AI on IBM Z

Fraud detection solution template

This solution template provides an example on how to deploy AI using an IBM Z environment, while making use of open source frameworks, Machine Learning for IBM z/OS (MLz), and more.

Within this solution template, there are various phases of the AI lifecycle included. Work through each of the following steps to deploy your own fraud detection solution on IBM Z.

Table of contents

Step 1

AI model training

We will build a fraud detection AI model by training with the provided rapid AI on IBM Z development Jupyter notebook. Simply point the Jupyter notebook to your dataset and run it to generate your AI model. This trained AI model can then be deployed with MLz.

All sample code for this section is within

```
ai-st-fraud-detection/zST-model-training-jupyter
```

Prerequisites

1. Must have Python (3.9 or 3.10) installed

Dataset guidance

Sample open source credit card transaction dataset can be found on Kaggle -

https://www.kaggle.com/datasets/ealtman2019/credit-card-transactions

There are several files included within the download. You can use *credit_card_transactions-ibm_v2.csv* for training. Due to the size of the sample dataset, the provided Jupyter notebook takes a subset of the data to decrease the training time. Please modifify the code in the "Fetch and process data" cell of the provided Jupyter notebook later to use more data during training.

Required features

- User (integer) – unique ID for user making transaction
- Card (integer) – unique ID for credit card
- Year (integer) – year of the transaction
- Month (integer) – month of the transaction
- Day (integer) – day of the month of the transaction
- Time (integer) - time of the transaction (HH:MM)
- Amount (float) – dollar amount of the transaction
- Use Chip (string) – the type of transaction (swipe transaction, etc)
- Merchant Name (integer) – unique ID for merchant name
- Zip (integer) – zip code of the transaction

Access rapid AI on IBM Z development environment

1. Create and activate Python virtual environment

```
python -m venv env
source env/bin/activate
```

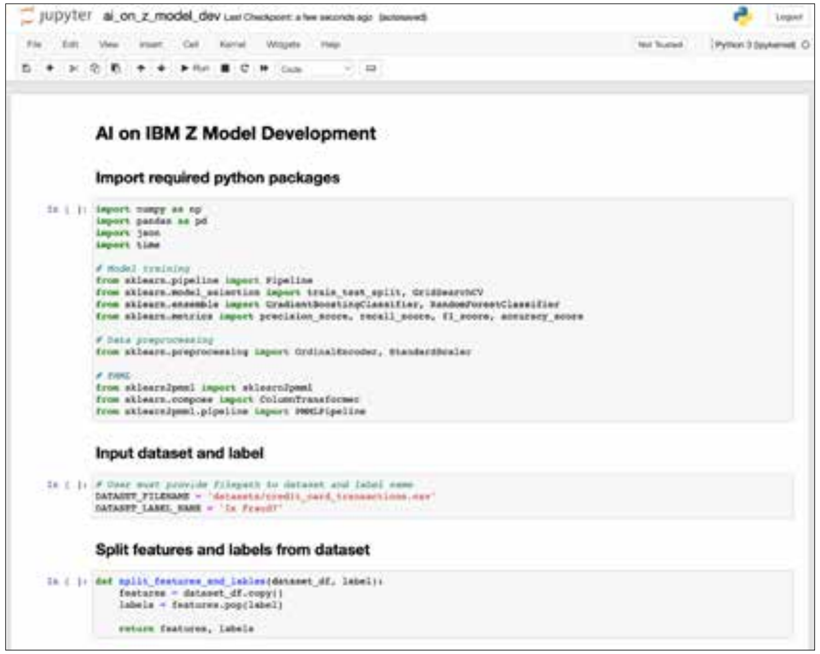
2. Install required Python packages

```
pip install -r requirements.txt
```

3. Run Jupyter

```
jupyter notebook
```

4. View Jupyter interface
   Go to localhost:8888 in a web browser


jupyter
ai_on_z_model_dev Last Checkpoint: a few seconds ago (autosaved)
Logout
File Edit View Insert Cell Kernel Widgets Help
Not Trusted
Python 3 (ipykernel)
Run
Code

AI on IBM Z Model Development

Import required python packages

```
In [ ]: import numpy as np
        import pandas as pd
        import json
        import time

        # Model training
        from sklearn.pipeline import Pipeline
        from sklearn.model_selection import train_test_split, GridSearchCV
        from sklearn.ensemble import GradientBoostingClassifier, RandomForestClassifier
        from sklearn.metrics import precision_score, recall_score, f1_score, accuracy_score

        # Data preprocessing
        from sklearn.preprocessing import OrdinalEncoder, StandardScaler

        # PMML
        from sklearn2pmml import sklearn2pmml
        from sklearn.compose import ColumnTransformer
        from sklearn2pmml.pipeline import PMMLPipeline
```

Input dataset and label

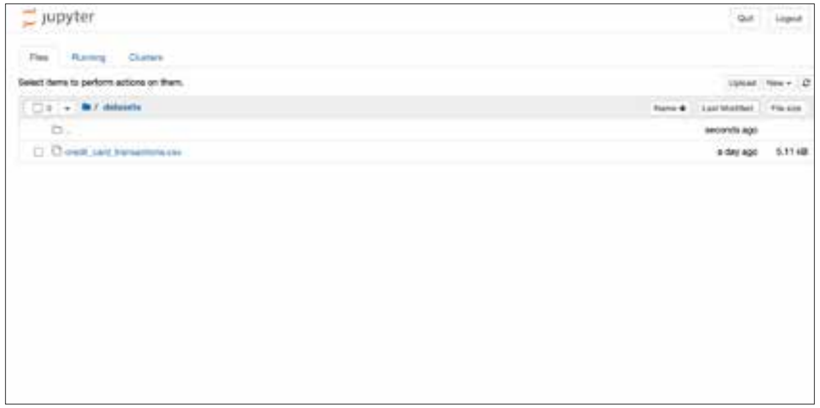
```
In [ ]: # User must provide filepath to dataset and label name
        DATASET_FILENAME = 'datasets/credit_card_transactions.csv'
        DATASET_LABEL_NAME = 'Is Fraud?'
```

Split features and labels from dataset

```
In [ ]: def split_features_and_lables(dataset_df, label):
            features = dataset_df.copy()
            labels = features.pop(label)

            return features, labels
```

Provide data

1. Add your input dataset (csv) into datasets/ directory
2. Add input data to Jupyter notebook
   - Set DATASET_FILENAME to the path to your dataset
   - Set DATASET_LABEL_NAME to the name of the column you're predicting from the dataset

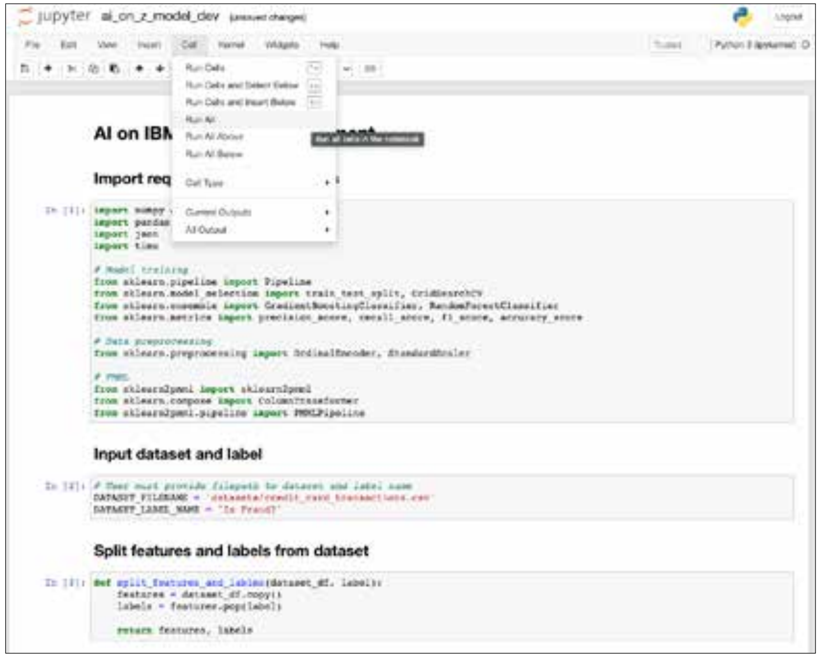


Select items to perform actions on them.

/ datasets		
..	seconds ago	
credit_card_transactions.csv	a day ago	5.11 kB

Model training

1. Step through and run Jupyter notebook from web browser



AI on IBM

Import req

```
In [1]: import numpy
        import pandas
        import json
        import time

        # Model training
        from sklearn.pipeline import Pipeline
        from sklearn.model_selection import train_test_split, GridSearchCV
        from sklearn.ensemble import GradientBoostingClassifier, RandomForestClassifier
        from sklearn.metrics import precision_score, recall_score, f1_score, accuracy_score

        # Data preprocessing
        from sklearn.preprocessing import OrdinalEncoder, StandardScaler

        # PMML
        from sklearn2pmml import sklearn2pmml
        from sklearn.compose import ColumnTransformer
        from sklearn2pmml.pipeline import PMMLPipeline
```

Input dataset and label

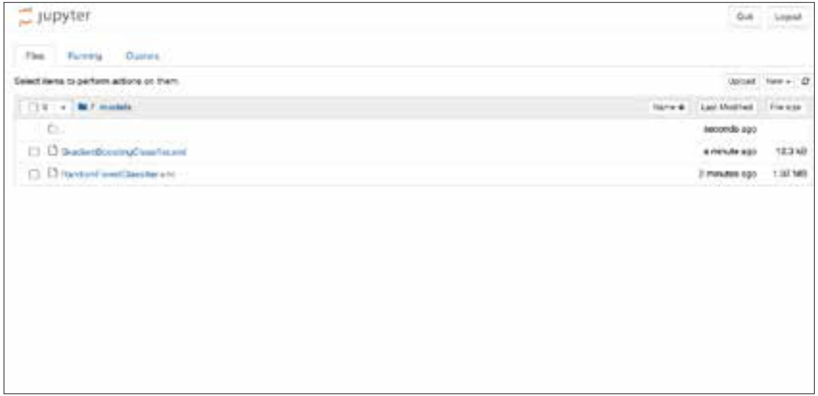
```
In [2]: # User must provide filepath to dataset and label name
        DATASET_FILENAME = 'datasets/credit_card_transactions.csv'
        DATASET_LABEL_NAME = 'Is Fraud?'
```

Split features and labels from dataset

```
In [3]: def split_features_and_lables(dataset_df, label):
            features = dataset_df.copy()
            labels = features.pop(label)

            return features, labels
```

Access trained AI model

1. Once training is complete, you can find your AI models within the models/directory (choose one for the following AI model deployment step)



AI model training complete

Step 2

AI model deployment

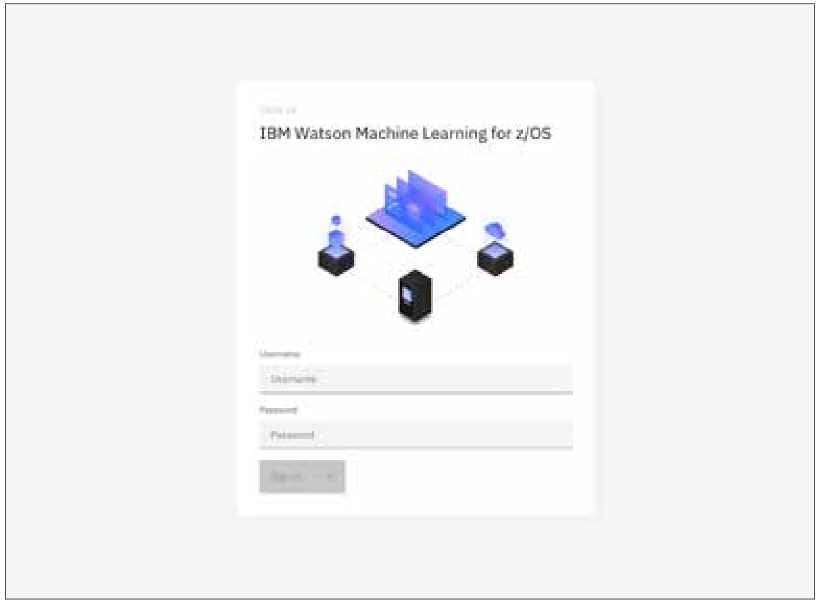
We will deploy our fraud detection AI model using MLz. We can utilize the model import functionality on the MLz UI. This deployed AI model can then be integrated into applications within the IBM Z environment.

Prerequisites

1. Must have MLz installed

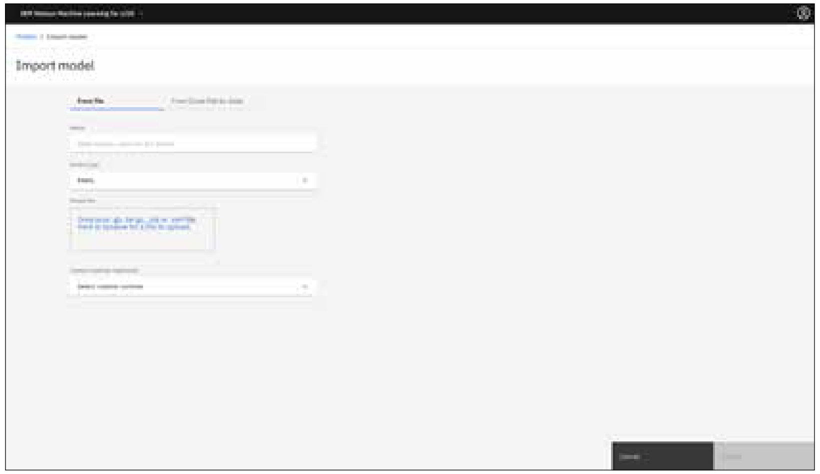
Go to MLz UI

1. Sign in with username/password



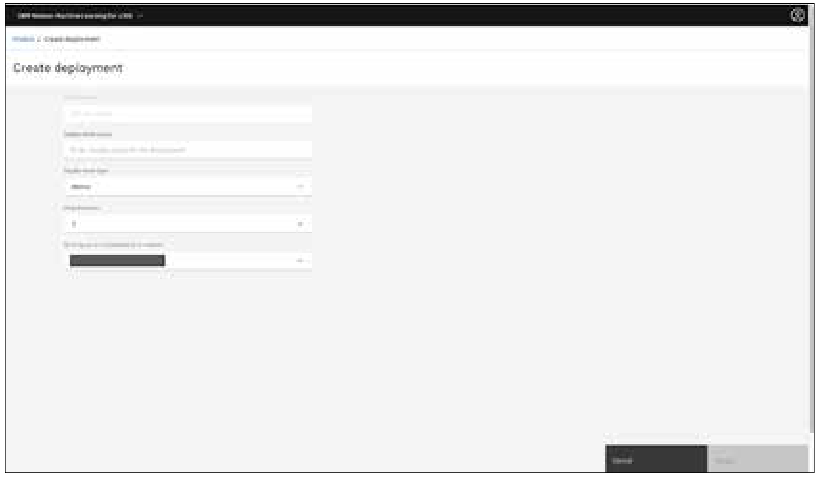
Import AI model

1. Go to models tab
2. Click import model
3. Enter model name
4. Choose model type
   Choose PMML if using your previously trained model
5. Drag and drop model file
   Use your previously trained model
6. Click import



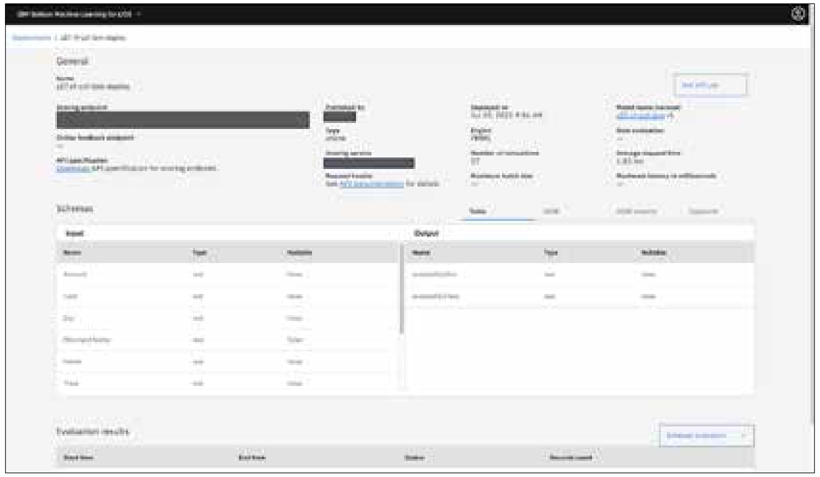
Deploy AI model

1. Go to models tab
2. Click action button for your model (on right side)
3. Click deploy
4. Enter deployment name
5. Choose deployment type
6. Choose model version
7. Choose scoring service
   Note: you should choose the correct scoring service based on your application (e.g. CICS or REST)
8. Click create

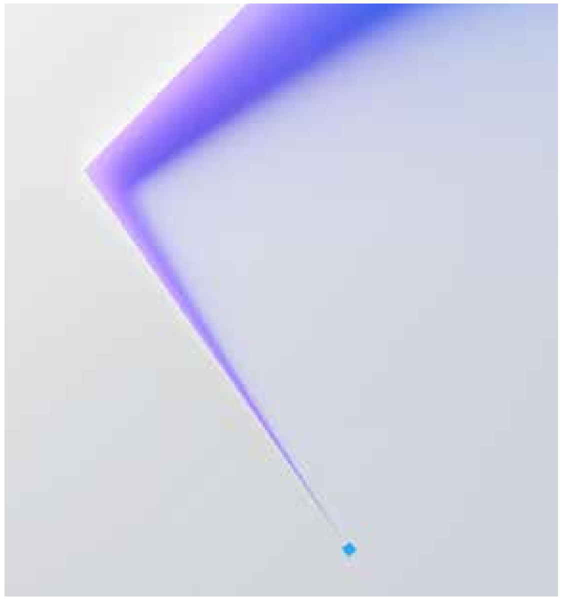


View deployed AI model

1. Go to deployments tab
2. Click on action button for your deployed model (on right side)
3. Click view details



AI model deployment complete



Step 3

AI model analysis

We will analyze our fraud detection AI model using a sample AI on IBM Z Fraud Detection Dashboard. We can invoke the API of this sample dashboard from another sample application to visualize the AI model inferencing.

All sample code for this section is within

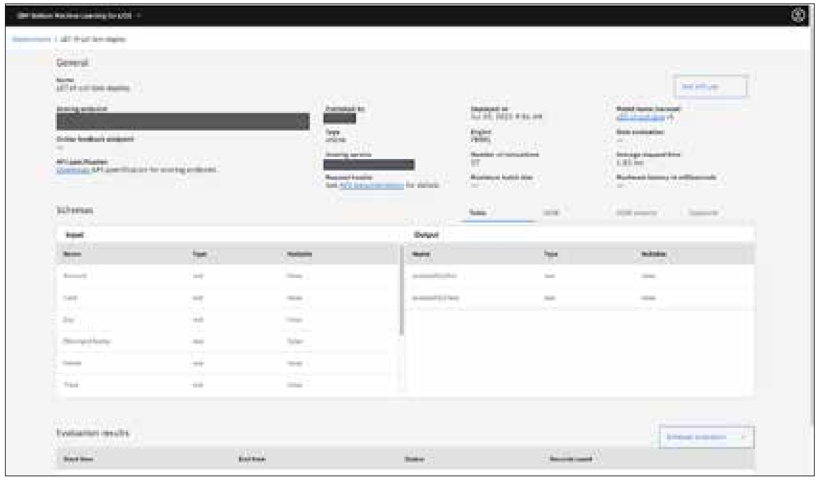
```
ai-st-fraud-detection/zST-model-analysis
```

Prerequisites

1. Must have MLz installed
2. Must have Python installed
3. Must have Git installed
4. Must have Docker or Podman installed

Get model details for inferencing

1. Go to MLz UI
2. Go to deployments tab
3. Click on action button for your deployed model (on right side)
4. Click view details
5. Copy scoring endpoint



Configure sample application

1. Set the enrionment variables within

```
ai-st-fraud-detection/zST-model-analysis/
env.list
```

- WML_IP_W_PORT (IP address of MLz with port)
- WML_USER (MLz username)
- WML_PASS (MLz password)
- WMLZ_ENDPOINT (scoring endpoint for deployed AI model)

Build sample application

1. Run command in terminal

```
docker build -t model-analysis .
```

Deploy sample application

1. Run command in terminal (e.g. port 5002)

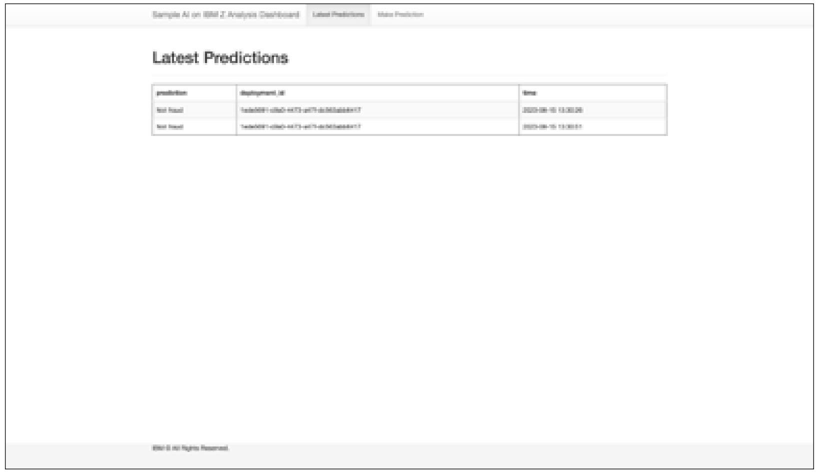
```
docker run --rm -p 5002:5002 --env-file
env.list --name model-analysis-app
model-analysis
```

Access sample application

1. View the following URL in a web browser
   http://{ip address}:{port}
   - IP address: IP of server you deployed application in
   - Port: port you used with Docker run

Analyze credit card events

1. Go to sample insights dashboard in web browser http://{ip address}:{port}
2. Go to latest predictions tab



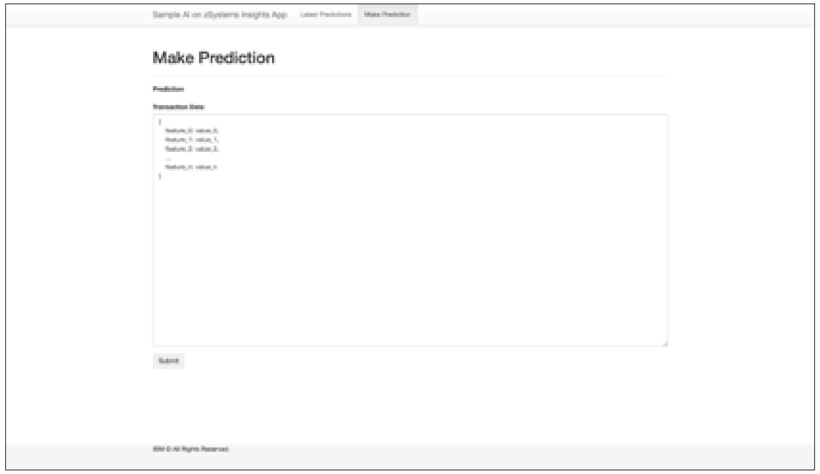
Latest Predictions

prediction	deployment_id	time
Not fraud	[illegible]	2023-08-15 13:30:26
Not fraud	[illegible]	2023-08-15 13:30:51

IBM © All Rights Reserved.

Make predication

1. Go to sample insights dashboard in web browser http://{ip address}:{port}
2. Go to latest make predication tab
3. Input json data
4. Click submit



Make Prediction

Prediction

Transaction Data

```
{
  feature_0: value_0,
  feature_1: value_1,
  feature_2: value_2,
  ...
  feature_n: value_n
}
```

IBM © All Rights Reserved.

AI model analysis complete

Step 4

AI model integration

Choose One:

Ecommerce web application
CICS-COBOL application

We can use our deployed MLz fraud detection AI model and integrate it into different types of applications. The AI model can be analyzed and/or provide inferencing APIs using the sample AI on IBM Z Fraud Detection Dashboard.

Ecommerce web application

The sample e-commerce application is based on the open source EverShop Storefront and has been extended to integrate with the AI on IBM Z Solution Template. EverShop is a GraphQL Based and React ecommerce platform with essential commerce features. Built with React, modular and fully customizable.

All sample code for this section is within

```
ai-st-fraud-detection/zST-storefront-evershop
```

Prerequisuties

1. Must have AI on IBM Z Sample Fraud Detection Dashboard deployed for inferencing and analysis
2. Must have Docker installed

Install and deploy sample ecommerce application

1. Set app_url_w_port variable in CheckoutForm.jsx to your server IP and port (ip:port)

```
ai-st-fraud-detection/zST-storefront-
evershop/packages/evershop/src/components/
frontStore/stripe/checkout/CheckoutForm.
jsx
```

2. Run command in terminal

```
docker-compose up
```

Configure sample ecommerce application

Access admin panel from web browser

1. Enter URL in web browser using app url (e.g. localhost)

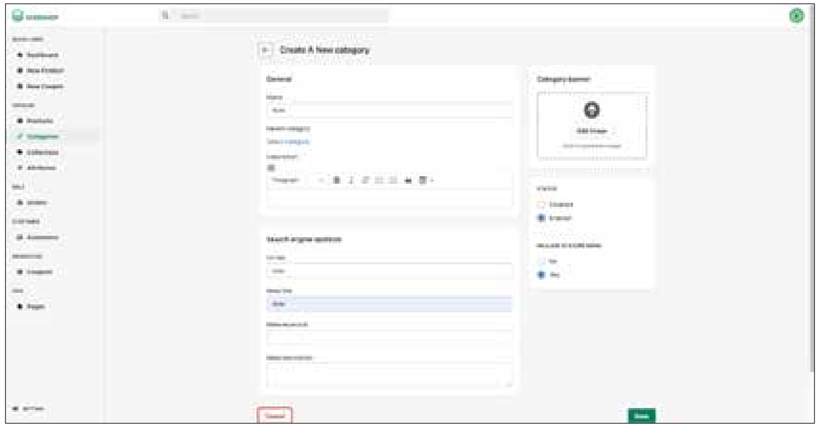
```
http://localhost:3000/admin
```

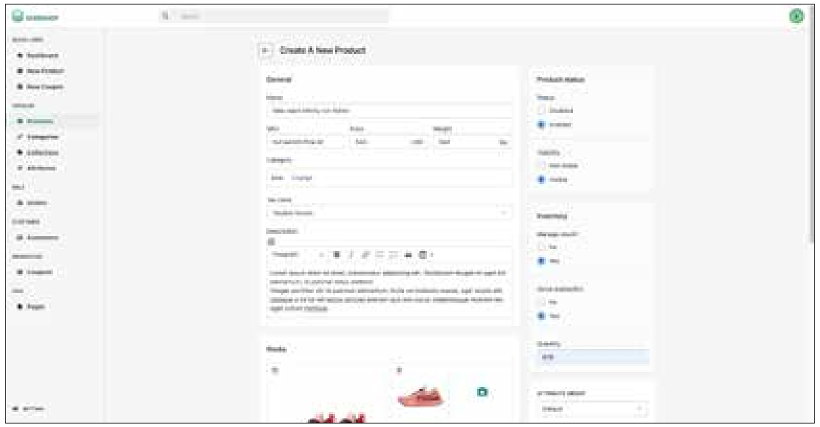
2. Login with default admin credentials
   - Email: admin@test.com
   - Password: password

Add products

1. Create categories
   - Click categories from the catalog section
   - Click new category
   - Add category details
     - Add name (e.g. Kids)
     - Add url key
     - Add meta title
     - Change status to enabled
     - Change include in store menu to yes
   - Click save

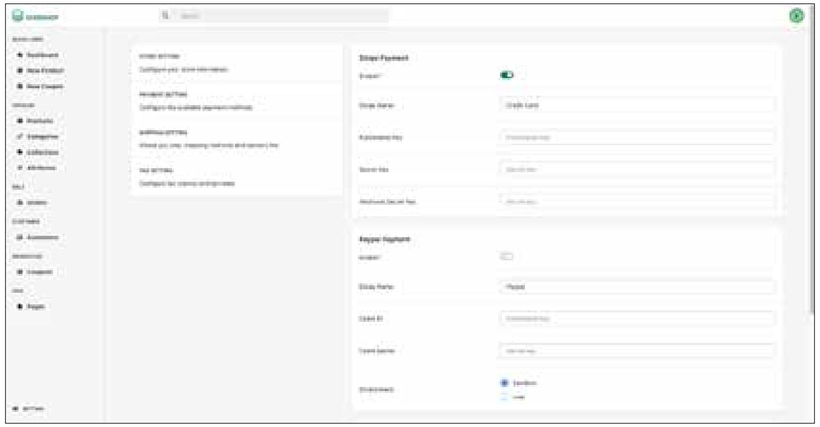
2. Add products
   - Click products from the catalog section
   - Click new product
   - Add category details
     - Make sure to change add category
     - Make sure to change status to enabled
     - Make sure to change visibility to visible





Configure store settings

1. Enter URL in web browser using app url (e.g. localhost)
2. Click settings on the bottom left
3. Click store setting

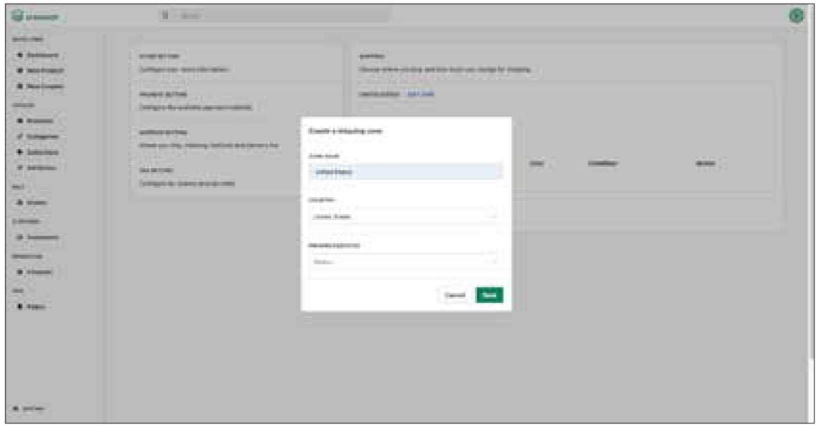


Configure payment settings

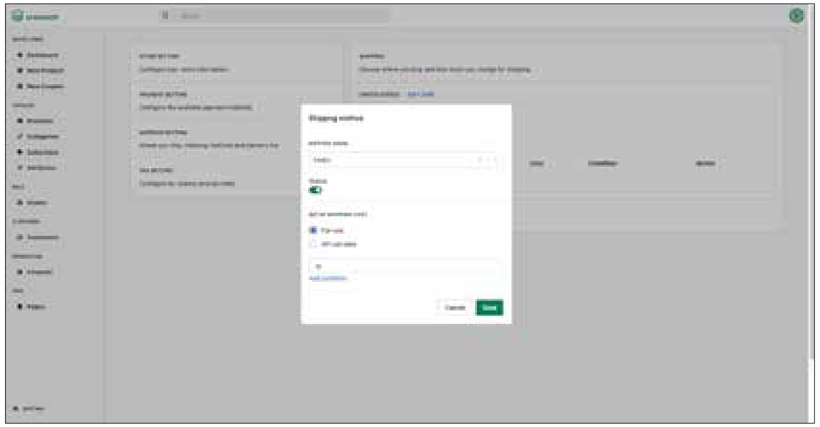
1. Click payment setting
2. Enable stripe payment
3. Click save

Configure shipping settings

1. Click shipping setting
2. Add shipping zone
    - Click create new shipping zone
    - Add shipping details
3. Click save



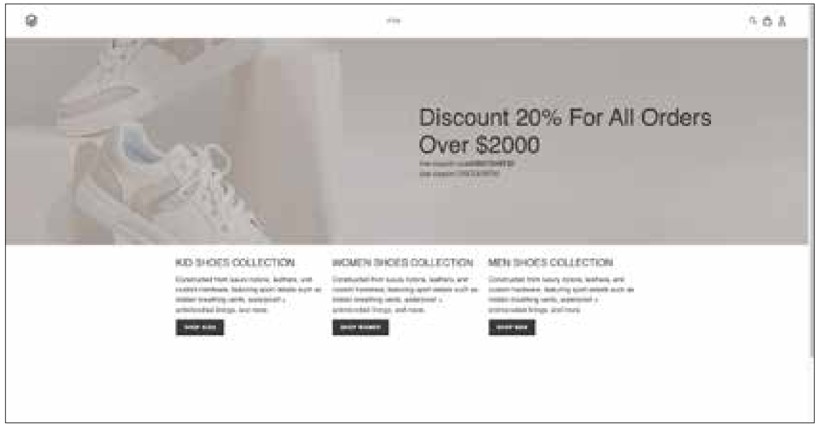
2. Add payment method
   - Click add method
   - Add method name (e.g. FedEx)
   - Enable status
   - Add flat rate (e.g. 10)
   - Click save



Access sampe ecommerce application

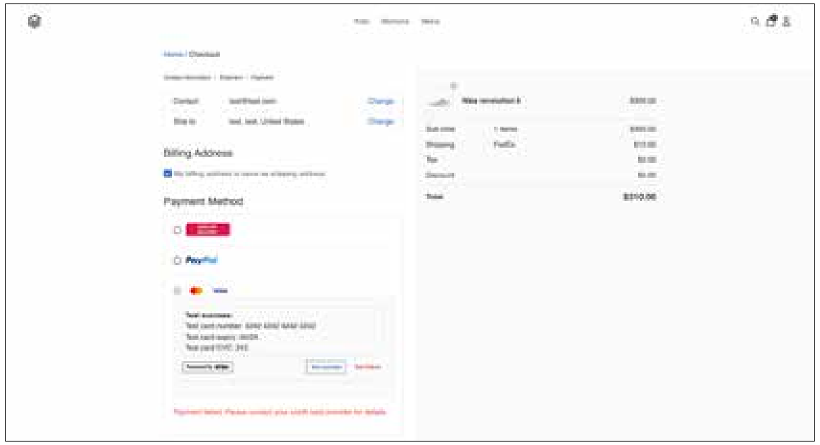
1. Enter URL in web browser using app url (e.g. localhost)

```
http://localhost:3000
```



Use fraud detection AI model with EverShop Storefront

1. Make sure you have AI on IBM Z Sample Fraud Detection Dashboard deployed for inferencing and analysis on the same local system
2. AI on IBM Z Sample Fraud Detection Dashboard is configured to invoke MLz AI model
3. Add items to cart
4. Place order
   - Choose test failure as payment method for fraud transaction example
   - Choose test success as payment method for non fraud transaction example



AI model integration complete

CICS-COBOL application

We can use our deployed MLz fraud detection AI model and integrate it into different types of applications. Guidance on integrating the AI model into a sample CICS-COBOL application is below.

All sample code for this section is within

```
ai-st-fraud-detection/zST-model-integration-CICS
```

Prerequisuties

1. Must have access to z/OS CICS environment
2. Must have MLz installed
3. Must have model deployed with the CICS-scoring server as scoring service
4. Must have the JVM server and bundle setup and running. To verify the same execute the below commands in the CICS.

   JMVSERVER

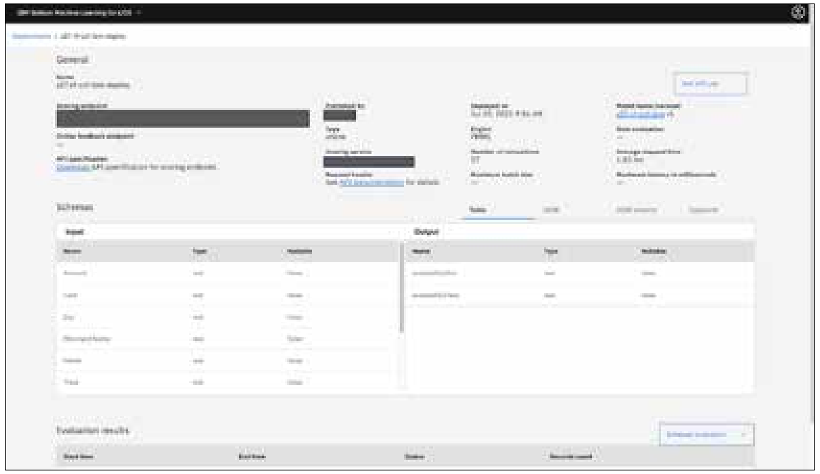
   ```
   CEMT INQUIRE JVMSERVER(ALNSCSER)
   ```

   BUNDLE

   ```
   CEMT INQUIRE BUNDLE(ALNSCBDL)
   ```

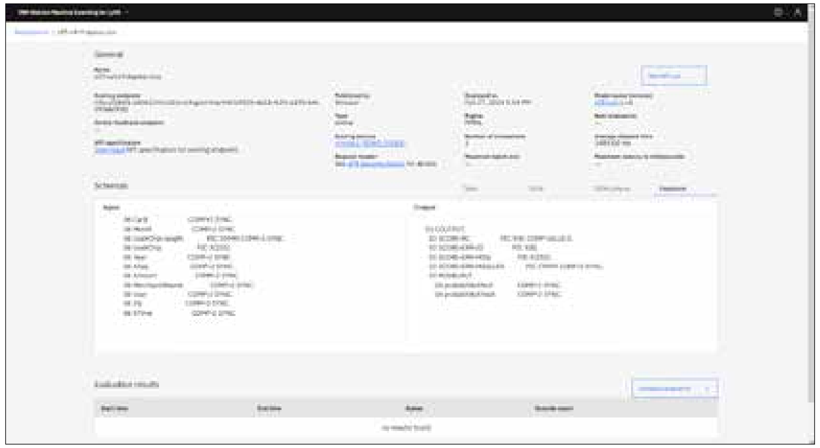
Get model details for inferencing

1. Go to MLz UI
2. Go to deployments tab
3. Click on action button for your deployed model (on right side)
4. Click view details
5. Copy scoring endpoint



Integrate into CICS application

1. Review the input and output copybooks from the MLz UI



2. Generate input and output Java helper classes
3. Run the

   ```
   $IML_INSTALL_ENT_DIR/cics-scoring/bin/gen_
   helper_class.sh
   ```

   script to generate helper classes

   - SERVER_NAME is the name of the scoring service the model is deployed to.
   - DEPLOYMENT_ID is the deployment ID of the model.
   - JCLASS_PREFIX is the prefix to be used for the generated class.
   - The generated input class will be named as: <JCLASS_PREFIX>InWrapper.class
   - The generated output class will be named as: <JCLASS_PREFIX>OutWrapper.class

   Ex:

   ```
   $IML_INSTALL_ENT_DIR/cics-scoring/bin/gen_
   helper_class.sh SERVER_NAME DEPLOYMENT_ID
   JCLASS_PREFIX
   ```

Get model details for inferencing

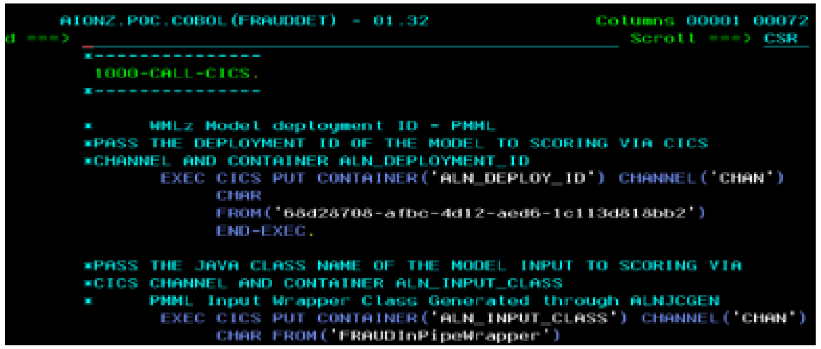
Integrate into CICS Application

3. Create COBOL program

- Create ALNJCGEN JCL
- Copy provided sample COBOL program

```
ai-st-fraud-detection/zST-model-
integration-CICS/FRAUDDET.cob
```

- Paste sample COBOL program into FRAUDDET
- Copy deployment ID from MLz UI
- Replace DEPLOYMENT_ID in sample COBOL program with your deployment ID
- Update the names of the input and output wrapper classes created in the previous



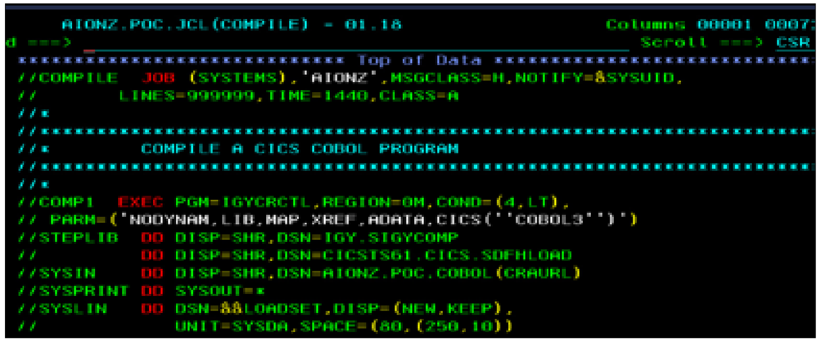
```
    AIONZ.POC.COBOL(FRAUDDET) - 01.32                    Columns 00001 00072
d ===>                                                      Scroll ===> CSR
      *----------------
       1000-CALL-CICS.
      *----------------

      *      WMLz Model deployment ID - PMML
      *PASS THE DEPLOYMENT ID OF THE MODEL TO SCORING VIA CICS
      *CHANNEL AND CONTAINER ALN_DEPLOYMENT_ID
                EXEC CICS PUT CONTAINER('ALN_DEPLOY_ID') CHANNEL('CHAN')
                     CHAR
                     FROM('68d28708-afbc-4d12-aed6-1c113d818bb2')
                     END-EXEC.

      *PASS THE JAVA CLASS NAME OF THE MODEL INPUT TO SCORING VIA
      *CICS CHANNEL AND CONTAINER ALN_INPUT_CLASS
      *      PMML Input Wrapper Class Generated through ALNJCGEN
                EXEC CICS PUT CONTAINER('ALN_INPUT_CLASS') CHANNEL('CHAN')
                     CHAR FROM('FRAUDInPipeWrapper')
```

4. Compile and link-edit CICS-COBOL program

- Create COMPILE file
- Copy provided sample COMPILE file

```
ai-st-fraud-detection/zST-model-
integration-CICS/COMPILE.jcl
```

- Paste sample COMPILE file into COMPILE file
- Paste sample COMPILE file into COMPILE file
- Submit job
- Verify job ran successfully (MAXCC = 0)



```
    AIONZ.POC.JCL(COMPILE) - 01.18                       Columns 00001 0007
d ===>                                                      Scroll ===> CSR
 ****************************** Top of Data ******************************
 //COMPILE   JOB (SYSTEMS),'AIONZ',MSGCLASS=H,NOTIFY=&SYSUID,
 //          LINES=999999,TIME=1440,CLASS=A
 //*
 //***********************************************************************
 //*          COMPILE A CICS COBOL PROGRAM
 //***********************************************************************
 //*
 //COMP1    EXEC PGM=IGYCRCTL,REGION=0M,COND=(4,LT),
 //  PARM=('NODYNAM,LIB,MAP,XREF,ADATA,CICS(''COBOL3'')')
 //STEPLIB   DD DISP=SHR,DSN=IGY.SIGYCOMP
 //          DD DISP=SHR,DSN=CICSTS61.CICS.SDFHLOAD
 //SYSIN     DD DISP=SHR,DSN=AIONZ.POC.COBOL(CRAURL)
 //SYSPRINT  DD SYSOUT=*
 //SYSLIN    DD DSN=&&LOADSET,DISP=(NEW,KEEP),
 //             UNIT=SYSDA,SPACE=(80,(250,10))
```

Get model details for inferencing

Integrate into CICS Application

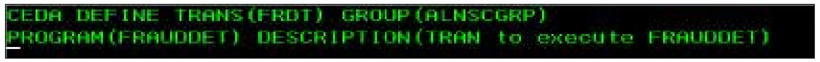
5. Define the transaction and program in the CICS region

   - Transaction:

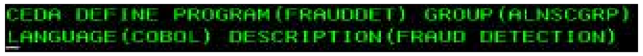
```
CEDA DEFINE TRANS(FRDT) GROUP(ALNSCGRP)
PROGRAM(FRAUDDET) DESCRIPTION(TRAN to
execute FRAUDDET)
```

   - Program:

```
CEDA DEFINE PROGRAM(FRAUDDET)
GROUP(ALNSCGRP) LANGUAGE(COBOL)
DESCRIPTION(FRAUD DETECTION)
```



```
CEDA DEFINE TRANS(FRDT) GROUP(ALNSCGRP)
PROGRAM(FRAUDDET) DESCRIPTION(TRAN to execute FRAUDDET)
```



```
CEDA DEFINE PROGRAM(FRAUDDET) GROUP(ALNSCGRP)
LANGUAGE(COBOL) DESCRIPTION(FRAUD DETECTION)
```

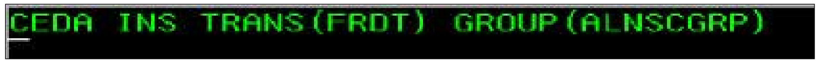
6. Install transaction and program in the CICS region

   - Transaction:

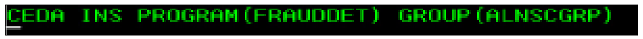
```
CEDA INS TRANS(FRDT) GROUP(ALNSCGRP)
```

   - Program:

```
CEDA INS PROGRAM(FRAUDDET) GROUP
(ALNSCGRP)
```



```
CEDA INS TRANS(FRDT) GROUP(ALNSCGRP)
```



```
CEDA INS PROGRAM(FRAUDDET) GROUP(ALNSCGRP)
```

7. Run transaction

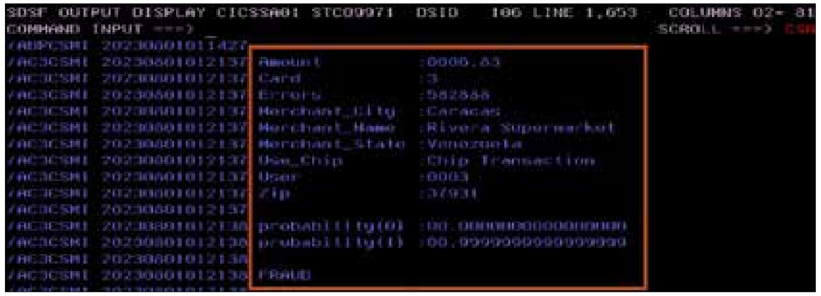
```
FRDT
```

```
FRDT
```

Get model details for inferencing

Integrate into CICS Application

8. View output results
   - Go to the Spool of the started task for CICS (e.g. CICSSA01)
   - Navigate to the CEEMSG dataset
   - View displays from the module in this dataset Sample output is shown as below



```
SDSF OUTPUT DISPLAY CICSSA01 STC09971  DSID   106 LINE 1,653    COLUMNS 02- 81
COMMAND INPUT ===> _                                            SCROLL ===> CSR
/ABPCSMI 20230801011427
/AC3CSMI 20230801012137 Amount            :0000.83
/AC3CSMI 20230801012137 Card              :3
/AC3CSMI 20230801012137 Errors            :582888
/AC3CSMI 20230801012137 Merchant_City     :Caracas
/AC3CSMI 20230801012137 Merchant_Name     :Rivera Supermarket
/AC3CSMI 20230801012137 Merchant_State    :Venezuela
/AC3CSMI 20230801012137 Use_Chip          :Chip Transaction
/AC3CSMI 20230801012137 User              :0003
/AC3CSMI 20230801012137 Zip               :37931
/AC3CSMI 20230801012137
/AC3CSMI 20230801012138 probability(0)    :00.0000000000000000
/AC3CSMI 20230801012138 probability(1)    :00.9999999999999999
/AC3CSMI 20230801012138
/AC3CSMI 20230801012138 FRAUD
```

✓ AI model integration complete