Artificial Intelligence - IBM Project Build-a-Thon 2022

Fertilizers Recommendation System for Disease Prediction

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Simulation and Results:

1) Fruit Dataset CNN Sequential Model Building

For target_size = (128,128) and batch_size=32

```
model.summary()

Model: "sequential"
_____
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d (Conv2D)             (None, 124, 124, 32)      2432

 max_pooling2d (MaxPooling2D  (None, 41, 41, 32)       0
 )

 conv2d_1 (Conv2D)           (None, 39, 39, 32)        9248

 max_pooling2d_1 (MaxPooling  (None, 19, 19, 32)       0
 2D)

 conv2d_2 (Conv2D)           (None, 17, 17, 64)        18496

 max_pooling2d_2 (MaxPooling  (None, 8, 8, 64)         0
 2D)

 flatten (Flatten)           (None, 4096)              0

 dense (Dense)               (None, 512)               2097664

 dropout (Dropout)           (None, 512)               0

 dense_1 (Dense)             (None, 128)               65664

 dense_2 (Dense)             (None, 6)                 774

=================================================================
Total params: 2,194,278
Trainable params: 2,194,278
Non-trainable params: 0
_____
```

```
model.fit_generator(x_train,steps_per_epoch=len(x_train),validation_data=x_test,validation_steps=52,epochs=15)
```

```
Epoch 1/15
169/169 [==============================] - 102s 594ms/step - loss: 0.7194 - accuracy: 0.7407 - val_loss: 0.2664 - val_accuracy:
0.8984
Epoch 2/15
169/169 [==============================] - 98s 580ms/step - loss: 0.3082 - accuracy: 0.8910 - val_loss: 0.1579 - val_accuracy:
0.9477
Epoch 3/15
169/169 [==============================] - 106s 629ms/step - loss: 0.3322 - accuracy: 0.8848 - val_loss: 0.3310 - val_accuracy:
0.8906
Epoch 4/15
169/169 [==============================] - 100s 587ms/step - loss: 0.2222 - accuracy: 0.9227 - val_loss: 0.1309 - val_accuracy:
0.9579
Epoch 5/15
169/169 [==============================] - 111s 657ms/step - loss: 0.1543 - accuracy: 0.9461 - val_loss: 0.1303 - val_accuracy:
0.9537
Epoch 6/15
169/169 [==============================] - 99s 585ms/step - loss: 0.1294 - accuracy: 0.9562 - val_loss: 0.1674 - val_accuracy:
0.9447
Epoch 7/15
169/169 [==============================] - 111s 656ms/step - loss: 0.1280 - accuracy: 0.9560 - val_loss: 0.1162 - val_accuracy:
0.9597
Epoch 8/15
169/169 [==============================] - 86s 509ms/step - loss: 0.1004 - accuracy: 0.9608 - val_loss: 0.0811 - val_accuracy:
0.9694
Epoch 9/15
169/169 [==============================] - 68s 402ms/step - loss: 0.0862 - accuracy: 0.9720 - val_loss: 0.0925 - val_accuracy:
0.9706
Epoch 10/15
169/169 [==============================] - 100s 590ms/step - loss: 0.0861 - accuracy: 0.9707 - val_loss: 0.0559 - val_accuracy:
0.9856

Epoch 11/15
169/169 [==============================] - 101s 599ms/step - loss: 0.0638 - accuracy: 0.9783 - val_loss: 0.0608 - val_accuracy:
0.9802
Epoch 12/15
169/169 [==============================] - 103s 612ms/step - loss: 0.0762 - accuracy: 0.9744 - val_loss: 0.0956 - val_accuracy:
0.9694
Epoch 13/15
169/169 [==============================] - 108s 640ms/step - loss: 0.0835 - accuracy: 0.9695 - val_loss: 0.1395 - val_accuracy:
0.9573
Epoch 14/15
169/169 [==============================] - 104s 615ms/step - loss: 0.0496 - accuracy: 0.9840 - val_loss: 0.0549 - val_accuracy:
0.9826
Epoch 15/15
169/169 [==============================] - 97s 576ms/step - loss: 0.0556 - accuracy: 0.9803 - val_loss: 0.0815 - val_accuracy:
0.9760

<keras.callbacks.History at 0x223fe0c5880>
```

```
Found 5384 images belonging to 6 classes.
Found 1686 images belonging to 6 classes.
```

```
x_train.class_indices
```

```
{'Apple___Black_rot': 0,
 'Apple___healthy': 1,
 'Corn_(maize)___Northern_Leaf_Blight': 2,
 'Corn_(maize)___healthy': 3,
 'Peach___Bacterial_spot': 4,
 'Peach___healthy': 5}
```

```
In [24]: model=load_model('fruit.h5')
```

```
In [25]: s\\IBM Buildathon\\Project Building\\Dataset Plant Disease\\fruit-dataset\\fruit-dataset\\test\\Apple___Black_rot\\00e909aa-e3ae-
```

```
In [26]: img
```

Out[26]:

```
In [27]: x=image.img_to_array(img)
         x=np.expand_dims(x,axis=0)
         y=np.argmax(model.predict(x),axis=1)
         #x_train.class_indices
         index=['Apple___Black_rot','Apple___healthy','Corn_(maize)___Northern_Leaf_Blight','Corn_(maize)___healthy','Peach___Bacterial_sp
         index[y[0]]
```

Out[27]: 'Apple___Black_rot'

```
In [28]: img=image.load_img("C:\\Users\\91978\\Desktop\\Python Projects\\IBM Buildathon\\Project Building\\Dataset Plant Disease\\fruit-da
         x=image.img_to_array(img)
         x=np.expand_dims(x,axis=0)
         y=np.argmax(model.predict(x),axis=1)
         #x_train.class_indices
         index=['Apple___Black_rot','Apple___healthy','Corn_(maize)___Northern_Leaf_Blight','Corn_(maize)___healthy','Peach___Bacterial_sp
         index[y[0]]
```

Out[28]: 'Apple___healthy'

```
In [29]: img=image.load_img("C:\\Users\\91978\\Desktop\\Python Projects\\IBM Buildathon\\Project Building\\Dataset Plant Disease\\fruit-da
         x=image.img_to_array(img)
         x=np.expand_dims(x,axis=0)
         y=np.argmax(model.predict(x),axis=1)
         index=['Apple___Black_rot','Apple___healthy','Corn_(maize)___Northern_Leaf_Blight','Corn_(maize)___healthy','Peach___Bacterial_sp
         index[y[0]]
```

Out[29]: 'Corn_(maize)___healthy'

```
In [30]: img=image.load_img("C:\\Users\\91978\\Desktop\\Python Projects\\IBM Buildathon\\Project Building\\Dataset Plant Disease\\fruit-da
         x=image.img_to_array(img)
         x=np.expand_dims(x,axis=0)
         y=np.argmax(model.predict(x),axis=1)
         #x_train.class_indices
         index=['Apple___Black_rot','Apple___healthy','Corn_(maize)___Northern_Leaf_Blight','Corn_(maize)___healthy','Peach___Bacterial_sp
         index[y[0]]
```

Out[30]: 'Peach___Bacterial_spot'

```
In [31]: Building\\Dataset Plant Disease\\fruit-dataset\\fruit-dataset\\test\\Corn_(maize)___Northern_Leaf_Blight\\0d0f6d14-be5c-4cb8-adb4



         _(maize)___healthy','Peach___Bacterial_spot','Peach___healthy']
```

Out[31]: 'Corn_(maize)___Northern_Leaf_Blight'

```
In [32]: oject Building\\Dataset Plant Disease\\fruit-dataset\\fruit-dataset\\test\\Peach___healthy\\4a87f671-1b68-49cb-bb69-7be29499caba__



         ,'Corn_(maize)___healthy','Peach___Bacterial_spot','Peach___healthy']
```

Out[32]: 'Peach___healthy'

2) Vegetable Dataset- CNN Sequential Model Building

```
Model: "sequential_6"

_____
 Layer (type)                Output Shape              Param #
=================================================================
 conv2d_13 (Conv2D)          (None, 126, 126, 32)      896

 max_pooling2d_6 (MaxPooling  (None, 63, 63, 32)        0
 2D)

 flatten_6 (Flatten)         (None, 127008)            0

 dense_18 (Dense)            (None, 300)               38102700

 dense_19 (Dense)            (None, 150)               45150

 dense_20 (Dense)            (None, 75)                11325

 dense_21 (Dense)            (None, 9)                 684

=================================================================
Total params: 38,160,755
Trainable params: 38,160,755
Non-trainable params: 0
_____
```

```
Epoch 12/20
356/356 [==============================] - 196s 550ms/step - loss: 0.1679 - accuracy: 0.9409 - val_loss: 0.3626 - val_accuracy:
0.8741
Epoch 13/20
356/356 [==============================] - 196s 550ms/step - loss: 0.1681 - accuracy: 0.9403 - val_loss: 0.2344 - val_accuracy:
0.9163
Epoch 14/20
356/356 [==============================] - 194s 546ms/step - loss: 0.1344 - accuracy: 0.9524 - val_loss: 0.0790 - val_accuracy:
0.9722
Epoch 15/20
356/356 [==============================] - 195s 546ms/step - loss: 0.1600 - accuracy: 0.9460 - val_loss: 0.1296 - val_accuracy:
0.9502
Epoch 16/20
356/356 [==============================] - 197s 552ms/step - loss: 0.1309 - accuracy: 0.9542 - val_loss: 0.1312 - val_accuracy:
0.9508
Epoch 17/20
356/356 [==============================] - 202s 566ms/step - loss: 0.1397 - accuracy: 0.9520 - val_loss: 0.0963 - val_accuracy:
0.9669
Epoch 18/20
356/356 [==============================] - 202s 566ms/step - loss: 0.1254 - accuracy: 0.9562 - val_loss: 0.0890 - val_accuracy:
0.9672
Epoch 19/20
356/356 [==============================] - 201s 565ms/step - loss: 0.1166 - accuracy: 0.9612 - val_loss: 0.1355 - val_accuracy:
0.9508
Epoch 20/20
356/356 [==============================] - 201s 564ms/step - loss: 0.1136 - accuracy: 0.9613 - val_loss: 0.0446 - val_accuracy:
0.9833
```

Found 11386 images belonging to 9 classes.
Found 3416 images belonging to 9 classes.

```python
x_train.class_indices
```

```
{'Pepper,_bell___Bacterial_spot': 0,
 'Pepper,_bell___healthy': 1,
 'Potato___Early_blight': 2,
 'Potato___Late_blight': 3,
 'Potato___healthy': 4,
 'Tomato___Bacterial_spot': 5,
 'Tomato___Late_blight': 6,
 'Tomato___Leaf_Mold': 7,
 'Tomato___Septoria_leaf_spot': 8}
```

In [13]: `model=load_model('vegetable.h5')`

In [14]: `ilding\\Dataset Plant Disease\\Veg-dataset\\Veg-dataset\\test_set\\Tomato___Septoria_leaf_spot\\c551c562-b93a-4b2e-9058-12519414b`

In [15]: `img`

Out[15]:

In [16]:
```python
x=image.img_to_array(img)
x=np.expand_dims(x,axis = 0)
```

In [17]: `y=model.predict(x)`

In [18]: `y`

Out[18]: `array([[0., 0., 0., 0., 0., 0., 0., 0., 1.]], dtype=float32)`

In [19]:
```python
x=image.img_to_array(img)
x=np.expand_dims(x,axis=0)
y=np.argmax(model.predict(x),axis=1)
#x_train.class_indices
index=['Pepper,_bell___Bacterial_spot','Pepper,_bell___healthy','Potato___Early_blight','Potato___Late_blight','Potato___healthy'
index[y[0]]
```

Out[19]: `'Tomato___Septoria_leaf_spot'`

In [26]: `thon\\Project Building\\Dataset Plant Disease\\Veg-dataset\\Veg-dataset\\test_set\\Pepper,_bell___Bacterial_spot\\afd0c913-1e90-4`

`Early_blight','Potato___Late_blight','Potato___healthy','Tomato___Bacterial_spot','Tomato___Late_blight','Tomato___Leaf_Mold','To`

Out[26]: `'Pepper,_bell___Bacterial_spot'`

In [10]: `\IBM Buildathon\\Project Building\\Dataset Plant Disease\\Veg-dataset\\Veg-dataset\\test_set\\Pepper,_bell___healthy\\b91d515b-9f`

`,'Potato___Early_blight','Potato___Late_blight','Potato___healthy','Tomato___Bacterial_spot','Tomato___Late_blight','Tomato___Lea`

Out[10]: `'Pepper,_bell___healthy'`

```
In [11]: Buildathon\\Project Building\\Dataset Plant Disease\\Veg-dataset\\Veg-dataset\\test_set\\Potato___Early_blight\\c03a3f69-00b7-4aa
```
```
         ato___Early_blight','Potato___Late_blight','Potato___healthy','Tomato___Bacterial_spot','Tomato___Late_blight','Tomato___Leaf_Mol
```

Out[11]: 'Potato___Early_blight'

```
In [13]: aset Plant Disease\\Veg-dataset\\Veg-dataset\\test_set\\Potato___healthy\\b42621c3-f751-46e1-a8d2-83ed85b90554___RS_HL 1740.jpg",
```
```
         e_blight','Potato___healthy','Tomato___Bacterial_spot','Tomato___Late_blight','Tomato___Leaf_Mold','Tomato___Septoria_leaf_spot']
```

Out[13]: 'Potato___healthy'

```
In [26]: ject Building\\Dataset Plant Disease\\Veg-dataset\\Veg-dataset\\test_set\\Tomato___Late_blight\\b6a42b14-eb81-4e7b-9ca7-be9bed86c
```
```
         ght','Potato___Late_blight','Potato___healthy','Tomato___Bacterial_spot','Tomato___Late_blight','Tomato___Leaf_Mold','Tomato___Se
```

Out[26]: 'Tomato___Late_blight'

```
In [41]: img
```

Out[41]:

3) Flask App python script on Spyder IDE

File Edit Search Source Run Debug Consoles Projects Tools View Help

...ects\IBM Buildathon\Project Building\Fertilizers Recommendation System For Disease Prediction\app.py

Files panel:

Name	Date Modified
static	17-07-2022 09:29
templates	17-07-2022 09:29
uploads	17-07-2022 21:00
app.py	18-07-2022 09:31
fruit.h5	16-07-2022 23:47
precautions - fruits.xlsx	01-12-2021 23:03
precautions - veg.xlsx	01-12-2021 23:03
vegetable.h5	17-07-2022 07:59

app.py:

```python
import pandas as pd
import tensorflow as tf
import os
from tensorflow.keras.models import load_model
from tensorflow.keras.preprocessing import image
from flask import Flask, redirect, url_for, render_template, request
from werkzeug.utils import secure_filename
from tensorflow.python.keras.backend import set_session

app=Flask(__name__)

model=load_model("vegetable.h5")
model1=load_model("fruit.h5")


@app.route('/')
def home():
    return render_template("home.html")

@app.route('/prediction')
def prediction():
    return render_template("predict.html")

@app.route('/predict',methods=['GET','POST'])
def predict():
    if request.method=='POST':
        f=request.files['image']

        basepath=os.path.dirname(__file__)
        file_path=os.path.join(basepath,'uploads', secure_filename (f.filenam
        f.save(file_path)
        img=image.load_img(file_path,target_size=(128,128))
```

Console 1/A:

```
Oopps!! Your pepper plant is infected by Bacterial Leaft Spot. The disease cycle
can be stopped by using the Sango formula for disinfectants. Bleach treatment and
hot water treatment is also helpful.
127.0.0.1 - - [18/Jul/2022 09:32:49] "POST /predict HTTP/1.1" 200 -
vegetable
1
Yaayy!! Your pepper plant is healthy. But, take the necessary precautions like,
putting the plant where it gets at least 10 hours of direct sunlight. Keep soil
evenly moist for good growth. Peppers need well draining soil that is rich and
loamy, but avoid too much nitrogen in the soil. Too much nitrogen can cause plenty
of leaves and little to no peppers. Your soil should have a pH between 6.0 and
6.5.
127.0.0.1 - - [18/Jul/2022 09:32:59] "POST /predict HTTP/1.1" 200 -
vegetable
2
Oopps!! Your potato plant is Early Blight. Avoid irrigation in cool cloudy weather
and time irrigation to allow plants time to dry before nightfall. Protectant
fungicides (e.g. maneb, mancozeb, chlorothalonil, and triphenyl tin hydroxide) are
effective.
```

IPython console History

LSP Python: ready   conda: base (Python 3.9.7)   Line 14, Col 28   ASCII   CRLF   RW   Mem 80%

4) Prediction results on HTML page

For Fruits:

← → C ⓘ 127.0.0.1:5000/prediction

Plant Disease Prediction

Drop in the image to get the prediction

Fruit ▾

Choose...

Prediction: Yaayy!! Your corn plant is healthy. But, maintain the soil consistently moist, but not soggy and only need fertilizer every 6 months. It prefers temperatures of 75 to 80 degrees F.

← → C ⓘ 127.0.0.1:5000/prediction

Plant Disease Prediction

Drop in the image to get the prediction

Fruit ▾

Choose...

Prediction: Oopps!! Your corn plant is infected by Northern Leaf Blight. The primary management strategy to reduce the incidence and severity of NCLB is planting resistant products. Using fungicides is also helpful.

Plant Disease Prediction

Drop in the image to get the prediction

Fruit ▾

Choose...

Prediction: Oopps!! Your peach plant is infected by Bacterial Spots. This is a difficult disease to control when environmental conditions favor pathogen spread. Compounds for the treatment include copper, oxytetracycline (Mycoshield and generic equivalents), and syllit+captan; however, repeated applications are typically necessary for even minimal disease control.

Plant Disease Prediction

Drop in the image to get the prediction

Fruit ▾

Choose...

Prediction: Yaayy!! Your peach plant is healthy. But, you should have deep sandy soil that ranges from a loam to a clay loam for healthy growth. Poor drainage in the soil will kill the root system of growing peach trees, so make sure the soil is well drained. Growing peach trees prefer a soil pH of around 6.5.

For Vegetatbles:

Plant Disease Prediction

Drop in the image to get the prediction

Vegetable

Choose...

Prediction: Oopps!! Your pepper plant is infected by Bacterial Leaft Spot. The disease cycle can be stopped by using the Sango formula for disinfectants. Bleach treatment and hot water treatment is also helpful.

Plant Disease Prediction

Drop in the image to get the prediction

Vegetable

Choose...

Prediction: Yaayy!! Your pepper plant is healthy. But, take the necessary precautions like, putting the plant where it gets at least 10 hours of direct sunlight. Keep soil evenly moist for good growth. Peppers need well draining soil that is rich and loamy, but avoid too much nitrogen in the soil. Too much nitrogen can cause plenty of leaves and little to no peppers. Your soil should have a pH between 6.0 and 6.5.

Plant Disease Prediction

Drop in the image to get the prediction

Vegetable

Choose...

Prediction: Oopps!! Your potato plant is Early Blight. Avoid irrigation in cool cloudy weather and time irrigation to allow plants time to dry before nightfall. Protectant fungicides (e.g. maneb, mancozeb, chlorothalonil, and triphenyl tin hydroxide) are effective.

Plant Disease Prediction

Drop in the image to get the prediction

Vegetable

Choose...

Prediction: Oopps!! Your tomato plant is late blight. Early treatment for this disease is needed. Fungicides like e Daconil fungicides from GardenTech brand prevent, stop, and control late blight and more than 65 types of fungal disease. Planting resistant cultivars and watering the plants early in the mornings help to prevent this infection.

As CUH is 0, instead of IBM cloud deployment, local deployment is done and integrated with Flask App for prediction.