Cloud-Based Smart Inventory Management System

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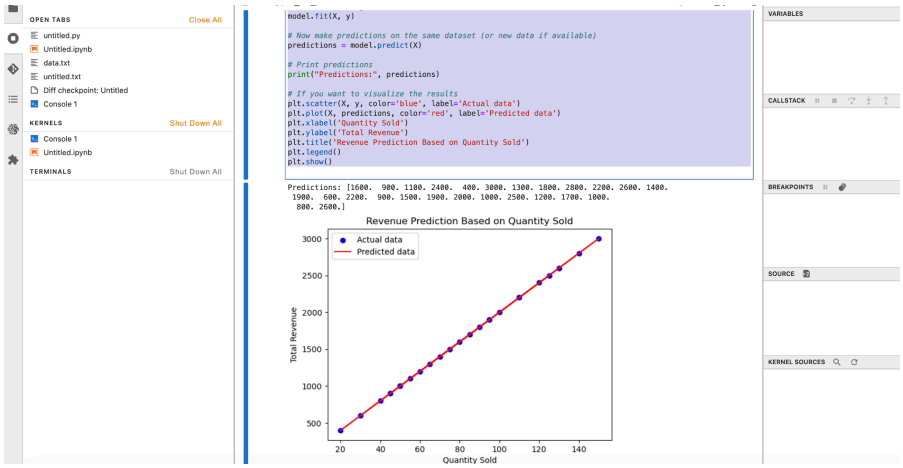
Executive Summary

The Cloud-Based Smart Inventory Management System is designed to provide businesses with a scalable and efficient solution for managing inventory across multiple locations in real-time. Leveraging Amazon Web Services (AWS), this system integrates advanced features like predictive analytics, real-time tracking, and robust security measures. This project explores the practical implementation of cloud computing concepts, showcasing the ability to analyze sales trends and optimize stock management. The deliverables include a fully functional system, technical documentation, and a comprehensive report detailing its architecture, implementation, and outcomes.



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1. Introduction

Cloud computing provides businesses with on-demand access to computing resources, enabling scalability, cost-efficiency, and improved collaboration. AWS, as a leading cloud platform, offers robust tools to create modern applications like the Smart Inventory Management System.

Project Goals

Develop a smart inventory system using AWS services.

Provide real-time inventory tracking and multi-location stock management.

Use machine learning for sales trend analysis.

Scope

The system includes features such as user management, product categorization, inventory logs, and real-time alerts. Limitations include initial setup constraints and basic predictive analytics.

2. System Architecture

The architecture leverages AWS services such as Amazon RDS, S3, Lambda, and ECS to provide a highly scalable and reliable solution.

Components:

Frontend: React.js hosted on Amazon S3 with CloudFront for CDN.

Backend: Golang (Gin) hosted on AWS.

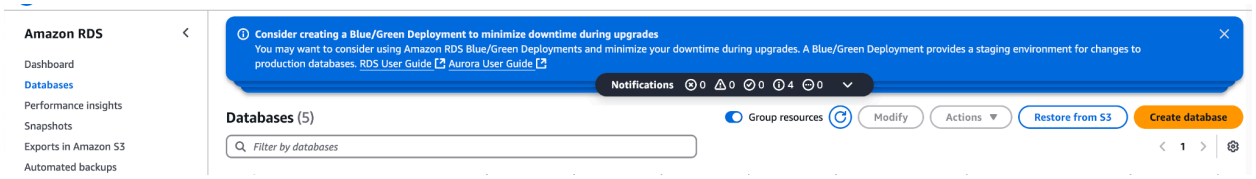
Database: Amazon RDS (PostgreSQL).

Machine Learning: Amazon SageMaker for predictive analytics.

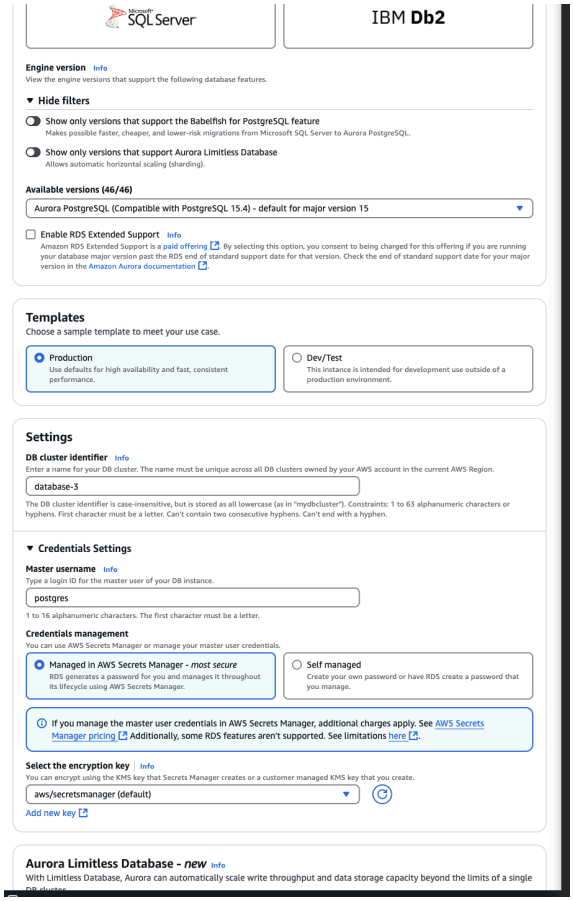
Storage: Amazon S3 for product images and backups.

3. Database

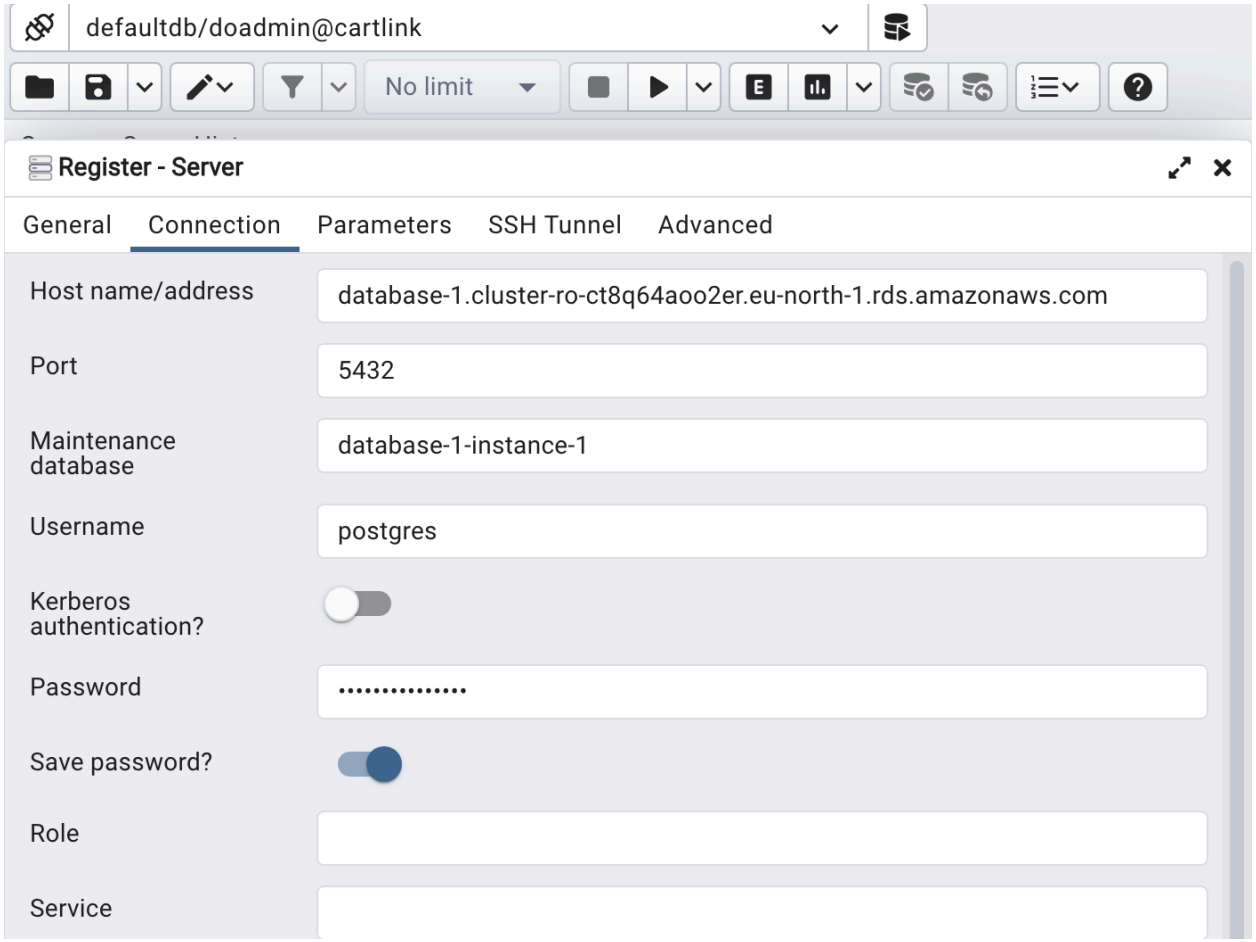
To create Database in AWS we use RDS Service, to create new Database we click “Create”



Here we need to set all necessary data such as passwords, security groups, database type etc.



We can connect to it using PgAdmin program



Here we can create our tables

SQL Scripts for Creating Tables

CREATE TABLE Users (

id SERIAL PRIMARY KEY,

username VARCHAR(255) NOT NULL,

email VARCHAR(255) UNIQUE NOT NULL,

password_hash TEXT NOT NULL,

role VARCHAR(50) DEFAULT 'user',

created_at TIMESTAMP DEFAULT CURRENT_TIMESTAMP,

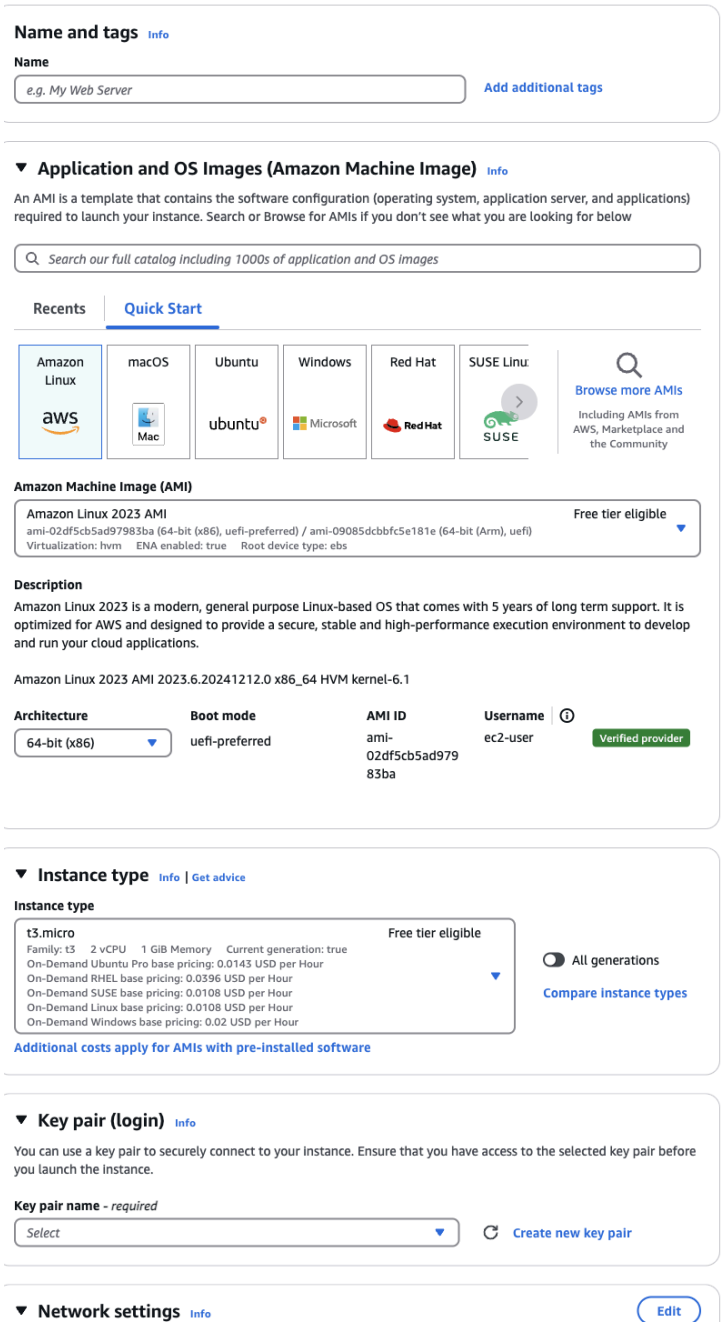
updated_at TIMESTAMP DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP

```
);

CREATE TABLE Products (
    id SERIAL PRIMARY KEY,
    name VARCHAR(255) NOT NULL,
    description TEXT,
    quantity INT DEFAULT 0,
    price DECIMAL(10, 2) NOT NULL,
    location_id INT,
    created_at TIMESTAMP DEFAULT CURRENT_TIMESTAMP,
    updated_at TIMESTAMP DEFAULT CURRENT_TIMESTAMP ON UPDATE
CURRENT_TIMESTAMP
);

CREATE TABLE Orders (
    id SERIAL PRIMARY KEY,
    user_id INT REFERENCES Users(id),
    product_id INT REFERENCES Products(id),
    quantity INT NOT NULL,
    order_date TIMESTAMP DEFAULT CURRENT_TIMESTAMP,
    status VARCHAR(50) DEFAULT 'pending'
);

CREATE TABLE SalesReport (
    id SERIAL PRIMARY KEY,
```

```
    product_id INT NOT NULL,
    sales_date DATE NOT NULL,
    quantity_sold INT NOT NULL,
    total_revenue DECIMAL(10, 2) NOT NULL,
    FOREIGN KEY (product_id) REFERENCES Products(id)
);
```

4. Development Process

Firstly we create EC2 Instance, choosing OS, name, Key Pairs for authentication



Technologies Used

- **Frontend:** React.js
- **Backend:** Python with Flask
- **Database:** PostgreSQL (Amazon RDS)

- **Storage:** Amazon S3
- **Hosting:** AWS Lambda and ECS

Implementation

Example 1: Lambda Function for Creating Users

```
import boto3

import json

import psycopg2


def create_user(event, context):

    body = json.loads(event['body'])

    username = body['username']

    email = body['email']

    password_hash = body['password_hash']


    conn = psycopg2.connect(

        host='YOUR_RDS_HOST',

        database='YOUR_DATABASE',

        user='YOUR_USER',

        password='YOUR_PASSWORD'

    )

    cursor = conn.cursor()

    cursor.execute(

        "INSERT INTO Users (username, email, password_hash) VALUES (%s, %s, %s)",

        (username, email, password_hash)

    )
```

```
    conn.commit()
    cursor.close()
    conn.close()

    return {
        'statusCode': 201,
        'body': json.dumps({'message': 'User created successfully'})
    }
```

Frontend

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Product List</title>
  <script>
    document.addEventListener("DOMContentLoaded", function () {
      fetch('/api/products')
        .then(response => response.json())
        .then(data => {
          const productList = document.getElementById('product-list');
          data.forEach(product => {
            const listItem = document.createElement('li');
```

```
            listItem.textContent = `${product.name} - $${product.price}`;
            productList.appendChild(listItem);
          });
        })
        .catch(error => console.error('Error fetching products:', error));
    });
  </script>
</head>
<body>
  <h1>Product List</h1>
  <ul id="product-list">
    <!-- Product items will be appended here -->
  </ul>
</body>
</html>
```

5. Storage Solutions in AWS

- **Amazon S3:** Used for storing product images and backup data

```
const multer = require('multer');
const multerS3 = require('multer-s3');
const s3 = require('../config/awsConfig');
const File = require('../models/file');



const upload = multer({
 storage: multerS3({
   s3: s3,
   bucket: process.env.S3_BUCKET_NAME,
   acl: 'public-read',
   metadata: (req, file, cb) => cb(null, { fieldName: file.fieldname }),
   key: (req, file, cb) => cb(null, `${Date.now()}-${file.originalname}`)
 }),
});



exports.uploadFile = upload.single('file');



exports.saveFileMetadata = async (req, res) => {
 if (req.file) {
```

```
    const file = new File({
      userId: req.userData.userId,
      fileName: req.file.originalname,
      fileUrl: req.file.location,
    });
    await file.save();
    res.json({ fileUrl: req.file.location });
  } else {
    res.status(400).json({ message: 'File upload failed' });
  }
};
```

6. Identity and Security Management

- **IAM Policies:** Defined roles for users and administrators.
- **Security Measures:** Implemented encryption for sensitive data.

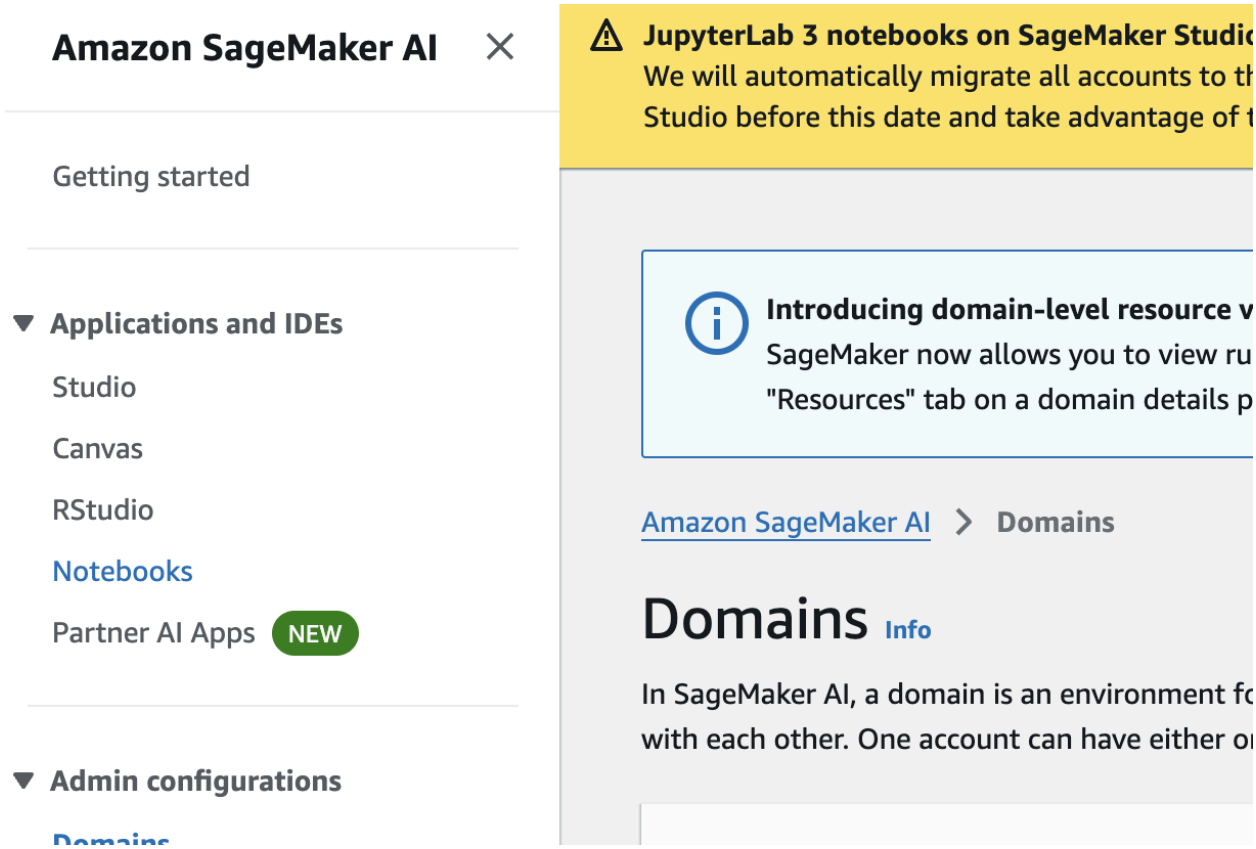
7. Monitoring and Logging

- **CloudWatch Metrics:** Monitored application performance.
- **Error Logs:** Logged errors for debugging and optimization.

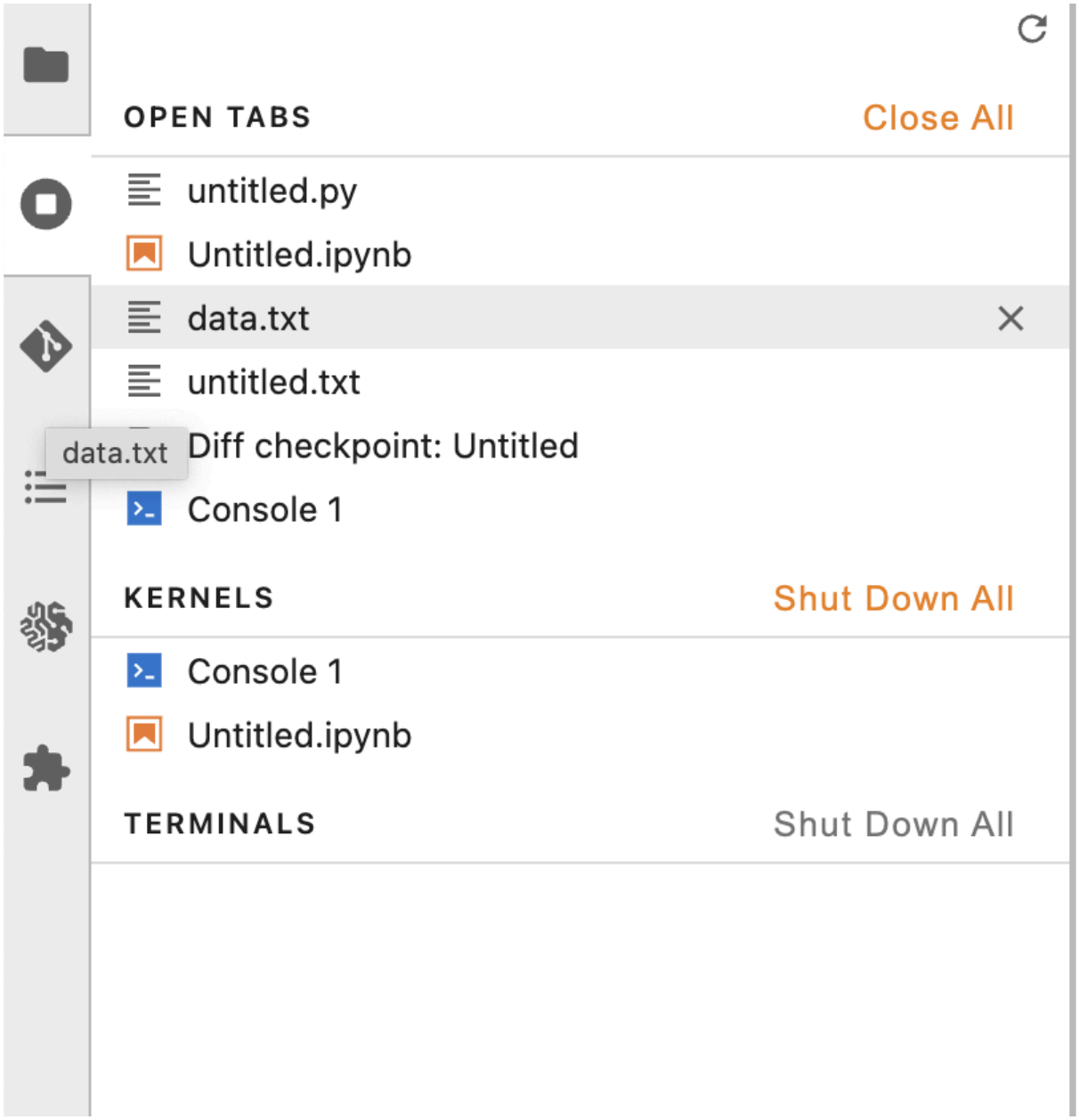
8. Big Data and Machine Learning Integration

- **Amazon SageMaker:** Trained predictive models for sales trends.

  To start we need to go to Notebooks on SageMaker



  Here we can create our jupiter notes



- **Training Script:**

import numpy as np

from sklearn.linear_model import LinearRegression

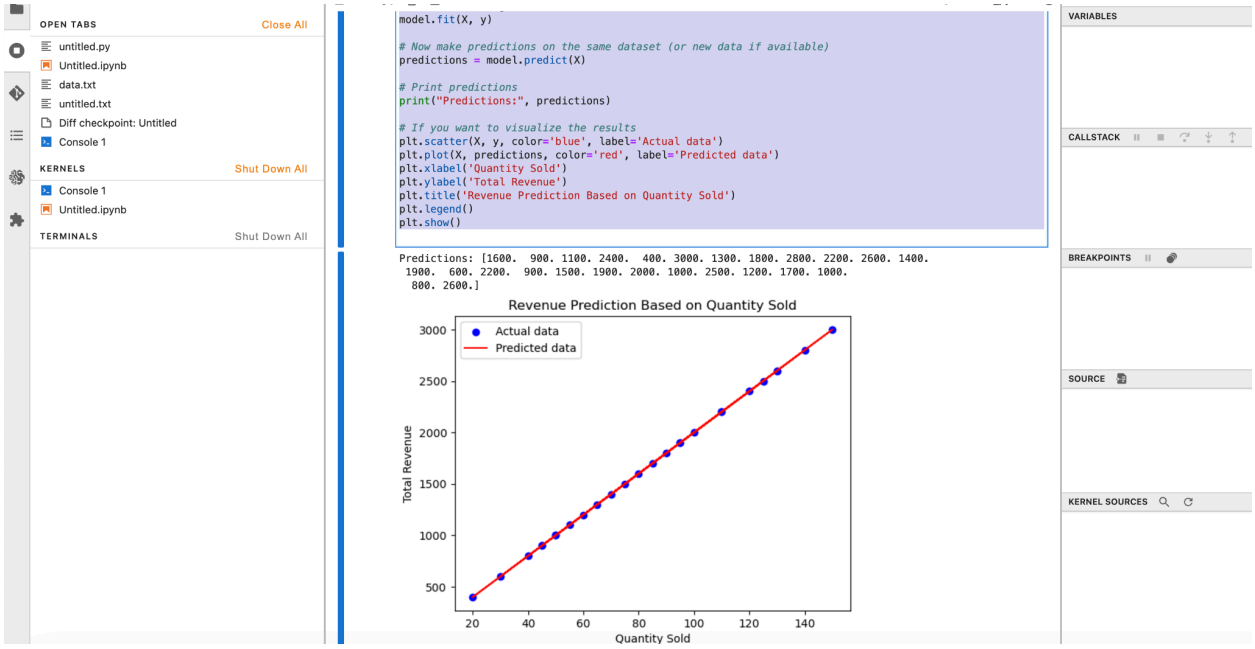
import matplotlib.pyplot as plt

 # Read the file content (similar to earlier example)

```
file_path = "data.txt"
with open(file_path, 'r') as file:
    file_content = file.read()

# Example: Extract Sales Report data from the text file
sales_data = []

for line in file_content.split("\n"):
    if line.startswith("ID:"):
        report_details = line.split(", ")
        report_info = {
            "id": int(report_details[0].split(": ")[1]),
            "product_id": int(report_details[1].split(": ")[1]),
            "sales_date": report_details[2].split(": ")[1],
            "quantity_sold": int(report_details[3].split(": ")[1]),
            "total_revenue": float(report_details[4].split(": ")[1]),
        }
        sales_data.append(report_info)

# Extract features (quantity_sold) and target (total_revenue)
X = np.array([report["quantity_sold"] for report in sales_data]).reshape(-1, 1)
y = np.array([report["total_revenue"] for report in sales_data])

# Train a Linear Regression model
```

```
model = LinearRegression()

model.fit(X, y)


# Now make predictions on the same dataset (or new data if available)

predictions = model.predict(X)



print("Predictions:", predictions)



plt.scatter(X, y, color='blue', label='Actual data')

plt.plot(X, predictions, color='red', label='Predicted data')

plt.xlabel('Quantity Sold')

plt.ylabel('Total Revenue')

plt.title('Revenue Prediction Based on Quantity Sold')

plt.legend()

plt.show()
```

Then we get our predictions



9. Challenges and Solutions

Challenges:

- Initial setup of AWS services.
- Managing cross-service communication.

Solutions:

- Used AWS documentation and SDKs for guidance.
- Automated infrastructure with Terraform.

10. Conclusion

The Cloud-Based Smart Inventory Management System demonstrates the power of cloud computing for modern business applications. AWS services provided scalability, reliability, and advanced analytics capabilities.

11. References

1. AWS Documentation: https://aws.amazon.com/documentation/
2. PostgreSQL Documentation: https://www.postgresql.org/docs/