**Machine Learning Model Deployment with IBM Cloud Watson Studio**

Abstract:

Machine learning model deployment is a critical step in turning data science projects into practical, real-world solutions. IBM Cloud Watson Studio provides a comprehensive platform for deploying machine learning models, offering a seamless integration of data preparation, model development, and deployment. In this document, we present a comprehensive guide to deploying machine learning models using IBM Cloud Watson Studio, encompassing key concepts, best practices, and step-by-step instructions. Whether you are a data scientist looking to deploy your models or an IT professional responsible for managing the deployment process, this guide will equip you with the knowledge and tools necessary for successful model deployment.

*1:* *Introduction to Model Deployment with IBM Cloud Watson Studio*

1.1 Understanding Model Deployment

1.2 Benefits of Using IBM Cloud Watson Studio

1.3 Prerequisites for Model Deployment

*2: Preparing Your Model for Deployment*

2.1 Model Selection and Training

2.2 Model Evaluation and Metrics

2.3 Model Serialization

2.4 Version Control for Models

2.5 Packaging Dependencies

*3: Setting Up IBM Cloud Watson Studio*

3.1 Creating an IBM Cloud Account

3.2 Provisioning Watson Studio

3.3 Creating a Project

3.4 Adding Collaborators and Access Control

*4: Deploying a Model in Watson Studio*

4.1 Model Deployment Options

4.2 Deploying a Model as an API Endpoint

4.3 Monitoring and Managing Deployed Models

4.4 Scaling and Load Balancing

*5: Integration with Data Sources and Applications*

5.1 Connecting Data Sources

5.2 Real-time Inference

5.3 Batch Inference

5.4 Deploying Models in Applications

*6: Model Versioning and Rollbacks*

6.1 Managing Model Versions

6.2 Rollback Strategies

6.3 Testing and Validation

*7: Security and Compliance*

7.1 Data Privacy and Compliance Considerations

7.2 Securing Model Endpoints

7.3 Access Control and Authentication

*8: Monitoring and Maintenance*

8.1 Model Performance Monitoring

8.2 Error Handling and Logging

8.3 Maintenance Best Practices

8.4 Continuous Improvement

*9: Cost Optimization*

9.1 Cost Management Strategies

9.2 Resource Scaling and Optimization

*10: Conclusion and Future Directions*

10.1 Summary of Key Takeaways

10.2 Future Trends in Model Deployment

10.3 Resources and Further Learning

This comprehensive guide will provide a step-by-step approach to deploying machine learning models using IBM Cloud Watson Studio, ensuring that your models are not only deployed successfully but also managed efficiently and securely in a production environment. Whether you are new to model deployment or looking to enhance your existing deployment practices, this guide will serve as a valuable resource.

***Implementation***

Step-1: Login to IBM Cloud here.

Step -2: Go to catalog and create a Watson Studio service in AI category.

Step-3: Click on Get started to launch Watson Studio Dashboard

Step-4: Create a project in IBM Watson Studio Dashboard and assign a Cloud object Storage service to manage datasets

***Note: Cloud Object Storage is a storage service in IBM Cloud. We use this service to manage our datasets for training the ML Model and store required files. For more info check out the documentation here***

Step-5: Add a jupyter notebook instance in your project to Develop and Deploy Machine Learning Model.

***Note: You can either create a blank notebook or import from existing file or URL.***

Step-6: Build a Machine Learning model using jupyter notebook instance.

***Sample program;***

Import numpy as np

Import matplotlib.pyplot as plt

Import pandas as pd

#Check Missing Values

Dataset.isnull().any()

#Spilt Dependent and Independent Variables

X = dataset.iloc[:, [2, 3]].values

Y = dataset.iloc[:, 4].values

# Splitting the dataset into the Training set and Test set

From sklearn.model\_selection import train\_test\_split

X\_train, X\_test, y\_train, y\_test = train\_test\_split(X, y, test\_size= 0.25, random\_state = 0)

# Fitting Decision Tree Classification to the Training set

From sklearn.tree import DecisionTreeClassifier

Classifier = DecisionTreeClassifier(criterion = ‘entropy’, random\_state = 0)

Classifier.fit(X\_train, y\_train)

# Predicting the Test set results

Y\_pred = classifier.predict(X\_test)

#Finding the accuracy score

From sklearn.metrics import accuracy\_score

Print(“Accuracy Score: “,accuracy\_score(y\_test,y\_pred)\*100,”%”)

Now we can proceed saving and deploying our Machine Learning model in Watson Machine Learning Repository.

So, before writing a code for deploying a model let’s create a Watson Machine Learning Service.

Step 7: Go back to catalog and create Machine Learning service in AI Category

Step 8: Go to service credentials, create a new credential and copy them for further use.

Step -9: Import WatsonMachineLearningAPIClient library. Watson studio uses Watson Machine Learning service credentials to access WML service, so paste the credentials.

From watson\_machine\_learning\_client import

WatsonMachineLearningAPIClient

Wml\_credentials={

“url”: “xxxxxxxxxxxxxxxxxx”,

“apikey”: “xxxxxxxxxxxxxxxxxxxxxxx”,

“username”: “xxxxxxxxxxxxxxxxxxxx”,

“password”: “xxxxxxxxxxxxxxxxxxxxxxx”,

“instance\_id”: “xxxxxxxxxxxxxxxxxxxxxx”

}

Initialize the WML API Client

Client = WatsonMachineLearningAPIClient(wml\_credentials)

Step-10: In this step we have to specify our machine learning model properties and store the model in WML repository.

***Note: Here classifier is our Machine Learning model instance***

#Specify the Properties

Model\_props = {client.repository.ModelMetaNames.AUTHOR\_NAME: “Abhi”,

Client.repository.ModelMetaNames.AUTHOR\_EMAIL: “”,

Client.repository.ModelMetaNames.NAME: “MyModel”}

#Store the Machine Learning Model

Model\_artifact=client.repository.store\_model(classifier, meta\_props=model\_props)

You can find the list of saved models

Client.repository.list()

Step- 11: Now we are ready to deploy our machine learning model as a Web service

#Get model UID

Published\_model\_uid = client.repository.get\_model\_uid(model\_artifact)

#Deploy the model

Created\_deployment = client.deployments.create(published\_model\_uid, name=”MyDeployment”)

Deploy Success ☺

Finally we are done deploying our machine learning model.

Here is the code to get the scoring endpoint of our deployed Machine learning model.

Scoring\_endpoint = client.deployments.get\_scoring\_url(created\_deployment)

Print(scoring\_endpoint)

Here is the sample code to test the scoring endpoint and get predictions

Scoring\_payload = {“fields”: [“Age”,”Salary”],”values”:[[25,50000]]}

Predictions = client.deployments.score(scoring\_endpoint, scoring\_payload)

Print(predictions)