MODEL INTEGRATION AND TESTING

Date	15 November 2022
Team ID	PNT2022TMID13084
Project Name	Flight Delay Prediction Using Machine Learning

DEVELOPMENT PHASE:

During this phase we have planned for training the model on IBM where we will register forIBM cloud, train the ML model on IBM and integrate flask with scoring end point.

Registered on IBM cloud and activated watson machine learning, cloud storage and watson studio then trained the ML model on IBM using API KEY.

Created a python notebook compatible with IBM cloud.

In [193]:

```
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='BGfN6kxTOYC8cVw9eyojsnDinGv0bDBu8u2OJGVPsM18',
    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 = 'flightdelay113-donotdelete-pr-b9qh0sw8dleyxc'
object_key = 'flight-1.csv'

body = cos_client.get_object(Bucket=bucket,Key=object_key)['Body']
# add missing __iter__ method, so pandas accepts body as file-like object
if not hasattr(body, "__iter__"): body.__iter__ = types.MethodType( __iter__, body )

data = pd.read_csv(body)
data.head()
```

In [396]:

```
!pip install -U ibm-watson-machine-learning
```

```
Requirement already satisfied: ibm-watson-machine-learning in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (1.0.257)
Requirement already satisfied: ibm-cos-sdk==2.11.* in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (2.11.0)
Requirement already satisfied: certifi in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (2022.9.24)
Requirement already satisfied: importlib-metadata in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (4.8.2)
Requirement already satisfied: requests in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (2.26.0)
Requirement already satisfied: tabulate in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (0.8.9)
Requirement already satisfied: pandas<1.5.0,>=0.24.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (1.3.4)
Requirement already satisfied: packaging in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (21.3)
Requirement already satisfied: urllib3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (1.26.7)
Requirement already satisfied: lomond in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-watson-machine-learning) (0.3.3)
Requirement already satisfied: jmespath<1.0.0,>=0.7.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk==2.11.*->ibm-watson-machine-learning) (0.10.0)
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==2.11.*->ibm-watson-machine-learning) (2.11.0)
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==2.11.*->ibm-watson-machine-learning) (2.11.0)
Requirement already satisfied: python-dateutil<3.0.0,>=2.1 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from ibm-cos-sdk-core==2.11.0->ibm-cos-sdk==2.11.*->ibm-watson-machine-learning) (2.8.2)
Requirement already satisfied: pytz>=2017.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas<1.5.0,>=0.24.2->ibm-watson-machine-learning) (2021.3)
Requirement already satisfied: numpy>=1.17.3 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from pandas<1.5.0,>=0.24.2->ibm-watson-machine-learning) (1.20.3)
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->ibm-cos-sdk-core==2.11.0->ibm-cos-sdk==2.11.*->ibm-watson-machine-learning) (1.15.0)
Requirement already satisfied: charset-normalizer~=2.0.0 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->ibm-watson-machine-learning) (2.0.4)
Requirement already satisfied: idna<4,>=2.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from requests->ibm-watson-machine-learning) (3.3)
Requirement already satisfied: zipp>=0.5 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from importlib-metadata->ibm-watson-machine-learning) (3.6.0)
Requirement already satisfied: pyparsing!=3.0.5,>=2.0.2 in /opt/conda/envs/Python-3.9/lib/python3.9/site-packages (from packaging->ibm-watson-machine-learning) (3.0.4)
```

Authenticate and set space

In [397]:
```
from ibm_watson_machine_learning import APIClient
```

In [398]:
```
wml_credentials = {
    "apikey":"UcLivhHTTfB4iebNB-BWzL3XrtMNt9_bDLi3qw0rosnB",
    "url":"https://us-south.ml.cloud.ibm.com"
}
```

In [399]:
```
wml_client=APIClient(wml_credentials)
wml_client.spaces.list()
```

```
Note: 'limit' is not provided. Only first 50 records will be displayed if the number of records exceed 50
------------------------------------  -------------  ------------------------
ID                                    NAME           CREATED
5a7700b2-ea31-42e3-b588-b2e077f7c0cc  flight_deploy  2022-11-14T11:11:34.221Z
------------------------------------  -------------  ------------------------
```

In [400]:
```
space_id="5a7700b2-ea31-42e3-b588-b2e077f7c0cc"
```

In [401]:
```
wml_client.set.default_space(space_id)
```

Out[401]: 'SUCCESS'

Save and deploy model

In [403]:
```
model_name="demo_model"
deployment_name="demo_deploy"
model=dc
```

In [404]:
```
software_spec_uid=wml_client.software_specifications.get_id_by_name("runtime-22.1-py3.9")
```

In [405]:
```
model_props={
    wml_client.repository.ModelMetaNames.NAME : model_name,
    wml_client.repository.ModelMetaNames.TYPE : "scikit-learn_1.0",
    wml_client.repository.ModelMetaNames.SOFTWARE_SPEC_UID : software_spec_uid

}
```

In [406]:
```
model_details= wml_client.repository.store_model(
    model=model,
    meta_props=model_props,
    training_data=x_train,
    training_target=y_train

)
```

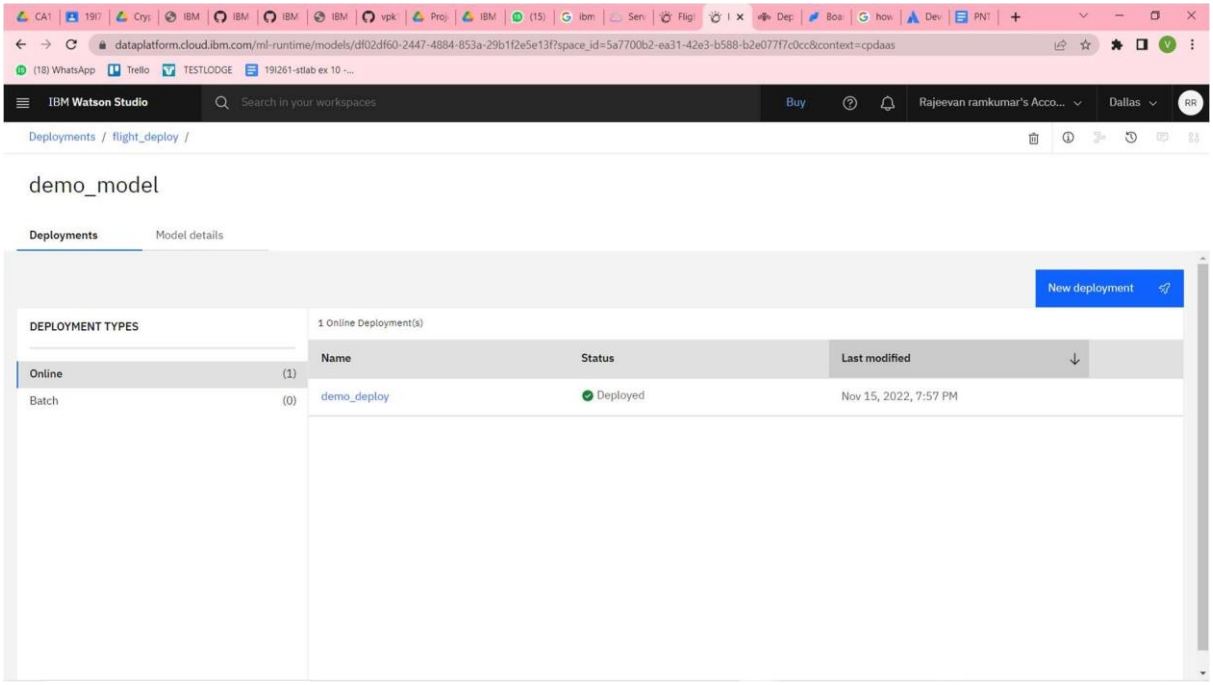
In [407]:
```
model_id=wml_client.repository.get_model_id(model_details)
model_id
```

Out[407]: '81c72738-41fb-4e79-bbdb-f5442d2cbf71'

In [408]:
```
deployment_props={
    wml_client.deployments.ConfigurationMetaNames.NAME:deployment_name,
    wml_client.deployments.ConfigurationMetaNames.ONLINE: {}
}
```

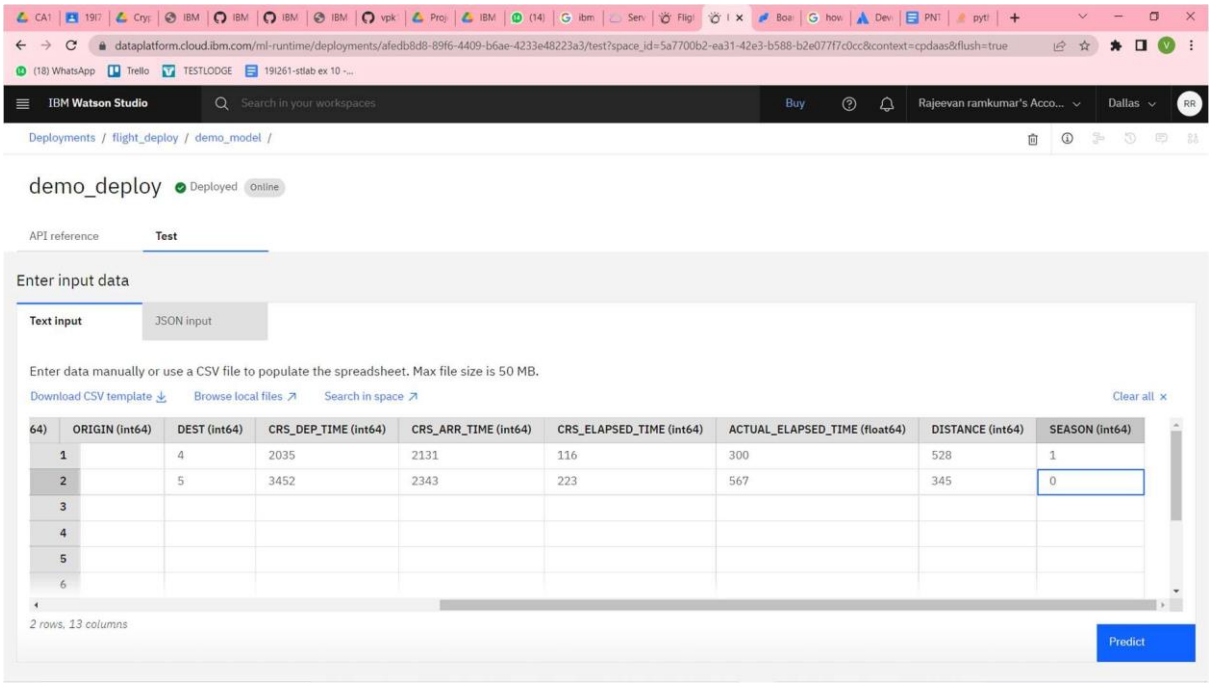
In [409]:
```
deployment=wml_client.deployments.create(
    artifact_uid=model_id,
    meta_props=deployment_props
)
```

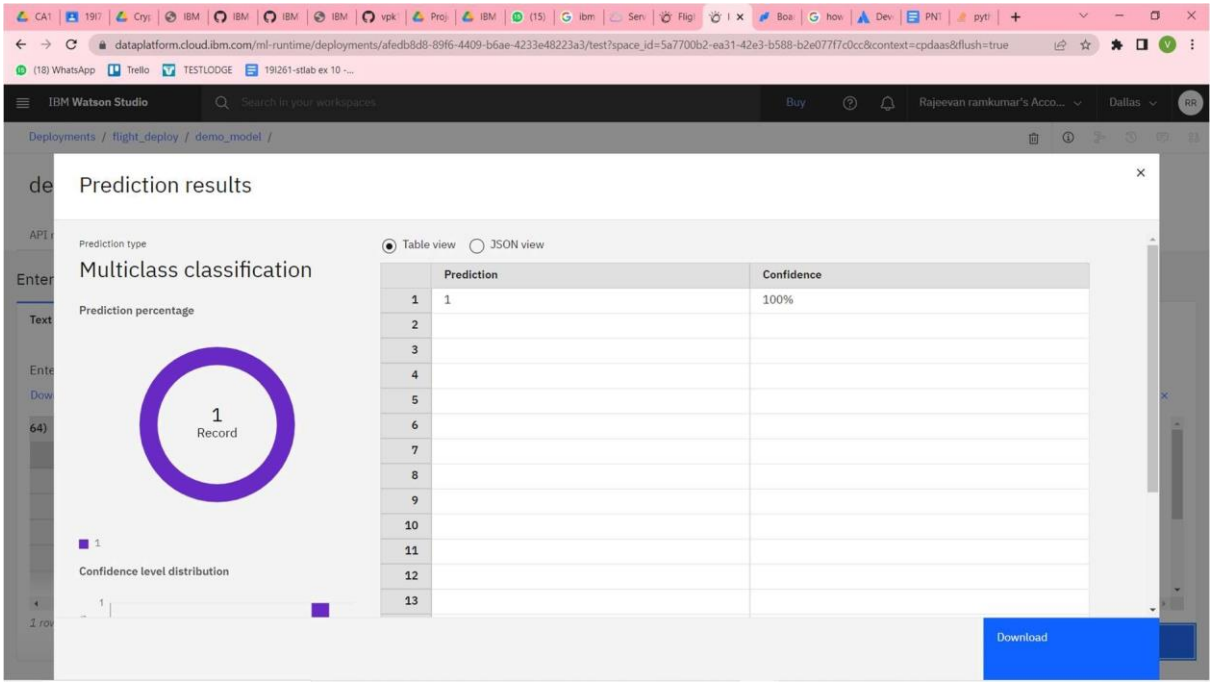
```
#######################################################################################

Synchronous deployment creation for uid: '81c72738-41fb-4e79-bbdb-f5442d2cbf71' started

#######################################################################################


initializing
Note: online_url is deprecated and will be removed in a future release. Use serving_urls instead.

ready


------------------------------------------------------------------------------------------------
Successfully finished deployment creation, deployment_uid='7e7da2f7-0679-417e-9f55-9403f2ca3fca'
------------------------------------------------------------------------------------------------
```



After successful deployment into IBM the same is integrated with flask file using api key and scoring endpoint.

Testing done on IBM Cloud platform:




dataplatform.cloud.ibm.com/ml-runtime/deployments/afedb8d8-89f6-4409-b6ae-4233e48223a3/test?space_id=5a7700b2-ea31-42e3-b588-b2e077f7c0cc&context=cpdaas&flush=true
IBM Watson Studio
Search in your workspaces
Buy
Rajeevan ramkumar's Acco...
Dallas
Deployments / flight_deploy / demo_model /
Prediction results
Prediction type
Multiclass classification
Prediction percentage
1
Record
1
Confidence level distribution
Table view
JSON view
Prediction
Confidence
1
100%
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