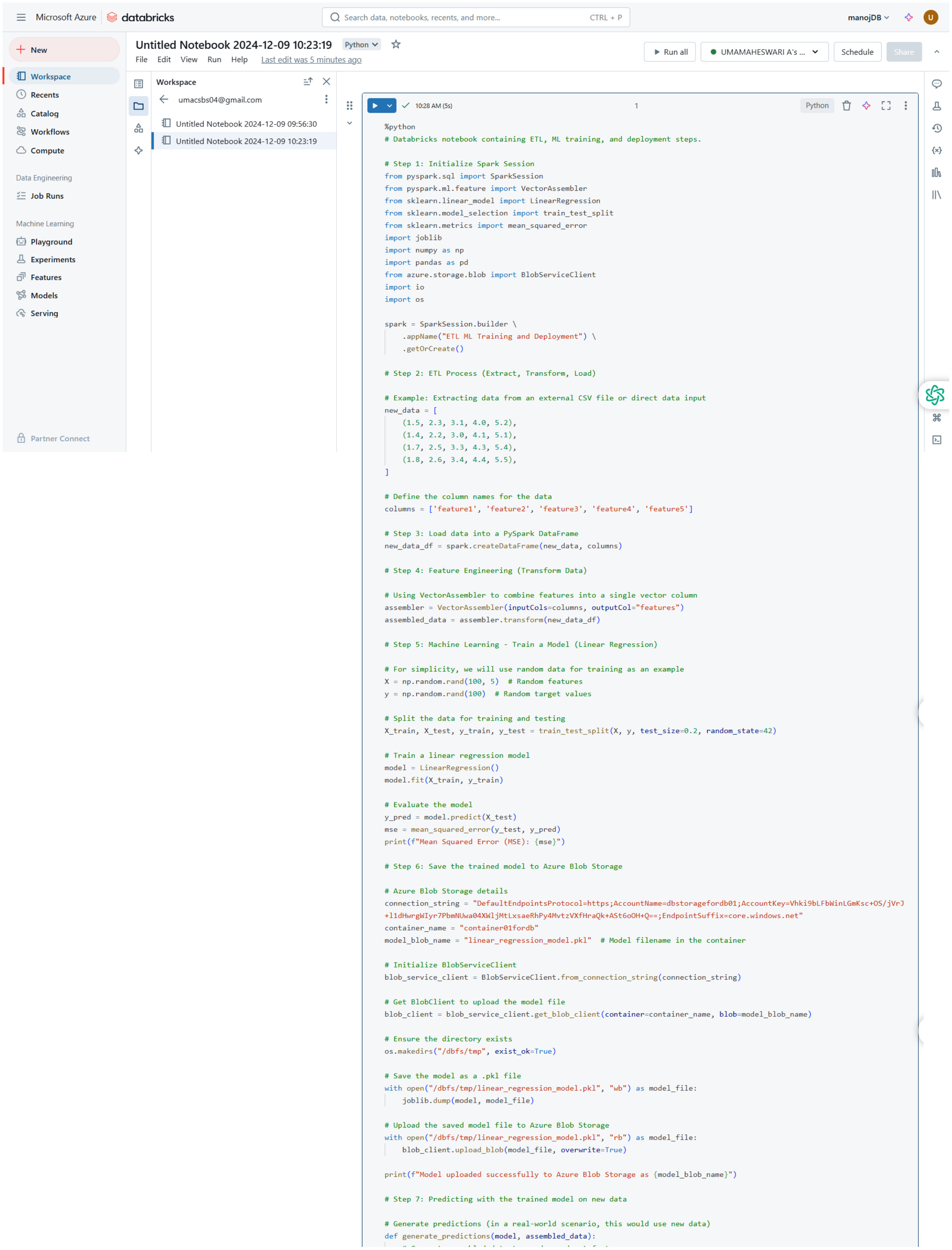
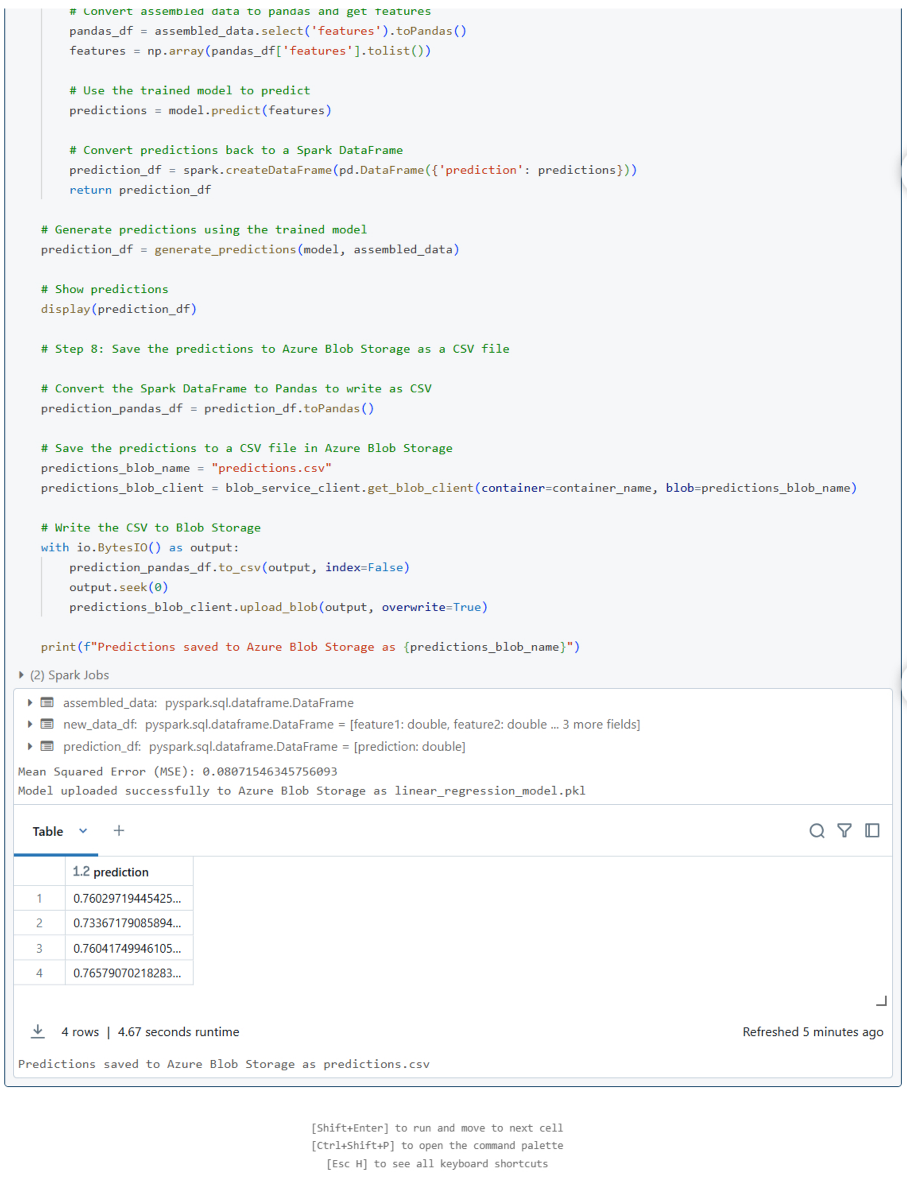


```
%python
# Databricks notebook containing ETL, ML training, and deployment steps.

# Step 1: Initialize Spark Session
from pyspark.sql import SparkSession
from pyspark.ml.feature import VectorAssembler
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import joblib
import numpy as np
import pandas as pd
from azure.storage.blob import BlobServiceClient
import io
import os

spark = SparkSession.builder \
    .appName("ETL ML Training and Deployment") \
    .getOrCreate()

# Step 2: ETL Process (Extract, Transform, Load)

# Example: Extracting data from an external CSV file or direct data input
new_data = [
    (1.5, 2.3, 3.1, 4.0, 5.2),
    (1.4, 2.2, 3.0, 4.1, 5.1),
    (1.7, 2.5, 3.3, 4.3, 5.4),
    (1.8, 2.6, 3.4, 4.4, 5.5),
]

# Define the column names for the data
columns = ['feature1', 'feature2', 'feature3', 'feature4', 'feature5']

# Step 3: Load data into a PySpark DataFrame
new_data_df = spark.createDataFrame(new_data, columns)

# Step 4: Feature Engineering (Transform Data)

# Using VectorAssembler to combine features into a single vector column
assembler = VectorAssembler(inputCols=columns, outputCol="features")
assembled_data = assembler.transform(new_data_df)

# Step 5: Machine Learning - Train a Model (Linear Regression)

# For simplicity, we will use random data for training as an example
X = np.random.rand(100, 5)  # Random features
y = np.random.rand(100)  # Random target values

# Split the data for training and testing
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

# Train a linear regression model
model = LinearRegression()
model.fit(X_train, y_train)

# Evaluate the model
y_pred = model.predict(X_test)
mse = mean_squared_error(y_test, y_pred)
print(f"Mean Squared Error (MSE): {mse}")

# Step 6: Save the trained model to Azure Blob Storage

# Azure Blob Storage details
connection_string = "DefaultEndpointsProtocol=https;AccountName=dbstoragefordb01;AccountKey=Vhki9bLFbWinLGmKsc+OS/jVrJ
+l1dHwrgWIyr7PbmNUwa04XWljMtLxsaeRhPy4MvtzVXfHraQk+ASt6oOH+Q==;EndpointSuffix=core.windows.net"
container_name = "container01fordb"
model_blob_name = "linear_regression_model.pkl"  # Model filename in the container

# Initialize BlobServiceClient
blob_service_client = BlobServiceClient.from_connection_string(connection_string)

# Get BlobClient to upload the model file
blob_client = blob_service_client.get_blob_client(container=container_name, blob=model_blob_name)

# Ensure the directory exists
os.makedirs("/dbfs/tmp", exist_ok=True)

# Save the model as a .pkl file
with open("/dbfs/tmp/linear_regression_model.pkl", "wb") as model_file:
    joblib.dump(model, model_file)

# Upload the saved model file to Azure Blob Storage
with open("/dbfs/tmp/linear_regression_model.pkl", "rb") as model_file:
    blob_client.upload_blob(model_file, overwrite=True)

print(f"Model uploaded successfully to Azure Blob Storage as {model_blob_name}")

# Step 7: Predicting with the trained model on new data

# Generate predictions (in a real-world scenario, this would use new data)
def generate_predictions(model, assembled_data):
```



```
    # Convert assembled data to pandas and get features
    pandas_df = assembled_data.select('features').toPandas()
    features = np.array(pandas_df['features'].tolist())

    # Use the trained model to predict
    predictions = model.predict(features)

    # Convert predictions back to a Spark DataFrame
    prediction_df = spark.createDataFrame(pd.DataFrame({'prediction': predictions}))
    return prediction_df

# Generate predictions using the trained model
prediction_df = generate_predictions(model, assembled_data)

# Show predictions
display(prediction_df)

# Step 8: Save the predictions to Azure Blob Storage as a CSV file

# Convert the Spark DataFrame to Pandas to write as CSV
prediction_pandas_df = prediction_df.toPandas()

# Save the predictions to a CSV file in Azure Blob Storage
predictions_blob_name = "predictions.csv"
predictions_blob_client = blob_service_client.get_blob_client(container=container_name, blob=predictions_blob_name)

# Write the CSV to Blob Storage
with io.BytesIO() as output:
    prediction_pandas_df.to_csv(output, index=False)
    output.seek(0)
    predictions_blob_client.upload_blob(output, overwrite=True)

print(f"Predictions saved to Azure Blob Storage as {predictions_blob_name}")
```

(2) Spark Jobs

```
assembled_data:  pyspark.sql.dataframe.DataFrame
new_data_df:  pyspark.sql.dataframe.DataFrame = [feature1: double, feature2: double ... 3 more fields]
prediction_df:  pyspark.sql.dataframe.DataFrame = [prediction: double]
Mean Squared Error (MSE): 0.08071546345756093
Model uploaded successfully to Azure Blob Storage as linear_regression_model.pkl
```

Table +

	1.2 prediction
1	0.76029719445425...
2	0.73367179085894...
3	0.76041749946105...
4	0.76579070218283...

4 rows | 4.67 seconds runtime Refreshed 5 minutes ago

```
Predictions saved to Azure Blob Storage as predictions.csv
```

```
[Shift+Enter] to run and move to next cell
[Ctrl+Shift+P] to open the command palette
[Esc H] to see all keyboard shortcuts
```