

TRAIN MODEL ON IBM

TEAM ID : PNT2022TMID04889

The screenshot displays a Jupyter Notebook interface within the IBM Cloud Pak for Data environment. The notebook is titled 'image_classification / image' and is running on a Python 3.9 kernel. The interface includes a top navigation bar with the IBM Cloud Pak for Data logo, a search bar, and user account information (VINOTHINI P's Account, Dallas, VP). The notebook content is divided into three cells:

- Cell 1:** A code cell where the user runs `pwd` to check the current directory, which returns `'/home/wsuser/work'`.
- Cell 2:** A code cell where the user installs Keras and TensorFlow. The output shows that Keras 2.2.4 and TensorFlow 1.14.0 are successfully installed, along with their dependencies (numpy, h5py, scipy, etc.).
- Cell 3:** A code cell where the user imports necessary libraries (`os`, `types`, `pandas`, `ibm_boto3`) and defines a class `__iter__` that returns 0.

Below the notebook interface, a Windows taskbar is visible, showing the system clock as 12:29 PM on 11/19/2022. The taskbar also includes icons for various applications and the system tray.

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In [1]:

```
import os, types
import pandas as pd
from botocore.client import Config
import ibm_boto3

def __iter__(self): return 0

#@hidden_cell
# The following code accesses a file in your IBM Cloud Object Storage. It includes your credentials.
# You might want to remove those credentials before you share the notebook.
cos_client = ibm_boto3.client(service_name='s3',
                              ibm_api_key_id='pzi75g3o5sh19q0cm8fouo96k0xxa2e-3rnzlsukdd74a',
                              ibm_auth_endpoint='https://iam.cloud.ibm.com/oidc/token',
                              config=Config(signature_version='oauth'),
                              endpoint_url='https://s3.private.us.cloud-object-storage.appdomain.cloud')

bucket = 'imageclassification-donotdelete-pr-8mrt7d4grx@chn'
object_key = 'TRAIN_SET.zip'

streaming_body_2 = cos_client.get_object(Bucket=bucket, Key=object_key)['Body']

# Your data file was loaded into a botocore.response.StreamingBody object.
# Please read the documentation of ibm_boto3 and pandas to learn more about the possibilities to load the data.
# ibm_boto3 documentation: https://ibm.github.io/ibm-cos-sdk-python/
# pandas documentation: http://pandas.pydata.org/
```

In [2]:

```
from io import BytesIO
import zipfile
```

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In [2]:

```
from io import BytesIO
import zipfile
unzip = zipfile.ZipFile(BytesIO(streaming_body_2.read()), 'r')
file_paths = unzip.namelist()
for path in file_paths:
    unzip.extract(path)
```

In [4]:

```
import os
filenames = os.listdir("/home/wsuser/work/TRAIN_SET")
```

In [8]:

```
from 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 [10]:

```
x_train = train_datagen.flow_from_directory(
    '/home/wsuser/work/TRAIN_SET', target_size=(64,64), batch_size=5, color_mode='rgb', class_mode='sparse')
Found 2626 images belonging to 5 classes.
```

In [16]:

```
x_test = train_datagen.flow_from_directory(
    '/home/wsuser/work/Dataset/TEST_SET', target_size=(64,64), batch_size=5, color_mode='rgb', class_mode='sparse')
Found 1055 images belonging to 5 classes.
```

In [17]:

```
print(x_train.class_indices)

{'APPLES': 0, 'BANANA': 1, 'ORANGE': 2, 'PINEAPPLE': 3, 'WATERMELON': 4}
```

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```
In [18]: print(x_test.class_indices)
{'APPLES': 0, 'BANANA': 1, 'ORANGE': 2, 'PINEAPPLE': 3, 'WATERMELON': 4}

In [19]: from collections import Counter as c
c(x_train.labels)
Out[19]: Counter({0: 606, 1: 445, 2: 479, 3: 621, 4: 475})

In [20]: import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense, Flatten
from tensorflow.keras.layers import Conv2D, MaxPooling2D, Dropout

In [21]: # Initializing the CNN
classifier = Sequential()

# First convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), input_shape=(64, 64, 3), activation='relu'))
classifier.add(MaxPooling2D(pool_size=(2, 2)))

# Second convolution layer and pooling
classifier.add(Conv2D(32, (3, 3), activation='relu'))

# input_shape is going to be the pooled feature maps from the previous convolution layer
classifier.add(MaxPooling2D(pool_size=(2, 2)))
```

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```
classifier.add(Flatten())

In [22]: classifier.add(Dense(units=128, activation='relu'))
classifier.add(Dense(units=5, activation='softmax'))

In [23]: #summary of our model
classifier.summary()

Model: "sequential"
Layer (type) Output Shape Param #
-----
conv2d (Conv2D) (None, 62, 62, 32) 896
max_pooling2d (MaxPooling2D) (None, 31, 31, 32) 0
conv2d_1 (Conv2D) (None, 29, 29, 32) 9248
max_pooling2d_1 (MaxPooling2D) (None, 14, 14, 32) 0
flatten (Flatten) (None, 6272) 0
dense (Dense) (None, 128) 802944
dense_1 (Dense) (None, 5) 645
Total params: 813,733
Trainable params: 813,733
```

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Trainable params: 813,733
Non-trainable params: 0

```
In [24]: # compiling the CNN
# categorical_crossentropy for more than 2
classifier.compile(optimizer='adam', loss='sparse_categorical_crossentropy', metrics=['accuracy'])

In [25]: classifier.fit_generator(generator=x_train, steps_per_epoch = len(x_train), epochs=20, validation_data=x_test, validation_steps = len(x_test))

/tmp/wsuser/ipykernel_164/4293874847.py:1: UserWarning: 'Model.fit_generator' is deprecated and will be removed in a future version. Please use 'Model.fit', which supports generators.
  classifier.fit_generator(generator=x_train, steps_per_epoch = len(x_train), epochs=20, validation_data=x_test, validation_steps = len(x_test))

Epoch 1/20
526/526 [=====] - 14s 25ms/step - loss: 0.1573 - accuracy: 0.9410 - val_loss: 0.0203 - val_accuracy: 1.0000
Epoch 2/20
526/526 [=====] - 13s 25ms/step - loss: 4.8924e-04 - accuracy: 1.0000 - val_loss: 0.0227 - val_accuracy: 0.9915
Epoch 3/20
526/526 [=====] - 13s 24ms/step - loss: 1.3434e-04 - accuracy: 1.0000 - val_loss: 0.0203 - val_accuracy: 0.9905
Epoch 4/20
526/526 [=====] - 13s 25ms/step - loss: 8.4644e-05 - accuracy: 1.0000 - val_loss: 0.0159 - val_accuracy: 0.9915
Epoch 5/20
526/526 [=====] - 13s 25ms/step - loss: 3.2203e-05 - accuracy: 1.0000 - val_loss: 0.0221 - val_accuracy: 0.9905
Epoch 6/20
526/526 [=====] - 13s 25ms/step - loss: 2.1435e-05 - accuracy: 1.0000 - val_loss: 0.0202 - val_accuracy: 0.9915
Epoch 7/20
526/526 [=====] - 13s 25ms/step - loss: 1.3939e-05 - accuracy: 1.0000 - val_loss: 0.0136 - val_accuracy: 0.9924
Epoch 8/20
526/526 [=====] - 13s 24ms/step - loss: 1.1812e-05 - accuracy: 1.0000 - val_loss: 0.0159 - val_accuracy: 0.9924
Epoch 9/20
```

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```
526/526 [=====] - 13s 25ms/step - loss: 1.3939e-05 - accuracy: 1.0000 - val_loss: 0.0136 - val_accuracy: 0.9924
Epoch 8/20
526/526 [=====] - 13s 24ms/step - loss: 1.1812e-05 - accuracy: 1.0000 - val_loss: 0.0159 - val_accuracy: 0.9924
Epoch 9/20
526/526 [=====] - 13s 25ms/step - loss: 7.0986e-06 - accuracy: 1.0000 - val_loss: 0.0228 - val_accuracy: 0.9886
Epoch 10/20
526/526 [=====] - 13s 25ms/step - loss: 4.8612e-06 - accuracy: 1.0000 - val_loss: 0.0268 - val_accuracy: 0.9915
Epoch 11/20
526/526 [=====] - 13s 25ms/step - loss: 3.2044e-06 - accuracy: 1.0000 - val_loss: 0.0259 - val_accuracy: 0.9896
Epoch 12/20
526/526 [=====] - 13s 25ms/step - loss: 7.0389e-06 - accuracy: 1.0000 - val_loss: 0.0287 - val_accuracy: 0.9877
Epoch 13/20
526/526 [=====] - 13s 25ms/step - loss: 5.3175e-06 - accuracy: 1.0000 - val_loss: 0.0366 - val_accuracy: 0.9848
Epoch 14/20
526/526 [=====] - 13s 25ms/step - loss: 1.5667e-06 - accuracy: 1.0000 - val_loss: 0.0141 - val_accuracy: 0.9943
Epoch 15/20
526/526 [=====] - 13s 24ms/step - loss: 7.4856e-07 - accuracy: 1.0000 - val_loss: 0.0358 - val_accuracy: 0.9829
Epoch 16/20
526/526 [=====] - 13s 25ms/step - loss: 1.1761e-06 - accuracy: 1.0000 - val_loss: 0.0305 - val_accuracy: 0.9848
Epoch 17/20
526/526 [=====] - 13s 25ms/step - loss: 1.3308e-06 - accuracy: 1.0000 - val_loss: 0.0122 - val_accuracy: 0.9943
Epoch 18/20
526/526 [=====] - 13s 25ms/step - loss: 8.9678e-07 - accuracy: 1.0000 - val_loss: 0.0189 - val_accuracy: 0.9877
Epoch 19/20
526/526 [=====] - 13s 25ms/step - loss: 2.3801e-07 - accuracy: 1.0000 - val_loss: 0.0304 - val_accuracy: 0.9848
Epoch 20/20
526/526 [=====] - 13s 24ms/step - loss: 1.6474e-07 - accuracy: 1.0000 - val_loss: 0.0230 - val_accuracy: 0.9896

Out[25]: <keras.callbacks.History at 0x7fd05b138c10>

In [125]: classifier.save("nutrition.h5")
```

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In [127]:

```
from tensorflow.keras.models import load_model
from keras.preprocessing import image
model = load_model("nutrition.h5")

<keras.engine.sequential.Sequential object at 0x7fcffa47aa0>
```

In [64]:

```
!tar -xvzf image-classification-model_new.tgz nutrition.h5
nutrition.h5
```

In [39]:

```
ls -l
Dataset/
image-classification-model_new.tgz
nutrition.h5
TRAIN_SET/
```

In [40]:

```
pip install watson-machine-learning-client --upgrade
```

Requirement already satisfied: watson-machine-learning-client in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.391)
Requirement already satisfied: pandas in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.3.4)
Requirement already satisfied: boto3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.18.21)
Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.3.3)
Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.8.9)
Requirement already satisfied: ibm-cos-sdk in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.11.0)
Requirement already satisfied: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.10.0)
Requirement already satisfied: botocore<1.22.0,>=1.21.21 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (1.21.41)

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In [66]:

```
from ibm_watson_machine_learning import APIClient
wml_credentials = {
    "url": "https://us-south.ml.cloud.ibm.com",
    "apikey": "3QzTG1QQ0mt3VXXvYr_o_rn52G14Rj0ty7czd1VBHJ"
}
client = APIClient(wml_credentials)
```

In [67]:

```
def guid_from_space_name(client, space_name):
    space = client.spaces.get_details()
```

Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.26.0)
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2022.9.24)
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (1.26.7)
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (0.8.9)
Requirement already satisfied: ibm-cos-sdk in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (2.11.0)
Requirement already satisfied: tqdm in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from watson-machine-learning-client) (4.62.3)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.10.0)
Requirement already satisfied: botocore<1.22.0,>=1.21.21 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (1.21.41)
Requirement already satisfied: s3transfer<0.6.0,>=0.5.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from boto3->watson-machine-learning-client) (0.5.0)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from botocore<1.22.0,>=1.21.21->boto3->watson-machine-learning-client) (2.8.2)
Requirement already satisfied: six>=1.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from python-dateutil<3.0.0,>=2.1->botocore<1.22.0,>=1.21.21->boto3->watson-machine-learning-client) (1.15.0)
Requirement already satisfied: ibm-cos-sdk-s3transfer==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.11.0)
Requirement already satisfied: ibm-cos-sdk-core==2.11.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk->watson-machine-learning-client) (2.11.0)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->watson-machine-learning-client) (3.3)
Requirement already satisfied: charset-normalizer==2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->watson-machine-learning-client) (2.0.4)
Requirement already satisfied: pytz==2017.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client) (2021.3)
Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas->watson-machine-learning-client) (1.20.3)

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```
def get_space_details(space_name):
    space = client.spaces.get_details()
    return(next(item for item in space['resources'] if item['entity']['name']==space_name)['metadata']['id'])

In [68]: space_uid = guid_from_space_name(client,"Vino_Image_Classification")
print("Space UID = " + space_uid)

Space UID = baa1614f-476c-4598-83f9-b8a7e9b33d02

In [69]: client.set.default_space(space_uid)

Out[69]: 'SUCCESS'

In [108]: client.software_specifications.list()
```

NAME	ASSET_ID	TYPE
default_py3.6	0062b8c9-8b7d-44a0-a9b9-46c416adcbd9	base
kernel-spark3.2-scala2.12	020d69ce-7ac1-5e68-ac1a-3118967356a	base
pytorch-onnx_1.3-py3.7-edt	069ea134-3346-5748-b513-49120e15d288	base
scikit-learn_0.20-py3.6	09c5a1d0-9c1e-4473-a344-e97b665f687	base
spark-mllib_3.0-scala_2.12	09f4c ffo-90a7-5890-b9ed-1ef348aebdee	base
pytorch-onnx_rt22.1-py3.9	0b848dd4-e681-5599-be41-b5f6fccc6471	base
ai-function_0.1-py3.6	0cdeb0f1e-5376-4f4d-92dd-da3b69aa9bda	base
shiny-r3.6	0e6e79df-875e-4f24-8ae9-62dccc2148306	base
tensorflow_2.4-py3.7-horovod	1092590a-307d-563d-9b62-4eb7d64b3f22	base
pytorch_1.1-py3.6	10ac12d6-6b30-4ccd-8392-3e922c096a92	base
tensorflow_1.15-py3.6-ddl	111e41b3-de2d-5422-a4d6-bf7768284b7	base
autoai-kb_rt22.2-py3.10	125b6d9a-5b1f-5e8d-972a-b251688ccf40	base
runtime-rt2.1-py3.9	12b83a17-24d8-5082-900f-0ab31fbfd3cb	base
scikit-learn_0.22-py3.6	154010fa-5b3b-4ac1-82af-4d5ee5abbc85	base

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```
autoai-ts_3.8-py3.8 2aa0c932-798f-5ae9-abd6-15e0c2402fb5 base
tensorflow_1.15-py3.6 2b73a275-7c6f-420b-a912-eae7f436e0bc base
kernel-spark3.3-py3.9 2b7961e2-e3b1-5a8c-a491-482c368839a base
pytorch_1.2-py3.6 2c8ef57d-2687-4b7d-acce-01f94976dac1 base
spark-mllib_2.3 2e51f700-bca0-4b0d-88dc-5dc6791338875 base
pytorch-onnx_1.1-py3.6-edt 32983cea-3f32-4400-8965-dde874a8d67e base
spark-mllib_3.0-py37 36507ebe-8770-55ba-ab2a-eafe787600e9 base
spark-mllib_2.4 390d21f8-e58b-4fac-9c55-d7ceda621326 base
autoai-ts_rt22.2-py3.10 396b2e83-0953-5b86-9a55-7ce1628a406f base
xgboost_0.82-py3.6 39e31acd-5f30-41dc-ae44-60233c80306e base
pytorch-onnx_1.2-py3.6-edt 40589d0e-7019-4e28-8daa-fb03b6f4fe12 base
pytorch-onnx_rt22.2-py3.10 40e73f55-783a-5535-b3fa-0c8b94291431 base
default_r36py38 41c247d3-45f8-5a71-b065-8580229facf0 base
autoai-ts_rt22.1-py3.9 4269d26e-07ba-5d40-8f66-2d495b0c71f7 base
autoai-obm_3.0 42b92e18-d9ab-567f-988a-4240ba1ed5f7 base
pmml-3.0_4.3 493bc095-16f1-5bc5-bee8-81b8af80e9c7 base
spark-mllib_2.4-r_3.6 49403dff-92e9-4c87-a3d7-a42d0021c095 base
xgboost_0.90-py3.6 4ff8d6c2-1343-4c18-85e1-689c965304d3 base
pytorch-onnx_1.1-py3.6 50f95b2a-bc16-43bb-bc94-b0bed208c60b base
autoai-ts_3.9-py3.8 52c57136-80fa-572e-8728-a5e7cbb42cde base
spark-mllib_2.4-scala_2.11 55a70f99-7320-4be5-9fb9-9ed5a443af5 base
spark-mllib_3.0 5c1b0ca2-4977-5c2e-9439-ffd44ea8ffe9 base
autoai-obm_2.0 5c2e37fa-80b6-5e77-840f-d912499614ee base
spss-modeler_18.1 5c3cad7e-507f-4b2a-a9a3-ab53a21deebb base
cuda-py3.8 5d3232bf-c86b-5df4-a2cd-7bb870a1cd4e base
runtime-rt2.2-py3.10-xc 5e8cdfff-db4a-5a6a-b8aa-2d4af9864dab base
autoai-kb_3.1-py3.7 632d4b22-10aa-5180-88f0-f52dfb6444d7 base
```

Note: Only first 50 records were displayed. To display more use 'limit' parameter.

```
In [1]: from tensorflow.keras.utils import to_numpy
```

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```
spark-mllib_2.4-scala_2.11 55a70f99-7320-4be5-9fb9-9edb5a443af5 base
spark-mllib_3.0 5c1b0ca2-4977-5c2e-9439-ffd44ea8ffe9 base
autoai-obm_2.0 5c2e37fa-80b8-5e77-840f-d912469614ee base
spss-modeler_18.1 5c3cad7e-507f-4b2a-a9a3-ab53a21dee8b base
cuda-py3.8 5d3232bf-c86b-5df4-a2cd-7bb870a1cd4e base
runtime-22.2-py3.10-xc 5e8cddff-db4a-5a6a-b8aa-2d4af9864dab base
autoai-kb_3.1-py3.7 632d4b22-10aa-5180-88f0-f52dfb6444d7 base
```

Note: Only first 50 records were displayed. To display more use 'limit' parameter.

```
In [ ]: from tensorflow.keras.utils import img_to_array
from tensorflow.keras.utils import load_img
#loading of the image
img = load_img('watermelon1.png', grayscale=False, target_size=(64,64))
#image to array
x = img_to_array(img)
#changing the shape
x = np.expand_dims(x, axis = 0)
predict_x=model.predict(x)
classes_x=np.argmax(predict_x,axis=-1)
classes_x
```

```
In [ ]: index=['APPLES', 'BANANA', 'ORANGE', 'PINEAPPLE', 'WATERMELON']
result=str(index[classes_x[0]])
result
```

WATERMELON

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