

## ASEANZK Cloud Pak for Data – Practicum Scenario:

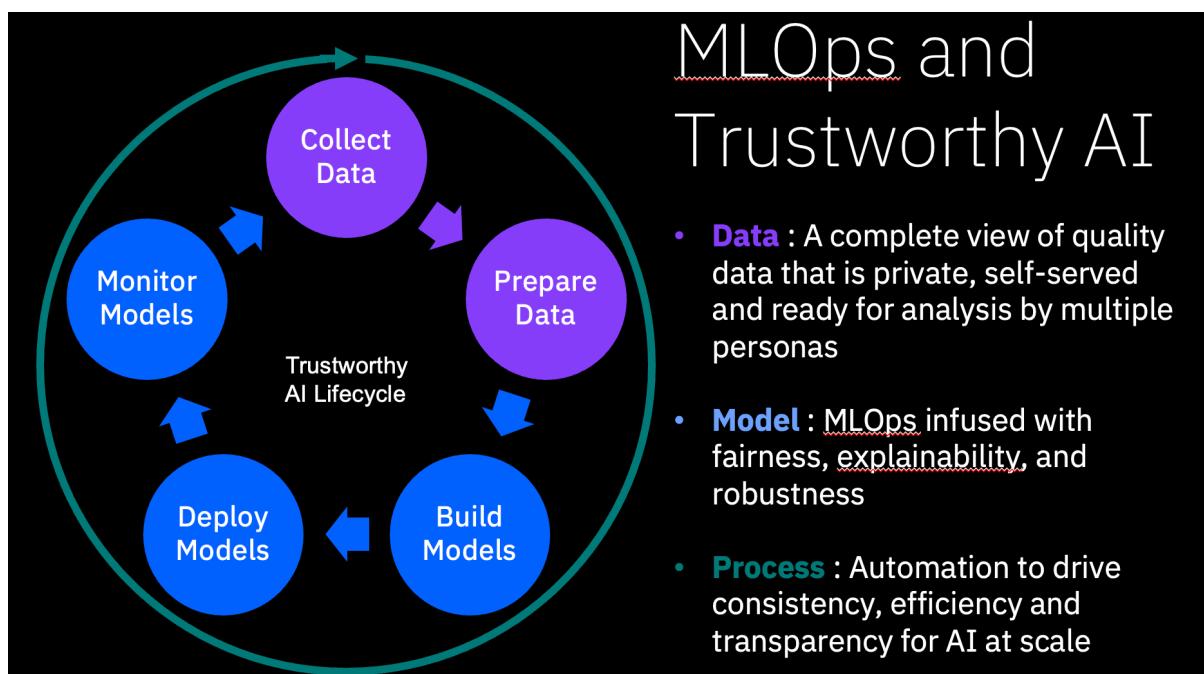
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### Use Case

MLOps and Trustworthy AI ( focusing on Model Development / Model Deployment / Monitoring)



### Scenario Description

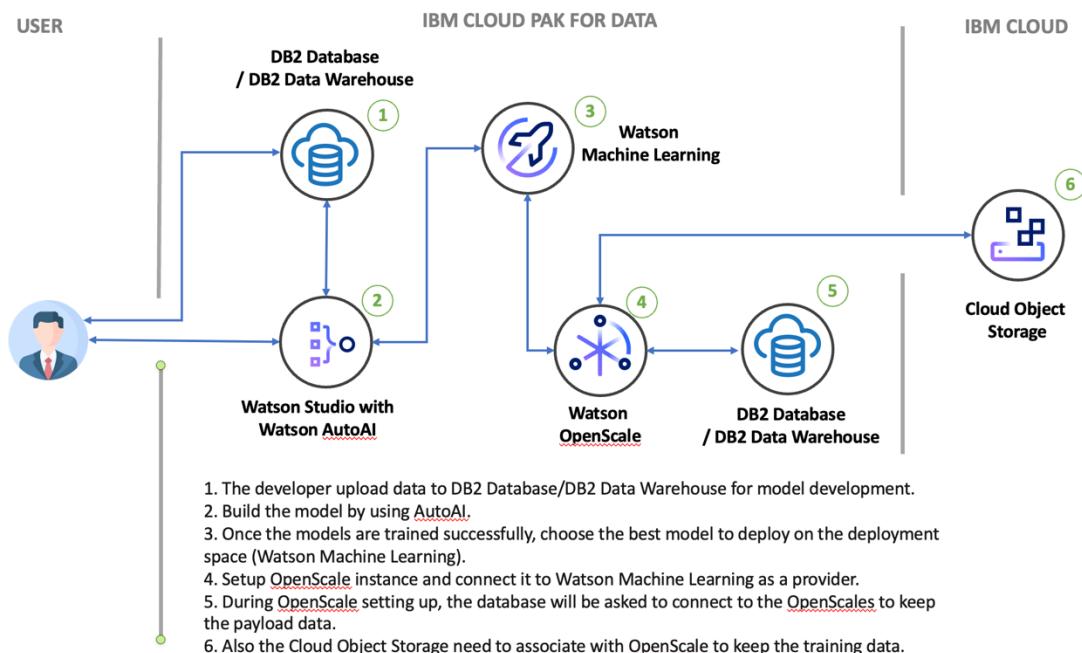
Credit risk is significant for the banking business. If the borrower fails to repay, it results in a loss. To minimize loan from the bank's perspective, ABC Bank needs a decision rule regarding to give approval of the loan and who not to. They decided to implement Application Score (A-Score) model to access loan application based on application's demographic and economic profiles. Loan analyst who has no programming skill has been asked to develop the model. The saved model need to be deployed machine learning engineer and generate the API for the front-end application. Due to economic uncertainty can cause the customer behaviour change which affects to the model. To avoid the opportunity cost in business from dropping in model accuracy. The team also has been asked to set up the instance to monitor the model after deploying.

The company has recently acquired Cloud Pak for Data v4 and are planning to utilize its key features to achieve the following goals :

- i. Accelerate model development without programming skill.
- ii. Save and deploy model seamlessly to reduce friction between model developer and machine learning engineer.
- iii. The model need to be an "on-line" deployment with API for the front end application.
- iv. After deployment successfully, you also have been asked to set up instance to monitor the model to see there are any changes affect to the model (Drift and Fairness for example).
- v. Use the Python Client to test the model and check the payload is logging in the OpenScale.

## High Level Architecture

Below is the high level architecture that we plan to implement as part of this scenario.



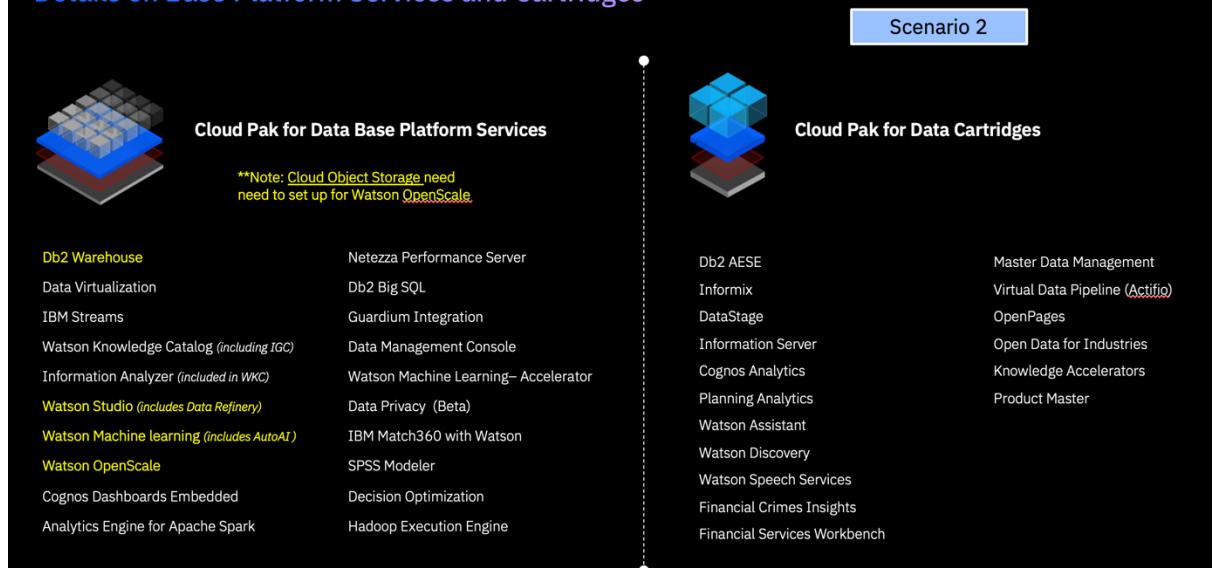
## Product Used

Your objective is to use IBM Cloud Pak for Data features to develop, deploy and monitor model under the MLOps and trustworthy AI concept. The key products you will be used for this project are here;

- 1x Watson Studio (WSL) with AutoAI
- 1x Watson Machine Learning (WML)
- 1x Watson OpenScale instance.
- 2x DB2 Database or DataWarehouse (1x for Training data storing, 1x for Watson OpenScale set up)
- 1x Cloud Object Storage (for Watson OpenScale to keep training data)
- 1x Data Management Console

# Cloud Pak for Data v4.0 Packaging

## Details on Base Platform Services and Cartridges



## Task Allocation by Roles

SI No	Tasks for Scenario 2	Role
1	Provision all required Services	CP4D Administrator
2	Upload data to the database	Data Engineer/Database Admin
3	Develop the Model using AutoAI	Data Scientist
4	Deploy the model	Machine Learning Engineer
5	Configure and monitor the model	Model validator / CP4D Administrator

## Implementation Step

### Task 0: Preparing Steps

- 1) For this lab, we need the number of services as shown below;
  - 1x Watson Studio (WSL) with AutoAI
  - 1x Watson Machine Learning (WML)
  - 1x Watson OpenScale instance.
  - 2x DB2 Database or Data Warehouse (1x for Training data storing, 1x for Watson OpenScale set up)

- 2) Please check all the services above are enabled or available, from the navigation bar go to services catalog. Check all the services are indicated as enabled like the example below. If there are any services above have no label “Enabled” or “Available”, please contact your facilitators.

 <b>Watson Studio</b> IBM  Unleash the power of your data. Build custom models and infuse your business with AI and machine learning.  Enabled ✓	 <b>Db2 Data Management Console</b> IBM  Administer, monitor, manage, and optimize your Db2 databases from a single web-based console.  Available ⓘ
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- 3) If all services are already enabled, Watson Studio (WSL) and Watson Machine Learning (WML) are already to use automatically.
- 4) For Watson OpenScale instance, Data Management Console and DB2 Database or Data Warehouse, you need to provision the instances by yourself.
- 5) To provision Watson OpenScale.
  1. Go to service catalog and search for “Watson OpenScale”. Click on it.

The screenshot shows the IBM Cloud Pak for Data Services catalog interface. A search bar at the top contains the text "watson openscale". On the left, there is a sidebar with filters for Category, Entitlement, Source, and Status, along with sections for "Explore more services", "Partners catalog", and "Industry accelerators". The main area displays a search result for "Watson OpenScale" under the "AI" category. The result card includes a brief description: "Understand your AI with trust and transparency. Understand how your AI models make decisions to detect and mitigate bias.", and a status indicator "Enabled".

2. On the left hand side, click drop down and create the instance.

The screenshot shows the IBM Cloud Pak for Data Services Catalog interface. On the left, the 'Watson OpenScale' service card is displayed, showing its type as 'Application', version '4.5.3', and provider 'IBM'. The 'Instances' dropdown menu is open, and the 'New instance' button is highlighted with a red box and an arrow pointing to it.

- Set up the name and choose the name space “cpd-instance”, then click next.

The screenshot shows the 'New service instance' creation page for the Watson OpenScale service. In the 'Instance details' section, the 'Name' field is filled with 'Openscale' and the 'Namespace' field is set to 'cpd-instance'. The 'Description (optional)' field is empty. At the top right, the 'Next' button is highlighted with a red box.

- See the summary and click create.

The screenshot shows the 'New service instance' summary page. The 'Summary' section is highlighted with a red box, displaying the following information:  
**Instance details**  
- Instance name: Openscale  
- Service type: aiops  
- Service version: 4.5.3  
At the top right, the 'Create' button is highlighted with a red box.

- Once the OpenScale instance is created successfully. The status will show as below.

The screenshot shows the IBM Cloud Pak for Data interface. At the top, a green banner displays a success message: "Success The platform is creating the OpenScale instance. When the instance is ready, it will appear in the instances list." Below the banner is a search bar and a filter dropdown set to "Type" and "Status". A "Find instances" button is followed by a "New instance" button. A table lists one instance: "opencscale" (Type: aios, Created by: admin, Status: Available, Created on: Dec 21, 2022).

## 6) To provision DB2 Data Management Console

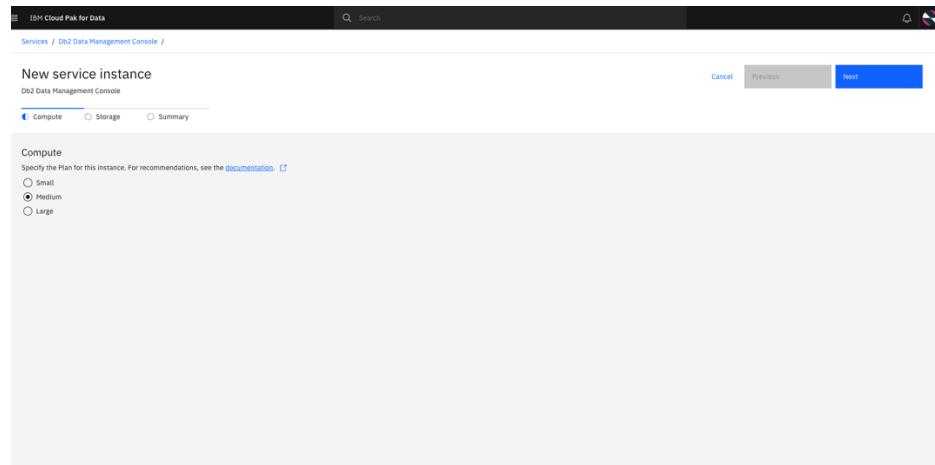
1. Go to service catalog and search for “DB2 Data Management Console”. Click on it.

The screenshot shows the "Services catalog" page. A search bar at the top contains the query "db2 data management console". The results section is titled "Data sources" and shows one item: "DB2 Data Management Console". A brief description follows: "Administer, monitor, manage, and optimize your DB2 databases from a single web-based console." The status is listed as "Available".

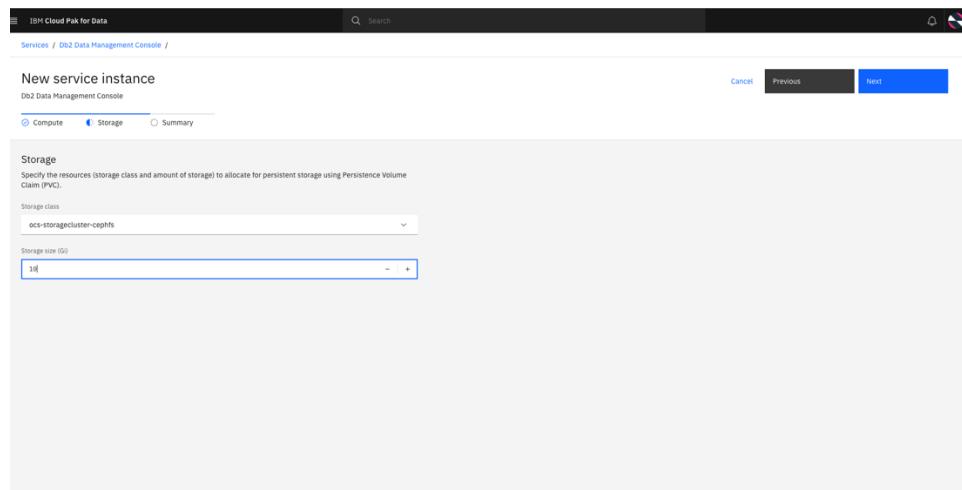
2. In the DB2 Data Management Console page, at the top right-hand side click “Provision Instance”.

The screenshot shows the "Db2 Data Management Console" page. On the right side, there is a prominent blue "Provision instance" button with a white arrow icon, which is highlighted with a red rectangular box.

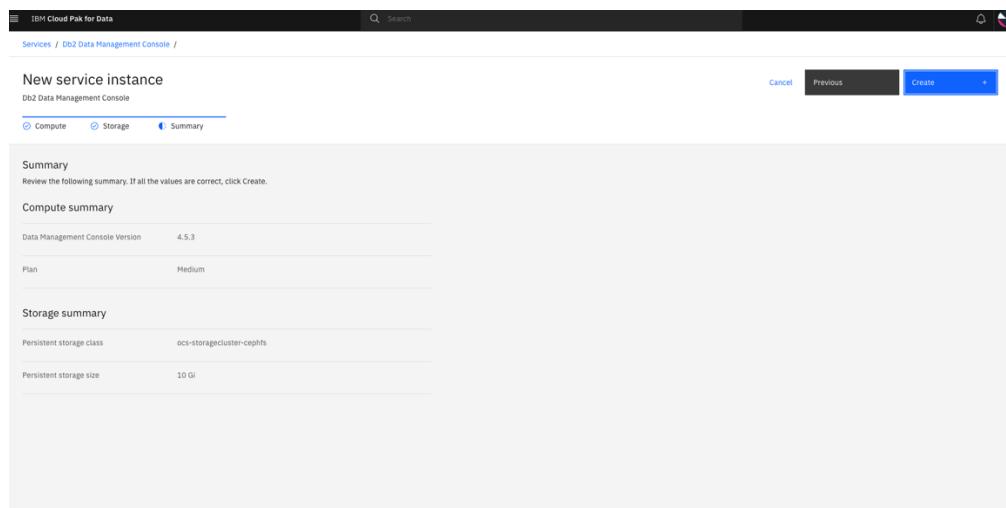
3. Choose Medium Size of Instance for compute.



4. Choose storage class to be “ocs-storagecluster-cephfs” and Storage size to be 10.



5. Review the summary and click “Create”.



6. Review the summary and click “Create” and wait until the service is ready. The status will show the green sign like the picture below.

The screenshot shows the 'Instances' section of the IBM Cloud Pak for Data interface. It displays a table with columns: Name, Type, Created by, vCPU requests, Memory requests (GiB), Users, Status, and Created on. Two instances are listed:

Name	Type	Created by	vCPU requests	Memory requests (GiB)	Users	Status	Created on
data-management-console	dmc	admin	5.20	21.40 Gi	1	<span>Green</span>	Dec 23, 2022
DB2-1	db2oltp	admin	2.20	5.75 Gi	1	<span>Green</span>	Dec 23, 2022

A blue 'New Instance' button is located in the top right corner of the table header.

## 7) To provision DB2.

1. Go to service catalog and search for “DB2”. Click on it.

The screenshot shows the 'Services catalog' page with a search bar containing 'DB2'. The results are categorized under 'Analytics' and 'Data sources'.

**Analytics** (1 item):

- DB2 Big SQL (IBM): Run fast analytical queries against object stores or HDFS with a cloud-native, distributed SQL query engine.

**Data sources** (4 items):

- DB2** (IBM): Relational database that delivers advanced data management and analytics capabilities for transactional and warehousing workloads. This card is highlighted with a red box.
- DB2 Data Gate (IBM): Extract, load, and synchronize mission-critical DB2 for z/OS data for high volume transactional or analytic applications.
- DB2 Data Management Console (IBM): Administer, monitor, manage, and optimize your DB2 databases from a single web-based console.
- DB2 Warehouse (IBM): Data warehouse designed for high-performance, in-database analytics.

2. On the left hand side, click drop down and create the instance.

Db2

Type Database

Version 11.5.7.0-cn7x86\_64

Provider IBM

Category Data sources

Related links Docs

**Summary**

Relational database that delivers advanced data management and analytics capabilities for transactional and warehousing workloads.

SQL	Number of executions	Statement execution time	Estimated runtime	CPU time (ms)	Rows read	Rows returned	Rows modified	Coordinator status
call get_dbspace_wholeTCAST (P AS INT)	5	0.00032	—	0.00005	0	1	0	
CALL SP_NOCACHE(TRANSACTIONNAME...)	1	0.00054	—	0.000	0	0	0	
with dm as (select distinct host_name, DBNAME,	5	0.00052	—	0.00002	0	1	0	
LOCK TABLE SHEDULES STATISTICS_DBNAME...	5	0.00002	—	0.00002	0	0	0	
select CPU_SYSTEM as cpusystem, CPU_US...	10	0.00001	—	0.00001	0	1	0	
SELECT TRIGNAME FROM SHEDULE_TRIGGER...	1	0.00001	—	0.000	4	4	0	
WITH UNQUOTE_FKNC AS (SELECT NULL FR...	5	0.00001	—	0.000	0	12	0	
SELECT POLICY FROM SYSTEM.POLICY_W...	1	0.00001	—	0.000	1	1	0	
SELECT TABSCHEMA, TABNAME, PROPERTY...	2	0.000	—	0.000	1	1	0	

### 3. Configure, keep everything as default.

Create a database

Type

Configure

Advanced configuration

System storage

User storage

Backup storage

Transaction logs storage

Temporary table spaces storage

Finalize

**Configure**

Database name: BLUDB

Number of nodes: 1

CPU per node for Db2: 2.1

Memory per node for Db2: 5.5

Deploy database on dedicated nodes

Namespace:

Use an existing namespace: cpd-instance

Storage structure:

Select a storage option: Separate locations for all data

Continue with defaults

### 4. Advance configuration, keep as default

Create a database

Type

Configure

Advanced configuration

System storage

User storage

Backup storage

Transaction logs storage

Temporary table spaces storage

Finalize

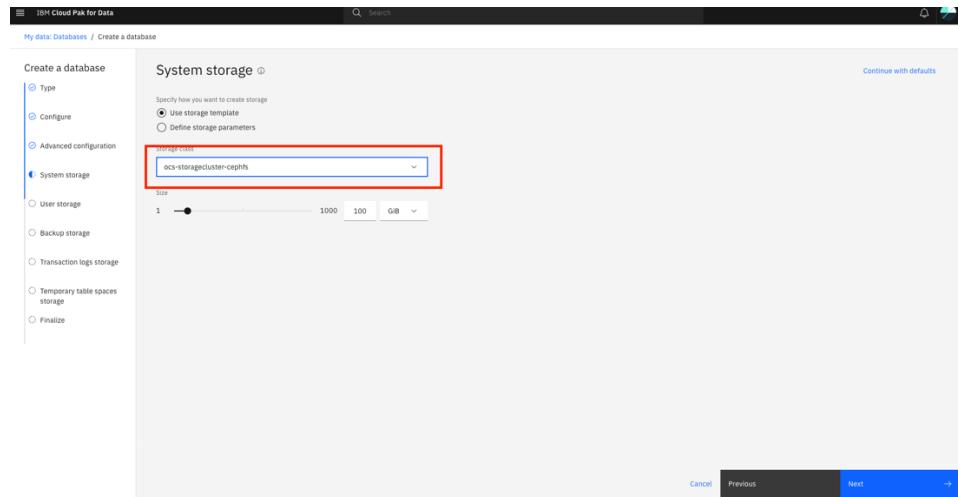
**Advanced configuration**

Oracle compatibility

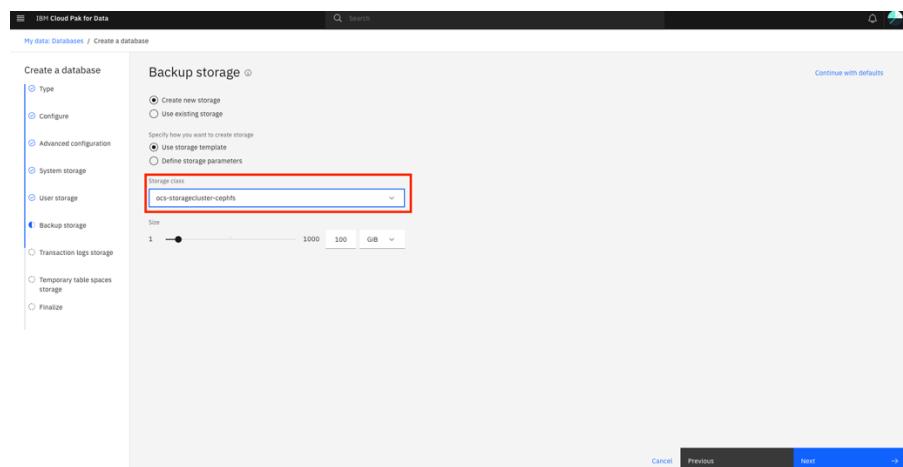
Page size: 16384

Continue with defaults

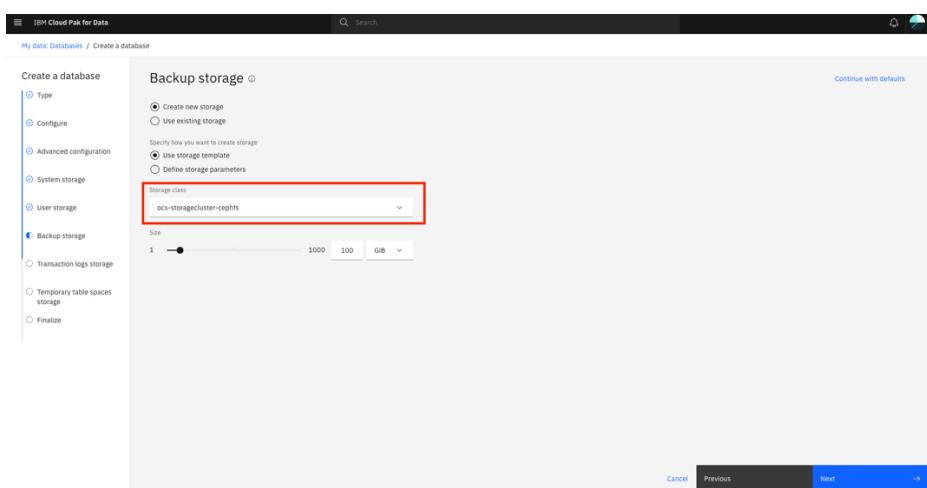
5. System storage , change the storage class to “ocs-storagecluster-cephfs” and keep others as default.



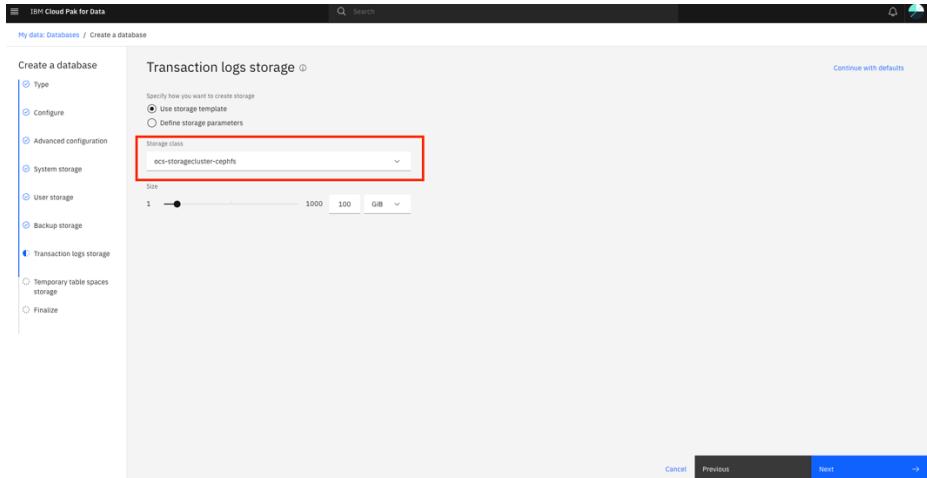
6. User storage , change the storage class to “ocs-storagecluster-cephfs” and keep others as default.



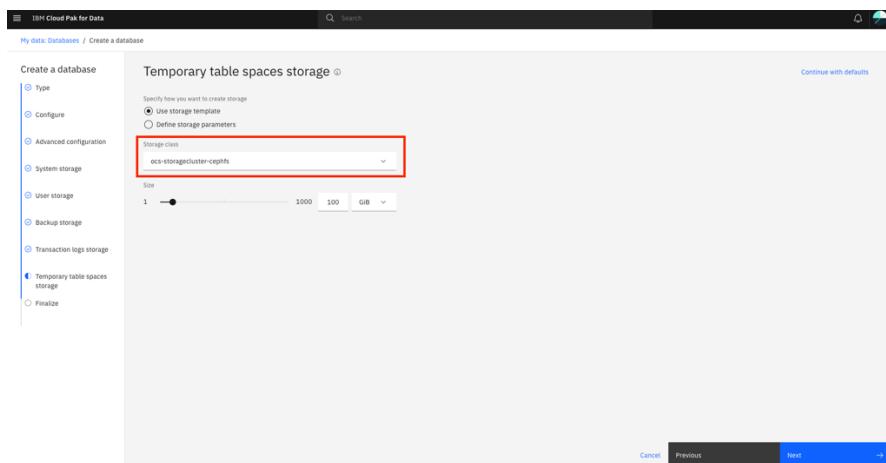
7. Backup storage , change the storage class to “ocs-storagecluster-cephfs” and keep others as default.



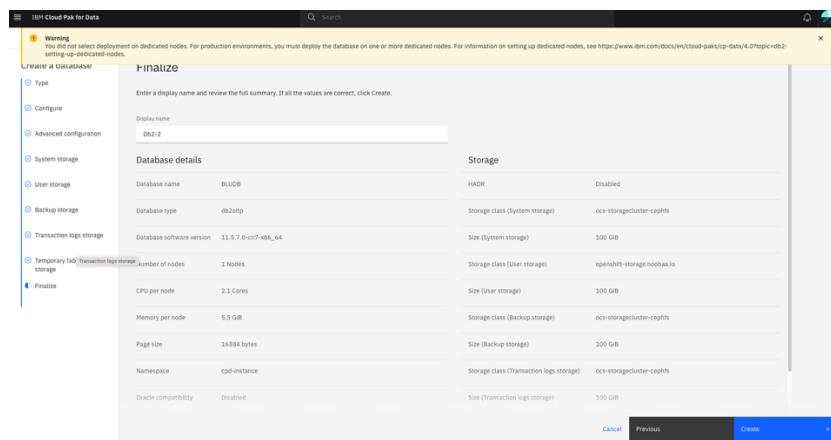
8. Transaction logs Storage , change the storage class to “ocs-storagecluster-cephfs” and keep others as default.



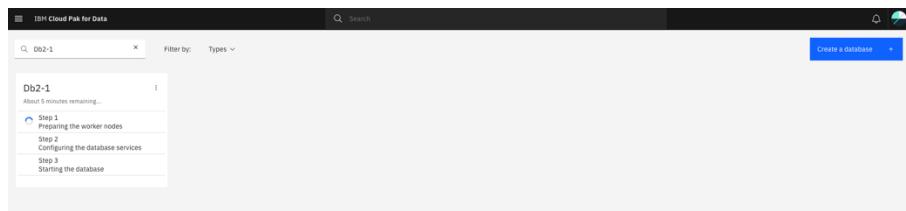
9. Temporary table spaces storage , change the storage class to “ocs-storagecluster-cephfs” and keep others as default.



10. Finalize, please review database and storage details information. Then, create.



11. The database is going to be created. Wait until it completes.



12. Create another one database by replete the step 1-11.

- 2) Create a Cloud Object Storage for Watson OpenScale to keep training data.

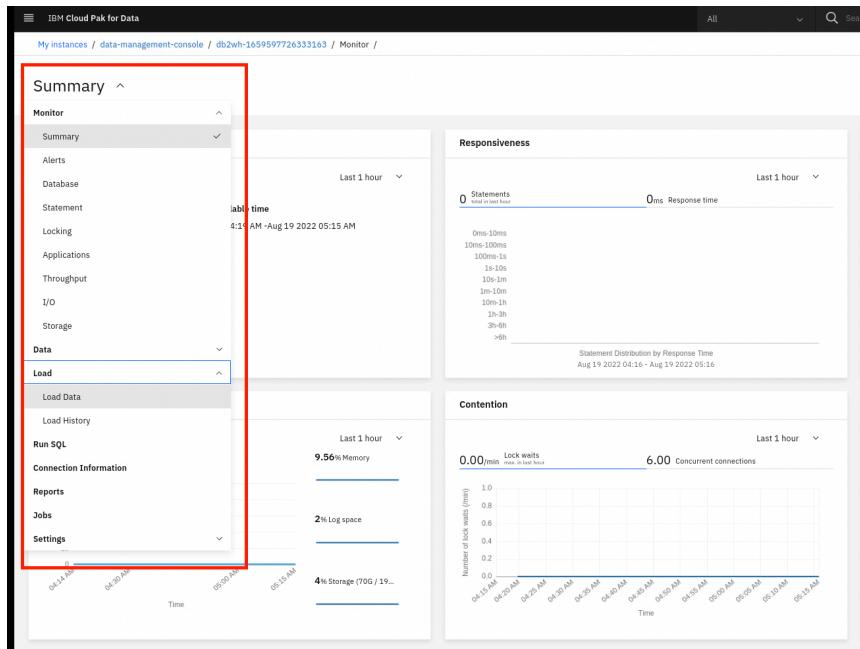
1. Going to <https://cloud.ibm.com/objectstorage>
2. Login to IBM console, if you don't have account, please create one.
3. After login, go to the "catalog" at the top bar. Click "catalog", in the search menu type "Object".
4. Select "Object Storage by IBM"
5. Choose the lite plan and create it.

*Loading the training data to the data warehouse for further model development.*

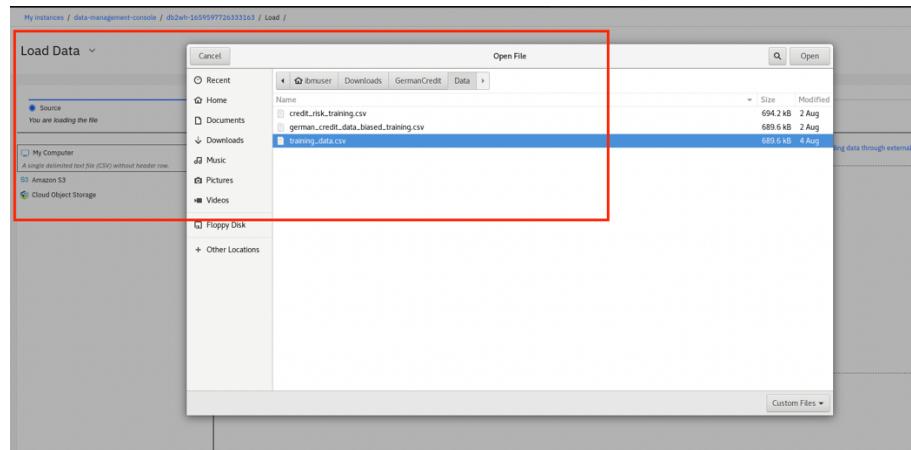
- 1) Go to [https://github.com/IBM-CSM-SG/ASEANZK-CP4D-Practicum/blob/main/scenario2/data/training\\_data.csv](https://github.com/IBM-CSM-SG/ASEANZK-CP4D-Practicum/blob/main/scenario2/data/training_data.csv) and loading training\_data to your local repository.
- 2) Go back to IBM Cloud Pak for Data.
- 3) From navigation menu, go to Data > Database.

Type	Created by	vCPU requests	Memory requests (GiB)	Users	Status	Created on
db2wh	admin	6.20	18.25 Gi	1	Green	Aug 4, 2022
db2wh	admin	6.20	18.25 Gi	1	Green	Aug 4, 2022
dv	admin	11.60	38.70 Gi	1	Green	Apr 5, 2022
dmc	admin	3.70	9.50 Gi	1	Green	Apr 5, 2022
aos	admin	-	-	1	Green	Apr 5, 2022

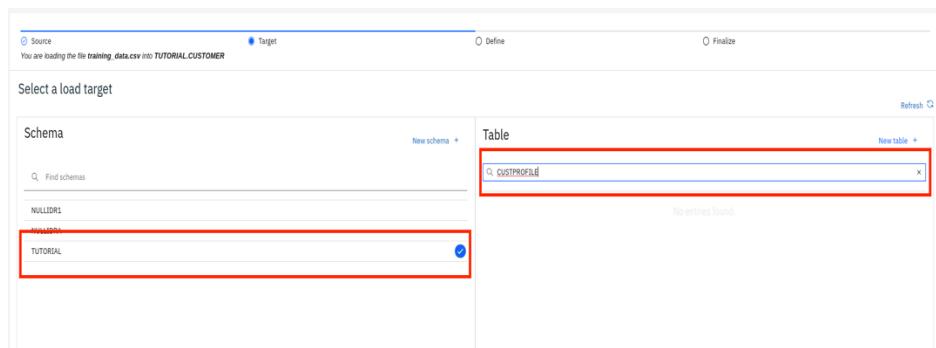
- 4) Open the first data warehouse you can see the "Summary" in the left hand-side. Click drop down and go to "Load". Under "Load", click load data.



5) From the Load Data GUI, browse file and upload training\_data to DB2 data warehouse.



6) Create new schema name “TUTORIAL” and Create new table name “CUSTPROFILE”



- 7) Click next and review columns name. Click next and begin load.

Load Data ▾

The screenshot shows the 'Load Data' interface in IBM Cloud Pak for Data. At the top, there are tabs for 'Source' (selected), 'Target', 'Define', and 'Finalize'. Below the tabs, there are settings for 'Code page (character encoding): 1208 (UTF-8)', 'Separator: ,', 'Header in first row: (checked)', 'Time & date format: (unchecked)', and 'Detect data types: (unchecked)'. The target table is 'TUTORIAL.CUSTPROFILE'. The data table contains 10 rows of customer profile information:

	LOANAMOUNT SMALLINT	SEX VARCHAR(6)	AGE SMALLINT	HOUSE VARCHAR(4)	CREDITCARD SMALLINT	JOB VARCHAR(10)	DEPENDENT SMALLINT	TELEPHONE VARCHAR(4)	FOREIGNER VARCHAR(3)	RISK VARCHAR(7)
1	1889	female	32	own	1	skilled	1	none	yes	No Risk
2	462	female	37	own	2	skilled	1	none	yes	No Risk
3	250	male	28	own	2	skilled	1	yes	no	No Risk
4	3693	male	32	own	1	skilled	1	none	yes	No Risk
5	6235	male	57	own	2	skilled	1	none	yes	Risk
6	9604	male	57	free	2	skilled	2	yes	yes	Risk
7	3109	female	36	own	2	skilled	1	none	yes	No Risk
8	7138	male	49	free	2	skilled	2	yes	yes	Risk
9	4302	male	34	free	1	skilled	1	none	yes	No Risk
10	3310	male	40	free	1	skilled	1	yes	yes	No Risk

- 8) In the final page, check the data is download completely.

The screenshot shows the final page of the data load process. It displays the 'Load details' section with a summary table showing 4,359 rows read, 4,359 rows loaded, and 0 rows rejected. The status bar indicates the start time was 08/16/2022 9:31:11 AM and the end time was 08/16/2022 9:31:17 AM. To the right, a message states 'The data load job succeeded. You can now work with your data.' and a 'View Table' button is available. A separate box on the right shows 'Errors 0' and 'Warnings 0' with the message 'No errors'.

### Create a project

- 1) If you have an existing project, open it. If you don't have an existing project, click **Create a project** on the home page or click New project on your **Projects** page.
- 2) Select **Analytics Project** and Next.
- 3) **Create an empty** project.
- 4) On the Create a project screen, add a name and optional description for the project.
- 5) Click Create.

### Task 1: Build Model

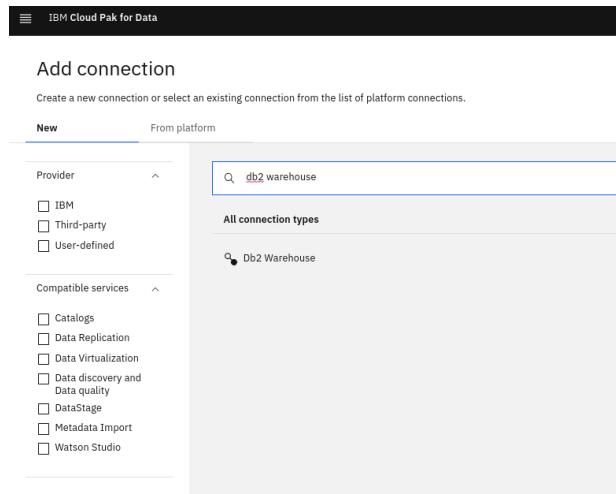
#### Task 1.1: Connect to the Data Warehouse.

Before you build the model using Auto AI, you need to connect the data to the project first. So, the data we will use is already located in the DB2 Data Warehouse which we have already loaded data in the previous step. To connect the Data Warehouse, follow the steps below;

- 1) Go to the project,

- 2) Set up the project connection first for CP4D communicate with DB2 Data Warehouse to get data for model development.

- Add to project.
- Go to connection and add connection.
- In the connection page find “DB2 Warehouse”, click and select.



- Open another window and navigate to DB2 data warehouse instance. Click on the instance name that used for storing `training_data` and click to see the details.

About this database		Storage	
Database name	BLUDB	Storage class (System storage)	managed-nfs
Database type	db2wh	Size (System storage)	100 GiB
Database software version	11.5.7.0-cn3-x86_64	Storage class (User storage)	managed-nfs
Processor	x86-64	Size (User storage)	100 GiB
Deployment id	db2wh-165959772633163	Storage class (Backup storage)	managed-nfs
Created on	Aug 4, 2022 3:22 AM	Size (Backup storage)	100 GiB
Status	Available	Storage class (Transaction logs storage)	managed-nfs
Nodes		Size (Transaction logs storage)	100 GiB
HOSTNAME	CPU	Storage class (Temporary table spaces storage)	managed-nfs
worker2	6.1 cores	Size (Temporary table spaces storage)	100 GiB

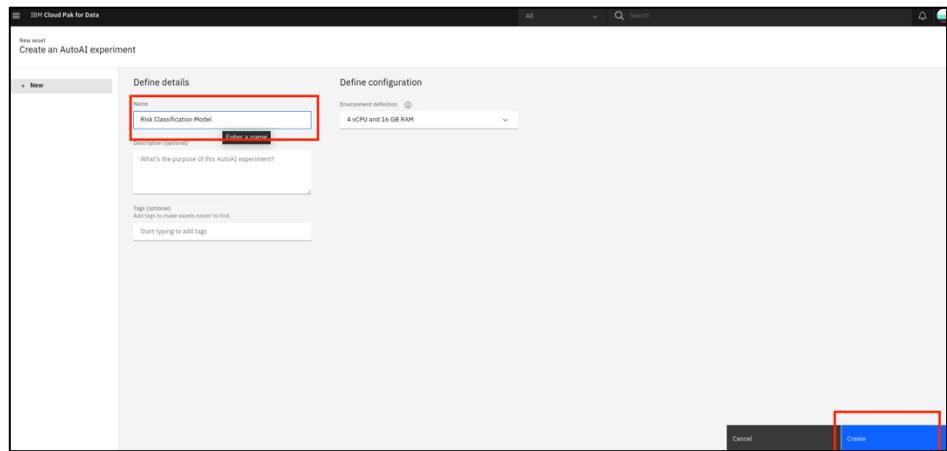
- Use the information fill in to the “Create connection: DB2 Warehouse”. After filling all information, then click create.
- If the the data warehouse is connected to data based properly, you will see the screen like this.

Note: If you need to connect via using API key, please generate the API key by going to your “profile and setting” which located in the top right corner. Then generate API key.

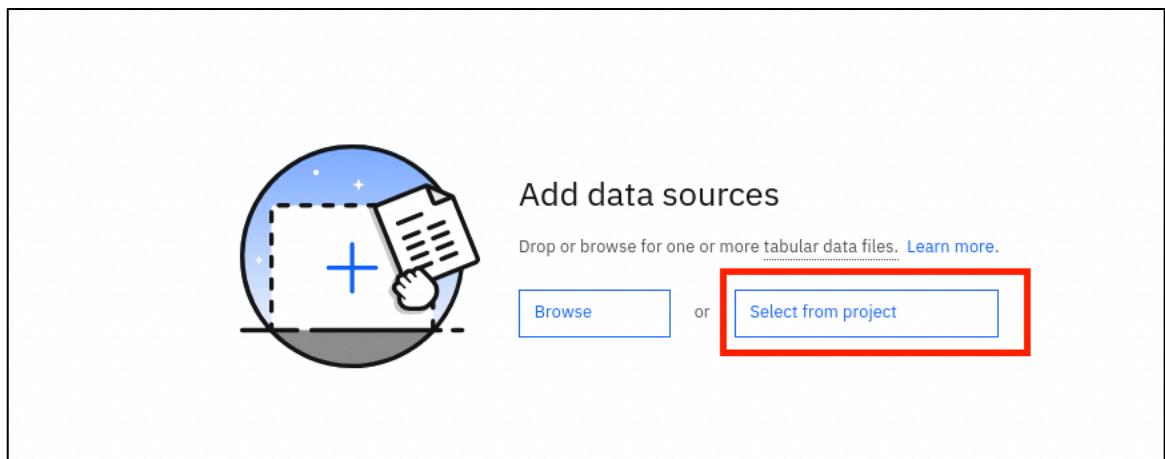
### Task 1.2: Build the model using Auto AI

- 1) In the project page under asset tab, go to the right hand side click “ADD to Project”
- 2) Add AutoAI Experiment to the project.

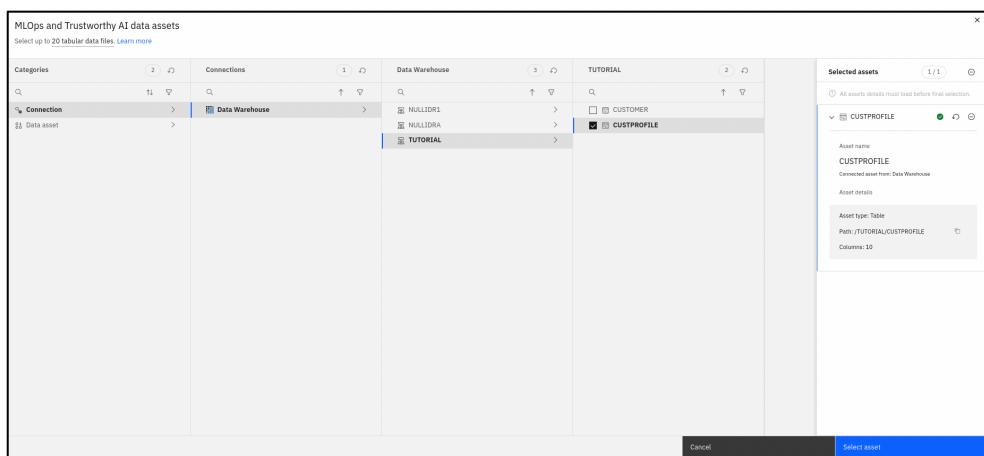
- 3) Give the name of the AutoAI Experiment and then create.



- 4) Add the data source, in our case we will use the connection from our project. So, choose select from project.

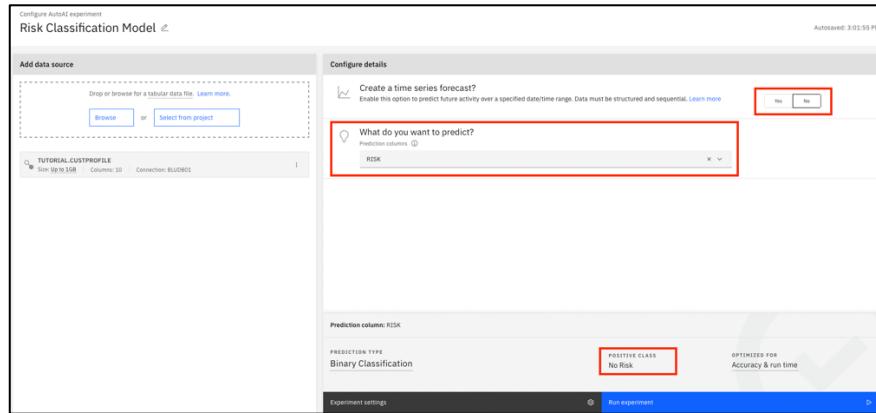


- 5) Select “Connection” > “Data Warehouse” > “TUTORIAL” > “CUSTOMERPROFILE” and select asset.



- 6) In the configuration page
- o Create a time series forecasting? Select “No”, because we will do the classification model to classify the customer “Risk”

- What do you want to predict? Choose the target variable in this case is “Risk”
- Select the Positive Class to be “No RISK”. This is what we are interested in.
- Then run the experiment.



- 7) During the AutoAI Experiment has been run, you can see the Experiment Summary. Please explore the AutoAI Page and list down any questions you have.
- 8) In the pipeline leader board, you can see the eight model pipeline are generated and they're already ranked by performance (Accuracy).

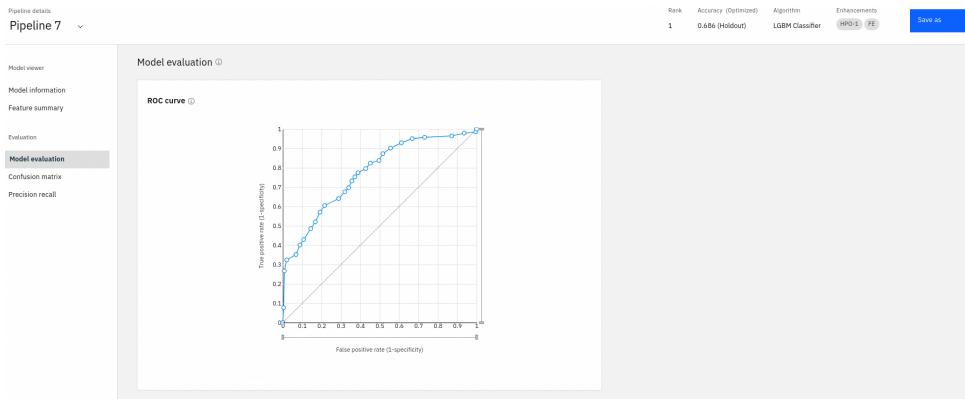
Rank	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
1	Pipeline 7	LGBM Classifier	0.733	HPO-1   FE	00:00:17
2	Pipeline 8	LGBM Classifier	0.733	HPO-1   FE   HPO-2	00:00:28
3	Pipeline 3	Snap SVM Classifier	0.731	HPO-1   FE	00:00:14
4	Pipeline 4	Snap SVM Classifier	0.731	HPO-1   FE   HPO-2	00:00:01
5	Pipeline 6	LGBM Classifier	0.727	HPO-1	00:00:16
6	Pipeline 1	Snap SVM Classifier	0.720	None	00:00:01
7	Pipeline 2	Snap SVM Classifier	0.720	HPO-1	00:00:01
8	Pipeline 5	LGBM Classifier	0.705	None	00:00:01

- 9) Under name click the top pipeline in your leader board to see the information of the model.

Pipeline leaderboard ▾

Rank	Name	Algorithm	Accuracy (Optimized) Cross Validation	Enhancements	Build time
1	Pipeline 7	LGBM Classifier	0.733	HPO-1   FE	00:00:17
2	Pipeline 8	LGBM Classifier	0.733	HPO-1   FE   HPO-2	00:00:28
3	Pipeline 3	Snap SVM Classifier	0.731	HPO-1   FE	00:00:14

- 10) You can see the details of model performance. The model information, feature summary, model evaluation and metric are generated for data scientist to examine.



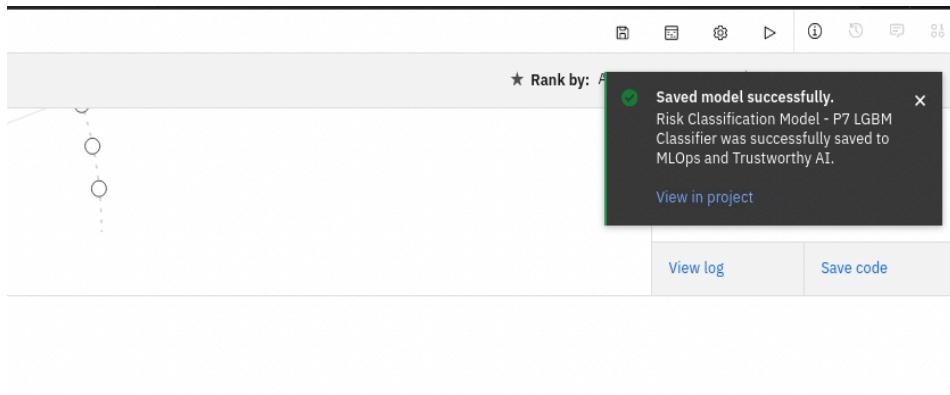
**Congratulation!!!** You have done for the model building part.

## Task 2: Save and Deploy Model

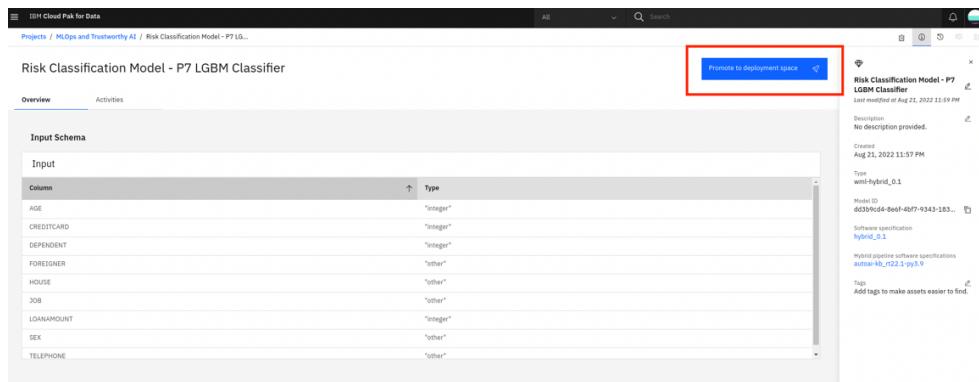
- 1) Go back to the model leader board.
- 2) Click “Save as” on the top rank model.

- 3) Go back to the model leader board.
- 4) Click “Save as” on the top rank model.
- 5) We keep everything default. We save the model as Model and Use the default name which generated by system. Click Create.

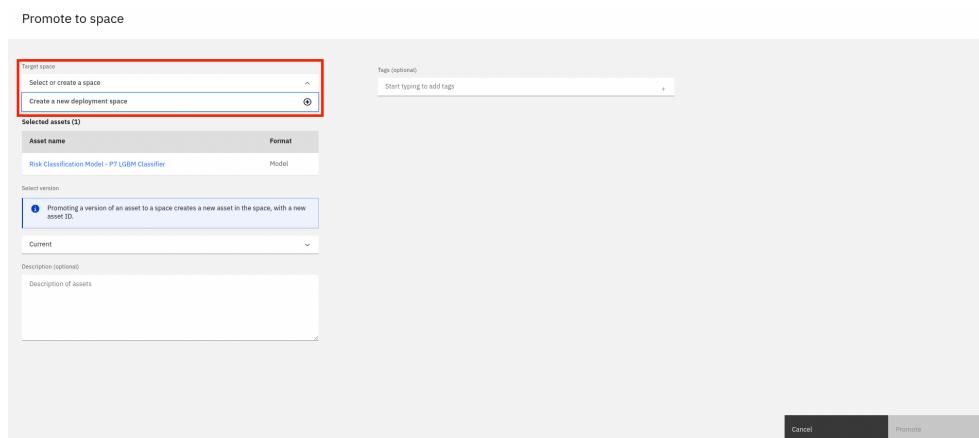
- 6) Once you save, it will back to AutoAI page, click view in project.



- 7) Review input schema and model information. On the top right corner, click "Promote to deployment space" to promote our model to deployment space (Watson Machine Learning).



- 8) Under target space, please click to create a new deployment space.



- 9) Give the deployment space name and then create.

Create a deployment space

Use a space to collect assets in one place to create, run, and manage deployments

**Define space details**

Name	Credit Risk
Description (optional)	Deployment space description

**Deployment space tags (optional) (1)**

Add a tag
-----------

**Create**

- 10) Back to promote to space page, select the target space that we just already created and keep everything default. Then click promote to promote our model.

Promote to space

**Target space**

Credit Risk
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Go to the model in the space after promoting it

**Selected assets (1)**

Asset name	Format
Risk Classification Model - P7 LGBM Classifier	Model

**Select version**

<input checked="" type="radio"/> Promoting a version of an asset to a space creates a new asset in the space, with a new asset ID.
--

**Description (optional)**

Description of assets

**Promote**

- 11) Once you promote it, it will lead you to the project page. You can see your model is saved and on the top right corner click "go to the deployment space"

IBM Cloud Pak for Data

Projects / ML Ops and Trustworthy AI

Overview Assets Environments Jobs Access control Settings

All Search

What assets are you looking for?

**Data assets**

0 assets selected.

Name	Type	Created by	Last modified
Data Warehouse	Connection	admin	Aug 21, 2022, 10:42 PM

**AutoAI experiments**

Name	Status	Model type	Last modified
Risk Classification Model	Completed	Binary Classification	Aug 21, 2022, 11:22 PM

**Models**

Watson Machine Learning models

Name	Type	Software specification	Last modified
Risk Classification Model - P7 LGBM Classifier	wml-hybrid_0.1	hybrid_0.1	Aug 21, 2022

**Success message**

Successfully promoted Risk Classification Model - P7 LGBM Classifier to the deployment space. Go to the deployment space to explore the assets for deployment.

- 12) On the deployment space under asset tab, you can see your model is registered to the repository. Click at your model name.

The screenshot shows the IBM Cloud Pak for Data interface. The top navigation bar includes 'IBM Cloud Pak for Data', 'All', a search bar, and various icons. Below the navigation is a breadcrumb trail: 'Deployments / Credit Risk'. The main content area has tabs for 'Overview', 'Assets' (which is selected), 'Deployments', 'Jobs', and 'Manage'. A search bar says 'What assets are you looking for?'. Under the 'Models' section, there is one entry: 'Risk Classification Model - P7 LGBM Classifier' (Type: wml-hybrid\_0.1, Software specification: hybrid\_0.1, Last modified: Aug 22, 2022 1:49 AM). On the right side, there is an 'Import model' button and a file upload area with instructions: 'Drop files here or browse for files to upload.' A note below says 'Stay on the page until upload completes. Incomplete uploads are cancelled.'

13) Click new deployment to deploy your model.

The screenshot shows the deployment details for the 'Risk Classification Model - P7 LGBM Classifier'. The top navigation bar shows 'Deployments / Credit Risk'. The main content area displays the model's details: 'Risk Classification Model - P7 LGBM Classifier' (Created: Aug 22, 2022 1:49 AM, Type: wml-hybrid\_0.1, Model ID: 63070794-c195-4ab3-9ba4-d923..., Software specification: hybrid\_0.1). It also shows 'Source asset details'. On the left, there is a message: 'You don't have any deployments yet. Create your first deployment for this model. Learn more'. A 'New deployment' button is highlighted with a red box.

14) Under create a deployment page.

- Choose deployment type to be “Online” because we need the model to return result on-line (real-time) upon inference.
- Give the name of this deployment
- Create.

The screenshot shows the 'Create a deployment' dialog. At the top, it says 'Create a deployment'. The 'Associated asset' section shows 'Risk Classification Model - P7 LGBM Classifier'. The 'Deployment type' section has two options: 'Online' (selected) and 'Batch'. The 'Name' field is filled with 'Credit Risk Model LGBM Deployment' and is highlighted with a red box. Below the name are fields for 'Deployment serving name', 'Description', and 'Deployment description'. At the bottom, there are 'Tags' and 'Software specification' sections, and a 'Create' button at the bottom right is highlighted with a red box.

15) Wait until the model is deployed successfully and then please click at the name of the model to see the details of deployment.

The screenshot shows the 'Deployments' section of the IBM Cloud Pak for Data interface. On the left, there's a navigation bar with 'Deployments / Credit Risk /'. Below it, the title 'Risk Classification Model - P7 LGBM Classifier' is displayed. A 'New deployment' button is located at the top right. The main area is divided into two tabs: 'Deployments' (selected) and 'Model details'. Under 'Deployments', there's a table for 'DEPLOYMENT TYPES' with rows for 'Online' and 'Batch'. The 'Online' row has one item: 'Credit Risk Model LGBM Deployment' with status 'Deployed' and last modified date 'Aug 22, 2022 2:02 AM'. To the right of the table, the 'Model details' tab is open, showing the model's metadata: Type 'wmn-hybrid\_0.1', Model ID '63076794-c195-4ab3-9ba4-d823...', Software specification 'hybrid\_0.1', and a note about hybrid pipeline software specifications. There are also sections for 'Description' (No description provided), 'Tags' (Add tags to make assets easier to find), and 'Source asset details'.

16) Under deployment page, you can see the detail of the deployment.

### Explore API Reference and Test

- API Reference – The endpoint and code snippets are created for further use in the other front-end system.
- Test – The testing area to test the API and model inference.
- Next step in the test tab, we will test the endpoint and inference. Please enter input data as follow;
  - LOANAMOUNT : 2000
  - SEX : male
  - AGE : 32
  - HOUSE : own
  - CREDITCARD : 1
  - JOB : skilled
  - DEPENDENT : 1
  - TELEPHONE : yes
  - FOREIGNER :no
- Add to list > Predict.
- Check the model can give you the result properly or not.

**Congratulation!!!** You have done for the model deployment and testing part.

### Task 3: Set up Model Monitoring with Watson OpenScales

- 1) Go back to the IBM Cloud Pak for Data Navigation bar. Service > Instance
- 2) Check the OpenScale instance is already created. If not, please contact your facilitator.

Instances								
Name	Type	Created by	vCPU requests	Memory requests (GiB)	Users	Status	Created on	
Db2 Warehouse-1 Db2 Warehouse 11.5.7.0-cn3-x86_64	db2wh	admin	6.20	18.25 Gi	1		Aug 4, 2022	
Db2 Warehouse-2 Db2 Warehouse 11.5.7.0-cn3-x86_64	db2wh	admin	6.20	18.25 Gi	1		Aug 4, 2022	
data-virtualization	dv	admin	11.60	38.70 Gi	1		Apr 5, 2022	
data-management-console Data Management Console	dmc	admin	3.70	9.50 Gi	1		Apr 5, 2022	
<b>openscale-defaultinstance IBM Watson OpenScale</b>	aos	admin	-	-	1		Apr 5, 2022	

- 3) On the right hand-side of OpenScale instance row, you will see triple dot. Click “Open” to the OpenScale Application.
- 4) On the OpenScale landing page, click “Manual setup”
- 5) In the system setup, first set up the database.
  - o Choose the database type to be “DB2”. We will use the second DB2 Data warehouse which is created for OpenScale (not the same as we use to keep training data)
  - o Go back to service > instance to get the data warehouse credential.

My data: Databases / Db2 Warehouse-2 / Details								
Details: Db2 Warehouse-2								
Deployment id	db2wh-1659596976865976							
Created on	Aug 4, 2022 3:09 AM			Storage class (Backup storage)	managed-nfs			
Status	Available			Size (Backup storage)	100 GiB			
Nodes				Storage class (Transaction logs storage)	managed-nfs			
HOSTNAME	CPU	MEMORY		Size (Transaction logs storage)	100 GiB			
master1	6.1 cores	18.0 GiB		Storage class (Temporary table spaces storage)	managed-nfs			
				Size (Temporary table spaces storage)	100 GiB			
Access information								
JDBC Connection URL	jdbc:db2://<CLUSTER_ACCESSIBLE_IP>:32236/BLUDB:user=-;password=<password>;securityMechanism=0;encryptionAlgorithm=2							
JDBC Connection URL (SSL)	jdbc:db2://<CLUSTER_ACCESSIBLE_IP>:30057/BLUDB:user=-;password=<password>;securityMechanism=9;sslConnection=true;encryptionAlgorithm=2							

- o Go back to the openpage data base configuration page and fill in the credential information. Then get connect.

**System setup**

Connect to a database, machine learning providers, and integrated services. Optionally enable batch support.

Database  
Machine learning providers  
Batch support (optional)  
Integrations (optional)  
Users & roles

Required  
Database  
Description  
Select a database to store your model transactions and model evaluation results. For Db2 options that are part of your cluster, see Services, Data Sources where you find options, such as Db2 Warehouse and Db2 Advanced Enterprise Server Edition. For an external database, you can use IBM DB2 Database.

Database type  
Db2

Database location  
Other

Hostname or IP address  
master1

Port  
32236

Use SSL

Database  
BLUDB

Username  
admin

Password  
\*\*\*\*\*

Connect Success

- Check the database is connected to OpenScale successfully.
- Then scroll down a bit, under schema choose Auto-create a new schema, then save.

Database  
BLUDB

Username  
admin

Password  
\*\*\*\*\*

Connect Success

Schema  
No schema found

Auto-create a new schema

Cancel Save

- Finish OpenScale database setup.

## 6) Setup machine learning provider.

- On the machine learning providers page, click “add machine learning provider”

System setup

Connect to a database, machine learning providers, and integrated services. Optionally enable batch support.

Database  
Machine learning providers  
Batch support (optional)  
Integrations (optional)  
Users & roles

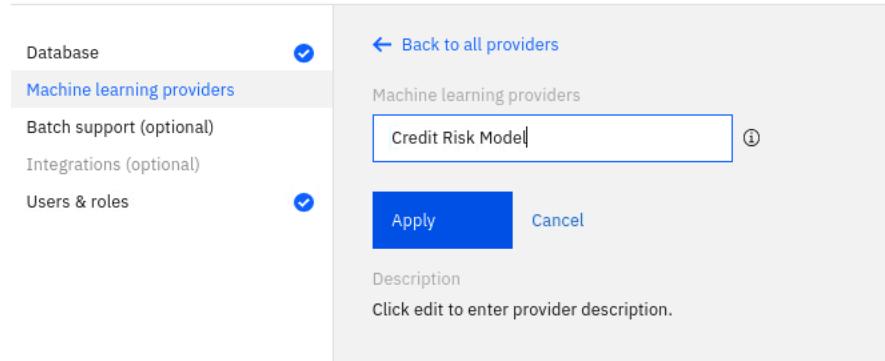
Required  
Machine learning providers  
Description  
Watson OpenScale connects to deployed models stored in a machine learning environment.

Add machine learning provider

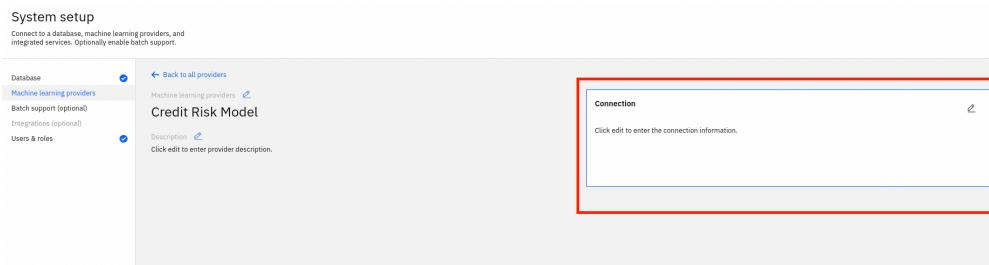
- Give the machine learning provider name.

## System setup

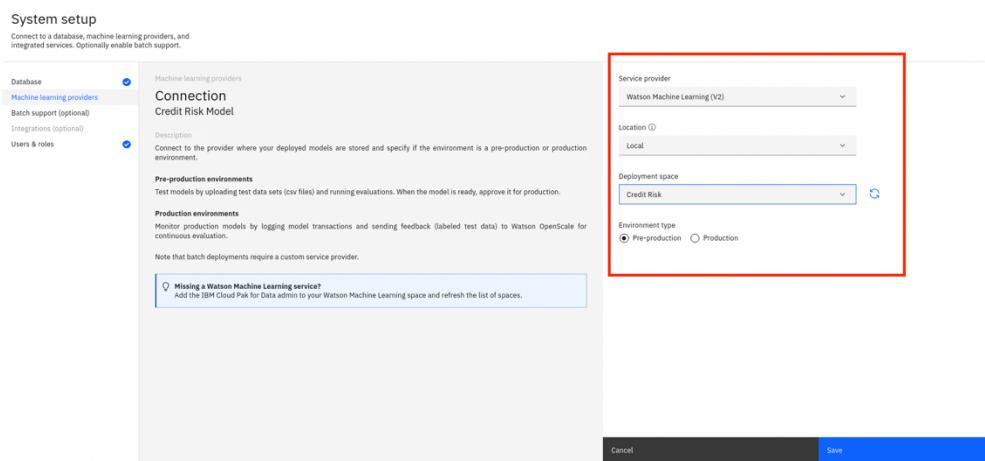
Connect to a database, machine learning providers, and integrated services. Optionally enable batch support.



- Click connection to set up the connection with machine learning provider.

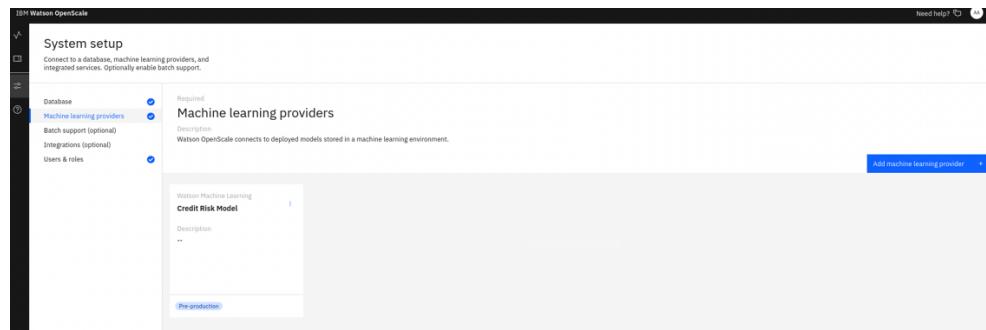


- Under connection set up page, please configure it as follows;
  - Service provider : Watson Machine Learning (V2)
  - Location : Local
  - Deployment space : <your deployment space name>
  - Save.



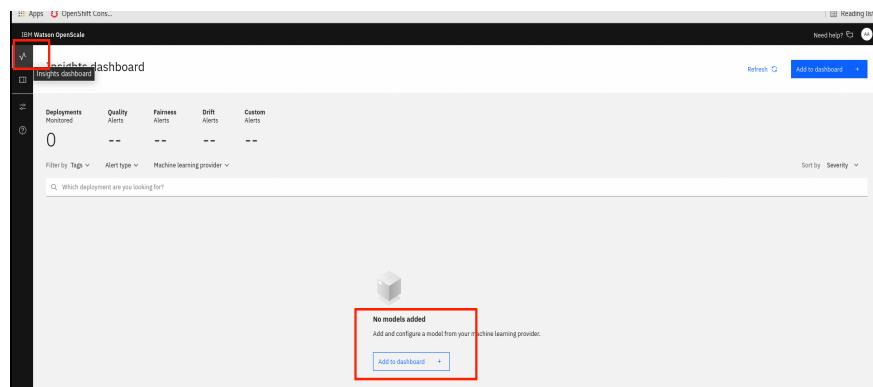
- Machine Learning Provider is setup successfully.

-

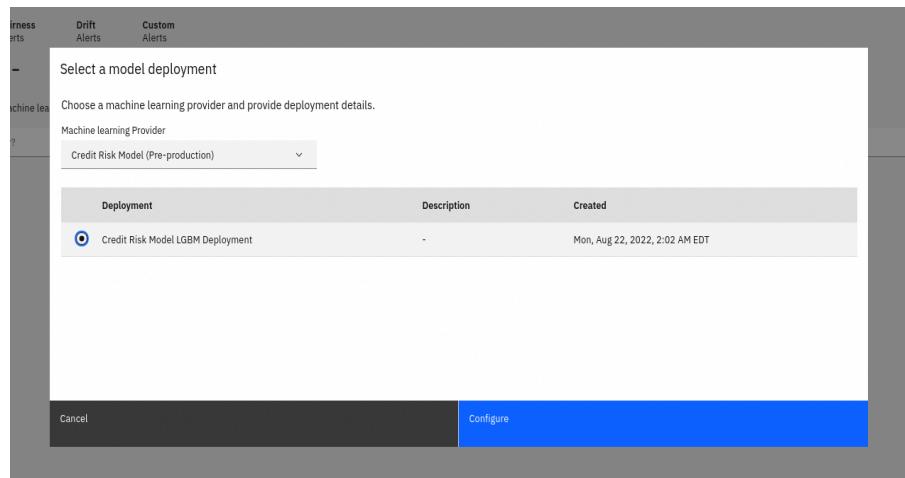


## 7) Setup OpenScale dashboard.

- Click insight dashboard on the left hand-side of the menu bar.
- From the insight dashboard page, click add to dash board.



- Add our machine learning provider to the dashboard.



- Our machine learning provider is added to the dashboard successfully.

The screenshot shows the 'Insights dashboard' for an 'IBM Watson OpenScale' deployment. At the top, there are tabs for 'Deployments Monitored', 'Quality Alerts', 'Fairness Alerts', 'Drift Alerts', and 'Custom Alerts'. Below these, a summary table shows a single deployment ('1') with all alert counts at zero. A search bar at the bottom allows filtering by 'Tags', 'Alert type', and 'Machine learning provider'. A sidebar on the left lists deployment details for 'Credit Risk Model' and 'Credit Risk Model LGBM Dep...'. The main content area displays deployment status as 'Pre-production' with 'Evaluation pending'.

## 8) Configure monitors.

- From the machine learning provider, click triple dots and configure monitor.

This screenshot shows the deployment configuration interface for a 'Credit Risk Model'. It includes sections for 'Deployments Monitored' (1), 'Quality Alerts', 'Fairness Alerts', 'Drift Alerts', and 'Custom Alerts'. A search bar at the bottom allows filtering by 'Tags', 'Alert type', and 'Machine learning provider'. In the deployment details section, under 'Issues', the 'Configure monitors' button is highlighted with a red box. Other options shown include 'View details', 'Remove deployment', and status indicators like 'Pre-production' and 'Evaluation pending'.

- Model details configuration.

- Model input:
  - Data type : Numeric/categorical
  - Algorithm type : Binary Classification
  - Save and continue.
- Training data:
  - Going to <https://www.ibm.com/cloudibm> and login to IBM console.
  - From the navigation bar left hand-side, select the resource list.
  - Find Storage and select your object storage.
  - Create bucket
    - Choose quickly get start
    - Give a bucket name for example “trainingdataforwos”
    - Next and the bucket will be created.
  - Upload the training data to the “trainingdataforwos” bucket

- Back to service credential to see the credential information.
- Back to model detail > Training data setup in OpenScale. Then configure and fill in Object Storage credential
  - Storage type : Database or cloud storage
  - Location : Cloud object Storage
  - Resource instance id : <your object storage resource instance id>
  - API Key : <your object storage API key>
  - Click connect
  - Choose the bucket
  - Choose the data set.
  - Next

Storage type  
Database or cloud storage

Location  
Cloud Object Storage

Resource instance ID  
crn:v1:bluemix:public:cloud-object-storage:global:a/432ff2d283604e4f8a4e4c

API key  
.....

Bucket  
trainingdataforwos

Data set  
training\_data.csv

Cancel      Next

- Select label columns
  - Choose “Risk”

- **Next**

Select the label column	
Features (10)	Type
AGE	81
CREDITCARD	81
DEPENDENT	81
FOREIGNER	A
HOUSE	A
JOB	A
LOANAMOUNT	81
RISK	A
SEX	A
TELEPHONE	A

**Back** **Next**

- **Select the training features**

- Choose all feature.
- **Next**

Select the training features Selected features 9

<input checked="" type="checkbox"/> Features (9)	Type	Categorical
<input checked="" type="checkbox"/> AGE	continuous	<input type="checkbox"/>
<input checked="" type="checkbox"/> CREDITCARD	continuous	<input type="checkbox"/>
<input checked="" type="checkbox"/> DEPENDENT	continuous	<input type="checkbox"/>
<input checked="" type="checkbox"/> FOREIGNER	categorical	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> HOUSE	categorical	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> JOB	categorical	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> LOANAMOUNT	continuous	<input type="checkbox"/>
<input checked="" type="checkbox"/> SEX	categorical	<input checked="" type="checkbox"/>
<input checked="" type="checkbox"/> TELEPHONE	categorical	<input checked="" type="checkbox"/>

Items per page: 25 | 1 - 9 of 9 items | 1 of 1 page | < | >

Back Next

- Configure Scoring
  - Scoring Method : JSON payload
  - Download JSON\_Payload\_Example from Github  
[https://github.com/sandeepved/ASEANZK-CP4D-Practicum/blob/main/scenario2/data/JSON\\_Payload\\_E](https://github.com/sandeepved/ASEANZK-CP4D-Practicum/blob/main/scenario2/data/JSON_Payload_E)xample.
  - Open the file and Copy the content.
  - Paste the content to the blank under enter a sample request and responses.
  - Click send now
  - Next.

Scoring method

JSON payload

Enter a sample request and response. Replace the fields and values to match your model input and output. [Learn more.](#)

```
{
  "values": [
    {
      "2000",
      "male",
      32,
      "own",
      1,
      "skilled",
      1,
      "yes",
      "no",
      [0.7541479304432869,
       0.24585206955671313
     ],
     "No RISK"
    }
  ]
}
```

**Send now**

**Back** **Next**

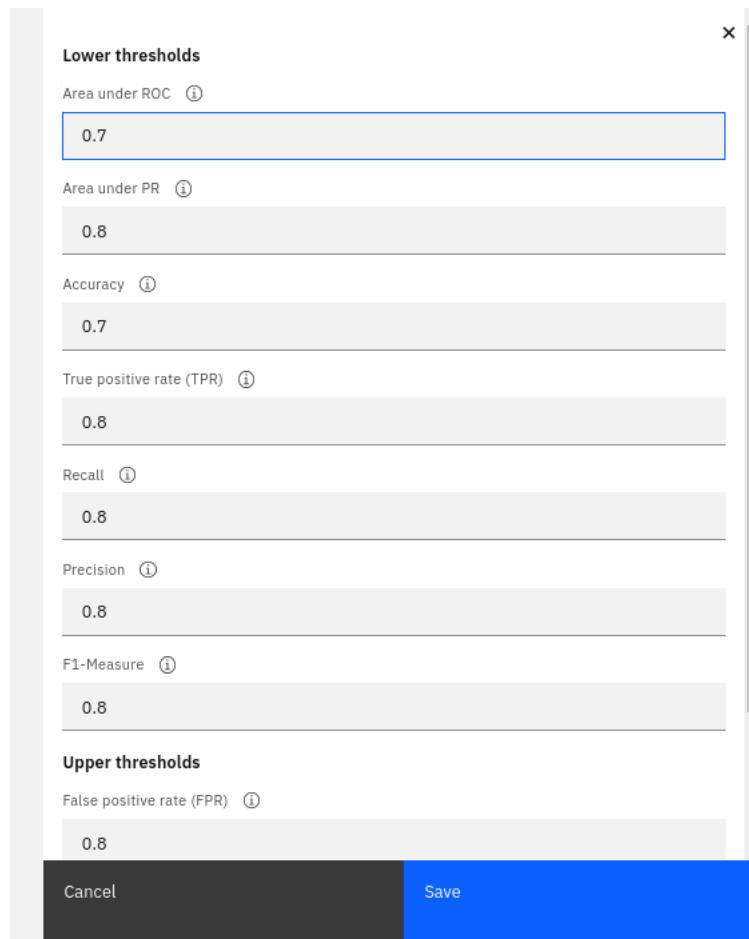
- Specify the model output.
  - Ensure you select prediction and probability.
  - Save

Use the checkboxes to make one or more selections

Features (2)	Type	Prediction	Probability
prediction	A	<input checked="" type="checkbox"/>	
probability	B		<input checked="" type="checkbox"/>

- Explainability
  - Explainability will be configured automatically, once you completed the previous steps correctly.
- Quality
  - Click Quality
  - Quality threshold > edit
  - The lower threshold and upper threshold is the configuration if the monitor metric gets lower up higher than the threshold we set, it will be alerted. Try to change some lower threshold (the
    - Area under ROC : 0.7
    - Accuracy : 0.7

- Save



- Sample size is the size of sample to get evaluate. We will keep 1,000 as default.
- Drift
  - Click Drift
  - Drift Model > edit
  - Training option
    - Choose Train in Watson OpenScale (Suitable when you connected your training data to Watson OpenScale and it is less than 500 MB)
  - Drift thresholds
    - There are two drift metrics, drop in accuracy and drop in data consistency. You can set the thresholds to get alert. We will set to 5percent., so it will give alert if drop in accuracy or data consistency greater than 5 percent.
    - Drop in accuracy : 5%
    - Drop in data consistency 5%

- Sample size is the size of sample to get evaluate. We will keep 1,000 as default.
- Save
- Fairness
  - Click Fairness
  - Favourable Outcome > edit
    - Add 0 and 1 value
    - Set 0 to favourable outcome
    - Set 1 to unfavourable outcome
    - Save

Select the favorable outcomes

1	-	+	Add value
			Favorable values 1 Unfavorable values 1
<input type="text"/>			
Values	Favorable	Unfavorable	
0	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Cancel	Save
--------	------

- Sample size is the size of sample to get evaluate. We will keep 1,000 as default.
- Select the fields to monitoring
  - Select SEX ( We will monitor bias based on SEX attributes)

Select one or more fields

Selected fields 1

Fields	Recommended	Type
<input type="checkbox"/> LOANAMOUNT		
<input checked="" type="checkbox"/> SEX		
<input type="checkbox"/> AGE		
<input type="checkbox"/> HOUSE		
<input type="checkbox"/> CREDITCARD		
<input type="checkbox"/> JOB		
<input type="checkbox"/> DEPENDENT		
<input type="checkbox"/> TELEPHONE		
<input type="checkbox"/> FOREIGNER		

- Specify the monitored groups for [SEX]
  - Add custom value
    - Type “male”, then add value. The check reference for male.
    - Type “female”, then add value. The check monitored for female.
    - Keep fairness alert threshold as default.
    - Save

Select the groups to monitor [SEX]

Add custom value

female Add value

Monitored group 1 Reference group 1

Values	Monitored	Reference	Recommended
female	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
male	<input type="checkbox"/>	<input checked="" type="checkbox"/>	

Set fairness alert threshold [SEX]

80

**Congratulation!!!** You have done for the model monitoring set up part.

Please note that we will not see any alert in the dashboard yet because there are no any new payload load to the model. Once, the payload reached out the threshold sample that we set (1,000 sample), it will evaluate and show the results.