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# Invoice Object Recommendation

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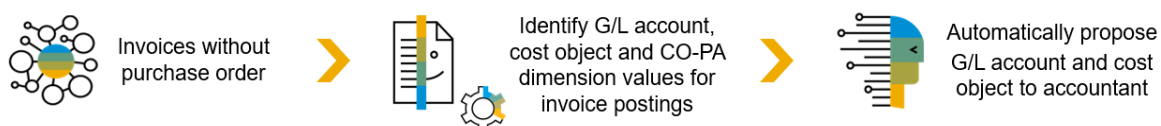
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# 1 What Is Invoice Object Recommendation?

Get recommendations of G/L accounts, CO-PA dimension values and cost objects.

Invoice Object Recommendation helps you to assign G/L (general ledger) accounts, cost objects and profitability analysis (CO-PA) dimension values to incoming invoices without a purchase order reference. To do so, the service includes training and inference capabilities to fit a machine learning model that uses a custom dataset based on historical invoice data. Invoice Object Recommendation is part of the SAP AI Business Services portfolio.



## i Note

This service is only relevant for invoices without a purchase order reference. Invoices with a purchase order reference already have the G/L account and cost object details required to post the invoice.

## Environment

This service runs in the Cloud Foundry environment.

## Features

<b>G/L Account Recommendation</b>	Receive G/L (general ledger) account recommendations for incoming invoices without a purchase order reference attached.
<b>Cost Object Recommendation</b>	Receive cost objects recommendations for incoming invoices without a purchase order reference attached.
<b>CO-PA Dimension Value Recommendation</b>	Receive profitability analysis (CO-PA) dimension value recommendations for the G/L (general ledger) accounts predicted.

## Business Benefits:

With Invoice Object Recommendation you can:

- Process more invoices efficiently and faster
- Increase quality and compliance of your G/L accounts and cost objects
- Reduce manual and repetitive work, allowing the members of your organization to focus on more relevant tasks that are in their field of expertise


## Prerequisites

See [Initial Setup \[page 15\]](#).

## Scope and Limitations

For information on technical limits, see [Input Limits \[page 42\]](#).

### Regional Availability

Get an overview on the availability of Invoice Object Recommendation according to region, infrastructure provider, and release status in the *Pricing* tab of the [SAP Discovery Center](#) .

### Trial Scope

Invoice Object Recommendation is available for trial use. A trial account lets you try out SAP Business Technology Platform (SAP BTP) for free and is open to everyone. Trial accounts are intended for personal exploration, and not for productive use or team development. They allow restricted use of the platform resources and services.

To activate your trial account, go to [Welcome to SAP BTP Trial](#).

#### i Note

See also the following information: [Trial Accounts](#).

In the Cloud Foundry environment, you get a free trial account for Invoice Object Recommendation with the following constraints: [Trial Account Input Limits \[page 42\]](#).

## 2 What's New for Invoice Object Recommendation

Technical Component	Capability	Environment	Title	Description	Type	Available as of
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Security Guide	Auditing and logging information is now available in the <a href="#">Security Guide [page 43]</a> .	New	2021-07-02
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Overall Improvements	There have been several code improvements.	Changed	2021-02-02
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Trial Account	The maximum limit of number of inference lines used when trying out the service with a trial account has been updated. See <a href="#">Trial Account Input Limits [page 42]</a> .	Changed	2021-01-15

### 2.1 2020 What's New for Invoice Object Recommendation (Archive)

Technical Component	Capability	Environment	Title	Description	Type	Available as of
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Tutorials	A new tutorial group is now available for Invoice Object Recommendation.  See <a href="#">Use Machine Learning to Get Recommendations of Invoice Financial Objects</a> .	New	2020-12-21
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Overall Improvements	There have been several code improvements, including enhancements in training data pre-processing.	Changed	2020-12-03
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Overall Improvements	There have been several code improvements.  The <a href="#">Feature Scope Description for Invoice Object Recommendation</a> has been updated.	Changed	2020-10-30
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	API Reference	The service now supports the lifecycle management of datasets. See <a href="#">Dataset API [page 26]</a> .  The <a href="#">Delete Upload Lock [page 24]</a> endpoint is now available.	New	2020-10-19
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Metering and Pricing	<a href="#">Metering and Pricing [page 13]</a> documentation is now available for Invoice Object Recommendation.	New	2020-10-19

Technical Component	Capability	Environment	Title	Description	Type	Available as of
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	New Profitability Analysis (CO-PA) Dimension Value Recommendation Feature	You can now use Invoice Object Recommendation to receive profitability analysis (CO-PA) dimension value recommendations for the G/L (general ledger) accounts predicted with the new profitability analysis (CO-PA) dimension value recommendation feature.	New	2020-10-19
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Training Data Structure	Simplification of the training data structure to reduce data modeling effort. See <a href="#">Best Practices [page 17]</a> .	Changed	2020-10-19
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Overall Improvements	There have been several code improvements.	Changed	2020-08-17
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Trial Account	You can now try out Invoice Object Recommendation on SAP Cloud Platform Trial. See <a href="#">Get a Trial Account</a> and <a href="#">Trial Account Input Limits [page 42]</a> .	New	2020-08-03



Technical Component	Capability	Environment	Title	Description	Type	Available as of
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Interactive Graphics	The end-to-end process of the <a href="#">Upload Data API [page 20]</a> and the <a href="#">Training API [page 32]</a> is now available in interactive graphics.	New	2020-08-03
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Overall Improvements	There have been several code improvements.	Changed	2020-08-03
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	New Cost Object Recommendation Feature	You can now use Invoice Object Recommendation to receive cost objects recommendations for incoming invoices without a purchase order reference attached with the new cost objects recommendation feature.	New	2020-06-04
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	Documentation Updates	The following Service Guide documentation sections have been updated: <ul style="list-style-type: none"> <li><a href="#">Concepts [page 11]</a></li> <li><a href="#">API Reference [page 17]</a></li> </ul>	Changed	2020-06-04

## 2.2 2019 What's New for Invoice Object Recommendation (Archive)

Technical Component	Capability	Environment	Title	Description	Type	Available as of
Invoice Object Recommendation	Extension Suite - Development Efficiency	Cloud Foundry	New Service	A new machine learning customizable service is now available. Based on historical invoices data from a particular customer, Invoice Object Recommendation recommends the G/L (general ledger) account for the line items of new invoices. To do so, the service includes training and inference capabilities to fit a model using a custom dataset. See <a href="#">Invoice Object Recommendation documentation</a> .	Announcement	2019-12-02

# 3 Concepts

The following terms are the main concepts of artificial intelligence (AI) and machine learning (ML) in the context of Invoice Object Recommendation:

Concept	Description
BKPF	Accounting Document Header. It is a standard table in SAP R/3 and SAP ERP systems.
BSEG	Accounting Document Segment. It is a standard table in SAP R/3 and SAP ERP systems.
CO-PA dimensions	The table field name in SAP tables for profitability analysis.
cost center	A cost object defined as an organizational unit within a controlling area that represents a defined location of cost incurrence.
dataset	A <b>dataset</b> is a table: the rows represent line items of invoices, and the columns represent information about each line item.
feature	Columns of the <b>dataset</b> which are used as inputs for the <b>machine learning model</b> .
G/L (general ledger) account	A structure that records value movements in a company code and represents the <b>G/L account</b> items in a chart of accounts. A <b>G/L account</b> has transaction figures that record changes to the account during a posting period. These figures are totals that are used for G/L reporting.
HKONT	The table field name in SAP tables for <b>G/L account</b> .
inference	Process during which a <b>machine learning model</b> receives input <b>features</b> and predicts the most probable <b>labels</b> for the <b>target feature</b> .
inference request	A single call to a <b>machine learning model</b> to perform <b>inference</b> .
KOSTL	The table field name in SAP tables for <b>cost object</b> .
label	Fields of the <b>dataset</b> that are predicted by the <b>machine learning model</b> .
machine learning	The ability of computers to learn on their own (without being programmed) by using algorithms that process large quantities of data.
machine learning model	A <b>machine learning</b> algorithm that learns patterns from a given set of training data to accomplish a certain task.
schema	Schema of the database.
tenant	Technical entity that represents a customer as an organization on SAP Business Technology Platform.

Concept	Description
<b>trained model</b>	Trained <b>machine learning model</b> that is available as an engine for prediction and classification via the corresponding API endpoint.
<b>training data</b>	Business data used to train a <b>machine learning model</b> . For Invoice Object Recommendation, the training data is the CSV file input with labels.
<b>training job</b>	A procedure whereby the <b>machine learning model</b> learns matching patterns from training data.
<b>training label</b>	The <b>label</b> defined for the training and trained model, that will be generated for the provided label.

See also [AI & ML Glossary](#).

# 4 Metering and Pricing

## Usage Metric

Invoice Object Recommendation is metered based on a predefined usage metric consisting of records, defined as uniquely identified objects processed by the cloud service monthly. A machine learning inference call can contain multiple unique objects that are individually processed by the cloud service. Each object is counted as an individual record.

## Block Size

1 block = 1,000 records. The final price is a sum of the number of records processed by the service.

## Basic Service

Invoice Object Recommendation allows users to train and deploy customizable models. For this service, the number of inference calls is relevant for the charged amount.

Metric	Tiers	Block Price per Month
Blocks of 1,000 records	1 to 14 blocks	EUR 250.00
	More than 15 blocks	EUR 188.00

## Example

Cost for 7 blocks =  $7 * \text{EUR } 250.00 = \text{EUR } 1,750.$

Cost for 16 blocks =  $16 * \text{EUR } 188.00 = \text{EUR } 3,008.$

### → Tip

Use the [pricing estimator tool](#).

## Related Information

[SAP Discovery Center](#)

[SAP BTP Service Description Guide and Agreement](#)

# 5 Initial Setup

To be able to use Invoice Object Recommendation for productive purposes, you must complete some steps in the SAP BTP cockpit.

## → Tip

See [Tutorials](#) to find out how to use a trial account to try out the service.

## Prerequisites

- You have an enterprise global account on SAP BTP. See [Enterprise Accounts](#).
- You are entitled to use the service.

## 1. Create a Subaccount in the Cloud Foundry Environment.

To be able to use Invoice Object Recommendation for productive purposes, you need to create a subaccount in your global account using the SAP BTP cockpit.

## → Tip

See [Create a Subaccount in the Cloud Foundry Environment](#).

## 2. Enable the Invoice Object Recommendation Service.

To enable Invoice Object Recommendation in the service catalog, using the SAP BTP cockpit, perform the following steps:

1. [Configure Entitlements and Quotas](#).
2. [Create Space](#).
3. [Create Service Instance](#).

## i Note

In the **New Instance** wizard, enter only the **Basic Info** details, and leave the **Parameters** details empty, instance parameters are not mandatory for this service.

4. [Create Service Key](#).

→ Tip

See [Using Services in the Cloud Foundry Environment](#).

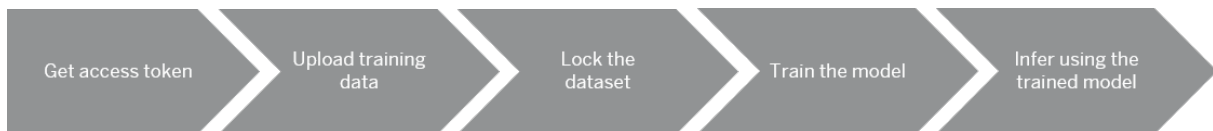


## 6 API Reference

Explore the Invoice Object Recommendation APIs.

Before using the Invoice Object Recommendation APIs listed below, you need to retrieve your OAuth access token as described in [Get Access Token \[page 19\]](#).

- [Upload Data API \[page 20\]](#)
- [Dataset API \[page 26\]](#)
- [Training API \[page 32\]](#)
- [Inference API \[page 37\]](#)



To display the comprehensive specification of the Invoice Object Recommendation APIs in Swagger UI, add the URL path extension `/api/v1` to the Invoice Object Recommendation base URL (that is, the url value from outside the uaa section of your service key).

### Related Information

[Best Practices \[page 17\]](#)

[Common Status and Error Codes \[page 41\]](#)

[Input Limits \[page 42\]](#)

### 6.1 Best Practices

Data modeling which was earlier a requirement to be implemented at the customer end is now taken care by the service. Now you only need to provide the data in CSV format by combining the data from BKPF and BSEG tables.

#### Creating the dataset to trigger training

- The dataset is created by joining the BKPF and BSEG tables.
- Follow the SQL statement detailed below to perform the merge of BKPF and BSEG tables and generate the input file to trigger training.

## SQL statement:

### Sample Code

```
SELECT
t2.BUKRS as BUKRS, t2.BELNR as BELNR, t2.GJAHR as GJAHR,
t2.BUZEI as BUZEI, t2.BUZID as BUZID, t2.AUGDT as AUGDT, t2.AUGCP as AUGCP,
t2.AUGBL as AUGBL, t2.BSCHL as BSCHL, t2.KOART as KOART, t2.UMSKZ as UMSKZ,
t2.ZUMSK as ZUMSK, t2.SHKZG as SHKZG, t2.GSBER as GSBER, t2.PARGB as PARGB,
t2.MWSKZ as MWSKZ, t2.WRBTR as WRBTR, t2.KZBTR as KZBTR, t2.PSWBT as PSWBT,
t2.PSWSL as PSWSL, t2.AUFNR as AUFNR, t2.VBELN as VBELN, t2.SAKNR as SAKNR,
t2.LIFNR as LIFNR, t2.EBELN as EBELN, t2.EBELP as EBELP, t2.MATNR as MATNR,
t2.WERKS as WERKS, t2.MENGE as MENGE, t2.MEINS as MEINS, t2.SPGRP as SPGRP,
t2.SPGRM as SPGRM, t2.SPGRG as SPGRG, t2.SPGRV as SPGRV,
t2.SPGRQ as SPGRQ, t2.HKONT as HKONT, t2.KOSTL as KOSTL,
t1.BLART as _BKPF_BLART,
t1.BUDAT as _BKPF_BUDAT,
t1.MONAT as _BKPF_MONTH,
t1.CPUDT as _BKPF_CPUDT,
t1.CPUTM as _BKPF_CPUTM,
t1.AEDAT as _BKPF_AEDAT,
t1.TCODE as _BKPF_TCODE,
t1.WAERS as _BKPF_WAERS,
t1.AWTYP as _BKPF_AWTYP,
t1.AWKEY as _BKPF_AWKEY,
t1.STBLG as _BKPF_STBLG,
from "SCHEMA"."BKPF" as t1 INNER JOIN "SCHEMA"."BSEG" as t2
ON t1.BELNR = t2.BELNR AND t1.GJAHR = t2.GJAHR
AND t1.BUKRS = t2.BUKRS WHERE t1.AWTYP IN ('BKPF', 'BKPF')
```

The above SQL query results are provided as input for training. Specify the fields and columns listed below in the appropriate endpoints.

- The following fields are mandatory for training:
  - HKONT
  - BUKRS
  - BELNR
  - GJAHR
  - BUZEI
  - BUZID
  - BSCHL
  - SHKZG
  - WRBTR
  - LIFNR
  - \_BKPF\_STBLG
  - \_BKPF\_BUDAT
  - \_BKPF\_WAERS
- The following columns are mandatory for inference input:
  - UID
  - LIFNR
  - WRBTR
  - BUKRS
  - BKPF\_BUDAT
- All other fields are optional for inference input, for example, KOART, MWSKZ and \_BKPF\_BLART.

- For better prediction results, make sure all optional fields included during training are also included in the inference input. For example, if `KOART` field was included in the training , then make sure it is also included in the inference input. Optional fields, that cannot be part of the inference input, should also be excluded from the training data to improve the model accuracy.
- If the above suggested best practices are not followed (if the optional columns provided during training are not provided during inference), the inference API will not throw any error message, but this will affect the prediction accuracy.

### i Note

- Training and inference pipelines internally perform currency conversion to standardize the `WRBTR` (amount/price) values into a single currency. `_BKPF_BUDAT`, `_BKPF_WAERS` and `WRBTR` columns are required for the currency conversion.
- The application only supports `WRBTR` (Amount/Price) values in the decimal format (decimal delimiter can be either period "." or comma ",").

## 6.2 Get Access Token

Retrieve your OAuth access token, which will grant you access to the Invoice Object Recommendation APIs.

### i Note

The token is valid for 12 hours. After that, you need to generate a new one.

### Request

**Base URL:** url value from inside the `uaa` section of the service key

**URL Path:** `/oauth/token`

**HTTP Method:** `POST`

### Request Headers

Header	Required	Values
<code>Content-Type</code>	Yes	<code>&lt;application/x-www-form-urlencoded&gt;</code>

### Request Parameters

Parameter	Required	Data Type	Description
<code>client_id</code>	Yes	String	The <code>clientid</code> value from the service key.
<code>client_secret</code>	Yes	String	The <code>clientsecret</code> value from the service key.

Parameter	Required	Data Type	Description
grant_type	Yes	String	Token grant type. Set it to <code>client_credentials</code> .
response_type	Yes	String	Token response type. Set it to <code>token</code> .

## Response

The response is given as a status (200 or 401). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "Success"

```
{
  "access_token": "<< your access token >>",
  "token_type": "bearer",
  "expires_in": 43199,
  "scope": "uaa.resource",
  "jti": "8d00c157058949daab714a44c04c416b"
}
```

## 6.3 Upload Data API

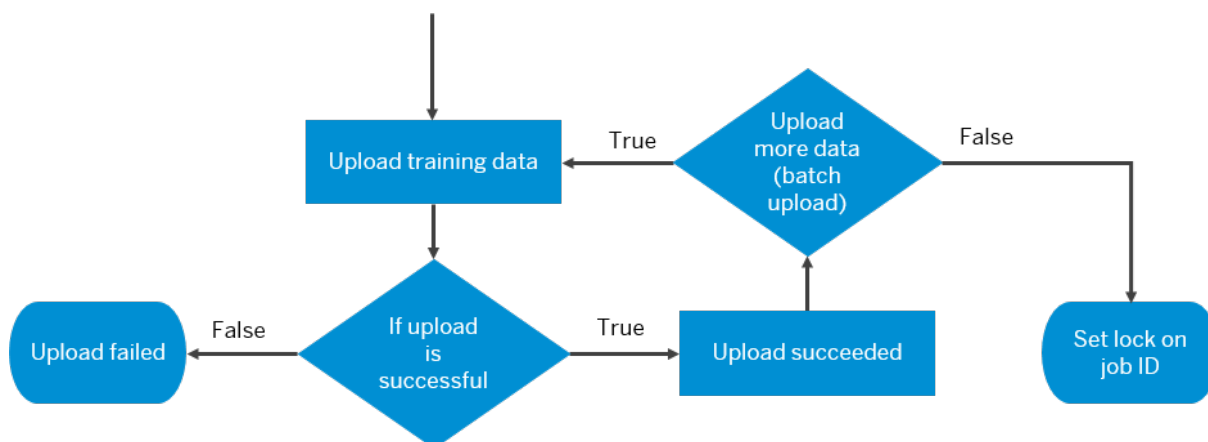
Upload training dataset file that is used to train the machine learning model.

Invoice Object Recommendation accepts CSV files as input parameter and uploads the training file by returning a `job_id` (uuid) to start the training of the uploaded model.

The upload functionality validates if the file is in CSV format, not a blank file, and has valid header fields. The header fields that are required to train G/L accounts or cost objects are validated. An exception is thrown if the header fields don't comply with the requirements and the Data Upload is not successful. See [Common Status and Error Codes \[page 41\]](#).

The upload lock is set for the `job_id` once the training file is uploaded successfully. The batch upload functionality allows you to upload the same file in chunks restricted to a file size of 20 MB (for each chunk). Use the same `job_id` for the training file chunks of the whole batch.

To find out more about endpoints of the Upload Data API, choose the links in the following image.



- [Upload Training Data \[page 21\]](#)
- [Set Upload Lock \[page 22\]](#)
- [Upload Data Lifecycle \[page 25\]](#)

#### Note

- For more information about valid header fields, see [Best Practices \[page 17\]](#).
- After the upload lock is set on the job ID, you have the option of checking the upload lock status. For further details, see [Get Upload Lock Status \[page 23\]](#).
- You can also [Delete Upload Lock \[page 24\]](#).

## 6.3.1 Upload Training Data

Store data for the machine learning model training. The training CSV file is validated and uploaded for training.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/upload`

**HTTP Method:** `POST`

## Request Parameters

Parameter	Required	Data Type	Description
file	Yes	file	The training file in CSV format to be uploaded for training.
batchName	No	String	Name for the batch file. On each upload we can give specific definition for each batch upload. If value is not given, it will be considered as empty.
datasetName	No	String	Name for the dataset. This value will be taken only in the first upload. For further batch uploads, this value will not be considered. If value is not given, it will be considered as empty.
job_id	No	String	For the first time, when the training data is uploaded for a job, the JobId is empty. Upon submitting the data for a new job, the API returns a unique JobId (GUID). To add data to the same job, use the same JobId.

## Response

The response is given as a status (201, 400, 401, 404, 415, 422, 429, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

201 "Training data has been uploaded successfully"

```
{
  "job_id": "4f7527de-6780-4c73-8ce9-47de96f8c7f3",
  "datasetName": "Q1 Transactions",
  "batchId": "1efd4778-db2d-40c8-a245-697bb9083d7f",
  "batchName": "January",
  "message": "Training data has been uploaded successfully"
}
```

#### i Note

The data uploaded will be stored up to 24 hours. After 24 hours, the data will be deleted and cannot be used for further operations. Training should be triggered within 24 hours.

## 6.3.2 Set Upload Lock

Set the upload lock on the `job_id` obtained in the Upload Training Data endpoint.

For more information, see [Upload Data API \[page 20\]](#).

## Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/upload`

**HTTP Method:** `PUT`

### Request Parameters

Parameter	Required	Data Type	Description
<code>job_id</code>	Yes	String	Enter the JobId for which the upload lock needs to be set.

## Response

The response is given as a status (201, 400, 401, 404, 409, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

201 "Lock is set successfully"

```
{
  "message": "Lock is set successfully"
}
```

## 6.3.3 Get Upload Lock Status

Get upload lock status by `job_id`.

## Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/upload`

**HTTP Method:** `GET`

## Request Parameters

Parameter	Required	Data Type	Description
job_id	Yes	String	Enter the JobId to check the upload lock status.

## Response

The response is given as a status (201, 400, 401, 404, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

201 "Lock status successfully retrieved"

```
{
  "status": "Lock is present",
  "message": "Lock status successfully retrieved"
}
```

201 "Lock status successfully retrieved"

```
{
  "status": "Lock is not present. To set the lock use PUT request with same
  JobId",
  "message": "Lock status successfully retrieved"
}
```

## 6.3.4 Delete Upload Lock

Remove the upload lock, and add or remove batches from it, and trigger training.

Delete upload lock on the `job_id` obtained in the Upload Training Data endpoint. The upload lock cannot be removed if training is in progress for the given `job_id`.

## Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/upload`

**HTTP Method:** `DELETE`



## Request Parameters

Parameter	Required	Data Type	Description
job_id	Yes	String	Enter the JobId for which the upload lock needs to be deleted.

## Response

The response is given as a status (200, 400, 401, 404, 409, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "Lock is removed successfully"

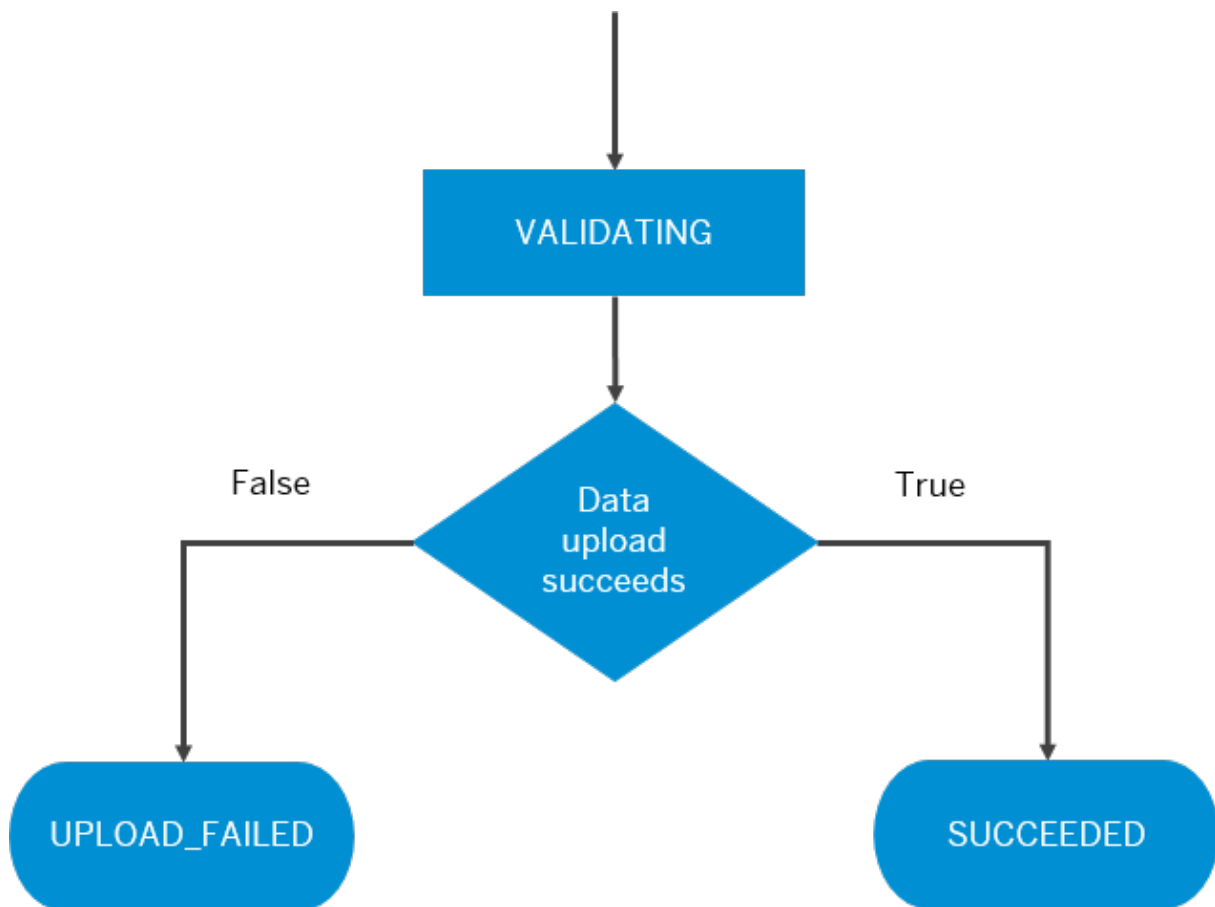
```
{
  "status": "Unlock successful",
  "message": "Lock is removed successfully"
}
```

## 6.3.5 Upload Data Lifecycle

See the statuses at the different stages of the data upload lifecycle for the Invoice Object Recommendation service.

Status	Description
<b>VALIDATING</b>	After the training file is uploaded, the dataset validation takes place. Wait until the status changes to either <b>SUCCEEDED</b> or <b>UPLOAD_FAILED</b> .
<b>SUCCEEDED</b>	The dataset validation process was successful (no fatal error was found). You can now start to train the machine learning model.
<b>UPLOAD_FAILED</b>	During the dataset validation process, fundamental problems were identified (for example, the file is not in CSV format or it does not contain a header). Fix the listed issues and upload a new training file, this will trigger data validation once again. Or the upload failed due to an issue with Minio.

When you upload data to Invoice Object Recommendation, the process is as follows:



## 6.4 Dataset API

Manage the training data uploaded.

Get the details of uploaded data and also allow the deletion of data. The deletion is only possible when the upload lock is not set and if any training is not in progress for that particular dataset. You can also delete individual data batches, and whole datasets using the corresponding `job_id`. When an entire dataset is deleted with `job_id`, the `job_id` cannot be used anymore for further upload or training.

### Related Information

[Get All Jobs \[page 27\]](#)

[Get Job Details \[page 28\]](#)

[Delete Job \[page 28\]](#)

[Get All Batches \[page 29\]](#)

[Get Batch Details \[page 30\]](#)

## 6.4.1 Get All Jobs

Get a list of all `job_ids` and whole datasets for a particular instance.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/datasets`

**HTTP Method:** `GET`

### Response

The response is given as a status (200, 401, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "OK"

```
{
  "data": {
    "count": 1,
    "datasets": [
      {
        "job_id": "9d8e2591-6307-4a87-af18-8c5e9d454b16",
        "datasetName": "",
        "createdAt": "2020-09-28T08:04:26"
      }
    ]
  }
}
```

## 6.4.2 Get Job Details

Get details about a `job_id`.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/datasets/<job_id>`

**HTTP Method:** `GET`

### Request Parameters

Parameter	Required	Data Type	Description
<code>job_id</code>	Yes	String	Enter the JobId to get the details.

### Response

The response is given as a status (200, 400, 401, 404, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "OK"

```
{
  "job_id": "395d96e2-a6b4-4692-99dd-de7114942558",
  "datasetName": "",
  "createdAt": "2020-09-29T06:35:19",
  "batchCount": 2,
  "documentSize": 214942
}
```

## 6.4.3 Delete Job

Delete all data under a `job_id`.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/datasets/<job_id>`

**HTTP Method:** `DELETE`

### Request Parameters

Parameter	Required	Data Type	Description
<code>job_id</code>	Yes	String	Enter the JobId to delete data.

### Response

The response is given as a status (200, 400, 401, 404, 405, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "OK"

```
{
  "job_id": "395d96e2-a6b4-4692-99dd-de7114942558",
  "message": "Data has been deleted successfully"
}
```

## 6.4.4 Get All Batches

Get a list of all batches for a `job_id`.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/datasets/<job_id>/batches`

**HTTP Method:** `GET`

### Request Parameters

Parameter	Required	Data Type	Description
<code>job_id</code>	Yes	String	Enter the JobId to get a list of all batches.

## Response

The response is given as a status (200, 400, 401, 404, or 500). See [Common Status and Error Codes \[page 41\]](#).

## Response Example

200 "OK"

```
{
  "job_id": "395d96e2-a6b4-4692-99dd-de7114942558",
  "datasetName": "",
  "batches": [
    {
      "batchId": "208a1057-a972-4680-8611-40693e2b4d8b",
      "batchName": ""
    },
    {
      "batchId": "5c13bb64-3b44-4122-b08c-741e3dc9f7d8",
      "batchName": ""
    }
  ]
}
```

## 6.4.5 Get Batch Details

Get details of a batch file of given `job_id`.

## Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/datasets/<job_id>/batches/<batch_id>`

**HTTP Method:** `GET`

## Request Parameters

Parameter	Required	Data Type	Description
<code>batch_id</code>	Yes	String	Enter the <code>batch_id</code> to get batch details.
<code>job_id</code>	Yes	String	Enter the <code>job_id</code> to get batch details.

## Response

The response is given as a status (200, 400, 401, 404, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "OK"

```
{
  "job_id": "395d96e2-a6b4-4692-99dd-de7114942558",
  "datasetName": "",
  "batchId": "208a1057-a972-4680-8611-40693e2b4d8b",
  "batchName": "",
  "createdAt": "2020-09-29T06:35:55",
  "documentSize": 107471
}
```

## 6.4.6 Delete Batch File

Delete a batch file of given `job_id`.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/datasets/<job_id>/batches/<batch_id>`

**HTTP Method:** `DELETE`

### Request Parameters

Parameter	Required	Data Type	Description
<code>batch_id</code>	Yes	String	Enter the <code>batch_id</code> to delete a batch file.
<code>job_id</code>	Yes	String	Enter the <code>job_id</code> to delete a batch file.

## Response

The response is given as a status (200, 400, 401, 404, 405, or 500). See [Common Status and Error Codes \[page 41\]](#).

## Response Example

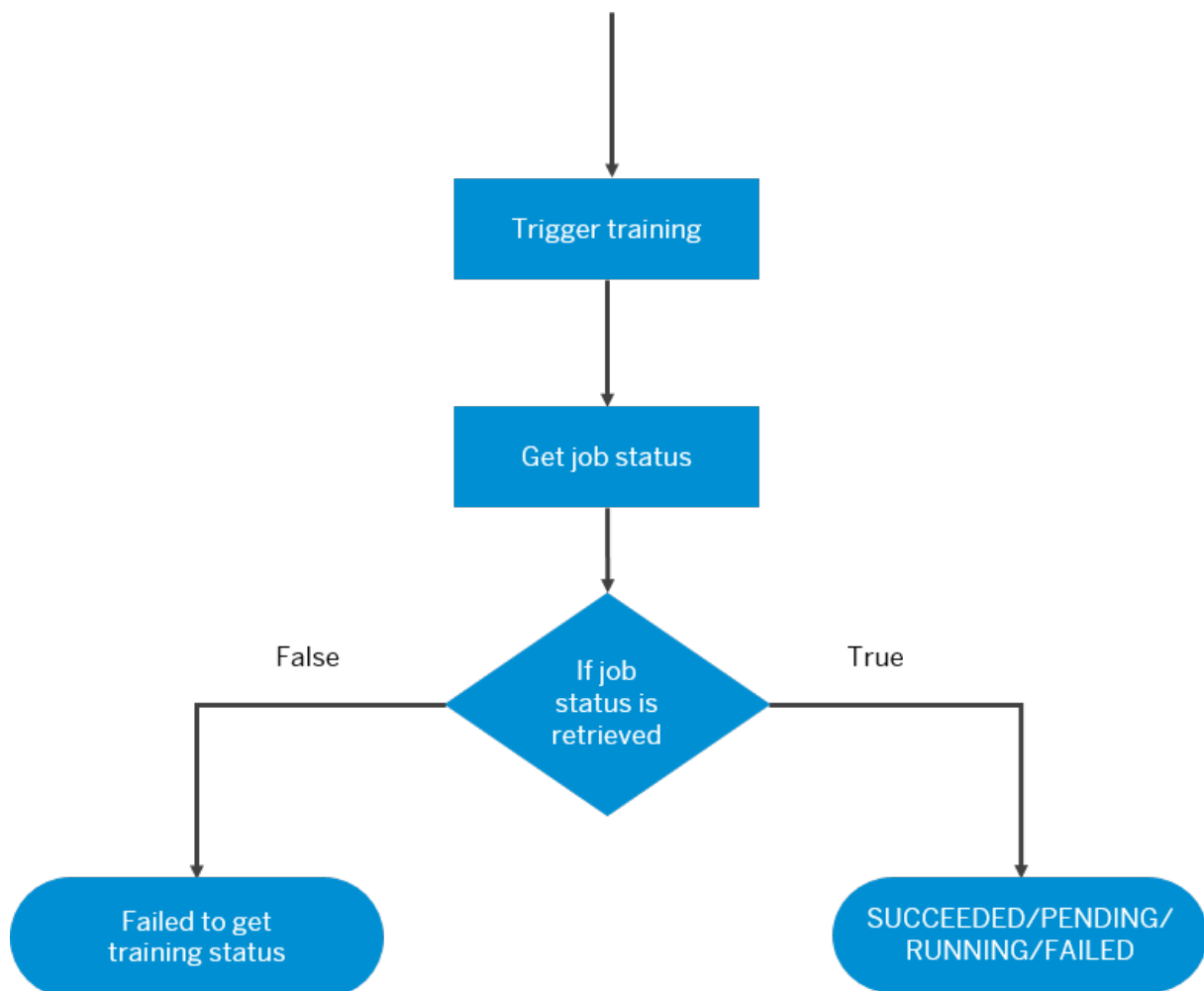
200 "OK"

```
{
  "job_id": "395d96e2-a6b4-4692-99dd-de7114942558",
  "batchId": "208a1057-a972-4680-8611-40693e2b4d8b",
  "message": "Data has been deleted successfully"
}
```

## 6.5 Training API

Use the `job_id` obtained in the Upload Training Data endpoint to start the machine learning model training and check the training progress status.

To display information on the endpoints of the Training API, choose the links in the following image.





- [Training Job Submission \[page 33\]](#)
- [Training Job Status by JobId \[page 34\]](#)
- [Training Lifecycle \[page 36\]](#)

## 6.5.1 Training Job Submission

Start the machine learning model training with the `job_id` obtained in the Upload Training Data endpoint.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/training/<job_id>`

**HTTP Method:** `POST`

### Request Parameters

Parameter	Required	Data Type	Description
<code>job_id</code>	Yes	String	Unique ID that identifies the training job.
			<div style="border: 1px solid #ccc; background-color: #f9f9f9; padding: 10px;"> <p><b>i Note</b></p> <p>Using the same <code>job_id</code> can trigger more than one training, but, at a time, only one training is allowed for one <code>job_id</code>. No concurrent training is allowed for same <code>job_id</code>.</p> </div>
<code>dateFormat</code>	No	String	Format of the date in the dataset.
<code>trainingTarget</code>	No	String	<p>Specify which label (also called target) needs to be trained. For example, <code>HKONT</code> or <code>KOSTL</code> or <code>COPA</code> or a combination of the above mentioned values separated by comma(s): <code>HKONT,KOSTL</code> or <code>HKONT,COPA</code>.</p> <p>This is an optional parameter. If it is not provided by default, it takes the label from the uploaded training data.</p>

## Response

The response is given as a status (201, 400, 401, 404, 429, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

201 "Training job has been submitted"

```
{
  "job_id": "a2be2176-bcb4-11e9-8f41-eeee0a9f7aa5",
  "job_status": "PENDING",
  "message": "Training job has been submitted"
}
```

201 "Training job has been submitted"

```
{
  "job_id": "a2be2176-bcb4-11e9-8f41-eeee0a9f7aa5",
  "job_status": "RUNNING",
  "message": "Training job has been submitted"
}
```

#### **i** Note

The date format should contain the day in DD, month in MM and year in YYYY, for example, dd-mm-yyyy and YYYYMMDD.

## 6.5.2 Training Job Status by JobId

Retrieve the machine learning model training status by `job_id`.

### Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/training/<job_id>`

**HTTP Method:** `GET`

### Request Parameters

Parameter	Required	Data Type	Description
<code>job_id</code>	Yes	String	Unique ID that identifies the training job.

## Response

The response is given as a status (201, 400, 401, 404, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

201 "OK" (Model replaced)

```
{
  "job_id": "fa785907-45f1-4d88-97f9-7ea44572b813",
  "job_status": "SUCCEEDED",
  "training_accuracy": 95.02966191574237,
  "test_accuracy": 92.2285855040335,
  "model_modified": "True",
  "verbose": "The previous model performs worse than the currently trained
model. Therefore, we are going to use the new model we just trained for
inference",
  "message": "OK"
}
```

201 "OK" (Training failed)

```
{
  "job_id": "fa785907-45f1-4d88-97f9-7ea44572b813",
  "job_status": "FAILED",
  "message": "OK"
}
```

201 "OK" (Model not replaced)

```
{
  "job_id": "fa785907-45f1-4d88-97f9-7ea44572b813",
  "job_status": "SUCCEEDED",
  "training_accuracy": 95.02966191574237,
  "test_accuracy": 92.2285855040335,
  "model_modified": "False",
  "verbose": "The previous model performs better than the currently trained
model. Therefore, we are going to continue to use the old model for inference",
  "message": "OK"
}
```

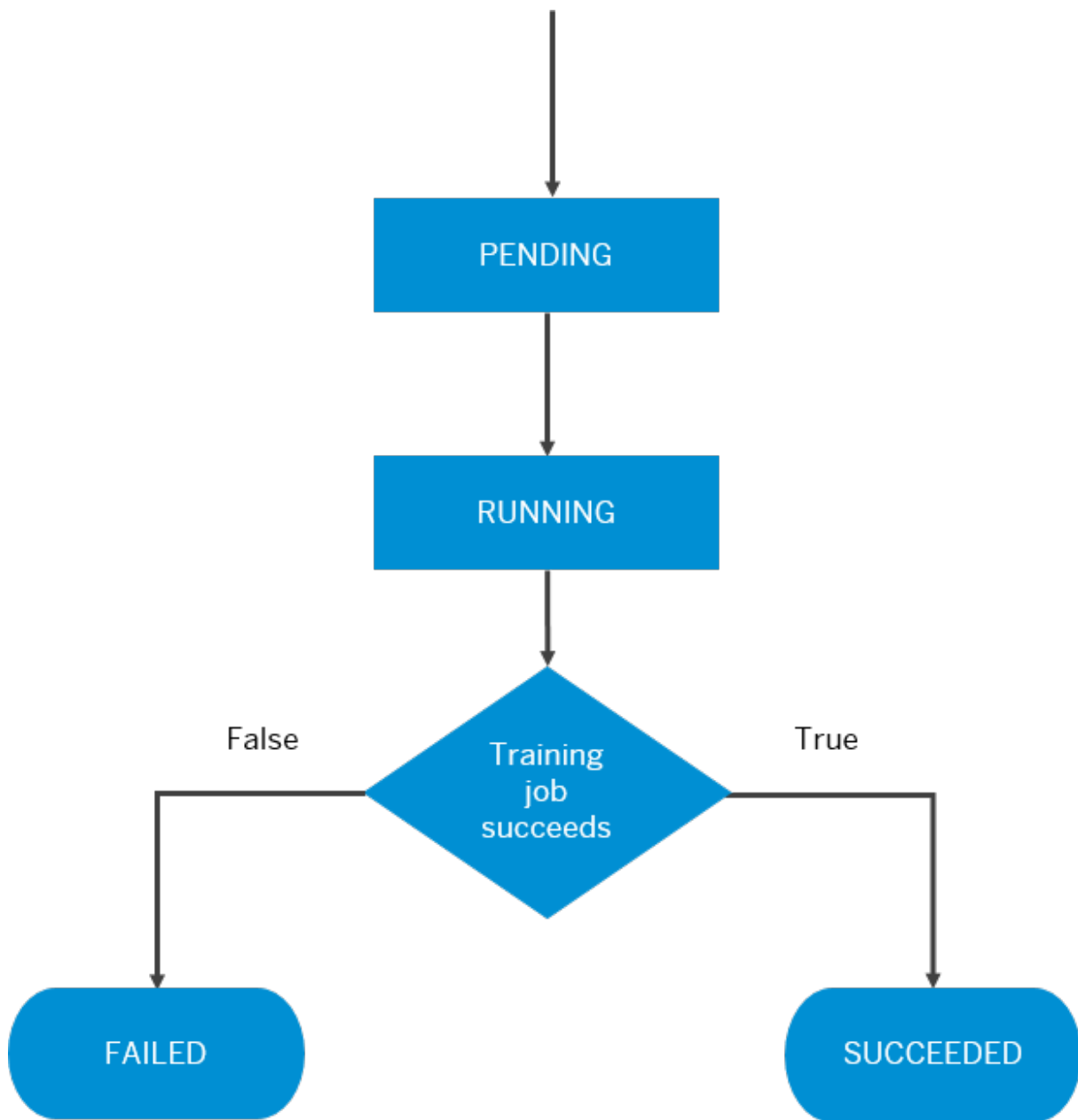
201 "OK" (Trained for first time)

```
{
  "job_id": "fa785907-45f1-4d88-97f9-7ea44572b813",
  "job_status": "SUCCEEDED",
  "training_accuracy": 95.02966191574237,
  "test_accuracy": 92.2285855040335,
  "model_modified": "True",
  "verbose": "Model trained for the first time for this tenant",
  "message": "OK"
}
```

# 6.5.3 Training Lifecycle

See the statuses at the different stages of the training jobs lifecycle for the Invoice Object Recommendation service.

Status	Description
PENDING	The training job has been enqueued for processing, but training hasn't started yet.
RUNNING	The model is being trained and you can follow the training progress.
SUCCEEDED	The model has been successfully trained.
FAILED	An error occurred during training or the training process was canceled.



## 6.6 Inference API

Predict the three most probable G/L accounts, the three most probable cost objects, and the three most probable CO-PA dimension values for each predicted G/L account using the trained model.

The Inference API returns three predictions each for G/L accounts, cost objects, and CO-PA dimension values for each predicted G/L account, along with their corresponding confidences. To use the Inference API, it is mandatory to train at least one model for either G/L account, cost object, or CO-PA dimension value

prediction. For CO-PA dimension value prediction, it is mandatory to have a model for G/L account prediction in place because CO-PA dimension values are predicted for each predicted G/L account.

## Request

**Base URL:** url value from outside the uaa section of the service key

**URL Path Extension:** `api/v1`

**URL Endpoint Path:** `/ivp/inference`

**HTTP Method:** `POST`

### Request Parameters

Parameter	Required	Data Type	Description
<code>file</code>	Yes	File	Inference CSV file.

## CSV File Fields

### Required fields:

- `UID` (unique identifier)
- `LIFNR` (supplier)
- `WRBTR` (price in document currency)
- `BUKRS` (company code)
- `BKPF_BUDAT` (posting date)
- The following fields that are mandatory for training:
  - `BUZEI`
  - `GJAHR`
  - `BELNR`
  - `HKONT` or `KOSTL` (predicted for you by default)

### Optional fields:

Every other field provided during training.

If you provide the `_BKPF_WAERS` columns (document currency type), the service calls the currency conversion module to normalize the prices.

Otherwise, it is assumed that the `WRBTR` field for line items sent already has normalized prices.

#### → Tip

`HKONT` is the table field name in SAP tables for G/L account, and `KOSTL` is the table field name in SAP tables for cost object. These fields define the model purpose to give predictions for both G/L accounts and cost objects, or G/L accounts only.

For more information about required and optional fields, see [Best Practices \[page 17\]](#).

## Response

The response is given as a status (200, 400, 401, 404, 415, 422, 429, or 500). See [Common Status and Error Codes \[page 41\]](#).

### Response Example

200 "Inference successful"

Predictions are provided as part of the API response in CSV file format.

#### i Note

When using Swagger UI, to call the Inference API, the result is a link to download the CSV file to your local file system.

## Response Fields

### If only `HKONT` model is available:

- `UID`
- `recommended_account_HKONT_1`
- `probability_HKONT_1`
- `recommended_account_HKONT_2`
- `probability_HKONT_2`
- `recommended_account_HKONT_3`
- `probability_HKONT_3`

### If `HKONT` and `KOSTL` models are available:

- `UID`
- `recommended_account_HKONT_1`
- `probability_HKONT_1`
- `recommended_account_HKONT_2`
- `probability_HKONT_2`
- `recommended_account_HKONT_3`
- `probability_HKONT_3`
- `recommended_account_KOSTL_1`
- `probability_KOSTL_1`
- `recommended_account_KOSTL_2`
- `probability_KOSTL_2`
- `recommended_account_KOSTL_3`

- probability\_KOSTL\_3

If COPA model is present in addition to HKONT and KOSTL models, the additional fields are:

- recommended\_account\_HKONT\_1\_COPA\_1
- probability\_HKONT\_1\_COPA\_1
- recommended\_account\_HKONT\_1\_COPA\_2
- probability\_HKONT\_1\_COPA\_2
- recommended\_account\_HKONT\_1\_COPA\_3
- probability\_HKONT\_1\_COPA\_3
- recommended\_account\_HKONT\_2\_COPA\_1
- probability\_HKONT\_2\_COPA\_1
- recommended\_account\_HKONT\_2\_COPA\_2
- probability\_HKONT\_2\_COPA\_2
- recommended\_account\_HKONT\_2\_COPA\_3
- probability\_HKONT\_2\_COPA\_3
- recommended\_account\_HKONT\_3\_COPA\_1
- probability\_HKONT\_3\_COPA\_1
- recommended\_account\_HKONT\_3\_COPA\_2
- probability\_HKONT\_3\_COPA\_2
- recommended\_account\_HKONT\_3\_COPA\_3
- probability\_HKONT\_3\_COPA\_3

To summarize, this is the prediction model for the inference for different labels.

GL	%	cc	%	COPA Set	%
GL1	90	CC1	75	CP Set11	90
				CP Set12	5
				CP Set13	5
GL2	7	CC2	20	CP Set21	85
				CP Set22	3
				CP Set23	2
GL3	2	CC3	5	CP Set31	75
				CP Set32	20
				CP Set33	5



## 6.7 Common Status and Error Codes

Code	Message	Reason
200	Success	Request was successful
201	OK	Request was successful
400	Bad request	Process could not be submitted or completed; possibly due to parameter error, bad request syntax or invalid request message framing
401	Not authorized	No token, bad or invalid token
404	Not found	Job id not found
405	Not allowed	Method not allowed. For example, deletion of data is not allowed when the upload lock is set or when training is in progress.
409	Conflicting job id	Request cannot be processed due to a conflict in the current state of the resource, for example, trying to set the upload lock for an already locked job id
415	File type not allowed	Not supported file type
422	Invalid header fields in the inference file	There are invalid header fields in the inference file uploaded
429	Limit exceeded	Input limits have been exceeded. See <a href="#">Input Limits [page 42]</a> .
500	Internal server error	Process could not be submitted or completed; possibly due to an internal error

## 6.8 Input Limits

All Invoice Object Recommendation APIs have strict limits on the inputs. See details in the table below.

Input	Maximum Limit
Size of training file chunks	20 MB
Total size of training file	1 GB

### Related Information

[Trial Account Input Limits \[page 42\]](#)

### 6.8.1 Trial Account Input Limits

When using the Invoice Object Recommendation trial account, be aware of the following input limits:

Input	Maximum Limit
Service instance	1
Total size of training file	10 MB
Number of datasets	10
Number of training jobs	10
Number of simultaneous training jobs	1
Number of trained models	1
Number of inference lines	1000

#### ! Restriction

After 7 days, any model trained, using the Invoice Object Recommendation trial account, is deleted from the model repo.

# 7 Security Guide

Get an overview on the security information that applies to Invoice Object Recommendation. Learn about the main security aspects of the service and its components.

## General Information

Invoice Object Recommendation provides a set of RESTful application programming interfaces (APIs) over which client applications can directly communicate with the service, in order to receive G/L (general ledger) account and cost object recommendations. All communication to the APIs is secured via the HTTPS protocol. Invoice Object Recommendation is a pure API-based service and provides no graphical user interface and has no dedicated frontend.

## Related Information

[User Administration, Authentication and Authorization \[page 43\]](#)

[Data Protection and Privacy \[page 44\]](#)

[Auditing and Logging Information \[page 46\]](#)

[Front-End Security \[page 47\]](#)

## 7.1 User Administration, Authentication and Authorization

### Introduction

For Invoice Object Recommendation, the standard user authentication and authorization mechanisms provided by SAP Business Technology Platform (SAP BTP) for Cloud Foundry is used. Following the standard mechanism of Cloud Foundry, the service consumer can create an instance of the Invoice Object Recommendation service and then generate credentials to communicate with the service instance (see [Using Services in the Cloud Foundry Environment](#) in the SAP BTP documentation for details on this process).

The credentials enable the user to retrieve a JSON Web Token (JWT), which is necessary for the secure communication between any client and the service. Overall, the communication with the service is secured by the OAuth 2.0 protocol. For more information on this topic, see [Data Privacy and Security](#) in the SAP BTP documentation.

## User Administration and Provisioning

The application does not manage or provision users.

## 7.2 Data Protection and Privacy

### Introduction

Data protection is associated with numerous legal requirements and privacy concerns. In addition to compliance with general data privacy acts, it is necessary to consider compliance with industry-specific legislation in different countries. This section describes the specific features and functions that SAP provides to support compliance with the relevant legal requirements and data privacy.

This section and any other sections in this Security Guide do not give any advice on whether these features and functions are the best method to support company, industry, regional or country-specific requirements. Furthermore, this guide does not give any advice or recommendations with regard to additional features that would be required in a particular environment; decisions related to data protection must be made on a case-by-case basis and under consideration of the given system landscape and the applicable legal requirements.

#### i Note

In the majority of cases, compliance with data privacy laws is not a product feature.

SAP software supports data privacy by providing security features and specific data-protection-relevant functions such as functions for the simplified blocking and deletion of personal data.

SAP does not provide legal advice in any form. The definitions and other terms used in this guide are not taken from any given legal source.

Invoice Object Recommendation generally requires the following types of data:

Data	Purpose
Data for inference	Consists of one or more CSV files, which are submitted by a user in order to receive G/L (general ledger) account and cost object recommendations.
Data for training	Consists of one or more CSV files containing invoice line items (ground truth) that are used in the machine learning training process to create a model that provides G/L (general ledger) account and cost object recommendations.

## Read Access Logging

The training data used by Invoice Object Recommendation is controlled and managed by the consuming application/customer which calls the service APIs. However, Invoice Object Recommendation does not have any means to verify whether the data uploaded to the service contains any personal information. Therefore, Invoice Object Recommendation does not support logging of read access to (sensitive) personal data.

## Information Report

The data used by Invoice Object Recommendation is controlled and managed by the consuming application/customer which calls the service APIs. Invoice Object Recommendation does not have any means to verify whether the data uploaded to the service contains any personal information. Therefore, the service does not provide any means to retrieve personal data of specific individuals. It is recommended that the consuming application/customer, which uses the service provides personal data reports to its users about the data being stored and transferred to Invoice Object Recommendation for processing.

## Deletion of Personal Data

Invoice Object Recommendation does not explicitly process any personal data. The service does not have any means to verify whether the data uploaded to the service contains any personal information. Therefore, no dedicated functionality for the deletion of personal data is available. See the table below for more details on the deletion of inference and training data.

Data	Deletion
Data for inference	Inference data is processed immediately, it is not stored temporarily anywhere. When the instance of the Invoice Object Recommendation service is deleted, all data that has been uploaded, but has not been used for training is also deleted.
Data for training	Training data is stored in cloud storage up to 24 hours from the uploaded time. The user also has the option to delete their uploaded data.

## Change Log

The data used by Invoice Object Recommendation is controlled and managed by the consuming application/customer which calls the service APIs. The service itself does not allow any change to the content of the uploaded data. Therefore, Invoice Object Recommendation does not support logging of data change.

## Consent

According to Personal Data Processing Agreement for SAP Cloud Services, SAP acts as data processor. Thus, customers are responsible for obtaining relevant consent to process personal data, including when applicable approval by controllers to use SAP as a processor.

## 7.3 Auditing and Logging Information

Here you can find a list of the security events that are logged by the Invoice Object Recommendation service.

Security events written in audit logs

Event grouping	What events are logged	How to identify related log events	Additional information
Dataset related events	Successful data upload	"DATA UPLOAD" and id consisting of: targetTenant tenant_id  Attribute "old_value" is "None" and "new_value" is "SUCCESS"	In the log events, {tenant_id} is the ID of the tenant used to access the service.
	Successful dataset deletion	"data\":"\Unexpected Error [ACTION : DATASET DELETION, STATE : SUCCESSFULLY DELETED]\"	
	Successful batch file deletion	"data\":"\Unexpected Error [ACTION : BATCH FILE DELETION, STATE : SUCCESSFULLY DELETED]\"	
	Malware detection in data upload and inference	"data\":"\Unexpected Error [ACTION : MALWARE CHECK, STATE : MALWARE DETECTED]\"	
Tenant related events	Tenant successful provisioning	"Tenant provisioned" and id consisting of: targetTenant {tenant_id}  Attribute "old_value" is "DOES_NOT_EXIST" and "new_value" is "SUCCESSFULLY PROVISIONED"	

Event grouping	What events are logged	How to identify related log events	Additional information
	Tenant successful de-provisioning	"Tenant de-provisioned" and id consisting of: targetTenant {tenant_id}  Attribute "old_value" is "SUCCESSFULLY_PROVISIONED" and "new_value" is "SUCCESSFULLY DEPROVISIONED"	
	Tenant provisioning failure	"data\": \"Unexpected Error [ACTION : Tenant Provision, STATE : FAILED]\""	
	Tenant de-provisioning failure	"data\": \"Unexpected Error [ACTION : Tenant De-provision, STATE : FAILED]\""	

## Related Information

[Audit Logging in the Cloud Foundry Environment](#)

## 7.4 Front-End Security

Invoice Object Recommendation does not have any user interface component. All functionalities are delivered via web services, CSV files over HTTPS.

The service is a backend-only service component and not designed to be invoked by a web browser. Additionally, outputs returned by the service depend on the data submitted to it. Therefore, a consumer of the service should sanitize the data submitted to the service and returned by it to avoid script injection attack.

# 8 Monitoring and Troubleshooting

Find out how to get support.

## Getting Support

If you encounter an issue with this service, we recommend to follow the procedure below.

### Check Platform Status

Check the availability of the platform at [SAP Trust Center](#).

For more information about selected platform incidents, see [Root Cause Analyses](#).

### Check Guided Answers

In the SAP Support Portal, check the [Guided Answers](#) section for SAP Business Technology Platform. You can find solutions for general platform issues as well as for specific services there.

### Contact SAP Support

You can report an incident or error through the SAP Support Portal. For more information, see [Getting Support](#).

Please use the following component for your incident:

Component Name	Component Description
CA-ML-AR	Account Recommender

When submitting the incident, we recommend including the following information:

- Region information (Canary, EU10, US10, for example)
- Subaccount technical name
- The URL of the page where the incident or error occurs
- The steps or clicks used to replicate the error
- Screenshots, videos, or the code entered





# Important Disclaimers and Legal Information

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We try not to use gender-specific word forms and formulations. As appropriate for context and readability, SAP may use masculine word forms to refer to all genders.

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