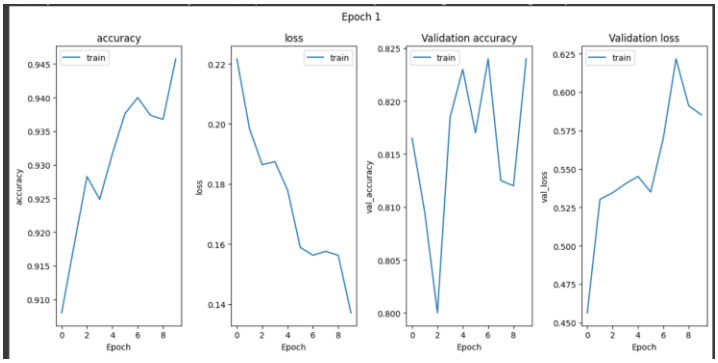
Training the Convolutional Neural Network

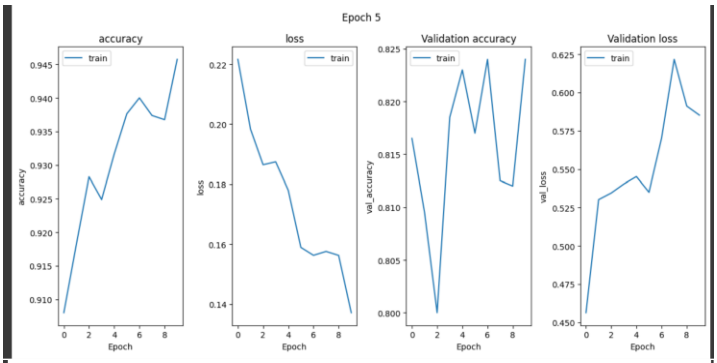
Training the Convolutional Neural Network

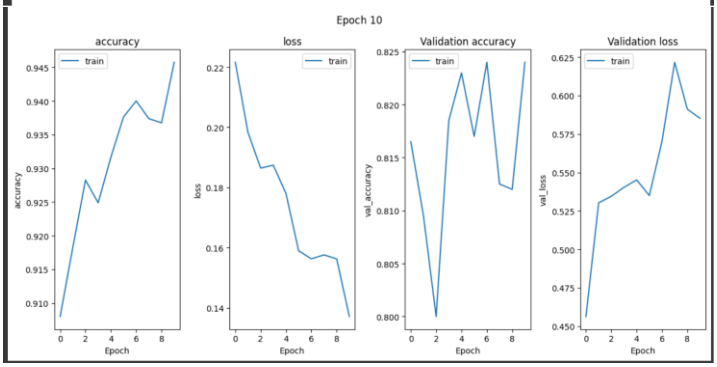
```
# Compile the model
cnn.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accuracy'])

# Train the model
history = cnn.fit(x=training_set, validation_data=test_set, epochs=10)

# Plotting the training and validation metrics
epoch_indices = [0, 4, 9]  # Indices of the desired epochs

for epoch_index in epoch_indices:
    metrics = ['accuracy', 'loss', 'val_accuracy', 'val_loss']

    plt.figure(figsize=(12, 6))

    for i, metric in enumerate(metrics):
        plt.subplot(1, 4, i+1)
        plt.plot(history.history[metric])

        # Check if metric starts with 'val_' to handle validation metrics correctly
        if metric.startswith('val_'):
            plt.title('Validation ' + metric[4:])
        else:
            plt.title(metric)

        plt.xlabel('Epoch')
        plt.ylabel(metric)
        plt.legend(['train', 'val'])

    plt.suptitle('Epoch {}'.format(epoch_index + 1))
    plt.tight_layout()
    plt.show()
```

```
Epoch 1/10
250/250 [==============================] - 286s 1s/step - loss: 0.2216 - accuracy: 0.9080 - val_loss: 0.4563 - val_accuracy: 0.8165
Epoch 2/10
250/250 [==============================] - 282s 1s/step - loss: 0.1983 - accuracy: 0.9183 - val_loss: 0.5302 - val_accuracy: 0.8095
Epoch 3/10
250/250 [==============================] - 282s 1s/step - loss: 0.1865 - accuracy: 0.9283 - val_loss: 0.5345 - val_accuracy: 0.8000
Epoch 4/10
250/250 [==============================] - 284s 1s/step - loss: 0.1874 - accuracy: 0.9249 - val_loss: 0.5403 - val_accuracy: 0.8185
Epoch 5/10
250/250 [==============================] - 281s 1s/step - loss: 0.1780 - accuracy: 0.9316 - val_loss: 0.5451 - val_accuracy: 0.8230
Epoch 6/10
250/250 [==============================] - 280s 1s/step - loss: 0.1590 - accuracy: 0.9376 - val_loss: 0.5350 - val_accuracy: 0.8170
Epoch 7/10
250/250 [==============================] - 280s 1s/step - loss: 0.1563 - accuracy: 0.9400 - val_loss: 0.5702 - val_accuracy: 0.8240
Epoch 8/10
250/250 [==============================] - 276s 1s/step - loss: 0.1576 - accuracy: 0.9374 - val_loss: 0.6217 - val_accuracy: 0.8125
Epoch 9/10
250/250 [==============================] - 274s 1s/step - loss: 0.1563 - accuracy: 0.9367 - val_loss: 0.5912 - val_accuracy: 0.8120
Epoch 10/10
250/250 [==============================] - 283s 1s/step - loss: 0.1372 - accuracy: 0.9457 - val_loss: 0.5853 - val_accuracy: 0.8240
```

Please share the output of the first, fifth and tenth epoch of training as an image here [2 marks]







Making Predictions With Our Convolutional Neural Network

Please share the output probability that you have obtained for the two test images. Please mention the name of the image and the probability value obtained for it. [2 marks]

Image 1 is class 1 which is Dog

Image 2 is class 0 which is Cat

```
[58] from tensorflow.keras.preprocessing import image

[61] test_image_1 = image.load_img('/content/cats-and-dogs/predictions/cat_or_dog_1.jpg', target_size = (64, 64))

     test_image_2 = image.load_img('/content/cats-and-dogs/predictions/cat_or_dog_2.jpg', target_size = (64, 64))

[62] test_image_1 = image.img_to_array(test_image_1)

     test_image_2 = image.img_to_array(test_image_2)

[63] test_image_1 = np.expand_dims(test_image_1, axis = 0)

     test_image_2 = np.expand_dims(test_image_2, axis = 0)

[68] print(cnn.predict(test_image_1)) #Dog

     1/1 [==============================] - 0s 27ms/step
     [[1.]]

[69] print(cnn.predict(test_image_2)) #Cat

     1/1 [==============================] - 0s 27ms/step
     [[0.]]
```