Phase 3 : Project Development Part 1

Project Title:

Machine learning model deployment with IBM cloud Watson Studio.

Problem Statement:

Become a wizard of predictive anlytics with IBM Cloud Watson Studio. Train machine learning models to predict the outcomes in real time. Deploy the models as web services and integrate them into your applications. Unlock the magic of data driven insights and make informed decidions like never before.

House Price Prediction Analysis - Part 1

Project overview

Data Understanding

Data Visualization

Data Preparation

Modeling

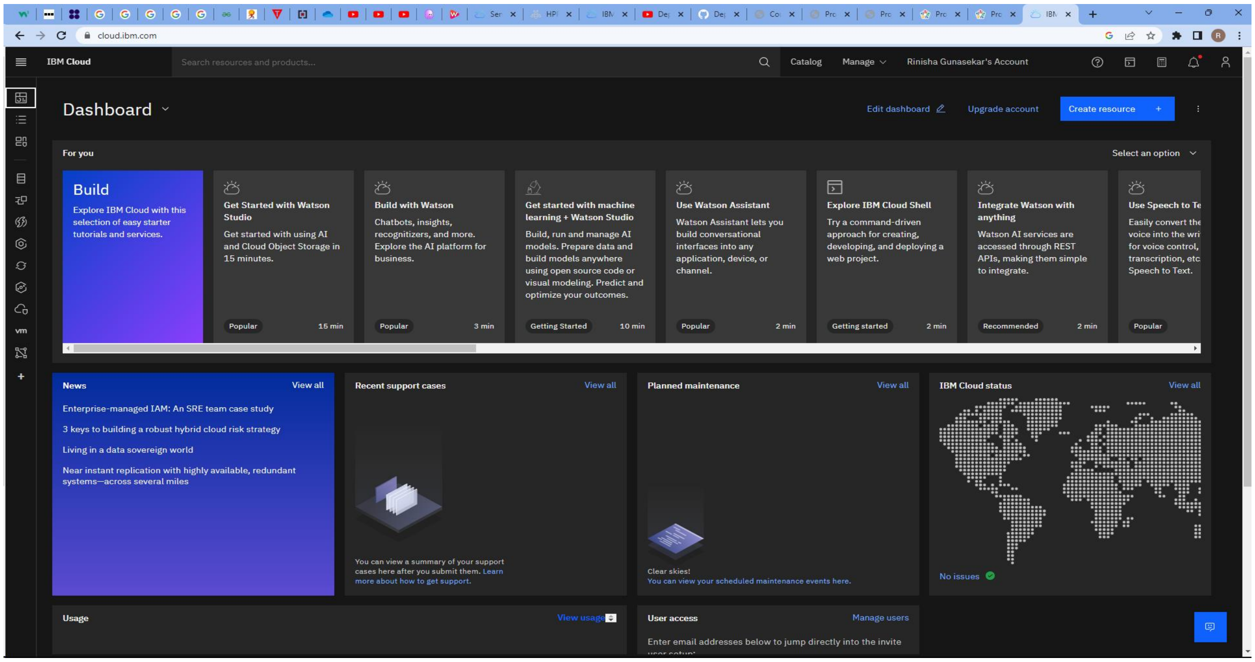
Evaluation

Project Overview:

House Price Prediction Analysis aims to use Machine learning analysis algorithms to predict the price of houses based on their features like number of rooms, number of bedrooms, age of the house, population of the respective area where the house is located, location of the house and the area income with other relevant factors if available.By this Machine Learning model user can predict the price of the house that can be sold.

Step wise process for the House Price Prediction Analysis Machine learning model deployment.

Step 1: Login to IBM cloud



Build
Explore IBM Cloud with this selection of easy starter tutorials and services.

Get Started with Watson Studio
Get started with using AI and Cloud Object Storage in 15 minutes.

Build with Watson
Chatbots, insights, recognitizers, and more. Explore the AI platform for business.

Get started with machine learning + Watson Studio
Build, run and manage AI models. Prepare data and build models anywhere using open source code or visual modeling. Predict and optimize your outcomes.

Use Watson Assistant
Watson Assistant lets you build conversational interfaces into any application, device, or channel.

Explore IBM Cloud Shell
Try a command-driven approach for creating, developing, and deploying a web project.

Integrate Watson with anything
Watson AI services are accessed through REST APIs, making them simple to integrate.

Use Speech to Te
Easily convert the voice into the wri for voice control, transcription, etc Speech to Text.

News
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3 keys to building a robust hybrid cloud risk strategy
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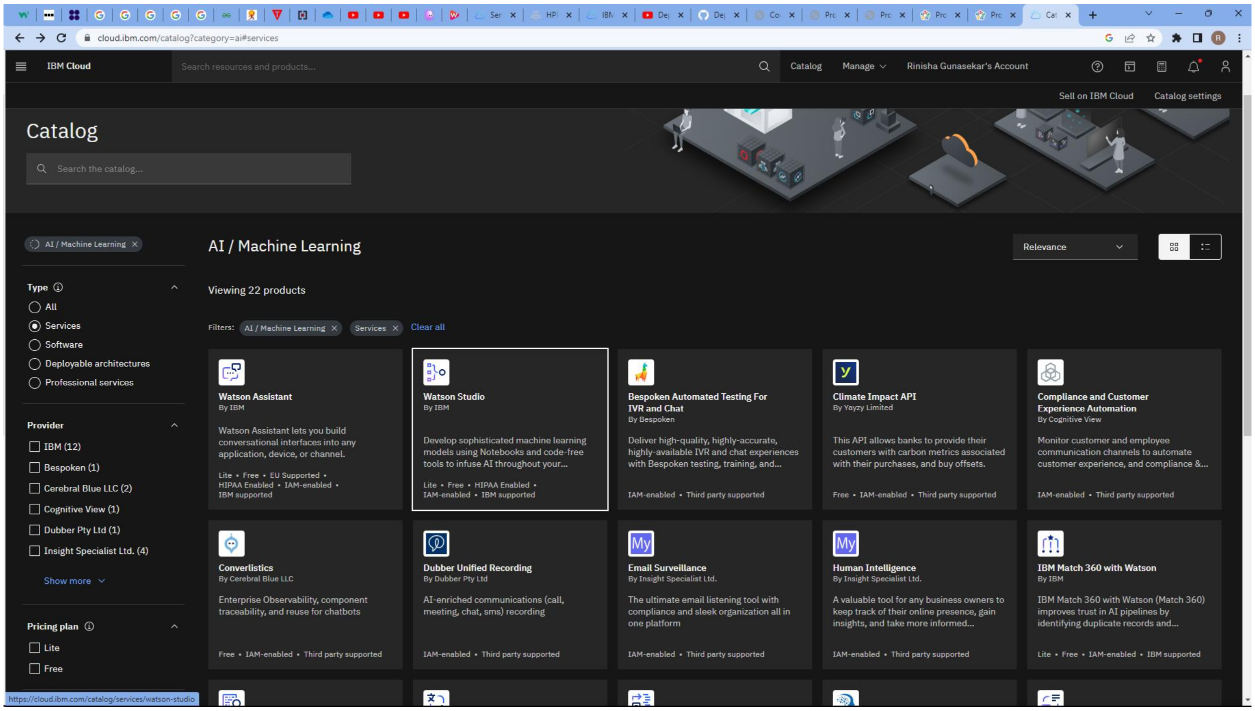
Near instant replication with highly available, redundant systems—across several miles

You can view a summary of your support cases here after you submit them. Learn more about how to get support.

Clear skies!
You can view your scheduled maintenance events here.

Enter email addresses below to jump directly into the invite user setup'

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


cloud.ibm.com/catalog?category=ai#services
IBM Cloud
Search resources and products...
Catalog
Manage
Rinisha Gunasekar's Account
Sell on IBM Cloud
Catalog settings
Catalog
Search the catalog...
AI / Machine Learning
AI / Machine Learning
Relevance
Show more
https://cloud.ibm.com/catalog/services/watson-studio

Viewing 22 products

Filters: AI / Machine Learning ✕ Services ✕ Clear all

Type
○ All
● Services
○ Software
○ Deployable architectures
○ Professional services

Provider
☐ IBM (12)
☐ Bespoken (1)
☐ Cerebral Blue LLC (2)
☐ Cognitive View (1)
☐ Dubber Pty Ltd (1)
☐ Insight Specialist Ltd. (4)

Pricing plan
☐ Lite
☐ Free

Watson Assistant
By IBM
Watson Assistant lets you build conversational interfaces into any application, device, or channel.
Lite • Free • EU Supported • HIPAA Enabled • IAM-enabled • IBM supported

Watson Studio
By IBM
Develop sophisticated machine learning models using Notebooks and code-free tools to infuse AI throughout your...
Lite • Free • HIPAA Enabled • IAM-enabled • IBM supported

Bespoken Automated Testing For IVR and Chat
By Bespoken
Deliver high-quality, highly-accurate, highly-available IVR and chat experiences with Bespoken testing, training, and...
IAM-enabled • Third party supported

Climate Impact API
By Yayzy Limited
This API allows banks to provide their customers with carbon metrics associated with their purchases, and buy offsets.
Free • IAM-enabled • Third party supported

Compliance and Customer Experience Automation
By Cognitive View
Monitor customer and employee communication channels to automate customer experience, and compliance &...
IAM-enabled • Third party supported

Converlistics
By Cerebral Blue LLC
Enterprise Observability, component traceability, and reuse for chatbots
Free • IAM-enabled • Third party supported

Dubber Unified Recording
By Dubber Pty Ltd
AI-enriched communications (call, meeting, chat, sms) recording
IAM-enabled • Third party supported

Email Surveillance
By Insight Specialist Ltd.
The ultimate email listening tool with compliance and sleek organization all in one platform
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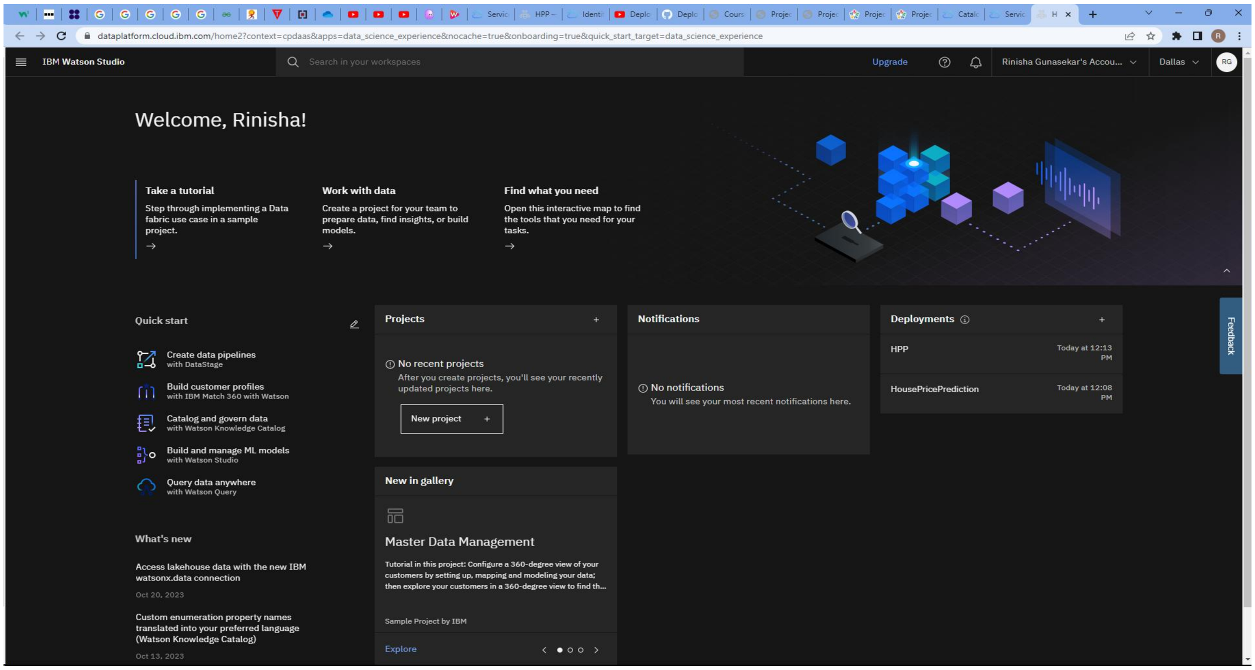
Human Intelligence
By Insight Specialist Ltd.
A valuable tool for any business owners to keep track of their online presence, gain insights, and take more informed...
IAM-enabled • Third party supported

IBM Match 360 with Watson
By IBM
IBM Match 360 with Watson (Match 360) improves trust in AI pipelines by identifying duplicate records and...
Lite • Free • IAM-enabled • IBM supported

Step 3: Get started to launch Watson Studio Dashboard.



dataplatform.cloud.ibm.com/home2?context=cpdaas&apps=data_science_experience&nocache=true&onboarding=true&quick_start_target=data_science_experience

IBM Watson Studio

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Dallas

Welcome, Rinisha!

Take a tutorial
Step through implementing a Data fabric use case in a sample project.

Work with data
Create a project for your team to prepare data, find insights, or build models.

Find what you need
Open this interactive map to find the tools that you need for your tasks.

Quick start

Create data pipelines
with DataStage

Build customer profiles
with IBM Match 360 with Watson

Catalog and govern data
with Watson Knowledge Catalog

Build and manage ML models
with Watson Studio

Query data anywhere
with Watson Query

What's new

Access lakehouse data with the new IBM watsonx.data connection
Oct 20, 2023

Custom enumeration property names translated into your preferred language (Watson Knowledge Catalog)
Oct 13, 2023

Projects

No recent projects
After you create projects, you'll see your recently updated projects here.

New project +

New in gallery

Master Data Management

Tutorial in this project: Configure a 360-degree view of your customers by setting up, mapping and modeling your data; then explore your customers in a 360-degree view to find th...

Sample Project by IBM

Explore

Notifications

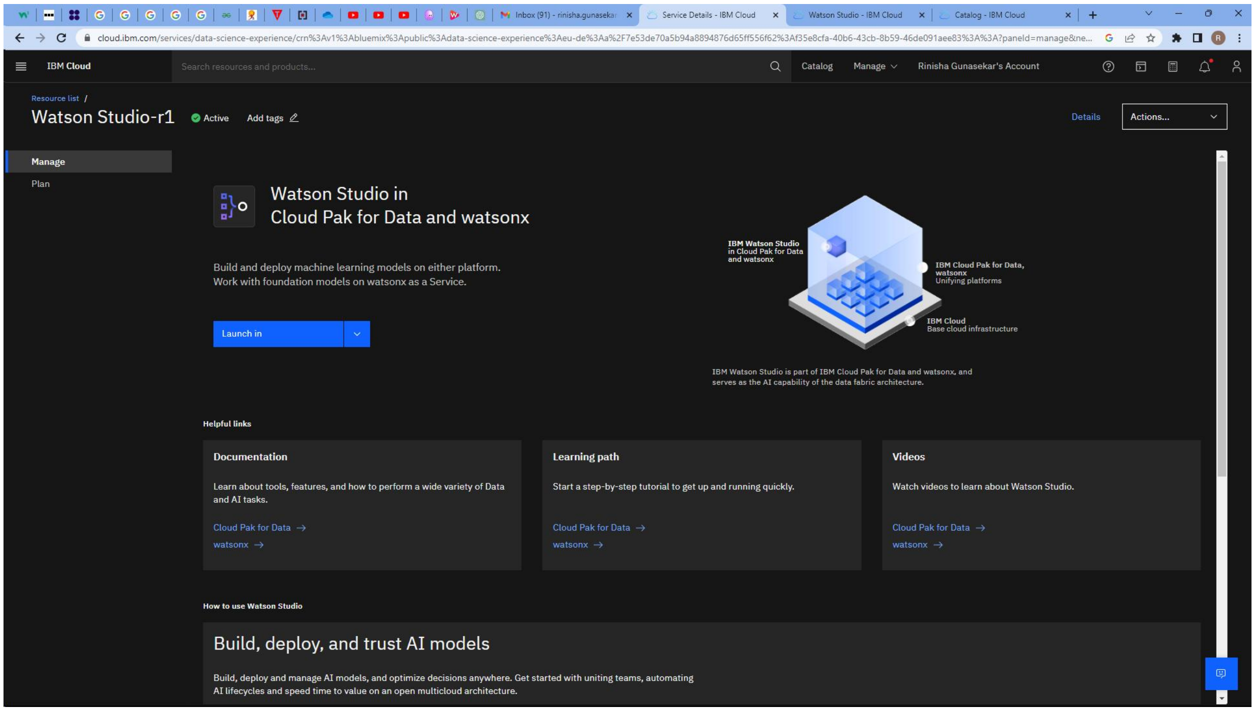
No notifications
You will see your most recent notifications here.

Deployments

HPP	Today at 12:13 PM
HousePricePrediction	Today at 12:08 PM

Feedback

Step 4: Launch in the Watson Studio in Cloud Park for Data and watsonx



cloud.ibm.com/services/data-science-experience/crn%3Av1%3Abluemix%3Apublic%3Adata-science-experience%3Aeu-de%3Aa%2F7e53de70a5b94a8894876d65ff556f62%3Af35e8cfa-40b6-43cb-8b59-46de091aee83%3A%3A?paneld=manage&ne...

IBM Cloud

Search resources and products...

Catalog Manage Rinisha Gunasekar's Account

Resource list /

Watson Studio-r1 Active Add tags

Details Actions...

Manage

Plan

Watson Studio in
Cloud Pak for Data and watsonx

Build and deploy machine learning models on either platform.
Work with foundation models on watsonx as a Service.

Launch in

IBM Watson Studio in Cloud Pak for Data and watsonx

IBM Cloud Pak for Data, watsonx
Unifying platforms

IBM Cloud
Base cloud infrastructure

IBM Watson Studio is part of IBM Cloud Pak for Data and watsonx, and serves as the AI capability of the data fabric architecture.

Helpful links

Documentation
Learn about tools, features, and how to perform a wide variety of Data and AI tasks.
Cloud Pak for Data →
watsonx →

Learning path
Start a step-by-step tutorial to get up and running quickly.
Cloud Pak for Data →
watsonx →

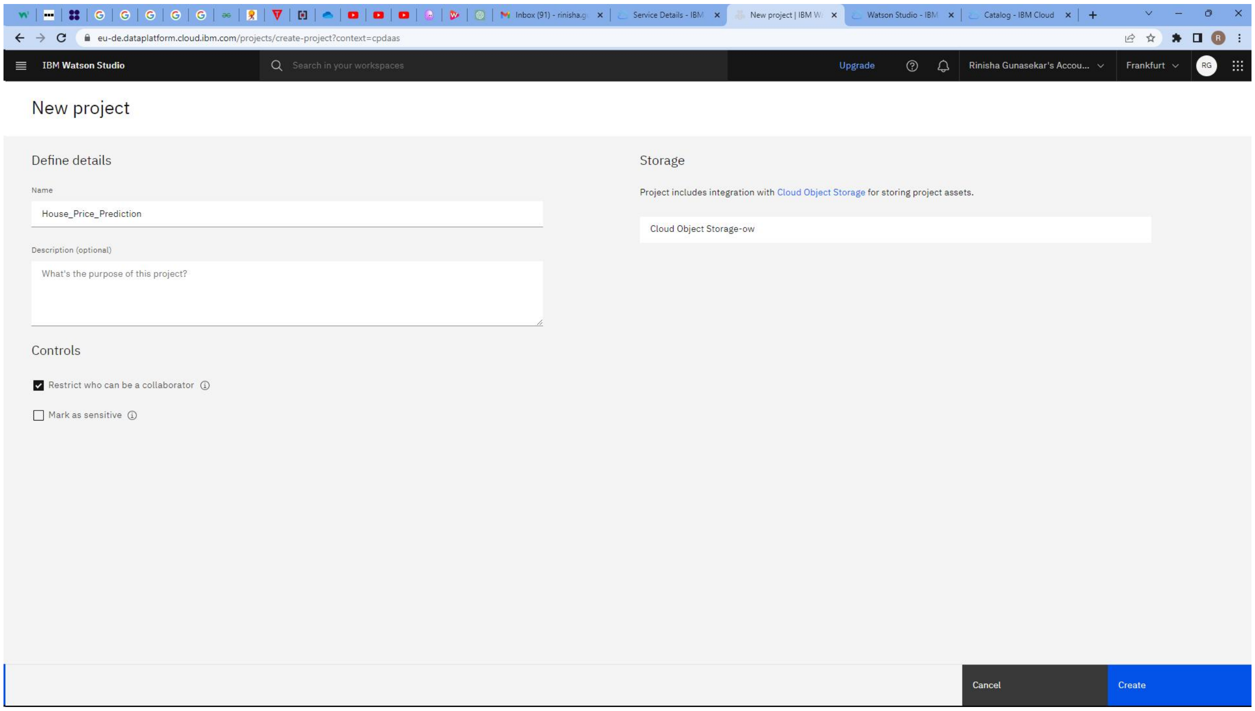
Videos
Watch videos to learn about Watson Studio.
Cloud Pak for Data →
watsonx →

How to use Watson Studio

Build, deploy, and trust AI models

Build, deploy and manage AI models, and optimize decisions anywhere. Get started with uniting teams, automating AI lifecycles and speed time to value on an open multicloud architecture.

Step 5: Start a New project



New project

Define details

Name

House_Price_Prediction

Description (optional)

What's the purpose of this project?

Controls

☑ Restrict who can be a collaborator

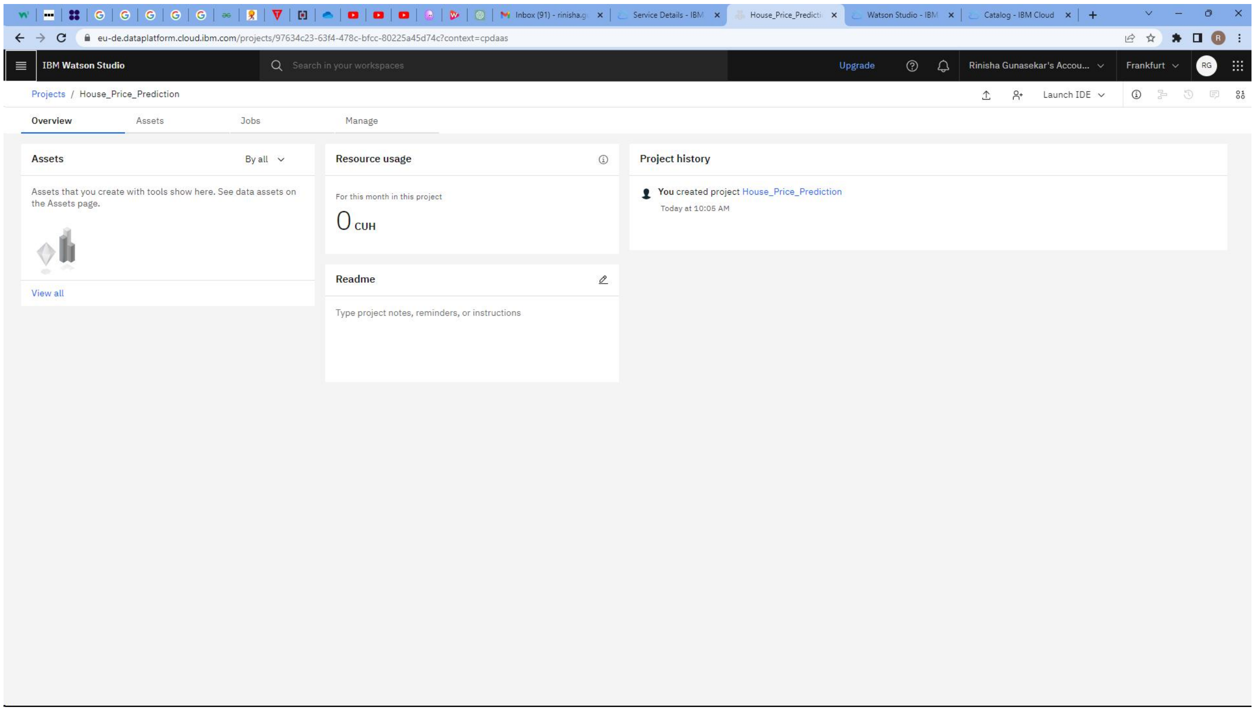
□ Mark as sensitive

Storage

Project includes integration with Cloud Object Storage for storing project assets.

Cloud Object Storage-ow

Step 6: Create a project named *House_Price_Prediction*


Inbox (91) - rinisha.g
Service Details - IBM
House_Price_Predicti
Watson Studio - IBM
Catalog - IBM Cloud
eu-de.dataplatform.cloud.ibm.com/projects/97634c23-63f4-478c-bfcc-80225a45d74c?context=cpdaas
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RG
Projects / House_Price_Prediction
Launch IDE
Overview
Assets
Jobs
Manage

Assets By all

Assets that you create with tools show here. See data assets on the Assets page.

View all

Resource usage

For this month in this project

0 CUH

Readme

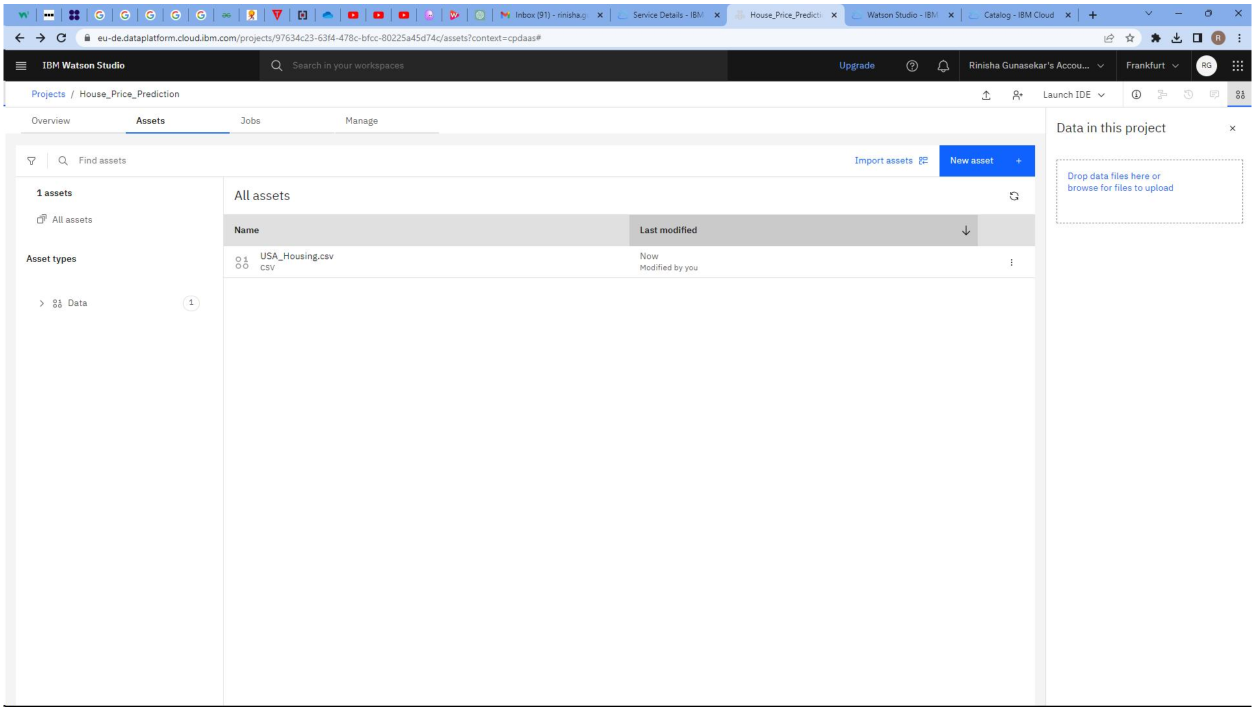
Type project notes, reminders, or instructions

Project history

You created project House_Price_Prediction

Today at 10:05 AM

Step 7: Import all assets



eu-de.dataplatform.cloud.ibm.com/projects/97634c23-63f4-478c-bfcc-80225a45d74c/assets?context=cpdaas#
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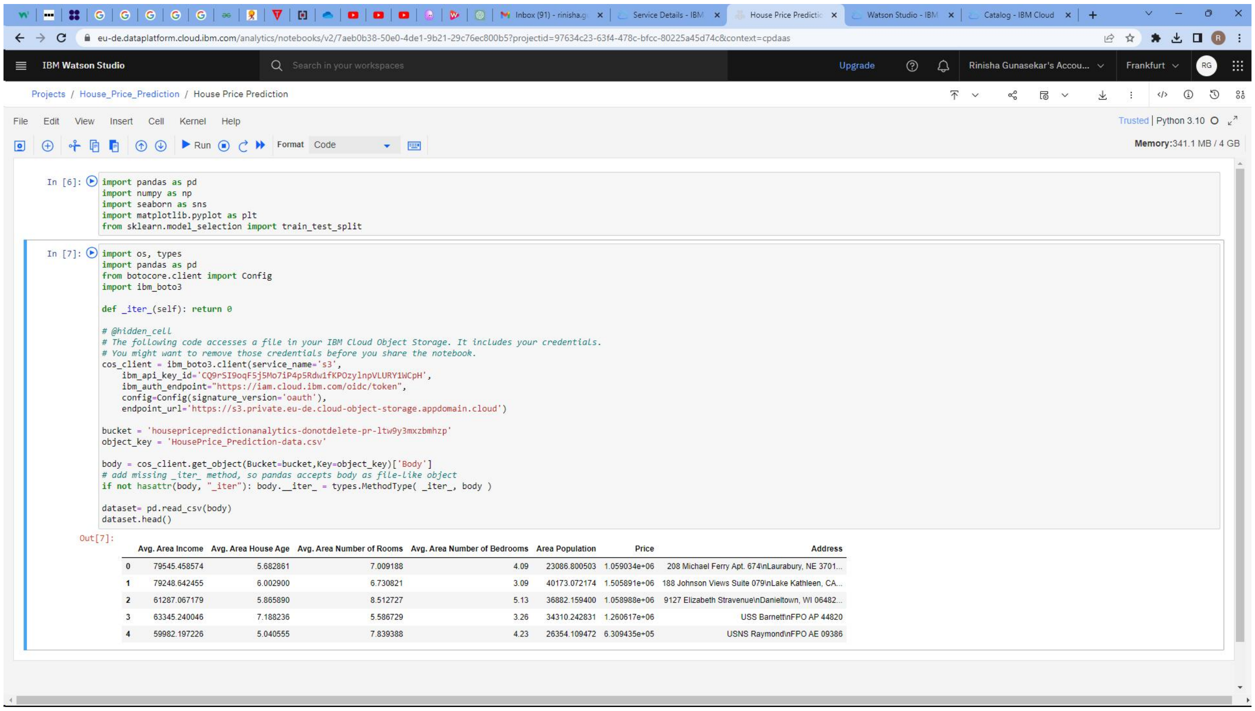
Launch IDE
Overview
Assets
Jobs
Manage
Find assets
Import assets
New asset +
1 assets
All assets
Asset types
Data 1
Data in this project
Drop data files here or browse for files to upload

All assets

Name	Last modified
USA_Housing.csv csv	Now Modified by you

Step 8: Add a jupyter notebook instance in your project to Develop and Deploy Machine Learning Model.

Import necessary library packages.



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Projects / House_Price_Prediction / House Price Prediction
File Edit View Insert Cell Kernel Help
Run
Format Code
Trusted | Python 3.10
Memory:341.1 MB / 4 GB

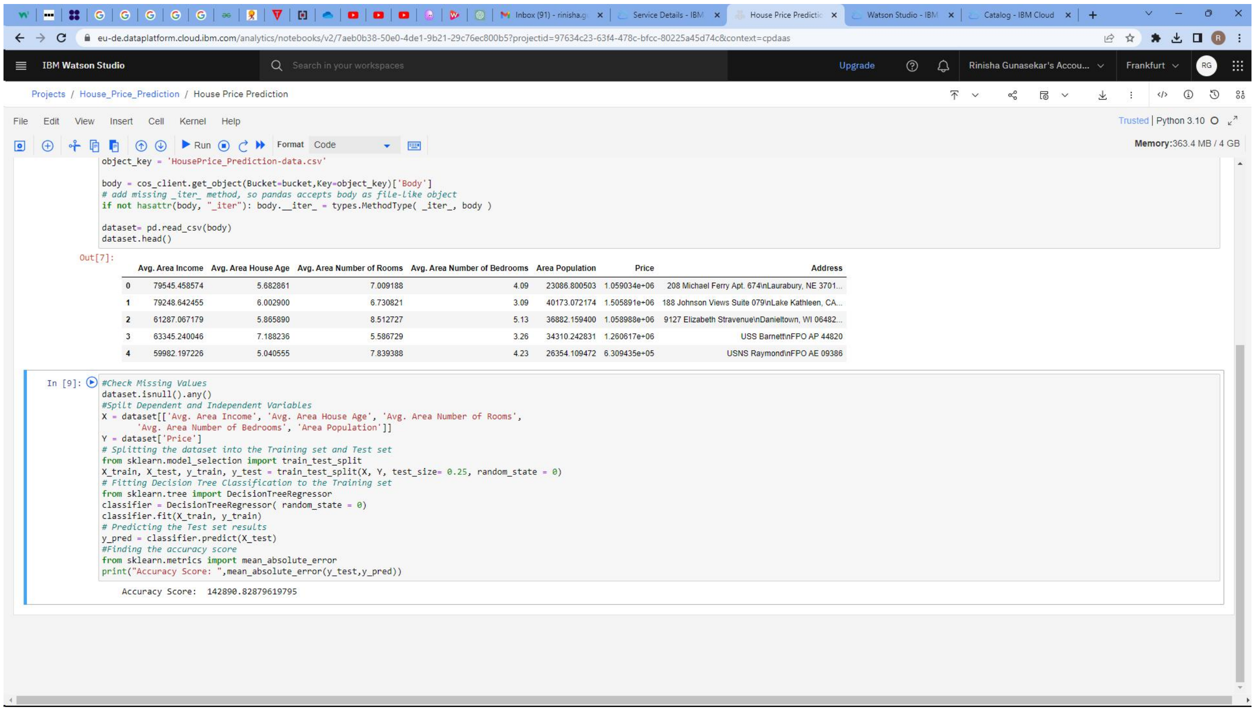
```
In [6]: import pandas as pd
        import numpy as np
        import seaborn as sns
        import matplotlib.pyplot as plt
        from sklearn.model_selection import train_test_split
```

```
In [7]: 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='CQ9rSI9oqF5j5Mo7iP4p5Rdw1fKPOzylnpVLURY1WCpH',
            ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
            config=Config(signature_version='oauth'),
            endpoint_url='https://s3.private.eu-de.cloud-object-storage.appdomain.cloud')

        bucket = 'housepricepredictionanalytics-donotdelete-pr-ltw9y3mxzbmhzp'
        object_key = 'HousePrice_Prediction-data.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 )

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

Out[7]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386

Step 9: Import dataset and proceed further with pre-processing steps and build the model.



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Projects / House_Price_Prediction / House Price Prediction
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Format Code
Trusted | Python 3.10
Memory:363.4 MB / 4 GB

```
object_key = 'HousePrice_Prediction-data.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 )

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

Out[7]:

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
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1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386

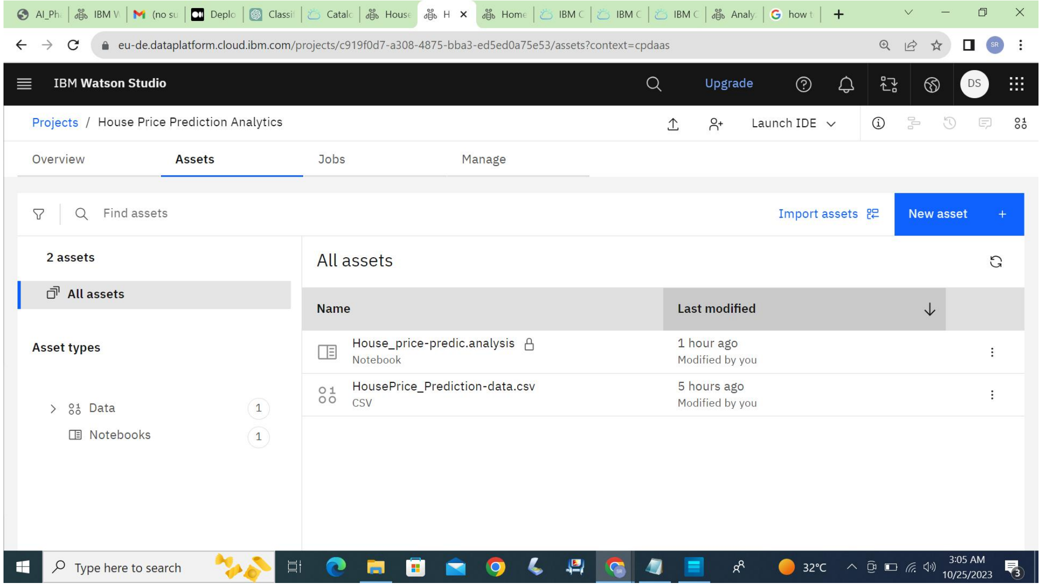
In [9]:

```
#Check Missing Values
dataset.isnull().any()
#Spilt Dependent and Independent Variables
X = dataset[['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population']]
Y = dataset['Price']
# 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 DecisionTreeRegressor
classifier = DecisionTreeRegressor( 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 mean_absolute_error
print("Accuracy Score: ",mean_absolute_error(y_test,y_pred))
```

```
Accuracy Score:  142890.82879619795
```

Hence the model was build, trained and tested

Step 4: Create a project in IBM Watson Studio in IBM Cloud and assign a Cloud object storage to manage datasets.



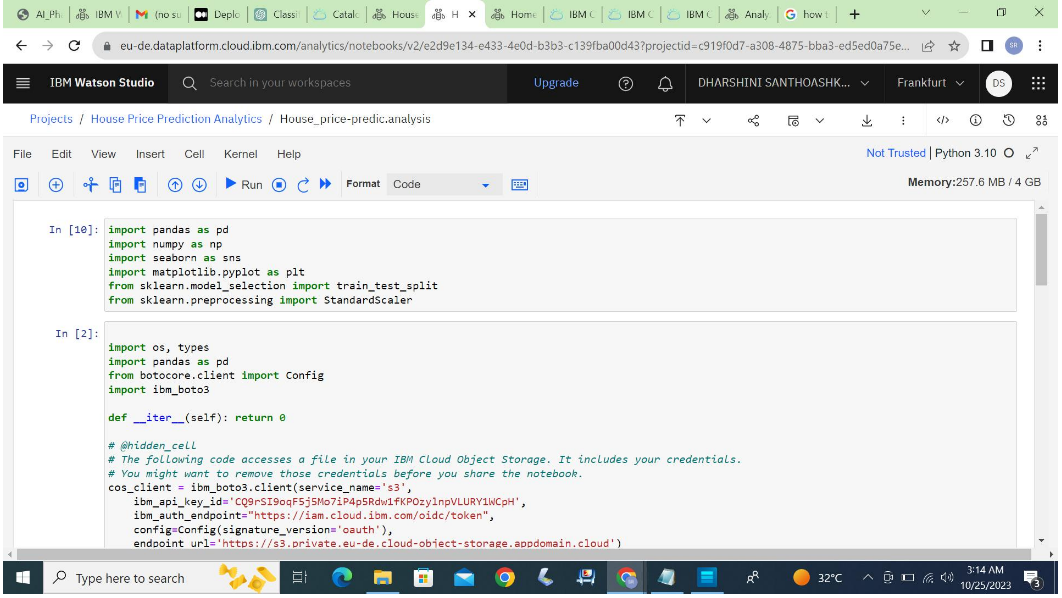
All assets

Name	Last modified
House_price-predic.analysis Notebook	1 hour ago Modified by you
HousePrice_Prediction-data.csv CSV	5 hours ago Modified by you

Cloud Object Storage is a storage service in IM Cloud. We use this service to manage our datasets for training the ML Model and store required files.

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

i. Import necessary library packages.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Frankfurt
Projects / House Price Prediction Analytics / House_price-predic.analysis
File Edit View Insert Cell Kernel Help
Not Trusted | Python 3.10
Run
Format Code
Memory:257.6 MB / 4 GB
Type here to search
32°C
3:14 AM
10/25/2023

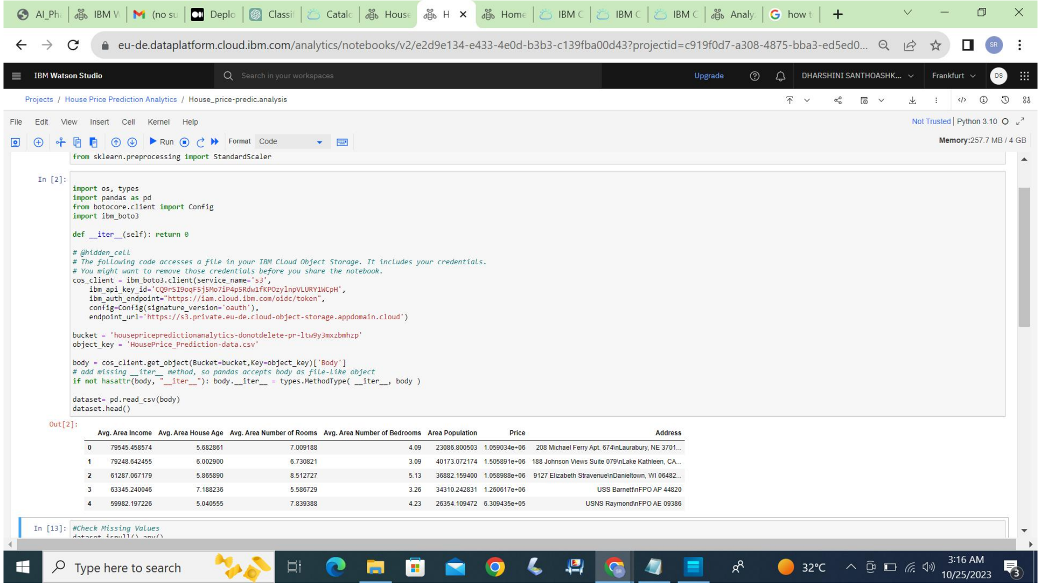
```
In [10]: import pandas as pd
         import numpy as np
         import seaborn as sns
         import matplotlib.pyplot as plt
         from sklearn.model_selection import train_test_split
         from sklearn.preprocessing import StandardScaler

In [2]:
         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='CQ9rSI9oqF5j5Mo7iP4p5Rdw1fKPOzylnpVLURY1WCpH',
             ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
             config=Config(signature_version='oauth'),
             endpoint_url='https://s3.private.eu-de.cloud-object-storage.appdomain.cloud')
```

ii.Import dataset and proceed further with pre-processing steps and build the model.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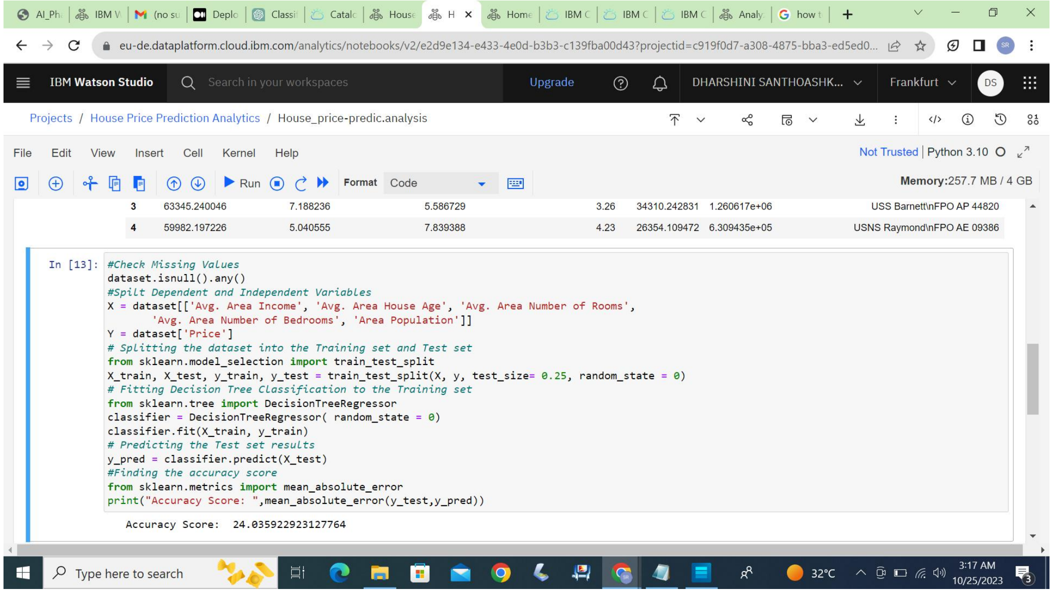
Upgrade
DHARSHINI SANTHOASHK...
Frankfurt
Projects / House Price Prediction Analytics / House_price-predic.analysis
File Edit View Insert Cell Kernel Help
Not Trusted | Python 3.10
Run
Format Code
Memory:257.7 MB / 4 GB
Type here to search
32°C
3:16 AM
10/25/2023

```
         from sklearn.preprocessing import StandardScaler

In [2]:
         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='CQ9rSI9oqF5j5Mo7iP4p5Rdw1fKPOzylnpVLURY1WCpH',
             ibm_auth_endpoint="https://iam.cloud.ibm.com/oidc/token",
             config=Config(signature_version='oauth'),
             endpoint_url='https://s3.private.eu-de.cloud-object-storage.appdomain.cloud')

         bucket = 'housepricepredictionanalytics-donotdelete-pr-ltw9y3mxzbmhzp'
         object_key = 'HousePrice_Prediction-data.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 )

         dataset= pd.read_csv(body)
         dataset.head()

Out[2]:
```

	Avg. Area Income	Avg. Area House Age	Avg. Area Number of Rooms	Avg. Area Number of Bedrooms	Area Population	Price	Address
0	79545.458574	5.682861	7.009188	4.09	23086.800503	1.059034e+06	208 Michael Ferry Apt. 674\nLaurabury, NE 3701...
1	79248.642455	6.002900	6.730821	3.09	40173.072174	1.505891e+06	188 Johnson Views Suite 079\nLake Kathleen, CA...
2	61287.067179	5.865890	8.512727	5.13	36882.159400	1.058988e+06	9127 Elizabeth Stravenue\nDanieltown, WI 06482...
3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386

```
In [13]: #Check Missing Values
         dataset.isnull().any()
```

Step 6: Train the build model and evaluate them.



3	63345.240046	7.188236	5.586729	3.26	34310.242831	1.260617e+06	USS Barnett\nFPO AP 44820
4	59982.197226	5.040555	7.839388	4.23	26354.109472	6.309435e+05	USNS Raymond\nFPO AE 09386

In [13]:

```
#Check Missing Values
dataset.isnull().any()
#Spilt Dependent and Independent Variables
X = dataset[['Avg. Area Income', 'Avg. Area House Age', 'Avg. Area Number of Rooms',
       'Avg. Area Number of Bedrooms', 'Area Population']]
Y = dataset['Price']
# 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 DecisionTreeRegressor
classifier = DecisionTreeRegressor( 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 mean_absolute_error
print("Accuracy Score: ",mean_absolute_error(y_test,y_pred))
```

```
Accuracy Score:  24.035922923127764
```

Model was build trained and tested.