Machine Learning and Decision Optimization

on

IBM Watson Studio and Watson Machine Learning

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Overview

In this lab you will complete the following tasks in **Watson Studio (WS)** and **Watson Machine Learning (WML)**:

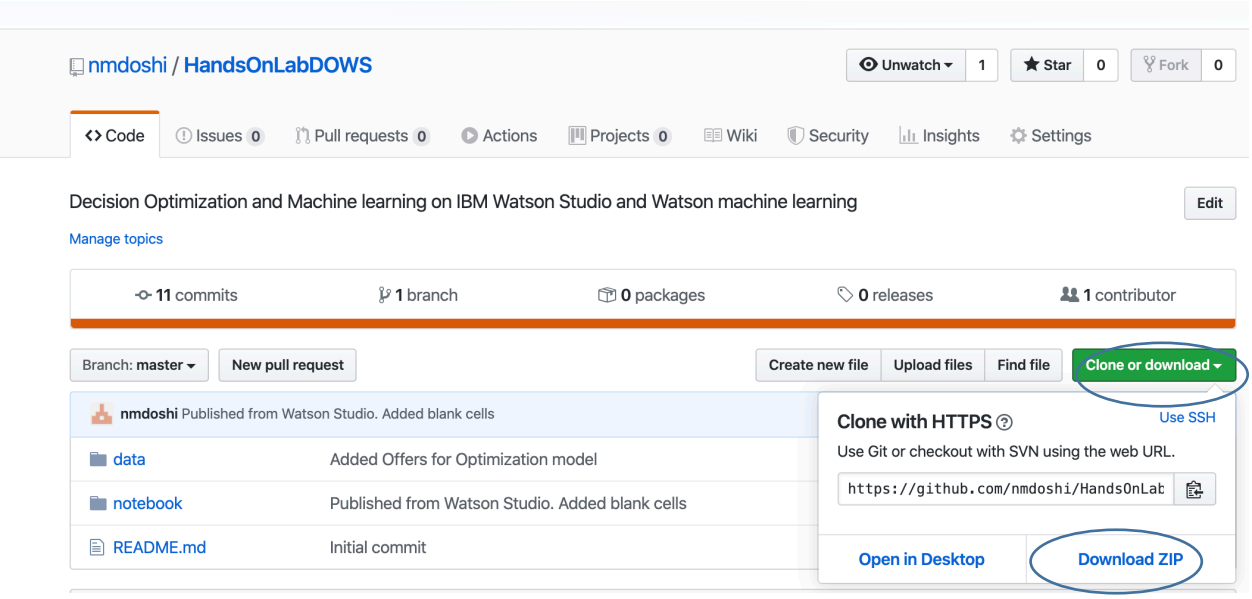
- Explore a working example
- Train a predictive model using scikit learn.
- Create an optimization model in notebook.
- Deploy predictive models in WML
- Deploy optimization model in WML
- Review a deployed application

Required software, access, and files

To complete this lab, you will need:

- **Watson Studio Cloud**
- **Watson Machine Learning**

You will also need to download and unzip this GitHub repository:
https://github.com/nmdoshi/HandsOnLabDOWS

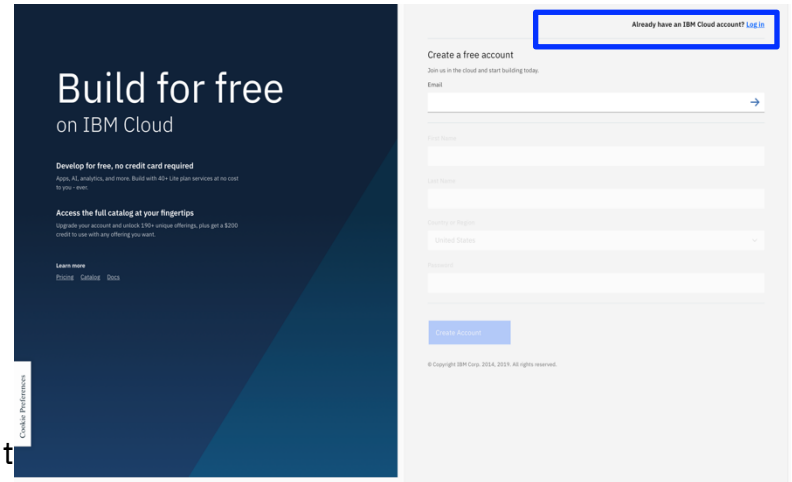


- Unzip the files and save it to a folder:

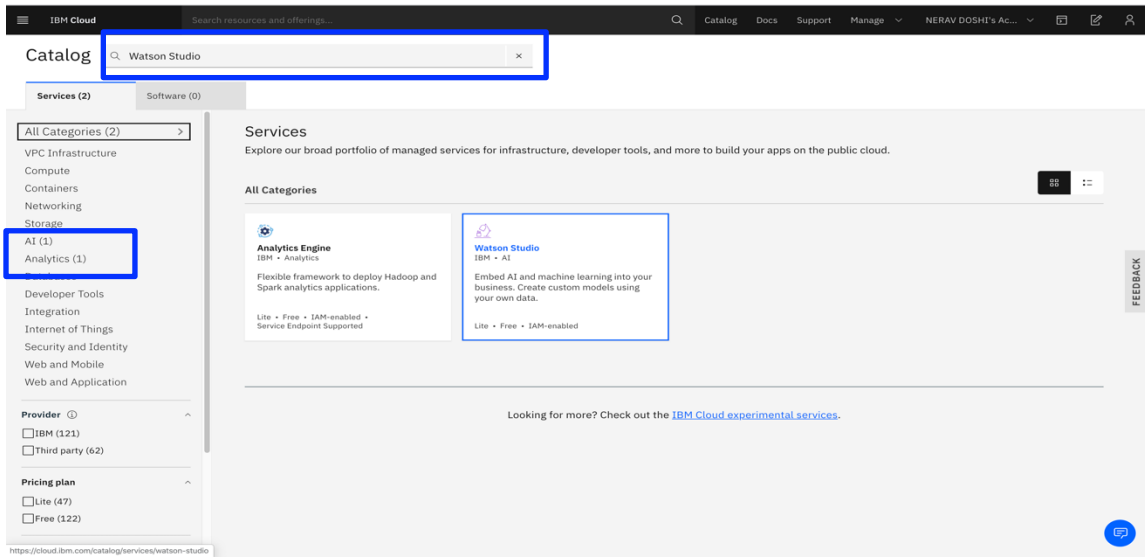
In the lab we will refer to this folder as the *git-repo* folder.

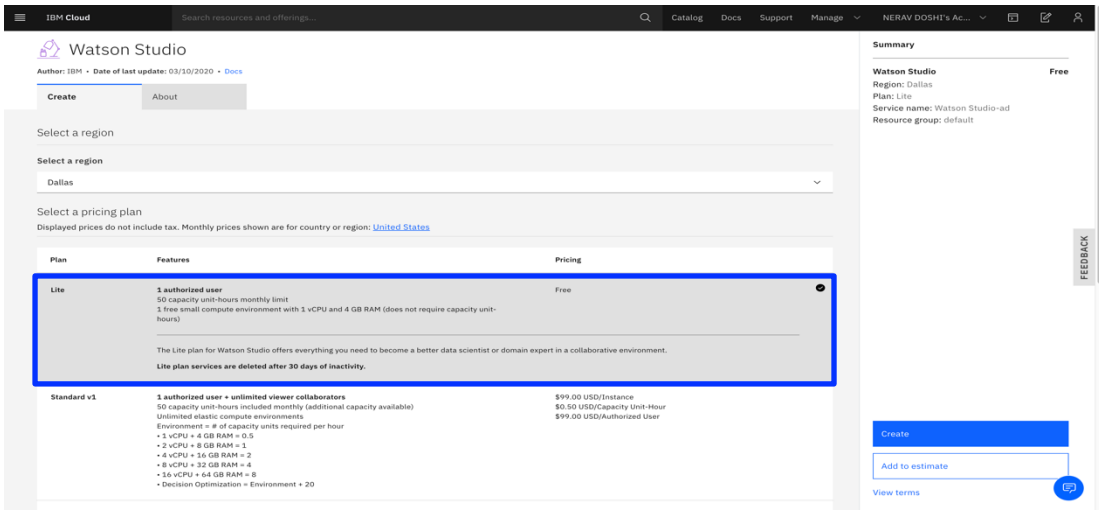
Pre-requisite – Setup on IBM Cloud

Set up **Watson Studio Cloud** (Free) Instance and **Watson Machine Learning** Lite Service.
You need some working access to Watson Studio (Cloud).
Visit IBM Cloud to sign up for a free account. https://ibm.biz/BdqjCP

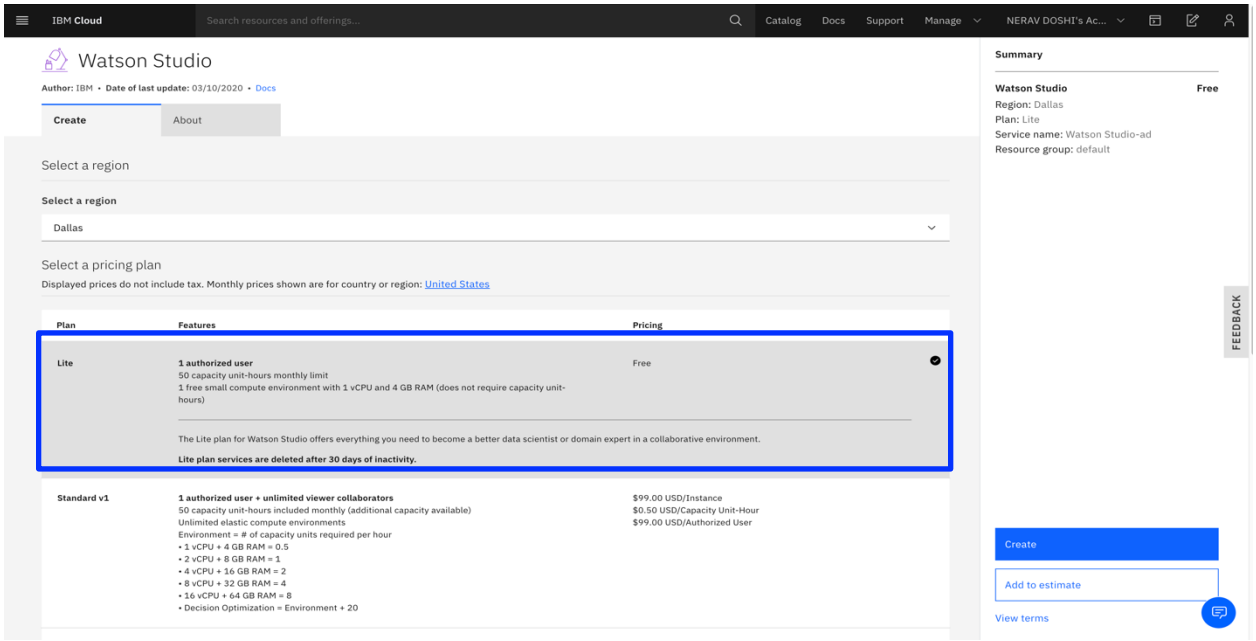


- This is t entire IBM site.
- You are directed to confirm your email to complete your registration.
- After clicking the information link in the email that you received, you are directed to the confirmation page. Now your account is activated.
- You need to acknowledge the terms and you're all set with your free IBM cloud account.
- Open Catalog from top of the page. Select AI from the Categories > Select Watson Studio.
- Use all default values. Make sure you use the Lite plan. Click Create. You are directed to Watson Studio service when its created.

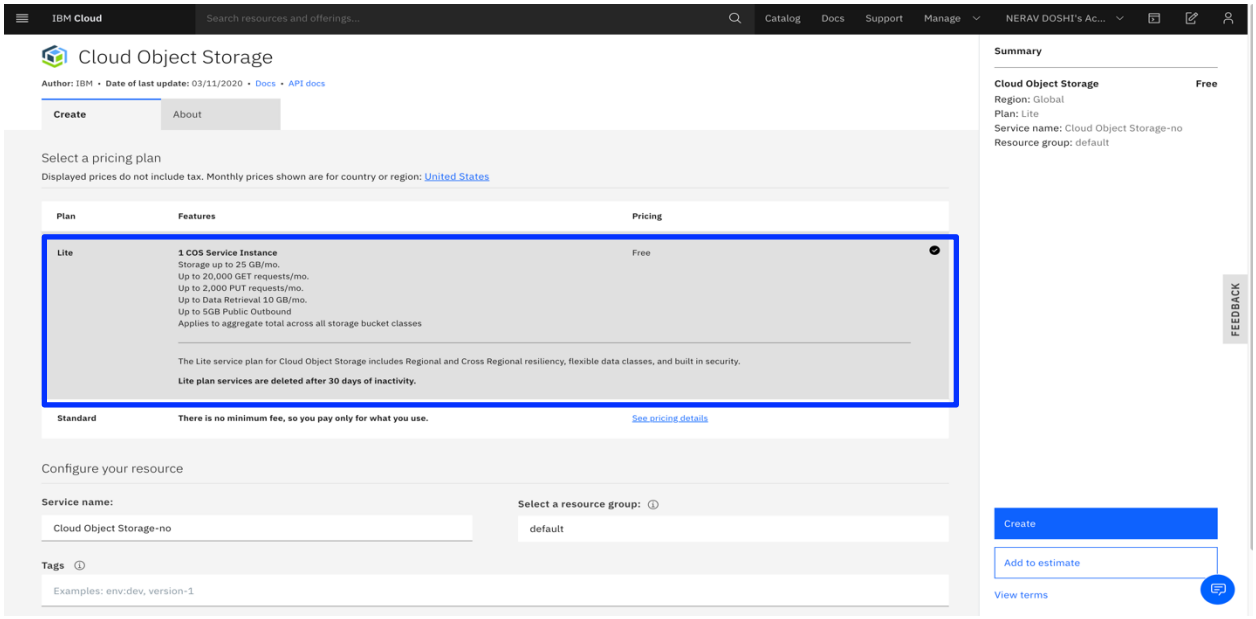




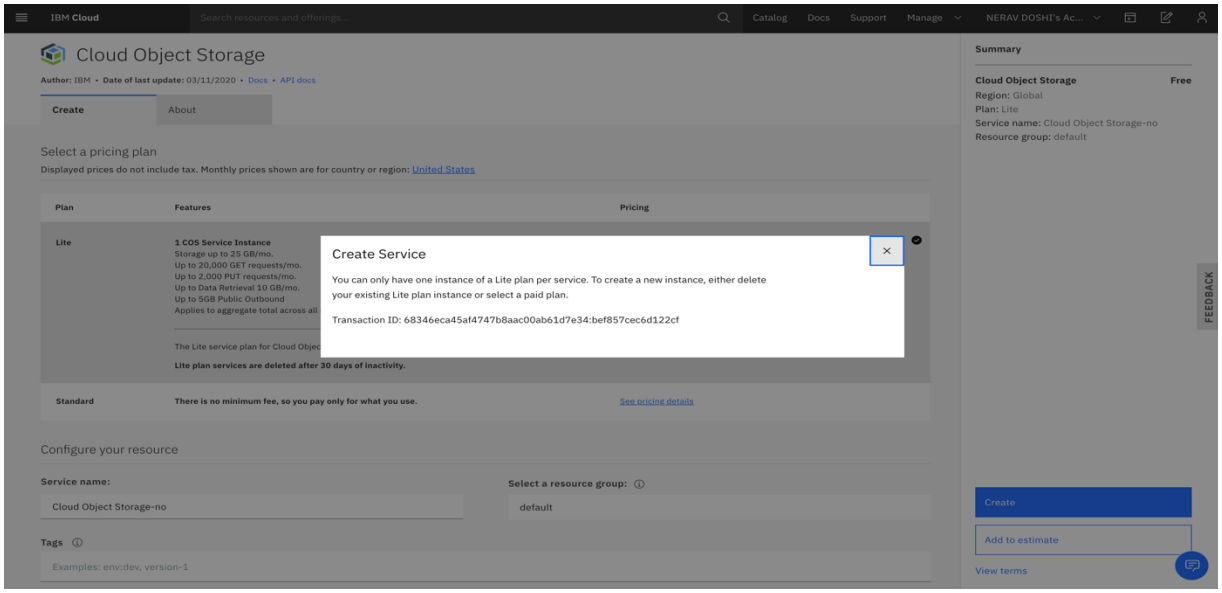
1. Click the "Get Started" button to Launch Watson Studio and start.
2. You will also need to provision Watson Machine Learning:
3. Open Catalog from top of the page.
4. Under Search type “Watson Machine Learning” and select the Lite plan



5. Open Catalog from top of the page.Under Search type “Cloud Object Storage” and select the Lite plan



6. The lite plan gives you only 1 service. If you get this message that means you already have a service and can use that. If you get the following message, then you already have 1 service in your account

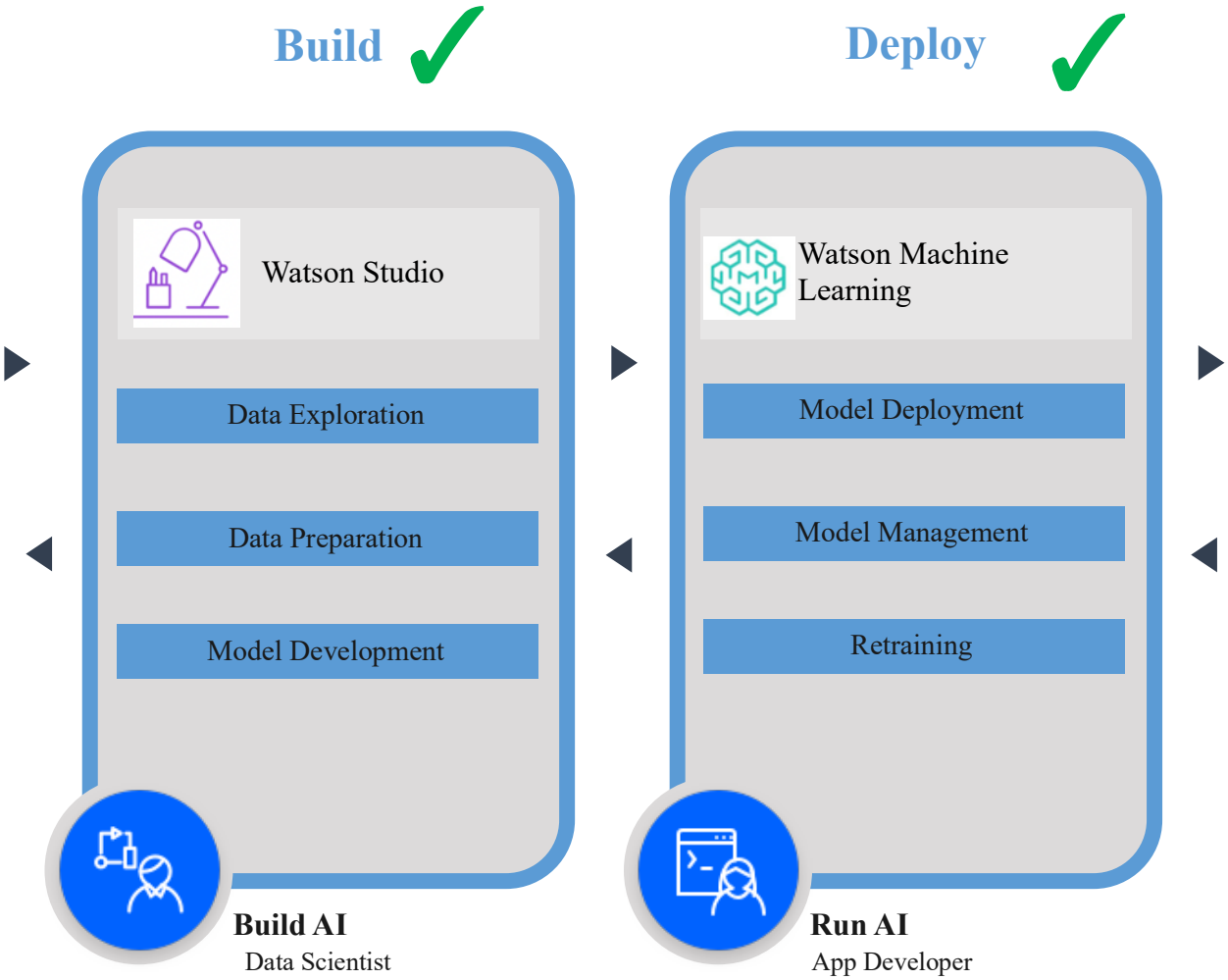


Introduction

Watson Studio is a comprehensive data science workbench. It is used to prepare and builds models with your choice of tool and run times. You can build models using open source codes or visual modeling.

Watson Machine Learning is a platform for deploying models. It supports deployment of AutoAI, SPSS, Decision optimization as well as open source models.

WS and WML support the entire machine learning lifecycle, which we will demonstrate in this lab.



Lab 1: Explore a working example

In this section we will review a predictive and optimization model from WS cloud gallery.

Use Case

Goal: Identify marketing campaign for a fictious Banks.

Approach:

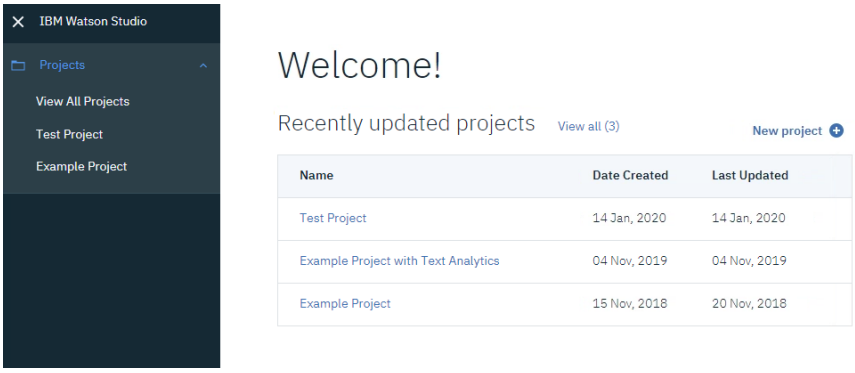
- Predictive models return the likelihood that a customer reacts to a given campaign on a given channel
- Prescriptive models return the set of assignment customer-campaign-channel that optimize the total benefit and take into account a large number of constraints
- In this section, we review a notebook that contains a decision optimization model that is written in Python.
- Review results

Benefit:Make targeted offers to the customers which has more likelihood of acceptance while balancing total budget.

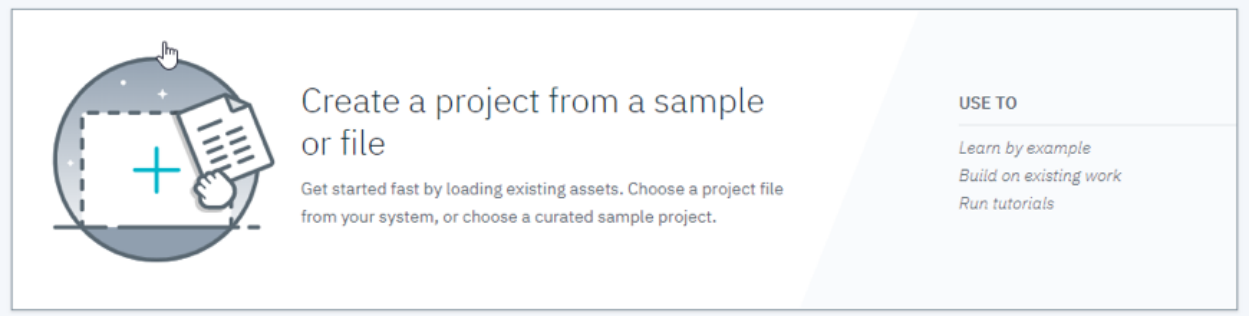
Create a Project and Load the Data

1. Open **WSD**.

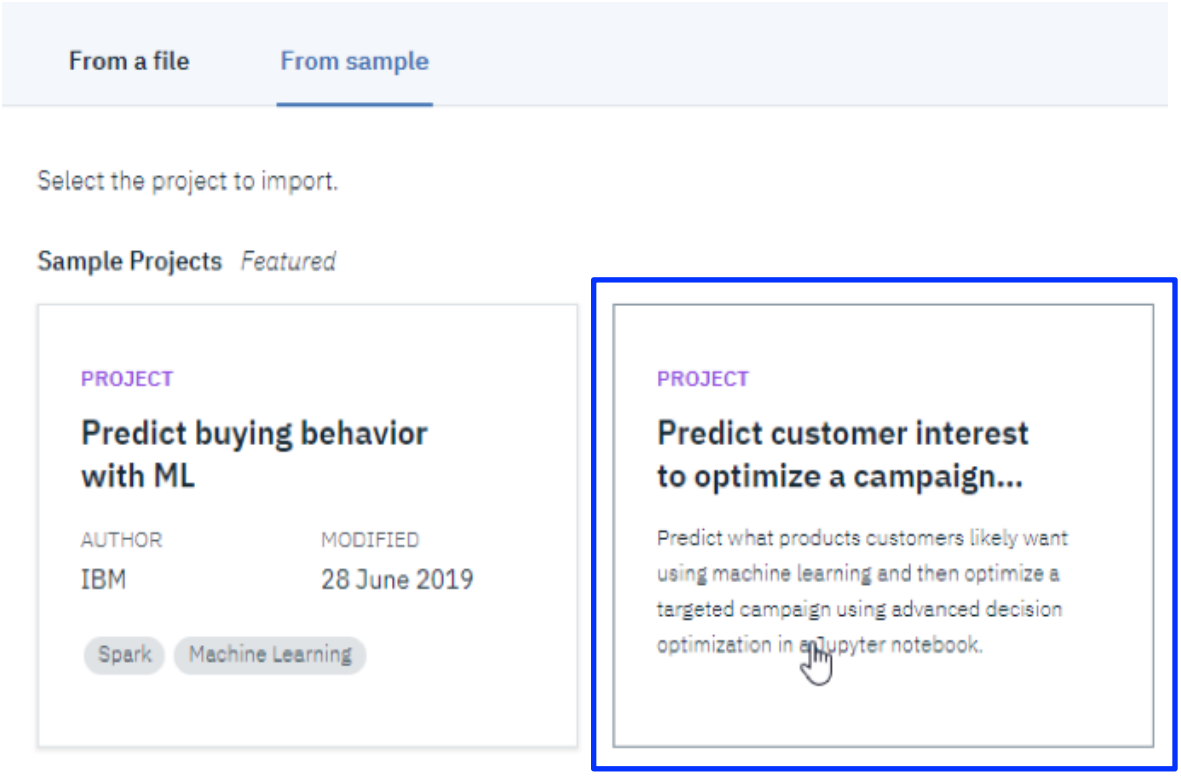
2. From the **Projects** home page, click **New Project.**



3. Click **Create a project**. from example



4. Choose the Predict customer interest to optimize a campaign with ML + DO.

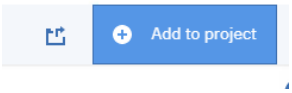


5. Under Assets you should see 2 csv and 1 notebook
6. Go through it optionally running cells (Note: a large dataset requires DO runtime environment).

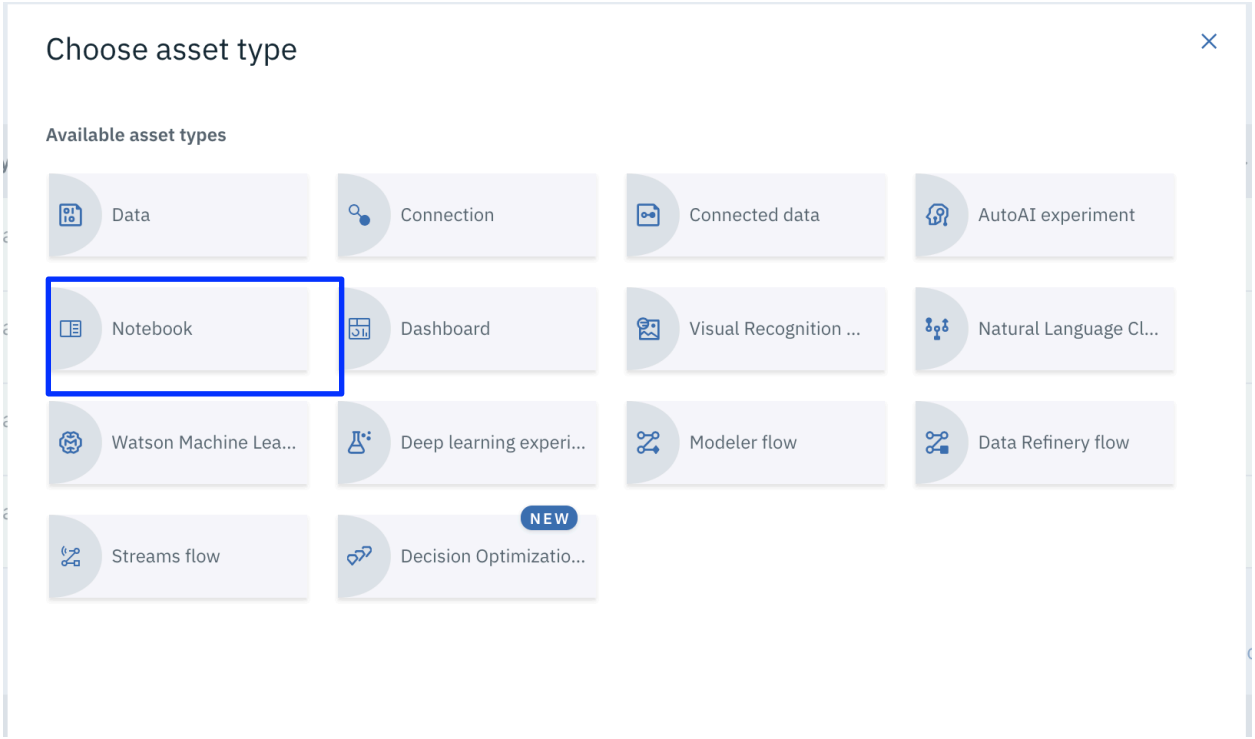
Lab 2: Train a predictive model using scikit learn

Next, we need to upload predictive model. The assets can be found within the HandOnLab notebook subfolder of your git repo folder.
https://github.com/nmdoshi/HandsOnLabDOWS/blob/master/notebook/Lab2%20-%20Predictive.ipynb

1. From the Project Asset page, choose Add to Project.



2. Select **Notebook**.

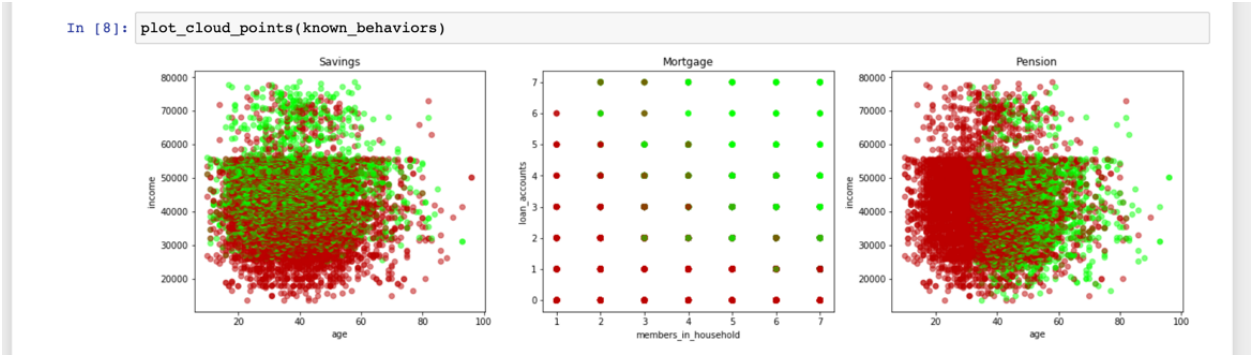


3. Select the From URL option and give your notebook a name.

Scroll down and copy and paste the following into the **Notebook URL** field:
https://github.com/nmdoshi/HandsOnLabDOWS/blob/master/notebook/Lab2%20-%20Predictive.ipynb

4. Click **Create Notebook**.
5. Execute the cells and follow instructions
6. After cell 8 run the following code in the empty cell
   plot_cloud_points(known_behaviors)

   you should see the results a plot based on known behaviors data set



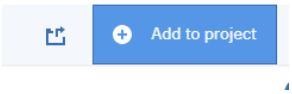
7. After cell 23, run the following code

```
Model for predicting if a customer is going to accept Savings and get the model score
X_train, X_test, y_train, y_test = train_test_split(X, y3, test_size=0.2)
model_pension = clf.fit(X_train, y_train)
y_pred = clf.predict(X_test)
print("model score: %.3f" % clf.score(X_test, y_test))
```

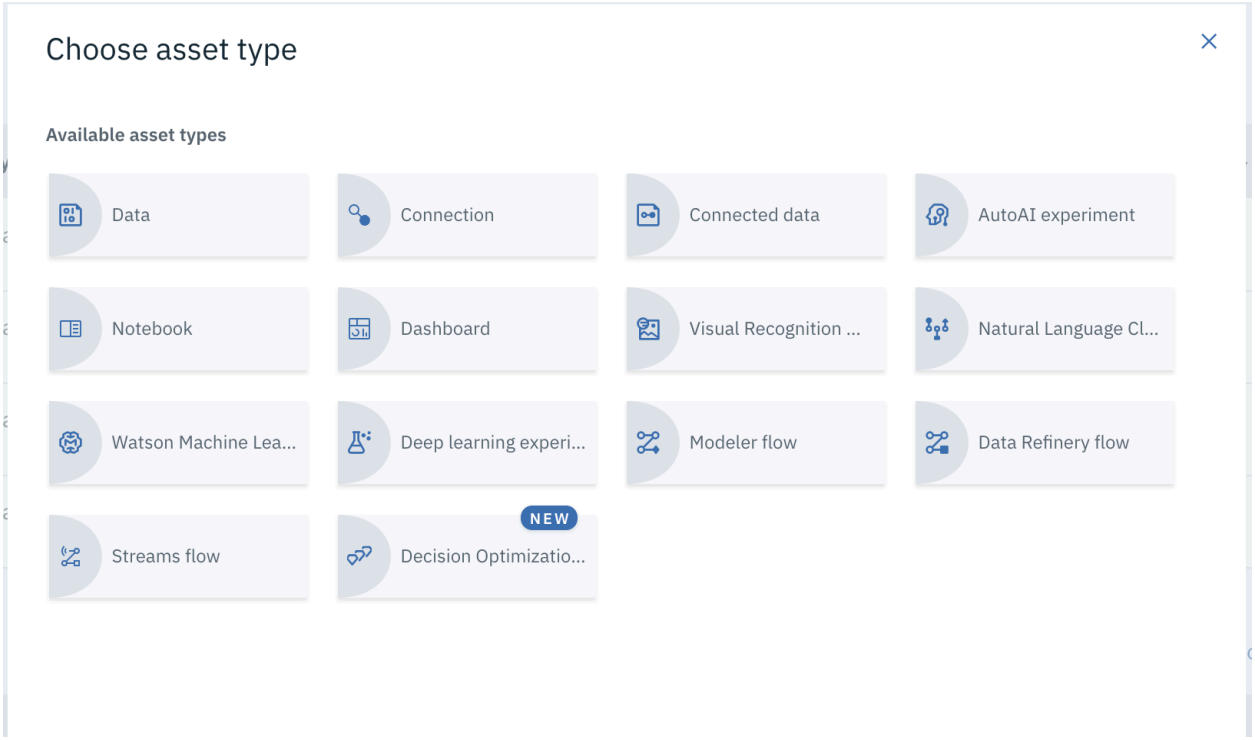
8. Run rest of the cells to make prediction for unknown dataset.

Lab 3: Create an Optimization Model

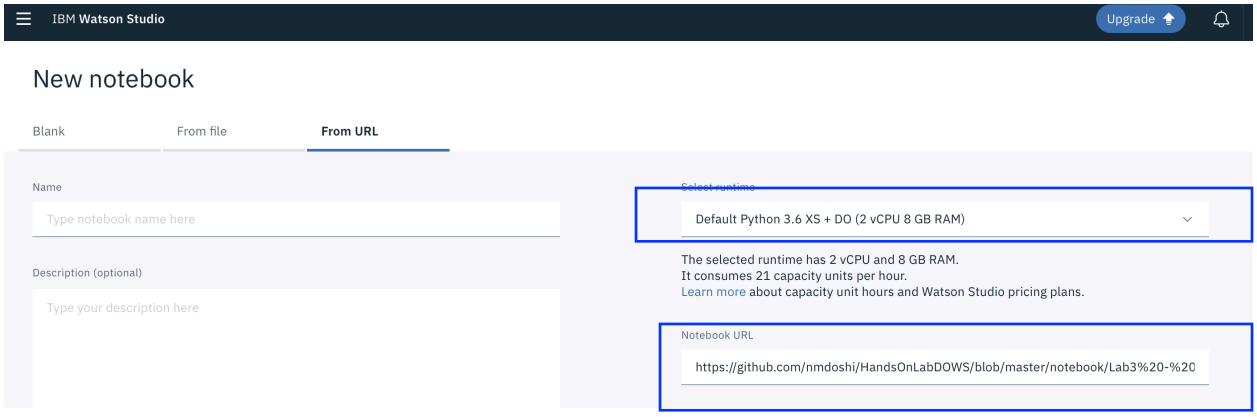
1. From the Project Asset page, choose Add to Project.



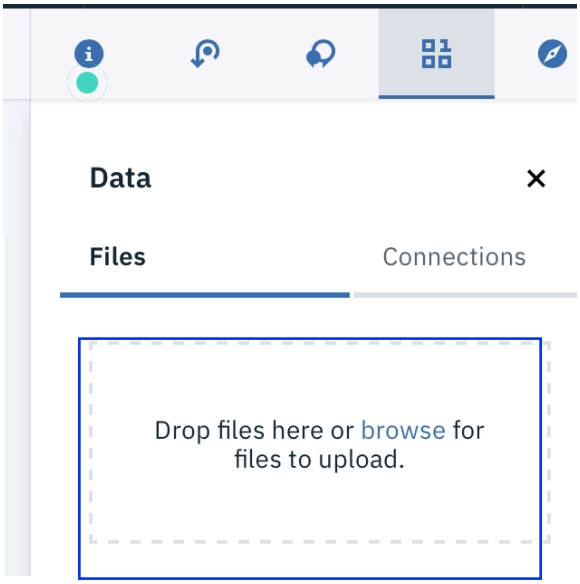
2. Select Notebook



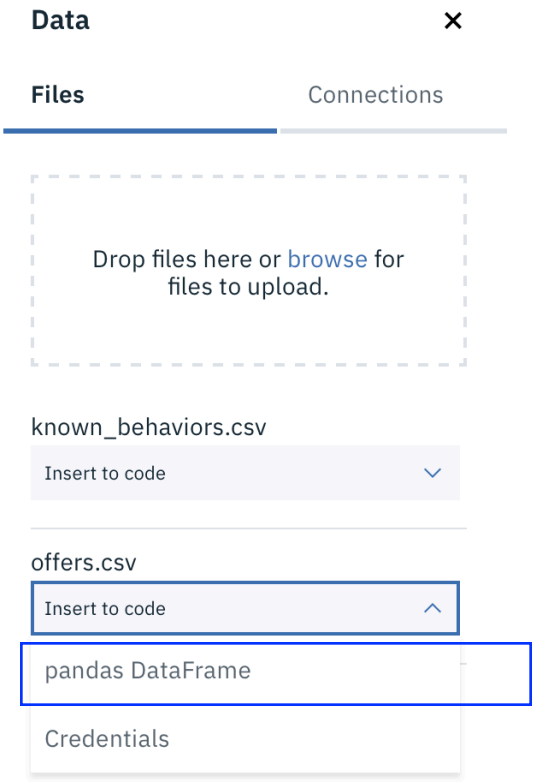
3. Select the runtime as **Default Python 3.6 XS + DO (2 vCPU 8 GB RAM)** and provide the URL
https://github.com/nmdoshi/HandsOnLabDOWS/blob/master/notebook/Lab3%20-%20Optimization.ipynb



4. Click Create Notebook.
5. Click on  icon on right-hand top corner and browse to get **Offers.csv** file from the zip folder that you saved



6. You should see 3 files on then click inside cell1
7. Next from data pane click on drop down menu from offers and click on insert pandas DataFrame



8. This will automatically add data frame along with cloud object storage API code into cell1. You should now have something like this.

Prepare the data

In [1]:
```
import 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.
client_b1267f57e7aa4cd1b558205e90b442cf = ibm_boto3.client(service_name='s3',
    ibm_api_key_id='[redacted]',
    ibm_auth_endpoint="[redacted]",
    config=Config(signature_version='oauth'),
    endpoint_url='[redacted]')

body = client_b1267f57e7aa4cd1b558205e90b442cf.get_object(Bucket='marketcampaign-donotdelete-pr-jv0t7co85w5hif',Key='o
ffers.csv')['Body']
# add missing __iter__ method, so pandas accepts body as file-like object
if not hasattr(body, "__iter__"): body.__iter__ = types.MethodType( __iter__, body )

df_data_1 = pd.read_csv(body)
df_data_1.head()
```

Out[1]:

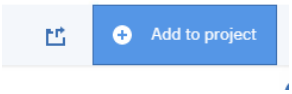
	age	income	members_in_household	loan_accounts	Savings	Mortgage	Pension	id	nb_products
0	38	47958.0	4	1	0	0	0	44256	0
1	30	48606.0	2	4	0	0	0	46883	0
2	41	42152.0	4	0	0	0	0	32387	0
3	42	39788.0	3	3	0	0	0	25504	0
4	42	44365.0	6	2	0	1	0	35979	1

9. Run the remaining cells and you should get an optimization model with KPI and results.

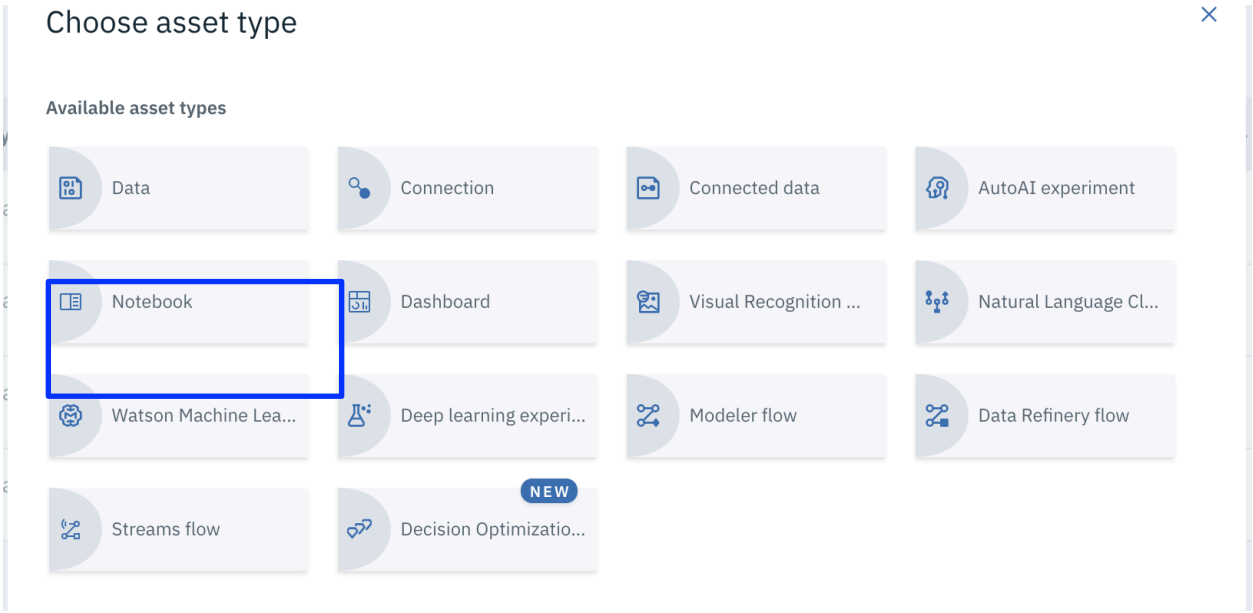
Lab 4: Deploy predictive model in WML

Next, we need to upload predictive model. The assets can be found within the HandOnLab notebook subfolder of your git repo folder.

1. From the **Project Asset** page, choose **Add to Project**.



2. Select **Notebook**.



3. Select the From URL option and give your notebook a name.

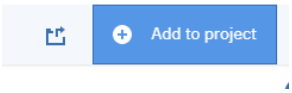
Scroll down and copy and paste the following into the **Notebook URL** field: https://github.com/nmdoshi/HandsOnLabDOWS/blob/master/notebook/Lab4%20-%20Deploy%20predictive%20model%20in%20WML.ipynb

4. Click **Create Notebook**.
5. Run all the cells till you reach **Step1- Store Model in Watson Machine Learning repository**
6. Insert your Watson Machine Learning credentials. The credentials can be found on IBM cloud website. Open another tab and follow this instruction
    a. Log in to IBM Cloud. (This takes you to your IBM Cloud dashboard.)
    b. In your IBM Cloud dashboard, click the Watson Machine Learning service instance for which you want to retrieve credentials. (This opens the service details page for the Watson Machine Learning service instance.)
    c. Click **Service credentials**.
    d. If there are no service credentials yet, click the **New credential** button.
    e. Under the **ACTION** menu, click "View credentials".
7. Run all the cells and get scoring URL

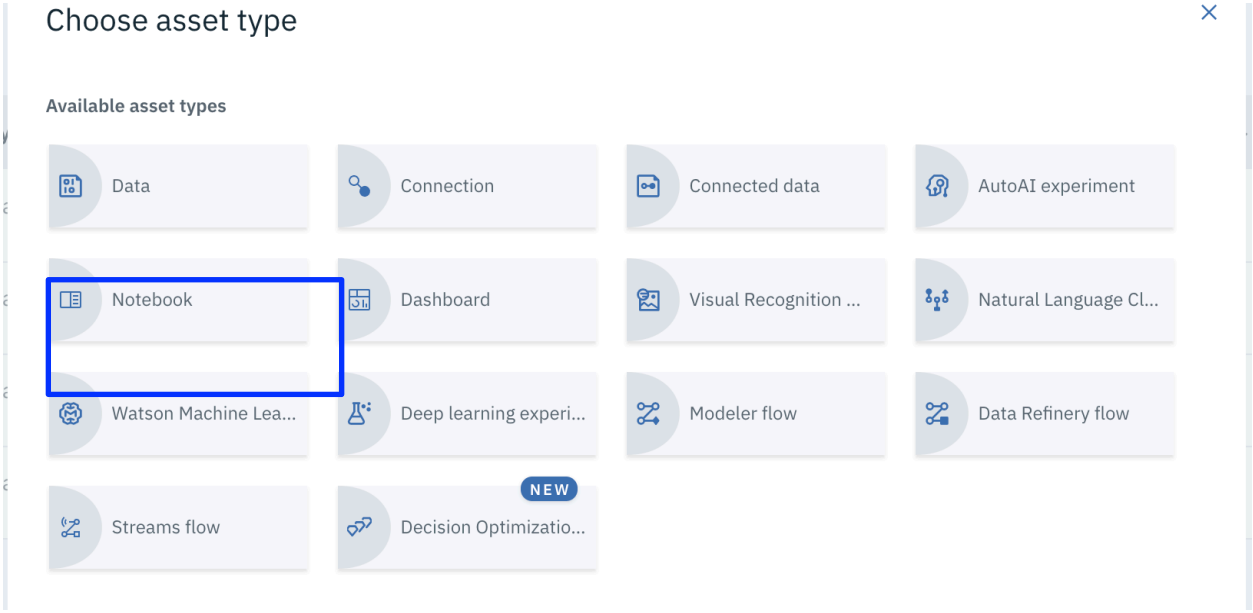
Lab 5: Deploy optimization model in WML

Next, we need to upload predictive model. The assets can be found within the HandOnLab notebook subfolder of your git repo folder.

1. From the **Project Asset** page, choose **Add to Project**.



2. Select **Notebook**.



3. Select the From URL option and give your notebook a name.

Scroll down and copy and paste the following into the **Notebook URL** field: https://github.com/nmdoshi/HandsOnLabDOWS/blob/master/notebook/Lab5%20-%20Deploy%20DO%20Model%20in%20WML.ipynb

4. Click **Create Notebook**.
5. Insert your Watson Machine Learning credentials (cell4). The credentials can be found on IBM cloud website. Open another tab and follow this instruction
    a. Log in to IBM Cloud. (This takes you to your IBM Cloud dashboard.)
    b. In your IBM Cloud dashboard, click the Watson Machine Learning service instance for which you want to retrieve credentials. (This opens the service details page for the Watson Machine Learning service instance.)
    c. Click **Service credentials**.
    d. If there are no service credentials yet, click the **New credential** button.
    e. Under the **ACTION** menu, click "View credentials".
6. The next step is to zip the optimization model into tar file and upload it to Watson machine learning and create a solve payload. **This step is already done.**
7. Run all the cells and look at optimization results.
8. The result file should look like

```
In [19]: import pandas as pd

In [20]: # Create a dataframe for the solution
         solution = pd.DataFrame(job_details['entity']['decision_optimization']['output_data'][0]['values'],
                                 columns = job_details['entity']['decision_optimization']['output_data'][0]['fields'])
         solution.head()
```

Out[20]:

	kpi	value
0	nb offers	1123
1	budget Spent	24597
2	gift	112
3	newsletter	112
4	seminar	899

```
In [21]: # Create a dataframe for the solution
         solution_report = pd.DataFrame(job_details['entity']['decision_optimization']['output_data'][1]['values'],
                                 columns = job_details['entity']['decision_optimization']['output_data'][1]['fields'])
         solution_report.head()
```

Out[21]:

	customer_id	channel	product	cost
0	55728	gift	Savings	20
1	94027	gift	Savings	20
2	56258	gift	Savings	20
3	58943	gift	Savings	20
4	49240	gift	Savings	20

```
In [22]: #Delete deployment model
         client.deployments.delete(deployment_uid)
```

Out[22]: 'SUCCESS'

Congratulations you have reached at the end of the tutorial

Summary

- Getting Started: https://dataplatform.cloud.ibm.com/docs/content/wsj/getting-started/get-started-wdp.html?linkInPage=true
- Introduction to Watson Studio: https://developer.ibm.com/articles/introduction-watson-studio/
- Watson Studio Gallery https://dataplatform.cloud.ibm.com/gallery
- Try IBM products for free https://www.ibm.com/demos
- Additional Hands on Lab documentation: https://www.ibm.com/cloud/garage/dte/tutorial/ibm-decision-optimization-ibm-watson-studio-market-campaign
- Watson Studio and Watson Machine Learning documentation: https://dataplatform.cloud.ibm.com/docs/content/wsj/getting-started/welcome-main.html?audience=wdp&context=wdp
- Join discussions on the Decision Optimization LinkedIn community
- Follow our blogs on optimization and Data Science