In [ ]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.mount("/content/drive", forc
e_remount=True).
```

In [ ]:
```
# import the important libraries

from tensorflow.keras.layers import Input, Lambda, Dense, Flatten
from tensorflow.keras.models import Model
from tensorflow.keras.applications.inception_v3 import InceptionV3
from tensorflow.keras.applications.inception_v3 import preprocess_input
from tensorflow.keras.preprocessing import image
from tensorflow.keras.preprocessing.image import ImageDataGenerator,load_img
from tensorflow.keras.models import Sequential
import numpy as np
from glob import glob
import matplotlib.pyplot as plt
```

In [ ]:
```
# re-size all the images to this
IMAGE_SIZE = [224, 224]

train_path = '/content/drive/MyDrive/Cotton Diseased Dataset/train'
valid_path = '/content/drive/MyDrive/Cotton Diseased Dataset/test'
```

In [ ]:
```
# Here we will be using imagenet weights

inception = InceptionV3(input_shape=IMAGE_SIZE + [3], weights='imagenet', include_top=False)
```

In [ ]:
```
# don't train existing weights
for layer in inception.layers:
    layer.trainable = False
```

In [ ]:
```
# useful for getting number of output classes
folders = glob('/content/drive/MyDrive/Cotton Diseased Dataset/train/*')
```

In [ ]:
```
# our layers - you can add more if you want
x = Flatten()(inception.output)
```

In [ ]:
```
prediction = Dense(len(folders), activation='softmax')(x)

# create a model object
model = Model(inputs=inception.input, outputs=prediction)
```

In [ ]:
```
# view the structure of the model
model.summary()
```

```
Model: "model_1"
```

Layer (type)	Output Shape	Param #	Connected to
input_2 (InputLayer)	[(None, 224, 224, 3)]	0	[]
conv2d_94 (Conv2D)	(None, 111, 111, 32)	864	['input_2[0][0]']
batch_normalization_94 (BatchNormalization)	(None, 111, 111, 32)	96	['conv2d_94[0][0]']
activation_94 (Activation)	(None, 111, 111, 32)	0	['batch_normalization_94[0][0]']
conv2d_95 (Conv2D)	(None, 109, 109, 32)	9216	['activation_94[0][0]']
batch_normalization_95 (BatchNormalization)	(None, 109, 109, 32)	96	['conv2d_95[0][0]']
activation_95 (Activation)	(None, 109, 109, 32)	0	['batch_normalization_95[0][0]']
conv2d_96 (Conv2D)	(None, 109, 109, 64)	18432	['activation_95[0][0]']
batch_normalization_96 (BatchNormalization)	(None, 109, 109, 64)	192	['conv2d_96[0][0]']
activation_96 (Activation)	(None, 109, 109, 64)	0	['batch_normalization_96[0][0]']
max_pooling2d_4 (MaxPooling2D)	(None, 54, 54, 64)	0	['activation_96[0][0]']

```
conv2d_97 (Conv2D)          (None, 54, 54, 80)          5120      ['max_pooling2d_4[0][0]']

batch_normalization_97 (Ba  (None, 54, 54, 80)          240       ['conv2d_97[0][0]']
tchNormalization)

activation_97 (Activation)  (None, 54, 54, 80)          0         ['batch_normalization_97[0][0
                                                                  ']

conv2d_98 (Conv2D)          (None, 52, 52, 192)         138240    ['activation_97[0][0]']

batch_normalization_98 (Ba  (None, 52, 52, 192)         576       ['conv2d_98[0][0]']
tchNormalization)

activation_98 (Activation)  (None, 52, 52, 192)         0         ['batch_normalization_98[0][0
                                                                  ']

max_pooling2d_5 (MaxPoolin  (None, 25, 25, 192)         0         ['activation_98[0][0]']
g2D)

conv2d_102 (Conv2D)         (None, 25, 25, 64)          12288     ['max_pooling2d_5[0][0]']

batch_normalization_102 (B  (None, 25, 25, 64)          192       ['conv2d_102[0][0]']
atchNormalization)

activation_102 (Activation  (None, 25, 25, 64)          0         ['batch_normalization_102[0][0
)                                                                 ]']

conv2d_100 (Conv2D)         (None, 25, 25, 48)          9216      ['max_pooling2d_5[0][0]']

conv2d_103 (Conv2D)         (None, 25, 25, 96)          55296     ['activation_102[0][0]']

batch_normalization_100 (B  (None, 25, 25, 48)          144       ['conv2d_100[0][0]']
atchNormalization)

batch_normalization_103 (B  (None, 25, 25, 96)          288       ['conv2d_103[0][0]']
atchNormalization)

activation_100 (Activation  (None, 25, 25, 48)          0         ['batch_normalization_100[0][0
)                                                                 ]']

activation_103 (Activation  (None, 25, 25, 96)          0         ['batch_normalization_103[0][0
)                                                                 ]']

average_pooling2d_9 (Avera  (None, 25, 25, 192)         0         ['max_pooling2d_5[0][0]']
gePooling2D)

conv2d_99 (Conv2D)          (None, 25, 25, 64)          12288     ['max_pooling2d_5[0][0]']

conv2d_101 (Conv2D)         (None, 25, 25, 64)          76800     ['activation_100[0][0]']

conv2d_104 (Conv2D)         (None, 25, 25, 96)          82944     ['activation_103[0][0]']

conv2d_105 (Conv2D)         (None, 25, 25, 32)          6144      ['average_pooling2d_9[0][0]']

batch_normalization_99 (Ba  (None, 25, 25, 64)          192       ['conv2d_99[0][0]']
tchNormalization)

batch_normalization_101 (B  (None, 25, 25, 64)          192       ['conv2d_101[0][0]']
atchNormalization)

batch_normalization_104 (B  (None, 25, 25, 96)          288       ['conv2d_104[0][0]']
atchNormalization)

batch_normalization_105 (B  (None, 25, 25, 32)          96        ['conv2d_105[0][0]']
atchNormalization)

activation_99 (Activation)  (None, 25, 25, 64)          0         ['batch_normalization_99[0][0]
                                                                  ']

activation_101 (Activation  (None, 25, 25, 64)          0         ['batch_normalization_101[0][0
)                                                                 ]']

activation_104 (Activation  (None, 25, 25, 96)          0         ['batch_normalization_104[0][0
)                                                                 ]']

activation_105 (Activation  (None, 25, 25, 32)          0         ['batch_normalization_105[0][0
)                                                                 ]']

mixed0 (Concatenate)        (None, 25, 25, 256)         0         ['activation_99[0][0]',
                                                                   'activation_101[0][0]',
                                                                   'activation_104[0][0]',
                                                                   'activation_105[0][0]']
```

```
conv2d_109 (Conv2D)         (None, 25, 25, 64)           16384     ['mixed0[0][0]']

batch_normalization_109 (B  (None, 25, 25, 64)           192       ['conv2d_109[0][0]']
atchNormalization)

activation_109 (Activation  (None, 25, 25, 64)           0         ['batch_normalization_109[0][0
)                                                                   ]']

conv2d_107 (Conv2D)         (None, 25, 25, 48)           12288     ['mixed0[0][0]']

conv2d_110 (Conv2D)         (None, 25, 25, 96)           55296     ['activation_109[0][0]']

batch_normalization_107 (B  (None, 25, 25, 48)           144       ['conv2d_107[0][0]']
atchNormalization)

batch_normalization_110 (B  (None, 25, 25, 96)           288       ['conv2d_110[0][0]']
atchNormalization)

activation_107 (Activation  (None, 25, 25, 48)           0         ['batch_normalization_107[0][0
)                                                                   ]']

activation_110 (Activation  (None, 25, 25, 96)           0         ['batch_normalization_110[0][0
)                                                                   ]']

average_pooling2d_10 (Aver  (None, 25, 25, 256)          0         ['mixed0[0][0]']
agePooling2D)

conv2d_106 (Conv2D)         (None, 25, 25, 64)           16384     ['mixed0[0][0]']

conv2d_108 (Conv2D)         (None, 25, 25, 64)           76800     ['activation_107[0][0]']

conv2d_111 (Conv2D)         (None, 25, 25, 96)           82944     ['activation_110[0][0]']

conv2d_112 (Conv2D)         (None, 25, 25, 64)           16384     ['average_pooling2d_10[0][0]']

batch_normalization_106 (B  (None, 25, 25, 64)           192       ['conv2d_106[0][0]']
atchNormalization)

batch_normalization_108 (B  (None, 25, 25, 64)           192       ['conv2d_108[0][0]']
atchNormalization)

batch_normalization_111 (B  (None, 25, 25, 96)           288       ['conv2d_111[0][0]']
atchNormalization)

batch_normalization_112 (B  (None, 25, 25, 64)           192       ['conv2d_112[0][0]']
atchNormalization)

activation_106 (Activation  (None, 25, 25, 64)           0         ['batch_normalization_106[0][0
)                                                                   ]']

activation_108 (Activation  (None, 25, 25, 64)           0         ['batch_normalization_108[0][0
)                                                                   ]']

activation_111 (Activation  (None, 25, 25, 96)           0         ['batch_normalization_111[0][0
)                                                                   ]']

activation_112 (Activation  (None, 25, 25, 64)           0         ['batch_normalization_112[0][0
)                                                                   ]']

mixed1 (Concatenate)        (None, 25, 25, 288)          0         ['activation_106[0][0]',
                                                                    'activation_108[0][0]',
                                                                    'activation_111[0][0]',
                                                                    'activation_112[0][0]']

conv2d_116 (Conv2D)         (None, 25, 25, 64)           18432     ['mixed1[0][0]']

batch_normalization_116 (B  (None, 25, 25, 64)           192       ['conv2d_116[0][0]']
atchNormalization)

activation_116 (Activation  (None, 25, 25, 64)           0         ['batch_normalization_116[0][0
)                                                                   ]']

conv2d_114 (Conv2D)         (None, 25, 25, 48)           13824     ['mixed1[0][0]']

conv2d_117 (Conv2D)         (None, 25, 25, 96)           55296     ['activation_116[0][0]']

batch_normalization_114 (B  (None, 25, 25, 48)           144       ['conv2d_114[0][0]']
atchNormalization)

batch_normalization_117 (B  (None, 25, 25, 96)           288       ['conv2d_117[0][0]']
atchNormalization)

activation_114 (Activation  (None, 25, 25, 48)           0         ['batch_normalization_114[0][0
```

```
)                                                                 ']']

activation_117 (Activation  (None, 25, 25, 96)          0         ['batch_normalization_117[0][0
)                                                                 ']']

average_pooling2d_11 (Aver  (None, 25, 25, 288)         0         ['mixed1[0][0]']
agePooling2D)

conv2d_113 (Conv2D)         (None, 25, 25, 64)          18432     ['mixed1[0][0]']

conv2d_115 (Conv2D)         (None, 25, 25, 64)          76800     ['activation_114[0][0]']

conv2d_118 (Conv2D)         (None, 25, 25, 96)          82944     ['activation_117[0][0]']

conv2d_119 (Conv2D)         (None, 25, 25, 64)          18432     ['average_pooling2d_11[0][0]']

batch_normalization_113 (B  (None, 25, 25, 64)          192       ['conv2d_113[0][0]']
atchNormalization)

batch_normalization_115 (B  (None, 25, 25, 64)          192       ['conv2d_115[0][0]']
atchNormalization)

batch_normalization_118 (B  (None, 25, 25, 96)          288       ['conv2d_118[0][0]']
atchNormalization)

batch_normalization_119 (B  (None, 25, 25, 64)          192       ['conv2d_119[0][0]']
atchNormalization)

activation_113 (Activation  (None, 25, 25, 64)          0         ['batch_normalization_113[0][0
)                                                                 ']']

activation_115 (Activation  (None, 25, 25, 64)          0         ['batch_normalization_115[0][0
)                                                                 ']']

activation_118 (Activation  (None, 25, 25, 96)          0         ['batch_normalization_118[0][0
)                                                                 ']']

activation_119 (Activation  (None, 25, 25, 64)          0         ['batch_normalization_119[0][0
)                                                                 ']']

mixed2 (Concatenate)        (None, 25, 25, 288)         0         ['activation_113[0][0]',
                                                                   'activation_115[0][0]',
                                                                   'activation_118[0][0]',
                                                                   'activation_119[0][0]']

conv2d_121 (Conv2D)         (None, 25, 25, 64)          18432     ['mixed2[0][0]']

batch_normalization_121 (B  (None, 25, 25, 64)          192       ['conv2d_121[0][0]']
atchNormalization)

activation_121 (Activation  (None, 25, 25, 64)          0         ['batch_normalization_121[0][0
)                                                                 ']']

conv2d_122 (Conv2D)         (None, 25, 25, 96)          55296     ['activation_121[0][0]']

batch_normalization_122 (B  (None, 25, 25, 96)          288       ['conv2d_122[0][0]']
atchNormalization)

activation_122 (Activation  (None, 25, 25, 96)          0         ['batch_normalization_122[0][0
)                                                                 ']']

conv2d_120 (Conv2D)         (None, 12, 12, 384)         995328    ['mixed2[0][0]']

conv2d_123 (Conv2D)         (None, 12, 12, 96)          82944     ['activation_122[0][0]']

batch_normalization_120 (B  (None, 12, 12, 384)         1152      ['conv2d_120[0][0]']
atchNormalization)

batch_normalization_123 (B  (None, 12, 12, 96)          288       ['conv2d_123[0][0]']
atchNormalization)

activation_120 (Activation  (None, 12, 12, 384)         0         ['batch_normalization_120[0][0
)                                                                 ']']

activation_123 (Activation  (None, 12, 12, 96)          0         ['batch_normalization_123[0][0
)                                                                 ']']

max_pooling2d_6 (MaxPoolin  (None, 12, 12, 288)         0         ['mixed2[0][0]']
g2D)

mixed3 (Concatenate)        (None, 12, 12, 768)         0         ['activation_120[0][0]',
                                                                   'activation_123[0][0]',
                                                                   'max_pooling2d_6[0][0]']
```

```
conv2d_128 (Conv2D)         (None, 12, 12, 128)          98304     ['mixed3[0][0]']

batch_normalization_128 (B  (None, 12, 12, 128)          384       ['conv2d_128[0][0]']
atchNormalization)

activation_128 (Activation  (None, 12, 12, 128)          0         ['batch_normalization_128[0][0
)                                                                  ]']

conv2d_129 (Conv2D)         (None, 12, 12, 128)          114688    ['activation_128[0][0]']

batch_normalization_129 (B  (None, 12, 12, 128)          384       ['conv2d_129[0][0]']
atchNormalization)

activation_129 (Activation  (None, 12, 12, 128)          0         ['batch_normalization_129[0][0
)                                                                  ]']

conv2d_125 (Conv2D)         (None, 12, 12, 128)          98304     ['mixed3[0][0]']

conv2d_130 (Conv2D)         (None, 12, 12, 128)          114688    ['activation_129[0][0]']

batch_normalization_125 (B  (None, 12, 12, 128)          384       ['conv2d_125[0][0]']
atchNormalization)

batch_normalization_130 (B  (None, 12, 12, 128)          384       ['conv2d_130[0][0]']
atchNormalization)

activation_125 (Activation  (None, 12, 12, 128)          0         ['batch_normalization_125[0][0
)                                                                  ]']

activation_130 (Activation  (None, 12, 12, 128)          0         ['batch_normalization_130[0][0
)                                                                  ]']

conv2d_126 (Conv2D)         (None, 12, 12, 128)          114688    ['activation_125[0][0]']

conv2d_131 (Conv2D)         (None, 12, 12, 128)          114688    ['activation_130[0][0]']

batch_normalization_126 (B  (None, 12, 12, 128)          384       ['conv2d_126[0][0]']
atchNormalization)

batch_normalization_131 (B  (None, 12, 12, 128)          384       ['conv2d_131[0][0]']
atchNormalization)

activation_126 (Activation  (None, 12, 12, 128)          0         ['batch_normalization_126[0][0
)                                                                  ]']

activation_131 (Activation  (None, 12, 12, 128)          0         ['batch_normalization_131[0][0
)                                                                  ]']

average_pooling2d_12 (Aver  (None, 12, 12, 768)          0         ['mixed3[0][0]']
agePooling2D)

conv2d_124 (Conv2D)         (None, 12, 12, 192)          147456    ['mixed3[0][0]']

conv2d_127 (Conv2D)         (None, 12, 12, 192)          172032    ['activation_126[0][0]']

conv2d_132 (Conv2D)         (None, 12, 12, 192)          172032    ['activation_131[0][0]']

conv2d_133 (Conv2D)         (None, 12, 12, 192)          147456    ['average_pooling2d_12[0][0]']

batch_normalization_124 (B  (None, 12, 12, 192)          576       ['conv2d_124[0][0]']
atchNormalization)

batch_normalization_127 (B  (None, 12, 12, 192)          576       ['conv2d_127[0][0]']
atchNormalization)

batch_normalization_132 (B  (None, 12, 12, 192)          576       ['conv2d_132[0][0]']
atchNormalization)

batch_normalization_133 (B  (None, 12, 12, 192)          576       ['conv2d_133[0][0]']
atchNormalization)

activation_124 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_124[0][0
)                                                                  ]']

activation_127 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_127[0][0
)                                                                  ]']

activation_132 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_132[0][0
)                                                                  ]']

activation_133 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_133[0][0
)                                                                  ]']
```

```
mixed4 (Concatenate)        (None, 12, 12, 768)          0         ['activation_124[0][0]',
                                                                    'activation_127[0][0]',
                                                                    'activation_132[0][0]',
                                                                    'activation_133[0][0]']

conv2d_138 (Conv2D)         (None, 12, 12, 160)          122880    ['mixed4[0][0]']

batch_normalization_138 (B  (None, 12, 12, 160)          480       ['conv2d_138[0][0]']
atchNormalization)

activation_138 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_138[0][0
)                                                                   ]']

conv2d_139 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_138[0][0]']

batch_normalization_139 (B  (None, 12, 12, 160)          480       ['conv2d_139[0][0]']
atchNormalization)

activation_139 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_139[0][0
)                                                                   ]']

conv2d_135 (Conv2D)         (None, 12, 12, 160)          122880    ['mixed4[0][0]']

conv2d_140 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_139[0][0]']

batch_normalization_135 (B  (None, 12, 12, 160)          480       ['conv2d_135[0][0]']
atchNormalization)

batch_normalization_140 (B  (None, 12, 12, 160)          480       ['conv2d_140[0][0]']
atchNormalization)

activation_135 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_135[0][0
)                                                                   ]']

activation_140 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_140[0][0
)                                                                   ]']

conv2d_136 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_135[0][0]']

conv2d_141 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_140[0][0]']

batch_normalization_136 (B  (None, 12, 12, 160)          480       ['conv2d_136[0][0]']
atchNormalization)

batch_normalization_141 (B  (None, 12, 12, 160)          480       ['conv2d_141[0][0]']
atchNormalization)

activation_136 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_136[0][0
)                                                                   ]']

activation_141 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_141[0][0
)                                                                   ]']

average_pooling2d_13 (Aver  (None, 12, 12, 768)          0         ['mixed4[0][0]']
agePooling2D)

conv2d_134 (Conv2D)         (None, 12, 12, 192)          147456    ['mixed4[0][0]']

conv2d_137 (Conv2D)         (None, 12, 12, 192)          215040    ['activation_136[0][0]']

conv2d_142 (Conv2D)         (None, 12, 12, 192)          215040    ['activation_141[0][0]']

conv2d_143 (Conv2D)         (None, 12, 12, 192)          147456    ['average_pooling2d_13[0][0]']

batch_normalization_134 (B  (None, 12, 12, 192)          576       ['conv2d_134[0][0]']
atchNormalization)

batch_normalization_137 (B  (None, 12, 12, 192)          576       ['conv2d_137[0][0]']
atchNormalization)

batch_normalization_142 (B  (None, 12, 12, 192)          576       ['conv2d_142[0][0]']
atchNormalization)

batch_normalization_143 (B  (None, 12, 12, 192)          576       ['conv2d_143[0][0]']
atchNormalization)

activation_134 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_134[0][0
)                                                                   ]']

activation_137 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_137[0][0
)                                                                   ]']
```

```
activation_142 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_142[0][0
)                                                                  ]']

activation_143 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_143[0][0
)                                                                  ]']

mixed5 (Concatenate)        (None, 12, 12, 768)          0         ['activation_134[0][0]',
                                                                    'activation_137[0][0]',
                                                                    'activation_142[0][0]',
                                                                    'activation_143[0][0]']

conv2d_148 (Conv2D)         (None, 12, 12, 160)          122880    ['mixed5[0][0]']

batch_normalization_148 (B  (None, 12, 12, 160)          480       ['conv2d_148[0][0]']
atchNormalization)

activation_148 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_148[0][0
)                                                                  ]']

conv2d_149 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_148[0][0]']

batch_normalization_149 (B  (None, 12, 12, 160)          480       ['conv2d_149[0][0]']
atchNormalization)

activation_149 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_149[0][0
)                                                                  ]']

conv2d_145 (Conv2D)         (None, 12, 12, 160)          122880    ['mixed5[0][0]']

conv2d_150 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_149[0][0]']

batch_normalization_145 (B  (None, 12, 12, 160)          480       ['conv2d_145[0][0]']
atchNormalization)

batch_normalization_150 (B  (None, 12, 12, 160)          480       ['conv2d_150[0][0]']
atchNormalization)

activation_145 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_145[0][0
)                                                                  ]']

activation_150 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_150[0][0
)                                                                  ]']

conv2d_146 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_145[0][0]']

conv2d_151 (Conv2D)         (None, 12, 12, 160)          179200    ['activation_150[0][0]']

batch_normalization_146 (B  (None, 12, 12, 160)          480       ['conv2d_146[0][0]']
atchNormalization)

batch_normalization_151 (B  (None, 12, 12, 160)          480       ['conv2d_151[0][0]']
atchNormalization)

activation_146 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_146[0][0
)                                                                  ]']

activation_151 (Activation  (None, 12, 12, 160)          0         ['batch_normalization_151[0][0
)                                                                  ]']

average_pooling2d_14 (Aver  (None, 12, 12, 768)          0         ['mixed5[0][0]']
agePooling2D)

conv2d_144 (Conv2D)         (None, 12, 12, 192)          147456    ['mixed5[0][0]']

conv2d_147 (Conv2D)         (None, 12, 12, 192)          215040    ['activation_146[0][0]']

conv2d_152 (Conv2D)         (None, 12, 12, 192)          215040    ['activation_151[0][0]']

conv2d_153 (Conv2D)         (None, 12, 12, 192)          147456    ['average_pooling2d_14[0][0]']

batch_normalization_144 (B  (None, 12, 12, 192)          576       ['conv2d_144[0][0]']
atchNormalization)

batch_normalization_147 (B  (None, 12, 12, 192)          576       ['conv2d_147[0][0]']
atchNormalization)

batch_normalization_152 (B  (None, 12, 12, 192)          576       ['conv2d_152[0][0]']
atchNormalization)

batch_normalization_153 (B  (None, 12, 12, 192)          576       ['conv2d_153[0][0]']
atchNormalization)

activation_144 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_144[0][0
```

```
)                                                                 ']']

activation_147 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_147[0][0
)                                                                 ']']

activation_152 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_152[0][0
)                                                                 ']']

activation_153 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_153[0][0
)                                                                 ']']

mixed6 (Concatenate)        (None, 12, 12, 768)          0        ['activation_144[0][0]',
                                                                   'activation_147[0][0]',
                                                                   'activation_152[0][0]',
                                                                   'activation_153[0][0]']

conv2d_158 (Conv2D)         (None, 12, 12, 192)          147456   ['mixed6[0][0]']

batch_normalization_158 (B  (None, 12, 12, 192)          576      ['conv2d_158[0][0]']
atchNormalization)

activation_158 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_158[0][0
)                                                                 ']']

conv2d_159 (Conv2D)         (None, 12, 12, 192)          258048   ['activation_158[0][0]']

batch_normalization_159 (B  (None, 12, 12, 192)          576      ['conv2d_159[0][0]']
atchNormalization)

activation_159 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_159[0][0
)                                                                 ']']

conv2d_155 (Conv2D)         (None, 12, 12, 192)          147456   ['mixed6[0][0]']

conv2d_160 (Conv2D)         (None, 12, 12, 192)          258048   ['activation_159[0][0]']

batch_normalization_155 (B  (None, 12, 12, 192)          576      ['conv2d_155[0][0]']
atchNormalization)

batch_normalization_160 (B  (None, 12, 12, 192)          576      ['conv2d_160[0][0]']
atchNormalization)

activation_155 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_155[0][0
)                                                                 ']']

activation_160 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_160[0][0
)                                                                 ']']

conv2d_156 (Conv2D)         (None, 12, 12, 192)          258048   ['activation_155[0][0]']

conv2d_161 (Conv2D)         (None, 12, 12, 192)          258048   ['activation_160[0][0]']

batch_normalization_156 (B  (None, 12, 12, 192)          576      ['conv2d_156[0][0]']
atchNormalization)

batch_normalization_161 (B  (None, 12, 12, 192)          576      ['conv2d_161[0][0]']
atchNormalization)

activation_156 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_156[0][0
)                                                                 ']']

activation_161 (Activation  (None, 12, 12, 192)          0        ['batch_normalization_161[0][0
)                                                                 ']']

average_pooling2d_15 (Aver  (None, 12, 12, 768)          0        ['mixed6[0][0]']
agePooling2D)

conv2d_154 (Conv2D)         (None, 12, 12, 192)          147456   ['mixed6[0][0]']

conv2d_157 (Conv2D)         (None, 12, 12, 192)          258048   ['activation_156[0][0]']

conv2d_162 (Conv2D)         (None, 12, 12, 192)          258048   ['activation_161[0][0]']

conv2d_163 (Conv2D)         (None, 12, 12, 192)          147456   ['average_pooling2d_15[0][0]']

batch_normalization_154 (B  (None, 12, 12, 192)          576      ['conv2d_154[0][0]']
atchNormalization)

batch_normalization_157 (B  (None, 12, 12, 192)          576      ['conv2d_157[0][0]']
atchNormalization)

batch_normalization_162 (B  (None, 12, 12, 192)          576      ['conv2d_162[0][0]']
atchNormalization)
```

```
batch_normalization_163 (B  (None, 12, 12, 192)          576       ['conv2d_163[0][0]']
atchNormalization)

activation_154 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_154[0][0
)                                                                  ]']

activation_157 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_157[0][0
)                                                                  ]']

activation_162 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_162[0][0
)                                                                  ]']

activation_163 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_163[0][0
)                                                                  ]']

mixed7 (Concatenate)        (None, 12, 12, 768)          0         ['activation_154[0][0]',
                                                                    'activation_157[0][0]',
                                                                    'activation_162[0][0]',
                                                                    'activation_163[0][0]']

conv2d_166 (Conv2D)         (None, 12, 12, 192)          147456    ['mixed7[0][0]']

batch_normalization_166 (B  (None, 12, 12, 192)          576       ['conv2d_166[0][0]']
atchNormalization)

activation_166 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_166[0][0
)                                                                  ]']

conv2d_167 (Conv2D)         (None, 12, 12, 192)          258048    ['activation_166[0][0]']

batch_normalization_167 (B  (None, 12, 12, 192)          576       ['conv2d_167[0][0]']
atchNormalization)

activation_167 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_167[0][0
)                                                                  ]']

conv2d_164 (Conv2D)         (None, 12, 12, 192)          147456    ['mixed7[0][0]']

conv2d_168 (Conv2D)         (None, 12, 12, 192)          258048    ['activation_167[0][0]']

batch_normalization_164 (B  (None, 12, 12, 192)          576       ['conv2d_164[0][0]']
atchNormalization)

batch_normalization_168 (B  (None, 12, 12, 192)          576       ['conv2d_168[0][0]']
atchNormalization)

activation_164 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_164[0][0
)                                                                  ]']

activation_168 (Activation  (None, 12, 12, 192)          0         ['batch_normalization_168[0][0
)                                                                  ]']

conv2d_165 (Conv2D)         (None, 5, 5, 320)            552960    ['activation_164[0][0]']

conv2d_169 (Conv2D)         (None, 5, 5, 192)            331776    ['activation_168[0][0]']

batch_normalization_165 (B  (None, 5, 5, 320)            960       ['conv2d_165[0][0]']
atchNormalization)

batch_normalization_169 (B  (None, 5, 5, 192)            576       ['conv2d_169[0][0]']
atchNormalization)

activation_165 (Activation  (None, 5, 5, 320)            0         ['batch_normalization_165[0][0
)                                                                  ]']

activation_169 (Activation  (None, 5, 5, 192)            0         ['batch_normalization_169[0][0
)                                                                  ]']

max_pooling2d_7 (MaxPoolin  (None, 5, 5, 768)            0         ['mixed7[0][0]']
g2D)

mixed8 (Concatenate)        (None, 5, 5, 1280)           0         ['activation_165[0][0]',
                                                                    'activation_169[0][0]',
                                                                    'max_pooling2d_7[0][0]']

conv2d_174 (Conv2D)         (None, 5, 5, 448)            573440    ['mixed8[0][0]']

batch_normalization_174 (B  (None, 5, 5, 448)            1344      ['conv2d_174[0][0]']
atchNormalization)

activation_174 (Activation  (None, 5, 5, 448)            0         ['batch_normalization_174[0][0
)                                                                  ]']
```

```
conv2d_171 (Conv2D)         (None, 5, 5, 384)           491520    ['mixed8[0][0]']

conv2d_175 (Conv2D)         (None, 5, 5, 384)           1548288   ['activation_174[0][0]']

batch_normalization_171 (B  (None, 5, 5, 384)           1152      ['conv2d_171[0][0]']
atchNormalization)

batch_normalization_175 (B  (None, 5, 5, 384)           1152      ['conv2d_175[0][0]']
atchNormalization)

activation_171 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_171[0][0
)                                                                  ]']

activation_175 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_175[0][0
)                                                                  ]']

conv2d_172 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_171[0][0]']

conv2d_173 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_171[0][0]']

conv2d_176 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_175[0][0]']

conv2d_177 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_175[0][0]']

average_pooling2d_16 (Aver  (None, 5, 5, 1280)          0         ['mixed8[0][0]']
agePooling2D)

conv2d_170 (Conv2D)         (None, 5, 5, 320)           409600    ['mixed8[0][0]']

batch_normalization_172 (B  (None, 5, 5, 384)           1152      ['conv2d_172[0][0]']
atchNormalization)

batch_normalization_173 (B  (None, 5, 5, 384)           1152      ['conv2d_173[0][0]']
atchNormalization)

batch_normalization_176 (B  (None, 5, 5, 384)           1152      ['conv2d_176[0][0]']
atchNormalization)

batch_normalization_177 (B  (None, 5, 5, 384)           1152      ['conv2d_177[0][0]']
atchNormalization)

conv2d_178 (Conv2D)         (None, 5, 5, 192)           245760    ['average_pooling2d_16[0][0]']

batch_normalization_170 (B  (None, 5, 5, 320)           960       ['conv2d_170[0][0]']
atchNormalization)

activation_172 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_172[0][0
)                                                                  ]']

activation_173 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_173[0][0
)                                                                  ]']

activation_176 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_176[0][0
)                                                                  ]']

activation_177 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_177[0][0
)                                                                  ]']

batch_normalization_178 (B  (None, 5, 5, 192)           576       ['conv2d_178[0][0]']
atchNormalization)

activation_170 (Activation  (None, 5, 5, 320)           0         ['batch_normalization_170[0][0
)                                                                  ]']

mixed9_0 (Concatenate)      (None, 5, 5, 768)           0         ['activation_172[0][0]',
                                                                   'activation_173[0][0]']

concatenate_2 (Concatenate  (None, 5, 5, 768)           0         ['activation_176[0][0]',
)                                                                  'activation_177[0][0]']

activation_178 (Activation  (None, 5, 5, 192)           0         ['batch_normalization_178[0][0
)                                                                  ]']

mixed9 (Concatenate)        (None, 5, 5, 2048)          0         ['activation_170[0][0]',
                                                                   'mixed9_0[0][0]',
                                                                   'concatenate_2[0][0]',
                                                                   'activation_178[0][0]']

conv2d_183 (Conv2D)         (None, 5, 5, 448)           917504    ['mixed9[0][0]']

batch_normalization_183 (B  (None, 5, 5, 448)           1344      ['conv2d_183[0][0]']
atchNormalization)
```

```
activation_183 (Activation  (None, 5, 5, 448)           0         ['batch_normalization_183[0][0
)                                                                  ']

conv2d_180 (Conv2D)         (None, 5, 5, 384)           786432    ['mixed9[0][0]']

conv2d_184 (Conv2D)         (None, 5, 5, 384)           1548288   ['activation_183[0][0]']

batch_normalization_180 (B  (None, 5, 5, 384)           1152      ['conv2d_180[0][0]']
atchNormalization)

batch_normalization_184 (B  (None, 5, 5, 384)           1152      ['conv2d_184[0][0]']
atchNormalization)

activation_180 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_180[0][0
)                                                                  ']

activation_184 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_184[0][0
)                                                                  ']

conv2d_181 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_180[0][0]']

conv2d_182 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_180[0][0]']

conv2d_185 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_184[0][0]']

conv2d_186 (Conv2D)         (None, 5, 5, 384)           442368    ['activation_184[0][0]']

average_pooling2d_17 (Aver  (None, 5, 5, 2048)          0         ['mixed9[0][0]']
agePooling2D)

conv2d_179 (Conv2D)         (None, 5, 5, 320)           655360    ['mixed9[0][0]']

batch_normalization_181 (B  (None, 5, 5, 384)           1152      ['conv2d_181[0][0]']
atchNormalization)

batch_normalization_182 (B  (None, 5, 5, 384)           1152      ['conv2d_182[0][0]']
atchNormalization)

batch_normalization_185 (B  (None, 5, 5, 384)           1152      ['conv2d_185[0][0]']
atchNormalization)

batch_normalization_186 (B  (None, 5, 5, 384)           1152      ['conv2d_186[0][0]']
atchNormalization)

conv2d_187 (Conv2D)         (None, 5, 5, 192)           393216    ['average_pooling2d_17[0][0]']

batch_normalization_179 (B  (None, 5, 5, 320)           960       ['conv2d_179[0][0]']
atchNormalization)

activation_181 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_181[0][0
)                                                                  ']

activation_182 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_182[0][0
)                                                                  ']

activation_185 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_185[0][0
)                                                                  ']

activation_186 (Activation  (None, 5, 5, 384)           0         ['batch_normalization_186[0][0
)                                                                  ']

batch_normalization_187 (B  (None, 5, 5, 192)           576       ['conv2d_187[0][0]']
atchNormalization)

activation_179 (Activation  (None, 5, 5, 320)           0         ['batch_normalization_179[0][0
)                                                                  ']

mixed9_1 (Concatenate)      (None, 5, 5, 768)           0         ['activation_181[0][0]',
                                                                   'activation_182[0][0]']

concatenate_3 (Concatenate  (None, 5, 5, 768)           0         ['activation_185[0][0]',
)                                                                  'activation_186[0][0]']

activation_187 (Activation  (None, 5, 5, 192)           0         ['batch_normalization_187[0][0
)                                                                  ']

mixed10 (Concatenate)       (None, 5, 5, 2048)          0         ['activation_179[0][0]',
                                                                   'mixed9_1[0][0]',
                                                                   'concatenate_3[0][0]',
                                                                   'activation_187[0][0]']

flatten_1 (Flatten)         (None, 51200)               0         ['mixed10[0][0]']
```

```
 dense_1 (Dense)             (None, 4)                 204804    ['flatten_1[0][0]']

==================================================================================================
Total params: 22007588 (83.95 MB)
Trainable params: 204804 (800.02 KB)
Non-trainable params: 21802784 (83.17 MB)
__________________________________________________________________________________________________
```

In [ ]:
```
# tell the model what cost and optimization method to use
model.compile(
  loss='categorical_crossentropy',
  optimizer='adam',
  metrics=['accuracy']
)
```

In [ ]:
```
# Use the Image Data Generator to import the images from the dataset
from tensorflow.keras.preprocessing.image import ImageDataGenerator

train_datagen = ImageDataGenerator(rescale = 1./255,
                                   shear_range = 0.2,
                                   zoom_range = 0.2,
                                   horizontal_flip = True)

test_datagen = ImageDataGenerator(rescale = 1./255)
```

In [ ]:
```
training_set = train_datagen.flow_from_directory('/content/drive/MyDrive/Cotton Diseased Dataset/train',
                                                 target_size = (224, 224),
                                                 batch_size = 32,
                                                 class_mode = 'categorical')
```

```
Found 1954 images belonging to 4 classes.
```

In [ ]:
```
test_set = test_datagen.flow_from_directory("/content/drive/MyDrive/Cotton Diseased Dataset/test",
                                            target_size = (224, 224),
                                            batch_size = 32,
                                            class_mode = 'categorical')
```

```
Found 18 images belonging to 4 classes.
```

In [ ]:
```
# fit the model
# Run the cell. It will take some time to execute
r = model.fit_generator(
  training_set,
  validation_data=test_set,
  epochs=20,
  steps_per_epoch=len(training_set),
  validation_steps=len(test_set)
)
```

```
<ipython-input-27-2d02736eff38>:3: UserWarning: `Model.fit_generator` is deprecated and will be removed in a fut
ure version. Please use `Model.fit`, which supports generators.
  r = model.fit_generator(
```

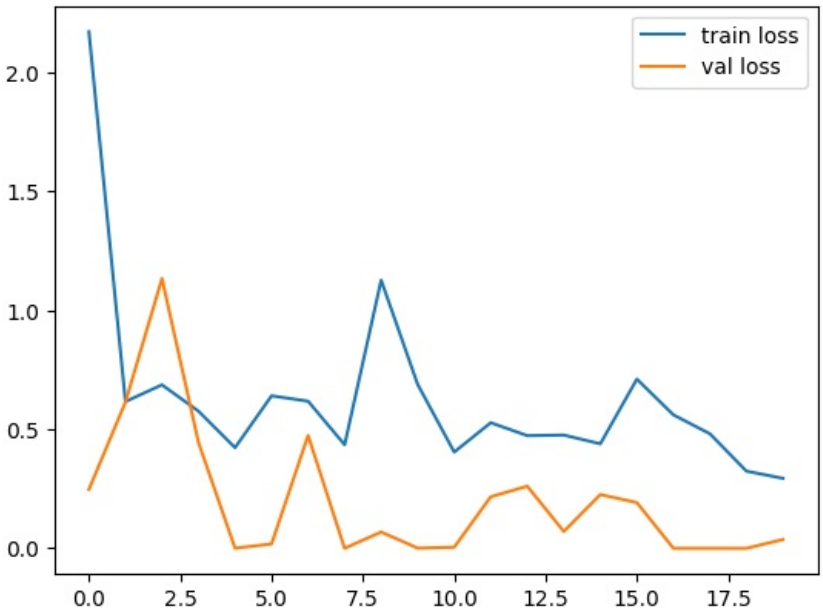
```
Epoch 1/20
62/62 [==============================] - 56s 814ms/step - loss: 2.1725 - accuracy: 0.7323 - val_loss: 0.2475 - v
al_accuracy: 0.9444
Epoch 2/20
62/62 [==============================] - 45s 725ms/step - loss: 0.6170 - accuracy: 0.8941 - val_loss: 0.6145 - v
al_accuracy: 0.7778
Epoch 3/20
62/62 [==============================] - 45s 728ms/step - loss: 0.6875 - accuracy: 0.8859 - val_loss: 1.1345 - v
al_accuracy: 0.7222
Epoch 4/20
62/62 [==============================] - 53s 853ms/step - loss: 0.5767 - accuracy: 0.9104 - val_loss: 0.4449 - v
al_accuracy: 0.8889
Epoch 5/20
62/62 [==============================] - 44s 717ms/step - loss: 0.4232 - accuracy: 0.9278 - val_loss: 4.7833e-04
- val_accuracy: 1.0000
Epoch 6/20
62/62 [==============================] - 45s 722ms/step - loss: 0.6413 - accuracy: 0.9145 - val_loss: 0.0184 - v
al_accuracy: 1.0000
Epoch 7/20
62/62 [==============================] - ETA: 0s - loss: 0.6186 - accuracy: 0.9237Epoch 8/20
62/62 [==============================] - 50s 817ms/step - loss: 0.4355 - accuracy: 0.9437 - val_loss: 6.4336e-05
- val_accuracy: 1.0000
Epoch 9/20
62/62 [==============================] - 45s 719ms/step - loss: 1.1276 - accuracy: 0.9058 - val_loss: 0.0685 - v
al_accuracy: 0.9444
Epoch 10/20
62/62 [==============================] - 45s 724ms/step - loss: 0.6891 - accuracy: 0.9253 - val_loss: 7.4679e-04
- val_accuracy: 1.0000
Epoch 11/20
62/62 [==============================] - 44s 716ms/step - loss: 0.4048 - accuracy: 0.9478 - val_loss: 0.0045 - v
al_accuracy: 1.0000
Epoch 12/20
62/62 [==============================] - 45s 728ms/step - loss: 0.5282 - accuracy: 0.9447 - val_loss: 0.2167 - v
al_accuracy: 0.9444
Epoch 13/20
62/62 [==============================] - 44s 712ms/step - loss: 0.4738 - accuracy: 0.9468 - val_loss: 0.2613 - v
al_accuracy: 0.9444
Epoch 14/20
62/62 [==============================] - 48s 776ms/step - loss: 0.4762 - accuracy: 0.9509 - val_loss: 0.0706 - v
al_accuracy: 0.9444
Epoch 15/20
62/62 [==============================] - 44s 716ms/step - loss: 0.4395 - accuracy: 0.9504 - val_loss: 0.2261 - v
al_accuracy: 0.9444
Epoch 16/20
62/62 [==============================] - 44s 714ms/step - loss: 0.7114 - accuracy: 0.9376 - val_loss: 0.1922 - v
al_accuracy: 0.9444
Epoch 17/20
62/62 [==============================] - 45s 721ms/step - loss: 0.5613 - accuracy: 0.9493 - val_loss: 7.5435e-05
- val_accuracy: 1.0000
Epoch 18/20
62/62 [==============================] - 48s 768ms/step - loss: 0.4815 - accuracy: 0.9601 - val_loss: 5.0887e-05
- val_accuracy: 1.0000
Epoch 19/20
62/62 [==============================] - 45s 729ms/step - loss: 0.3245 - accuracy: 0.9678 - val_loss: 3.8941e-06
- val_accuracy: 1.0000
Epoch 20/20
62/62 [==============================] - 45s 727ms/step - loss: 0.2943 - accuracy: 0.9683 - val_loss: 0.0369 - v
al_accuracy: 1.0000
```

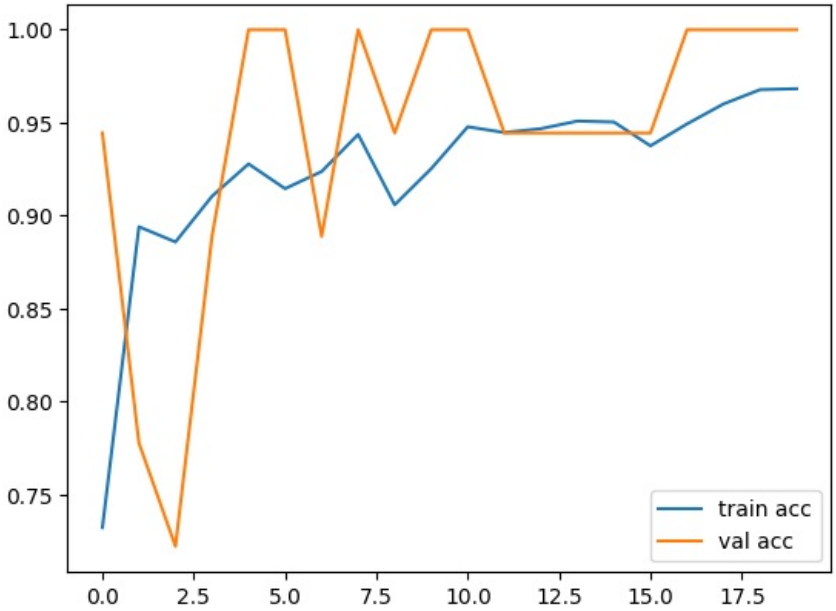
In [ ]:

```python
# plot the loss
plt.plot(r.history['loss'], label='train loss')
plt.plot(r.history['val_loss'], label='val loss')
plt.legend()
plt.show()
plt.savefig('LossVal_loss')

print("")

# plot the accuracy
plt.plot(r.history['accuracy'], label='train acc')
plt.plot(r.history['val_accuracy'], label='val acc')
plt.legend()
plt.show()
plt.savefig('AccVal_acc')
```






```
<Figure size 640x480 with 0 Axes>
```

In [ ]:
```
# save it as a h5 file


from tensorflow.keras.models import load_model

model.save('model_inception.h5')
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/engine/training.py:3103: UserWarning: You are saving your mode
l as an HDF5 file via `model.save()`. This file format is considered legacy. We recommend using instead the nati
ve Keras format, e.g. `model.save('my_model.keras')`.
  saving_api.save_model(
```

In [ ]:
```
y_pred = model.predict(test_set)
```

```
1/1 [==============================] - 3s 3s/step
```

In [ ]:
```
y_pred
```

Out[ ]:
```
array([[9.67322199e-34, 2.56255582e-31, 6.70218252e-34, 1.00000000e+00],
       [0.00000000e+00, 9.13072359e-19, 0.00000000e+00, 1.00000000e+00],
       [9.99966502e-01, 3.35183213e-05, 3.11084494e-26, 6.82262763e-27],
       [1.00000000e+00, 1.12432621e-22, 2.64439266e-25, 0.00000000e+00],
       [4.22736296e-29, 1.00000000e+00, 9.59525156e-23, 2.22756245e-21],
       [1.37253325e-11, 4.00074969e-16, 1.00000000e+00, 1.03001150e-18],
       [1.00000000e+00, 0.00000000e+00, 6.35795369e-34, 1.87552122e-31],
       [0.00000000e+00, 1.00000000e+00, 0.00000000e+00, 0.00000000e+00],
       [1.35298436e-34, 1.00000000e+00, 4.07272948e-35, 9.72241304e-36],
       [2.46025994e-01, 2.65590737e-19, 7.53974020e-01, 1.55860796e-19],
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       [6.80393513e-14, 7.87627869e-07, 9.99999166e-01, 5.17310566e-31],
       [0.00000000e+00, 1.00000000e+00, 0.00000000e+00, 4.86102310e-38],
       [3.20524753e-11, 3.06067616e-10, 1.44860845e-19, 1.00000000e+00],
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       [3.55616625e-17, 1.54721674e-05, 4.46794330e-24, 9.99984503e-01],
       [4.02983311e-14, 0.00000000e+00, 1.00000000e+00, 2.57389291e-37]],
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Created by: *Abdul Mannan*