



INTERNAL

SAP AI Core hands-on exercises

AI220-EXERCISE02- BYOM_SOUND_BASED_PDM_WITH_SAP_AI_LAUNCHPAD

This document will guide you step-by-step through the process of training and implementing an AI model in SAP AI Core by using SAP AI Launchpad as a client.

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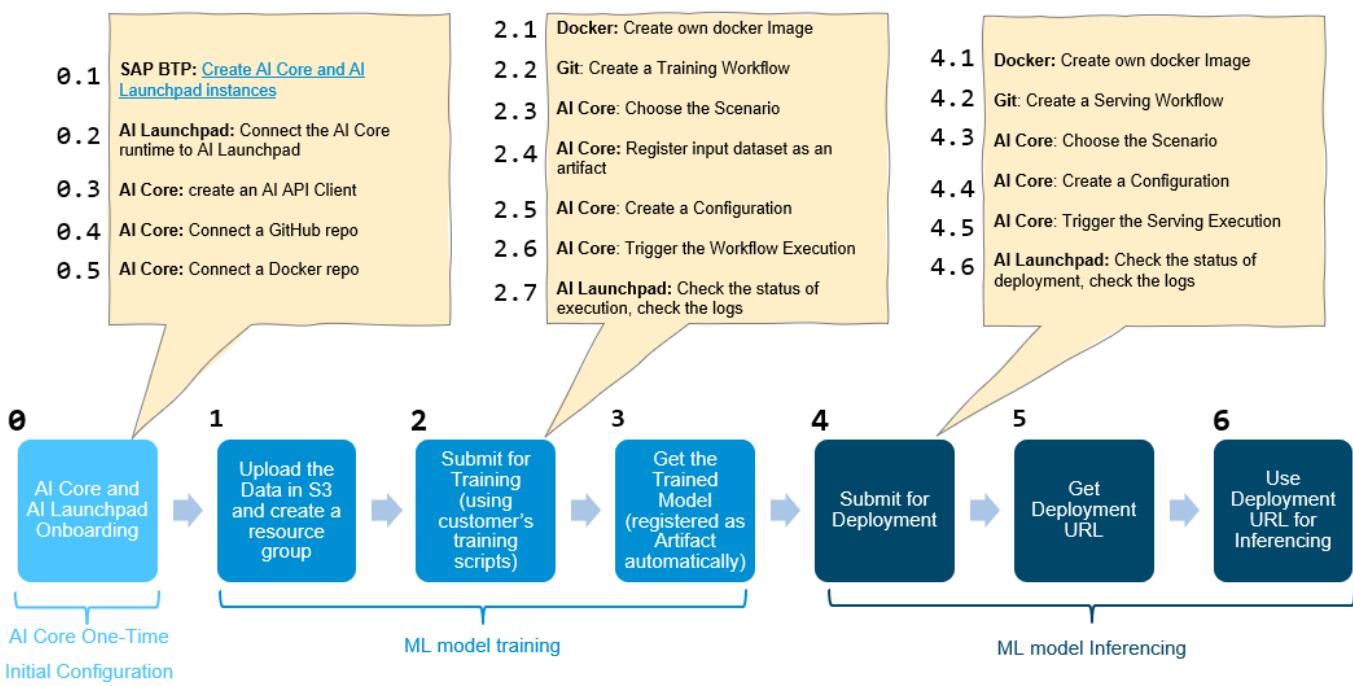
OBJECTIVE

The objective of this exercise is to show that it is possible to start a training or a deployment also from SAP AI Launchpad without passing through a Jupyter notebook.

For this exercise we assume the one-time configurations are already done and that we need to retrain our model for some reason (for instance because we have changed the dataset, we have changed the architecture of the model, we are not satisfied with the previous training, etc...) and to deploy it again.

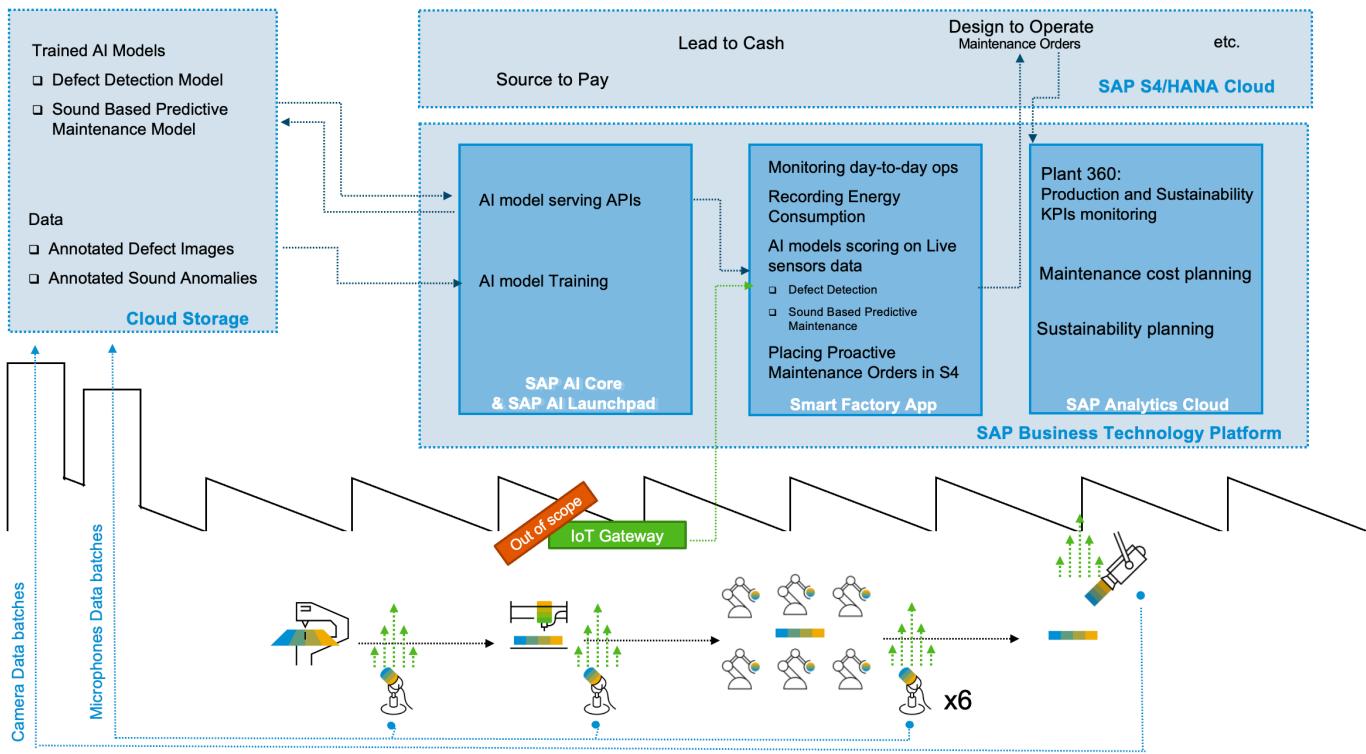
So we are going to reuse the Docker images that we have already built and loaded in the Docker repo, the application and the resource group we have already created.

From the point of view of the ML workflow reported below and with the assumptions we have made, our exercise starts at step 2.



SCENARIO

This exercise follows the scenario you were introduced to in the demo. Bagnoli & Co manufactures Light Guide Plates (LGPs) used in LED panels. An SAP Partner proposed to implement a Smart Factory Application on top of SAP BTP to improve manufacturing operations and raise awareness on sustainability KPIs. Machine condition monitoring based on sound classification was implemented to replace time-based preventive maintenance with proactive (and predictive) maintenance and to prevent downtimes. Sounds are acquired along the production line with several microphones. A Deep Learning model is then built, trained and deployed to classify the sounds, identify anomalies and therefore achieve proactive maintenance of the production line (see image below).



ENVIRONMENT ACCESS

Steps	Explanation
SAP provisioned environments	<p>SAP have provisioned the following:</p> <ul style="list-style-type: none"> • SAP AI Core • SAP AI Launchpad • AWS S3 data storage bucket
Prerequisites	<p>You have completed exercise 2 available in the bootcamp repository: https://github.com/SAP-samples/btp-ai-sustainability-bootcamp/tree/main/src/ai-models/predictive-maintenance/exercises</p> <p>Your trainer will allocate each student a unique user number. This number is used when you save or create objects in the application. In these training instructions, the user number is referred to as uXXXX.</p> <p>Please, refer to your ID in order to reuse the objects you have already created in the exercise 2 with Jupyter notebooks: application, resource group, scenarios, executables, ...</p>

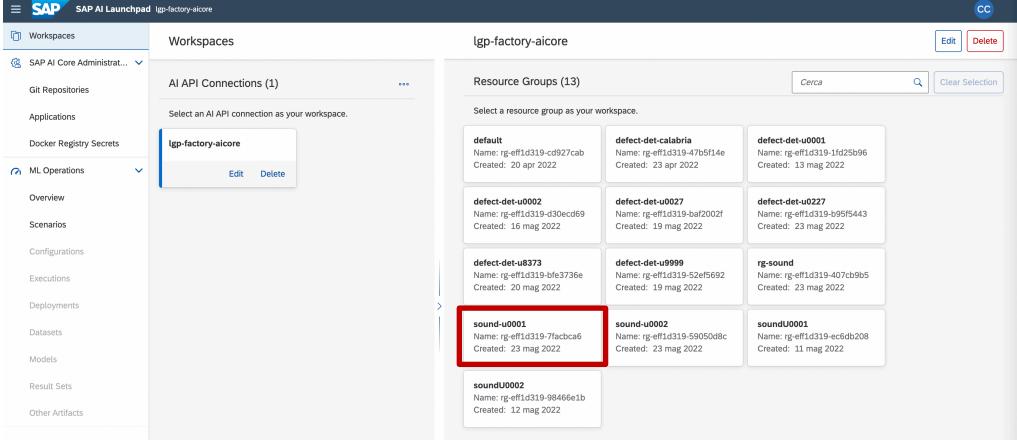
STEP 2 – SUBMIT THE TRAINING

Please, remember that it is assumed that you have performed step 0 and 1 already during Exercise 2. You will start directly with step 2 and will use SAP AI Launchpad exclusively.

It is assumed that substeps 2.1, 2.2 and 2.4 have already been performed, while substep 2.3 is basically included in substep 2.5.

The main reasons for retraining a model are:

- The dataset has changed, e.g. because new data have been added;
- The model architecture has changed or other parts of the code have changed;
- The training templates have changed:
 - Different resource plan;
 - Different docker secret;
 - Different pipeline in the number of steps and container used;

Steps	Explanation + Screenshots
Access SAP AI Launchpad	Please, refer to the instructions reported in the Teams channel: SAP AI Launchpad in System Access 
Choose your resource group from Workspaces in SAP AI Launchpad	 <p>The screenshot shows the SAP AI Launchpad interface. On the left, there's a sidebar with 'Workspaces', 'SAP AI Core Administrat...', 'Git Repositories', 'Applications', 'Docker Registry Secrets', and 'ML Operations' (which is expanded). Under 'ML Operations', there are 'Overview', 'Scenarios', 'Configurations', 'Executions', 'Deployments', 'Datasets', 'Models', 'Result Sets', and 'Other Artifacts'. The main area is titled 'Workspaces' and shows 'AI API Connections (1)'. Below that, it says 'Select an AI API connection as your workspace.' and lists 'lgp-factory-aicore' with 'Edit' and 'Delete' buttons. To the right, there's a section titled 'Resource Groups (13)' with a search bar and a 'Clear Selection' button. It lists 13 resource groups, each with a name, ID, and creation date. One group, 'sound-u0001', is highlighted with a red box.</p>
2.5 Create a training configuration	<p>Once you have selected your resource group, move to the left and from the ML Operations menu choose Configurations.</p> <p>There you will find all the previous configurations you have created during exercise 2 with the second Jupyter notebook. You will create a new configuration.</p> <p>Click on the Create button at the top right of the page.</p>

SAP AI Launchpad Operations / All Configurations

Configurations (4)

Name / ID	Scenario	Executable	Created On	Parameters	Input Artifacts	Action
serving-configuration	sound-scen-u0001	sound-serve-exec-u0001	1 giorno fa 12:26:11	0	1	>
dev-tutorial-serving-configuration	sound-scen-u0001	sound-serve-exec-u0001	1 giorno fa 12:25:51	0	1	>
training-configuration	sound-scen-u0001	sound-train-exec-u0001	1 giorno fa 11:42:51	0	1	>
training-configuration	sound-scen-u0001	sound-train-exec-u0001	1 giorno fa 11:01:57	0	1	>

In the menu, you assign a name to the new configuration and choose a scenario from the ones available (please refer to the one identified by your personal ID). Also choose the version (in this exercise there should be just one available - the one you specified in the templates).

SAP AI Launchpad Operations / All Configurations / Create Configuration

1. Enter Name and Executable

Configuration Name: *	training_configuration
Scenario: *	sound-scen-u0001
Version: *	1.0.0
Executable: *	(dropdown menu)

Then you choose the executable. Since you are going to submit a training, choose the one belonging to the training pipeline.

SAP AI Launchpad Operations / All Configurations / Create Configuration

1. Enter Name and Executable

Configuration Name: *	training_configuration
Scenario: *	sound-scen-u0001
Version: *	1.0.0
Executable: *	(dropdown menu)

Workflow Executables

sound-train-exec-u0001

Serving Executables

sound-serve-exec-u0001

The next step of the creation would be to choose the parameters for your executable. In this exercise, you do not need any parameter so you can click

Next and move to the selection of the input artifact from the ones available (from those previously registered for your resource group).

The screenshots show the SAP AI Launchpad interface for creating a configuration. The left sidebar shows 'ML Operations' selected under 'Configurations'. The main area is titled 'Create Configuration' with four steps: 1. Enter Name and Executable, 2. Input Parameters, 3. Input Artifacts, and 4. Review.

Step 3: Input Artifacts

Available Artifacts (3)

Name	ID	Type	Scenario	Labels	Assignment
sound-model	658631d9-f968-4...	model	sound-scen-u0001	0	
sound-data	Seb42090-da6e-4...	dataset	sound-scen-u0001	0	
sound-data	5c58bb40-17ed-4...	dataset	sound-scen-u0001	0	

Selected Artifacts (1/1)

sound-d sound-model (658631d9-f968-4...)

Available Artifacts (3)

Name	ID	Type	Scenario	Labels	Assignment
sound-model	658631d9-f968-4...	model	sound-scen-u0001	0	sound-data
sound-data	Seb42090-da6e-4...	dataset	sound-scen-u0001	0	
sound-data	5c58bb40-17ed-4...	dataset	sound-scen-u0001	0	

Click Review to review what you have done so far. If you are satisfied you can click create.

The screenshot shows the SAP AI Launchpad interface at the 'Review' step of creating a configuration. The left sidebar shows 'ML Operations' selected under 'Configurations'. The main area is titled 'Create Configuration' with four steps: 1. Enter Name and Executable, 2. Input Parameters, 3. Input Artifacts, and 4. Review.

4. Review

1. Name and Executable

Configuration Name: training_configuration
Scenario Name: sound-scen-u0001
Scenario Version: 1.0.0
Executable Name: sound-train-exec-u0001

2. Input Parameters

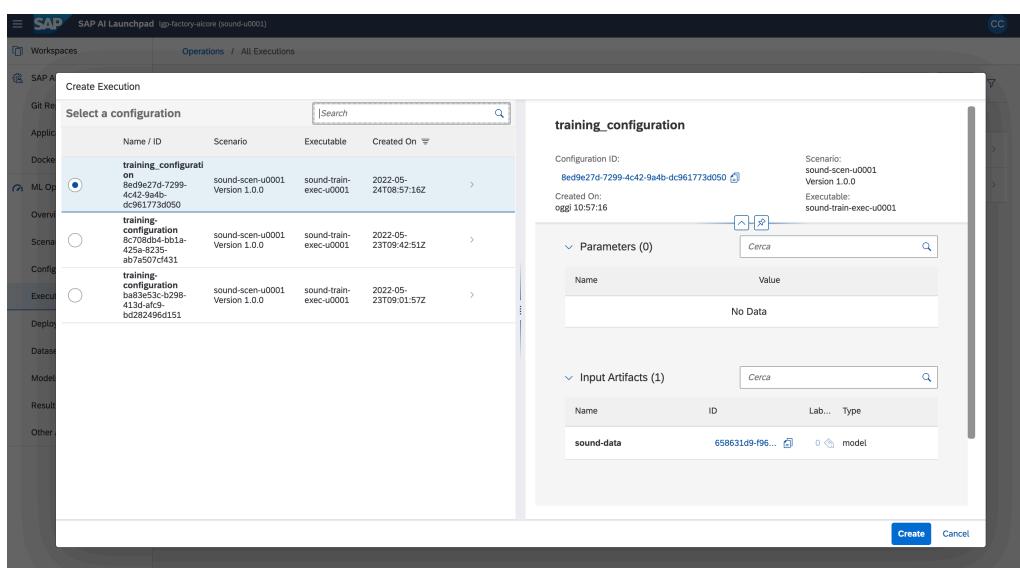
No parameters are defined for this executable.

3. Input Artifacts

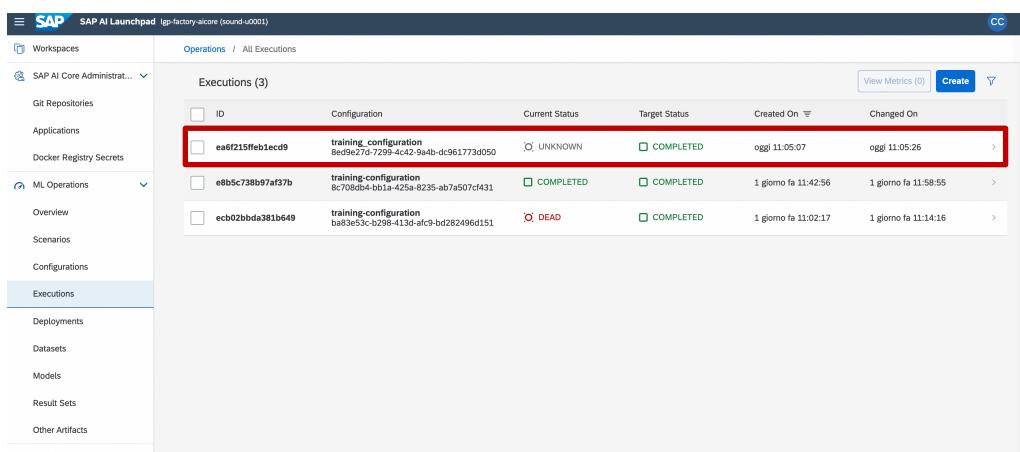
sound-data: sound-model (658631d9-f968-485b-9ad2-94a822ae3650)

Now the new configuration will appear under Configurations.

	<p>The screenshot shows the SAP AI Launchpad interface under the Operations section. The sidebar is identical to the previous screenshot. The main content area is titled 'Executions (2)' and lists two entries. The first entry is 'e8b5c738b97af37b' with status 'COMPLETED'. The second entry is 'ecb02bbda381b649' with status 'DEAD'. Both entries include columns for ID, Configuration, Current Status, Target Status, Created On, and Changed On.</p>
<h2>2.6 Trigger the training execution</h2>	<p>Once the configuration is created, you can proceed and submit a training execution. You need to move to Executions where you will find the list of all the previous executions.</p> <p>You need to click on the Create button, at the top right of the page, and a menu will appear where you can select which configuration you want to start. For this exercise, select the one you have just created (you could also choose an old configuration if needed).</p>



At this point, you need to click Create to start the training and it will appear under Executions.



2.7 Check the status of the execution

This step can be performed in SAP AI Launchpad by clicking on the running execution. A page similar to the one shown below will appear. From there you can check the logs for example.

3 Get the trained model	<p>When the training is completed, a new model is produced and saved in the AWS S3 bucket.</p> <p>It is automatically registered as an artifact in SAP AI Core, and it will appear under Models.</p> <table border="1"> <thead> <tr> <th>Name</th> <th>ID</th> <th>Scenario</th> <th>Execution ID</th> <th>Labels</th> <th>Created On</th> <th>Changed On</th> </tr> </thead> <tbody> <tr> <td>sound-model</td> <td>2edb8361-373e-4c4e-82ab-67...</td> <td>sound-scen-u0001</td> <td>eb63aa0ff75f2493</td> <td>0</td> <td>oggi 11:35:08</td> <td>oggi 11:35:08</td> </tr> <tr> <td>sound-model</td> <td>658631d9-f968-485b-9ad2-94...</td> <td>sound-scen-u0001</td> <td>e8b5c738b97af37b</td> <td>0</td> <td>1 giorno fa 11:58:52</td> <td>1 giorno fa 11:58:52</td> </tr> </tbody> </table>	Name	ID	Scenario	Execution ID	Labels	Created On	Changed On	sound-model	2edb8361-373e-4c4e-82ab-67...	sound-scen-u0001	eb63aa0ff75f2493	0	oggi 11:35:08	oggi 11:35:08	sound-model	658631d9-f968-485b-9ad2-94...	sound-scen-u0001	e8b5c738b97af37b	0	1 giorno fa 11:58:52	1 giorno fa 11:58:52
Name	ID	Scenario	Execution ID	Labels	Created On	Changed On																
sound-model	2edb8361-373e-4c4e-82ab-67...	sound-scen-u0001	eb63aa0ff75f2493	0	oggi 11:35:08	oggi 11:35:08																
sound-model	658631d9-f968-485b-9ad2-94...	sound-scen-u0001	e8b5c738b97af37b	0	1 giorno fa 11:58:52	1 giorno fa 11:58:52																
Checking the loss function trend and the metrics	<p>The loss function and the chosen metrics values are defined in the training python code and there they are required to be stored in SAP AI Core.</p> <p>It is possible to consult them also through SAP AI Launchpad. It is enough to go under Executions, select the desired (completed) execution and then go in the metrics tab.</p> <p>Here it is possible to check the value of the metrics like the overall accuracy of the model obtained by applying the trained model to an independent test sample (created internally in the training code from the original input dataset).</p>																					

Additional info has been stored as custom info that can be also checked: we have saved in SAP AI Core all the loss function and accuracy values for each iteration/epoch for both the training and validation samples.

```

{
  "loss": [
    1.015304564296875, 0.3219686448574066, 0.14422516524791718, 0.140776023266
  ],
  "val_loss": [
    0.247454464435574, 0.1414605975151062, 0.09994245320558548, 0.091269910335
  ],
  "accuracy": [
    0.745033085346219, 0.9056291580200195, 0.9552980065345764, 0.9668874144554
  ],
  "val_accuracy": [
    0.8910890817642212, 0.9554455280303955, 0.9702970385551453, 0.960396051406E
  ]
}

```

Moreover we have saved the final confusion matrix obtained by applying the trained model to an independent test sample.

```

{
  "cf_matrix": [
    [
      [116, 0, 0],
      [0, 46, 2],
      [0, 1, 37]
    ],
    {
      "classes": [
        "ok",
        "anomaly1",
        "anomaly2"
      ]
    }
  ]
}

```

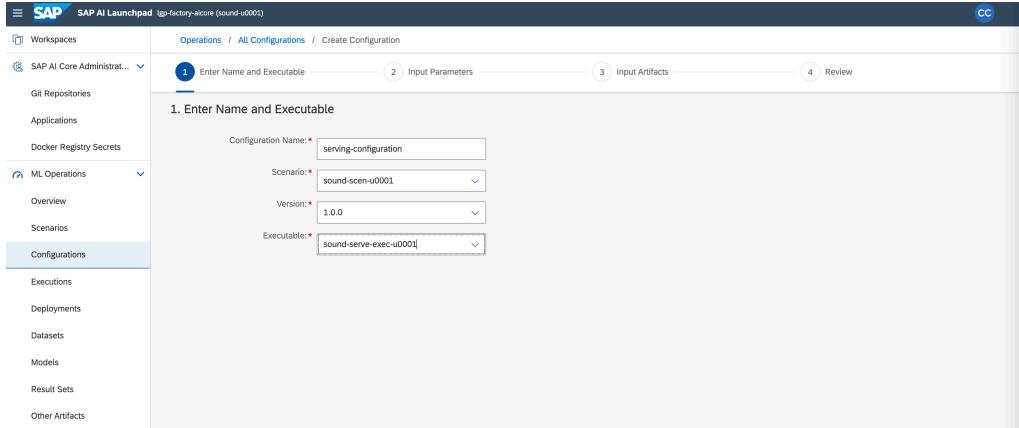
STEP 4 – SUBMIT THE DEPLOYMENT

In this section it is assumed you have already performed a training and generated a model, or that a model was loaded into the AWS S3 bucket and registered as an artifact in SAP AI Core.

It is assumed substeps 4.1 and 4.2 have been already performed, while substep 4.3 is basically included in substep 4.4.

The main reasons why you might need to start a new deployment are:

- The model has changed so it has been retrained;
- The serving applications has changed;
- The resource plan has changed in the serving template.

4.4 Create a serving configuration	<p>To create a serving configuration, you need to repeat the same operations you did in substep 2.5:</p> <ul style="list-style-type: none">• Go to Configurations;• Click the Create button;• In the menu choose a name for the configuration;• Choose a scenario from the ones available;• Choose an executable (this time choose the one corresponding to the serving part);• Choose the parameters if they are defined for your executable. Here, in this exercise, no parameters have to be passed.  <p>Then you choose the model to use as an input artifact for the serving part. Use the one you have just trained.</p>
---	---

The screenshot shows the SAP AI Launchpad interface for creating a configuration. On the left, a sidebar lists 'Workspaces', 'SAP AI Core Administration...', 'ML Operations' (selected), and other options like 'Configurations', 'Executions', 'Deployments', 'Datasets', 'Models', 'Result Sets', and 'Other Artifacts'. The main area is titled 'Operations / All Configurations / Create Configuration'. It has four numbered steps: 1. Enter Name and Executable, 2. Input Parameters, 3. Input Artifacts (which is active), and 4. Review. Step 3 shows a 'Selected Artifacts (1/1)' section with 'soundmodel' and an 'Available Artifacts (4)' section listing 'sound-model', 'sound-data', 'Cutting machine so...', and 'Cutting machine so...'. A search bar and a 'Create' button are at the top right.

Once you are happy with the configuration, you can click Create and then the new serving configuration will appear under Configurations.

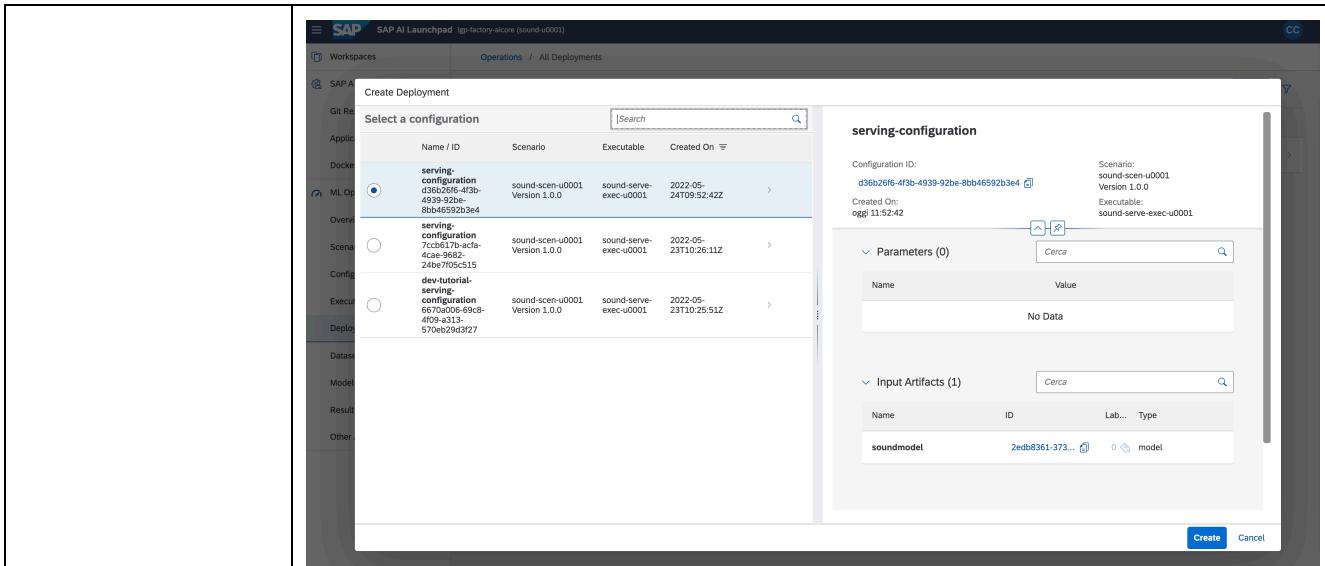
The screenshot shows the SAP AI Launchpad interface displaying the 'Configurations' list. The sidebar is identical to the previous screen. The main area is titled 'Operations / All Configurations' and shows a table of configurations. One configuration, 'serving-configuration', is highlighted with a red border. Other configurations listed include 'training_configuration', 'dev-tutorial-serving-configuration', and 'training-configuration'. The table columns are 'Name / ID', 'Scenario', 'Executable', 'Created On', 'Parameters', and 'Input Artifacts'. A 'Create' button is located at the top right of the configuration table.

4.5 Trigger the serving execution

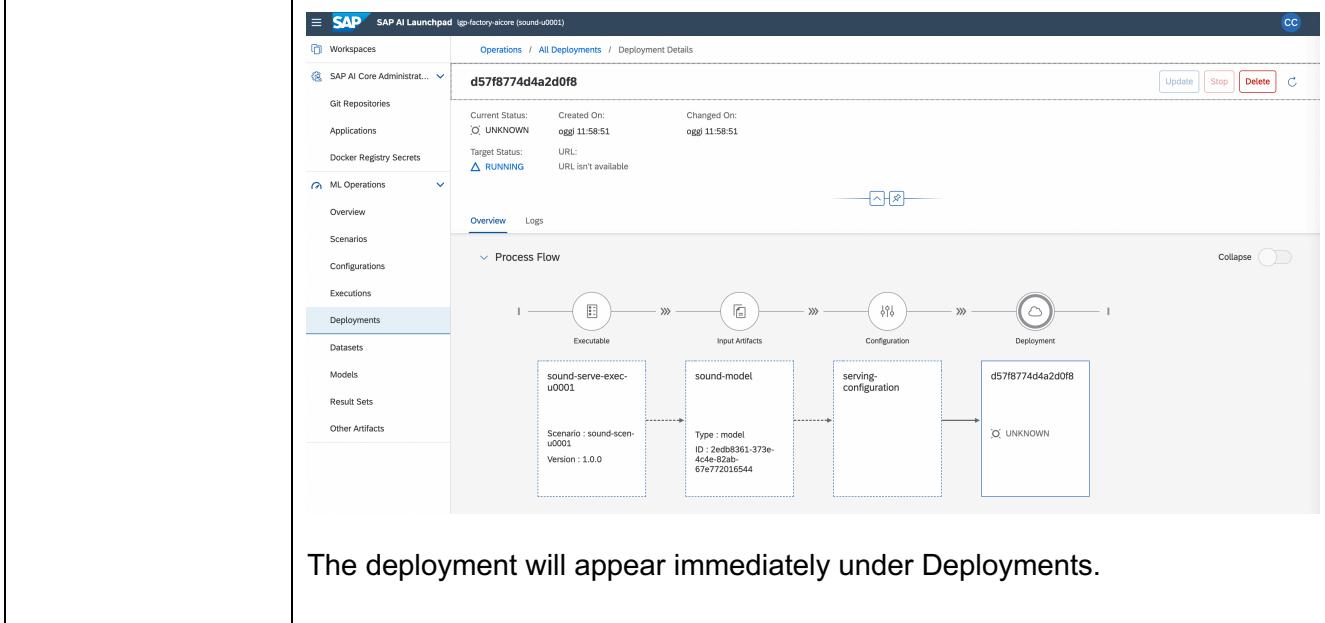
In order to start the deployment, you need to go to Deployments. There you will find the list of past deployments, or running deployments.

The screenshot shows the SAP AI Launchpad interface displaying the 'Deployments' list. The sidebar is identical to the previous screens. The main area is titled 'Operations / All Deployments' and shows a table of deployments. One deployment, 'd031c792a231687b', is listed with a status of 'STOPPED'. The table columns are 'ID', 'Configuration', 'Current Status', 'Target Status', 'Created On', and 'Changed On'. A 'Create' button is located at the top right of the deployment table.

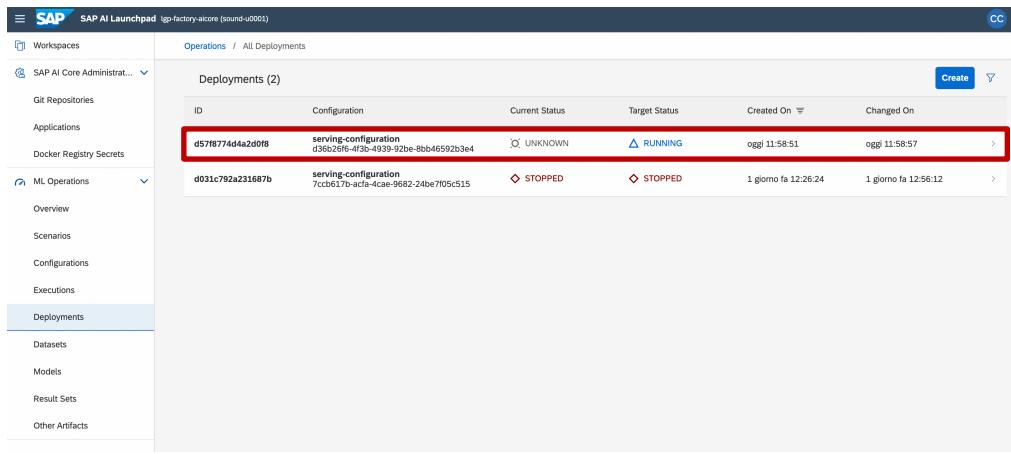
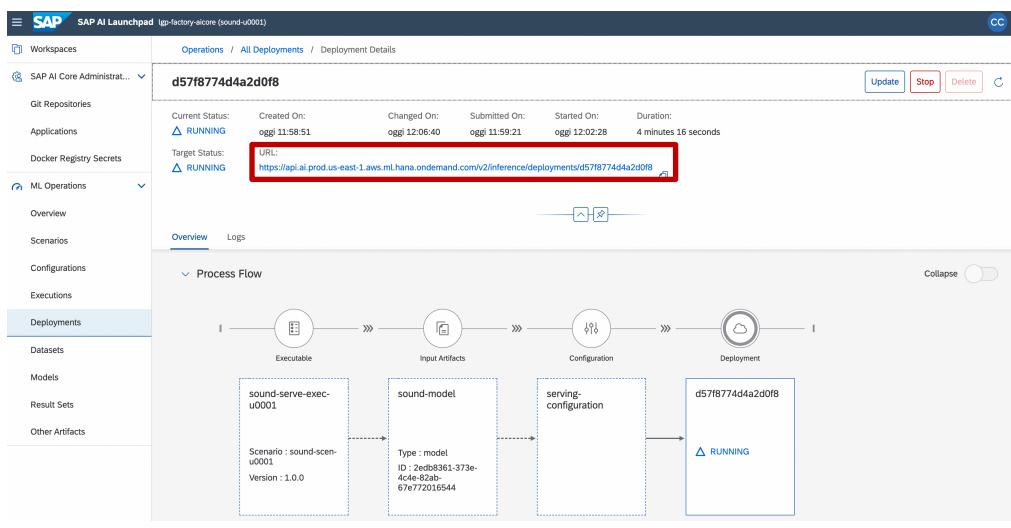
Click on the Create button at the top right of the screen to create your deployment. From the left side screen, choose the serving configuration you want to use. In this exercise, choose the one you have just created (you can also reuse an old configuration if required).



Click Create and then the deployment will start on all the nodes you have specified in the serving templates. This operation will take few minutes to complete.



The deployment will appear immediately under Deployments.

	
4.6 Check the status of the deployment	<p>From Deployments, it is possible to check on the status of the deployment by clicking on the item in the list. You can check all the logs and once the deployment is completed, you can check the deployment URL. This is the URL that can be used to send inference request to the deployed model. The serving requests will be managed by the web application you have developed.</p> 
6 Use the deployment URL	<p>The model is deployed and the serving applications is running. You can choose just one anomalous sound from the dataset, and convert it to a binary string. For example, use this online service: https://base64.guru/converter/encode/audio</p>

Base64*Guru
A virtual teacher who reveals to you the great secrets of Base64

Comments: 10 | Rating: 4.8/5

Audio to Base64

Convert audio to Base64 online and use the result string as data URI, HTML object, JavaScript Audio, and others. Sometimes you have to send or output a sound file within a text document (for example, HTML, JSON, XML), but you cannot do this because binary characters will damage the syntax of the text document. To prevent this, for example, you can encode sound file to Base64 and embed it using the data URI. Please note that the audio to Base64 encoder accepts any sound files types with a size of up to 50 MB. If you are looking for the reverse process, check [Base64 to Audio](#).

Datatype
Local File
Local File*
Choose file | No file chosen
Choose a file or drag and drop it here

Output Format
Plain text - just the Base64 value

Encode audio to Base64

Base64
0k1Gbs...
The result of Base64 encoding will appear here

The you can use Postman. Note that Postman should be configured by following the instructions here: <https://developers.sap.com/tutorials/ai-core-aiapi-postman-setup.html>

Please, remember to get an authorization token before trying to send an API call to the deployment URL.

Postman

Home Workspaces Reports Explore

Scratch Pad New Import Overview GET Get Auth token POST Inference + ***

AI-API / Get Auth token

GET [https://\(auth.url\)/oauth/token?grant_type=client_credentials](https://(auth.url)/oauth/token?grant_type=client_credentials)

Params: Authorization Headers (7) Body Pre-request Script Tests Settings

Type Basic Auth

The authorization header will be automatically generated when you send the request.
Learn more about authorization ↗

Username Password Show Password

Send Cookies

Body Cookies Headers (11) Test Results

Pretty Raw Preview Visualize JSON

Status: 200 OK Time: 182 ms Size: 10.01 KB Save Response

1 "access_token": "eyJhbGciOiD...
2 X...
Please also remember to enter the deployment URL in the SAP AI Core environment. The model's name variable must be updated with the name you have given to your model artifact (in our case it is "soundmodel").

The screenshot shows the 'aicore-ai-env' workspace in Postman. It displays environment variables with their initial and current values:

VARIABLE	INITIAL VALUE	CURRENT VALUE
deploymenturl		https://api.ai.prod.us-east-1.aws.ml.hana.ondemand.com/v2/inference/deployments/d57f8774d4a2d0f8
modelName		soundmodel

No global variables
Global variables are a set of variables that are always available in a workspace.

① Use variables to reuse values and protect sensitive data
Store sensitive data in variable type secret to keep its values masked on the screen. [Learn more about variable type](#)
Work with the current value of a variable to prevent sharing sensitive values with your team. [Learn more about variable values](#)

Please remember to set the resource group variable in the inference api with the name of your resource group.

The screenshot shows a POST request in Postman's Scratch Pad. The Headers section is configured as follows:

KEY	VALUE	DESCRIPTION
Content-Type	application/json	
AI-Resource-Group	sound-u0001	

Once you have completed this, you are ready to send an api call to the deployment URL. The response will indicate which class the sound belongs to.

The screenshot shows the Postman application interface. At the top, there's a navigation bar with Home, Workspaces, Reports, Explore, and a search bar for 'Postman'. Below the navigation is a 'Scratch Pad' sidebar with sections for Collections, APIs, Environments, Media Servers, Monitors, and History. The main area is titled 'Inference' under 'POST /predict'. The URL in the address bar is `({{deploymenturi}}/v1)/models/{{modelName}}/predict`. The request body is set to 'JSON' and contains the following JSON:

```
1 "sound": "Uk1GR0wvBA8BVQDVFZelB18AAAABAAEARwvAABcPAAEACAAZGFBY9JgZBaJa4z6zPsIgphxL9X0CY+uBvP9+V9OChMlcj57uXkA0B2dVjYc/...
2 * sound": "Uk1GR0wvBA8BVQDVFZelB18AAAABAAEARwvAABcPAAEACAAZGFBY9JgZBaJa4z6zPsIgphxL9X0CY+uBvP9+V9OChMlcj57uXkA0B2dVjYc/...
3 * Slow_Sound": "1.0"
```

Below the body, there are tabs for Params, Authorization, Headers (T1), Body (T2), Pre-request Script, Tests, and Settings. A status bar at the bottom indicates 'Status: 200 OK | Time: 2.03 s | Size: 187 B | Save Response'.

Stop the deployment

Please remember to stop the deployment in order to reduce costs. This can be done easily from SAP AI Launchpad.

In Deployments, choose the deployment you want to stop and click on it. Click on the Stop button at the top right of the new page that opens, and then the execution will be stopped.

SAP SAP AI Launchpad (lp-factory-eicore (sound-u0001)) CC

Workspaces SAP AI Core Administrat... Git Repositories Applications Docker Registry Secrets ML Operations Overview Scenarios Configurations Executions Deployments Datasets Models Result Sets Other Artifacts

Operations / All Deployments / Deployment Details

d57f8774d4a2d0f8

Current Status: **RUNNING** Created On: 2023-11-18T11:58:51 Changed On: 2023-11-18T12:06:40 Submitted On: 2023-11-18T11:59:21 Started On: 2023-11-18T12:02:28 Duration: 4 minutes 16 seconds

Target Status: **RUNNING** URL: <https://api.ai.prod.us-east-1.aws.ml.hana.ondemand.com/v2/inference/deployments/d57f8774d4a2d0f8>

Overview Logs

Process Flow

Collapsible diagram showing the deployment flow from Executable to Deployment, with specific components like sound-serve-exec-u0001, sound-model, and serving-configuration.

```
graph LR; Executable((Executable)) --> InputArtifacts((Input Artifacts)); InputArtifacts --> Configuration((Configuration)); Configuration --> Deployment((Deployment));
```

Executable: sound-serve-exec-u0001
Input Artifacts: sound-model
Configuration: serving-configuration
Deployment: d57f8774d4a2d0f8

△ RUNNING

Update Stop Delete ↻