

Machine Learning

## Applied ML Prototypes (AMPs)

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# CLOUDERA

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## Applied ML Prototypes (AMPs)

Applied ML Prototypes (AMPs) provide reference example machine learning projects in Cloudera Data Science Workbench. More than simplified quickstarts or tutorials, AMPs are fully-developed expert solutions created by Cloudera's research arm, Fast Forward Labs.

These solutions to common problems in the machine learning field demonstrate how to fully use the power of Cloudera Data Science Workbench. AMPs show you how to create Cloudera Data Science Workbench projects to solve your own use cases.

AMPs are available to install and run from the Cloudera Data Science Workbench user interface. As new AMPs are developed, they will become available to you for your study and use.



**Note:** In an airgapped installation, the default AMPs catalog included at installation and default AMPs may be inaccessible. Consider creating a custom AMPs catalog. See “Custom AMP Catalog” for more information.

### Using AMPs

It's simple to get started with AMPs.

1. Log in to your Cloudera Data Science Workbench workspace, and in the left panel click AMPs.
2. Click on an AMP tile to read its description.
3. Click Configure Project and provide any configuration values required by the AMP. The Description field explains how to determine these configuration values. After you click Launch Project, the installation process may take several minutes.
4. When the installation is complete, click Overview to read the documentation for the AMP and explore the code and project structure.



**Note:** If nothing appears in the AMPs panel, an administrator may need to reconfigure and refresh the catalog. In Site Administration AMPs, click Refresh. The administrator can also refresh periodically to add newly developed AMPs to the panel.

### Related Information

[Custom AMP Catalog](#)

## Creating New AMPs

One great use for AMPs is to showcase reference examples specific to your business by creating your own AMPs in-house. Once a data science project has been built in Cloudera Data Science Workbench, you can package it and have the Cloudera Data Science Workbench Admin add it to the AMP Catalog.

Each individual AMP requires a project metadata file, which defines the environmental resources needed by the AMP, and the setup steps to install the AMP in a Cloudera Data Science Workbench workspace. See AMP Project Specification for details.



**Note:** You can store your AMPs in a git repo hosted on Github, Github Enterprise, or GitLab servers (not limited to github.com or gitlab.com.)

Additionally, only simple authentication is supported, such as passing an API key, or including the username and password, as part of the URL. If additional authentication steps are required, then that git host is not supported.

You can also look at an example for a Cloudera AMP, such as: [.project-metadata.yaml](#).

### Related Information

[AMP Project Specification](#)

## Custom AMP Catalog

An AMP catalog is a collection of AMPs that can be added to a workspace as a group. Cloudera Data Science Workbench ships with the Cloudera AMP catalog, containing AMPs developed by Cloudera Fast Forward Labs, but you can also create and add your own catalog, containing AMPs developed by your organization.

To create an AMP catalog, you need to create a YAML file called the catalog file. This file is hosted on GitHub or another git server. This could be either a public or a private git server.

The catalog file contains information about each AMP in the catalog, and provides a link to the AMP repository itself. The catalog file specification is shown in Catalog File Specification.

You can also look at the Cloudera catalog file for an example. To view the file, click directly on the URL for Cloudera in Catalog Sources.

For more details on creating the AMPs that you will include in your catalog, see Creating New AMPs.

One use case you might consider is creating a fork of the Cloudera AMP catalog, in order to host it internally. In this case, you will need to edit the URLs in the catalog and project metadata files to point to the appropriate internal resources.

### Related Information

[Catalog File Specification](#)

[Creating New AMPs](#)

## Add a catalog

The collection of AMPs available to end users can draw from one or more sources. For example, you might have an internal company catalog in addition to the default Cloudera catalog. The catalog must be provided with a catalog file and one or more project metadata YAML files.

### About this task

Specify Catalog File URL if your git hosting service allows you to access the raw content of the repo without authenticating. (That is, the source files can be retrieved with a curl command, and do not require logging into a web page). Otherwise, specify the Git Repository URL. To use a git repository as a catalog source, the catalog file and the AMP files must be in a repository that can be cloned with `git clone` without authentication.

### Procedure

1. As an Administrator, go to Site Administration AMPs .
2. Select Git Repository URL or Catalog File URL to specify a new source. Paste or enter the URL to the new source, and file name for the catalog file if necessary.
3. Click Add Source.  
The catalog YAML file is loaded, and the projects found there are displayed in Catalog Entries.
4. If there are projects that are not yet ready for use, or that should not be displayed in the catalog, deselect Enabled in the Catalog Entries.

## Catalog File Specification

The Catalog file is a YAML file that contains descriptive information and metadata for the displaying the AMP projects in the Project Catalog.

### Fields

Fields are in snake\_case. Each project in the catalog uses the following fields:

Field Name	Type	Example	Description
name	string	name: Cloudera	Required. Name of the catalog, displayed as Source in the Prototype Catalog tab.
entries	string	entries:	Required. Contains the entries for each project.
title	string	title: Churn Modeling	Required. The title of the AMP, as displayed in the Prototype Catalog.
label	string	label: churn-prediction	Required.
short_description	string	short_description: Build an scikit-learn model...	Required. A short description of the project. Appears on the project tile in the Prototype Catalog.
long_description	string	long_description: >- This project demonstrates...	Required. A longer description that appears when the user clicks on the project tile.
image_path	string	image_path: >- https://raw.git...	Required. Path to the image file that displays in the Prototype Catalog.

Field Name	Type	Example	Description
tags	string	tags: - Churn Prediction - Logistic Regression	Required. For sorting in the Prototype Catalog pane.
git_url	string	git_url: "https:..."	Required. Path to the git repository for the project.
is_prototype	boolean	is_prototype: true	Optional. Indicates the AMP should be displayed in the Prototype Catalog. Use if coming_soon is not used.
coming_soon	boolean	coming_soon: true	Optional. Displays the AMP in the Prototype Catalog with a "COMING SOON" watermark. Use if is_prototype is not used.

Example:

```
name: Cloudera

entries:
  - title: Churn Modeling with scikit-learn
    label: churn-prediction
    short_description: Build an scikit-learn model to predict churn using
customer telco data.
    long_description: >-
This project demonstrates how to build a logistic regression classific
ation model to predict the probability
that a group of customers will churn from a fictitious telecommunicatio
ns company. In addition, the model is
interpreted using a technique called Local Interpretable Model-agnos
tic Explanations (LIME). Both the logistic
regression and LIME models are deployed using CML's real-time model dep
loyment capability and interact with a
basic Flask-based web application.
    image_path: >-
https://raw.githubusercontent.com/cloudera/Applied-ML-Prototypes/maste
r/images/churn-prediction.jpg
    tags:
      - Churn Prediction
      - Logistic Regression
      - Explainability
      - Lime
    git_url: "https://github.com/cloudera/CML_AMP_Churn_Prediction"
    is_prototype: true
```

## AMP Project Specification

AMP projects include a project metadata file that provides configuration and setup details. These details may include environment variables and tasks to be run on startup.

## YAML File Specification # Version 1.0

The project metadata file is a YAML file. It must be placed in your project's root directory, and must be named `.project-metadata.yaml`. The specifications for this file are listed below. You can also look at an example for one of the Cloudera AMPs, such as: [.project-metadata.yaml](#).

### Fields

Fields for this YAML file are in snake\_case. String fields are generally constrained by a fixed character size, for example `string(64)` is constrained to contain at most 64 characters. Click Show to see the list of fields.

Field Name	Type	Example	Description
name	string(200)	ML Demo	Required: The name of this project prototype. Prototype names do not need to be unique.
description	string(2048)	This demo shows off some cool applications of ML.	Required: A description for this project prototype.
author	string(64)	Cloudera Engineer	Required: The author of this prototype (can be the name of an individual, team, or organization).
date	date string	"2020-08-11"	The date this project prototype was last modified. It should be in the format: "YYYY-MM-DD" (quotation marks are required).
specification_version	string(16)	0.1	Required: The version of the YAML file specification to use.
prototype_version	string(16)	1.0	Required: The version of this project prototype.
shared_memory_limit	number	0.0625	Additional shared memory in GB available to sessions running in this project. The default is 0.0625 GB (64MB).
environment_variables	<a href="#">environment variables object</a>	See below	Global environment variables for this project prototype.
feature_dependencies	<a href="#">feature_dependencies</a>	See below	A list of feature dependencies of this AMP. A missing dependency in workspace blocks the creation of the AMP.



Field Name	Type	Example	Description
engine_images	<a href="#">engine_images</a>	See below	Engine images to be used with the AMP. What's specified here is a recommendation and it does not prevent the user from launching an AMP with non recommended engine images.
runtimes	<a href="#">runtimes</a>	See below	Runtimes to be used with the AMP. What's specified here is a recommendation and it does not prevent the user from launching an AMP with non recommended runtimes.
tasks	<a href="#">task list</a>	See below	A sequence of tasks, such as running Jobs or deploying Models, to be run after project import.

#### Example

```
name: ML Demo
description: >-
This demo shows off some cool applications of ML.
author: Cloudera Engineer
date: '2020-08-11T17:40:00.839Z'
specification_version: 1.0
environment_variables:
...
tasks:
...
```

#### Environment variables object

The YAML file can optionally define any number of global environment variables for the project under the environment field. This field is an object, containing keys representing the names of the environment variables, and values representing details about those environment variables. Click Show to see the list of fields in the Environment variables object.

Field Name	Type	Example	Description
default	string	"3"	The default value for this environment variable. Users may override this value when importing this project prototype.
description	string	The number of Model replicas, 3 is standard for redundancy.	A short description explaining this environment variable.

Field Name	Type	Example	Description
required	boolean	true	Whether the environment variable is required to have a non-empty value, the default is false.

Example: This example creates four environment variables.

```
environment_variables:
  AWS_ACCESS_KEY:
    default: ""
    description: "Access Key ID for accessing S3 bucket"
  AWS_SECRET_KEY:
    default: ""
    description: "Secret Access Key for accessing S3 bucket"
    required: true
  HADOOP_DATA_SOURCE:
    default: ""
    description: "S3 URL to large data set"
    required: false
  MODEL_REPLICAS:
    default: "3"
    description: "Number of model replicas, 3 is standard for redundancy"
    required: true
```

### Feature Dependencies

AMPs might depend on some optional features of a workspace. The `feature_dependencies` field accepts a list of such features. Unsatisfied feature dependencies prevent the AMP from being launched in a workspace, and display an appropriate error message. The supported feature dependencies are as follows:

- `model_metrics`

### Runtimes Specification

The `runtimes` field accepts a list of runtimes objects defined as follows. This Runtimes specification can be added per task or per project.

```
- editor: the_name_of_the_editor # case-sensitive string required. e.g. Workbench, Jupyter, etc. (how it appears in the UI)
  kernel: the_kernel # case-sensitive string required. e.g. Python 3.6, Python 3.8, R 3.6, etc. (how it appears in the UI)
  edition: the_edition # case-sensitive string required. e.g. Standard, Nvidia GPU, etc. (how it appears in the UI)
  version: the_short_version # case-sensitive string optional. e.g. 2021.03, 2021.05, etc. (how it appears in the UI)
  addons: the_list_addons_needed # list of case-sensitive strings optional. e.g. Spark 2.4.7 - CDP 7.2.11 - CDE 1.13, etc. (how it appears in the UI)
```

This example specifies the Runtimes the Workbench version for Python 3.8.

```
runtimes:
- editor: Workbench
  kernel: Python 3.8
  edition: Standard
  addons: ['Spark 2.4.7 - CDP 7.2.11 - CDE 1.13']
```

## Engine Images Specification

The `engine_images` field accepts a list of `engine_image` objects defined as follows:

```
- image_name: the_name_of_the_engine_image # string (required)
  tags: # list of strings (optional)
    - the_tag_of_engine_image
    - ...
```

This example specifies the official engine image with version 11 or 12:

```
engine_images:
  - image_name: engine
    tags:
      - 12
      - 11
```

This example specifies the most recent version of the `dataviz` engine image in the workspace:

```
engine_images:
  - image_name: cmldataviz
  - image_name: cdsdataviz
```

Note that when specifying CDV images, both `cmldataviz` and `cdswdataviz` must be specified. When tags are not specified, the most recent version of the engine image with the matching name is recommended. The following rule is used to determine the most recent `engine_image` with the matching name:

Official Engine (`engine`) and CDV (`cmldataviz` and `cdswdataviz`) images

Since the officially released engine images follow semantic versioning (where a newer version is always larger than any older version, when compared with `>`), the most recent engine image is the one with the largest tag. For example, `engine:14` will be recommended over `engine:13` and `cmldataviz:6.3.4-b13` is recommended over `cmldataviz:6.2.1-b12`.

Custom engine images

There is no way for Cloudera Data Science Workbench to determine the rules for customer custom engine image tags, and therefore there is no reliable way to determine the most recent custom engine image. You should use the engine image that has the correct matching name and has the newest id. The newest id means that the engine image is the most recently added engine image.

## Task list

This defines a list of tasks that can be automatically run on project import. Each task will be run sequentially in the order they are specified in this YAML file. Click Show to see the list of fields.

Field Name	Type	Example	Description
<code>type</code>	string	<code>create_job</code>	Required: The type of task to be executed. See below for a list of allowed types.
<code>short_summary</code>	string	Creating a Job that will do a task.	A short summary of what this task is doing.
<code>long_summary</code>	string	Creating a Job that will do this specific task. This is important because it leads up to this next task.	A long summary of what this task is doing.

## Jobs

### Create Job

#### Example

```
- type: create_job
  name: howdy
  entity_label: howdy
  script: greeting.py
  arguments: Ofek 21
  short_summary: Creating a job that will greet you.
  environment_variables:
    SAMPLE_ENVIRONMENT_VARIABLE: CREATE/RUN_JOB
  kernel: python3
```

Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	create_job	Required: Must be create_j ob.
name	string	howdy	Required: Job name.
entity_label	string	howdy	Required: Uniquely identifies this job for future tasks, i.e. run_job tasks. Entity labels must be lowercase alphanumeric, and may contain hyphens or underscores.
script	string	greeting.py	Required: Script for this Job to run.
kernel	string	python3	Required: What kernel this Job should use. Acceptable values are python2, python3, r, and scala. Note that scala might not be supported for every cluster.
arguments	string	Ofek 21	Command line arguments to be given to this Job when running.
environment_variables	<a href="#">environment variables object</a>	See above	See above
cpu	number	1.0	The amount of CPU virtual cores to allocate for this Job, the default is 1.0.

Field Name	Type	Example	Description
memory	number	1.0	The amount of memory in GB to allocate for this Job, the default is 1.0.
gpu	integer	0	The amount of GPU to allocate for this Job, the default is 0.
timeout	integer	10	The amount of time in minutes to wait before timing out this Job, the default is 10.
timeout_kil	boolean	false	Whether or not to stop this Job when it times out, the default is false.

### Run Job

Example run job task:

```
- type: run_job
  entity_label: howdy
  short_summary: Running the job that will greet you.
  long_summary: >-
    Running the job that will greet you. It will greet you by the name
    which is the first and only command line argument.
```

Most Job run tasks should just contain the type and entity\_label fields. Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	run_job	Required: Must be run_job.
entity_label	string	howdy	Required: Must match an entity_label of a previous create_job task.

However, they can optionally override previously defined fields. Click Show to see the list of fields.

Field Name	Type	Example	Description
script	string	greeting.py	Required: Script for this Job to run.
kernel	string	python3	Required: What kernel this Job should use. Acceptable values are python2, python3, r, and scala. Note that scala might not be supported for every cluster.

Field Name	Type	Example	Description
arguments	string	Ofek 21	Command line arguments to be given to this Job when running.
environment_variables	<a href="#">environment variables object</a>	See above	See above
cpu	number	1.0	The amount of CPU virtual cores to allocate for this Job, the default is 1.0
memory	number	1.0	The amount of memory in GB to allocate for this Job, the default is 1.0.
gpu	integer	0	The amount of GPU to allocate for this Job, the default is 0.
shared_memory_limit	number	0.0625	Limits the additional shared memory in GB that can be used by this Job, the default is 0.0625 GB (64MB).

## Models

Note: All models have authentication disabled, so their access key alone is enough to interact with them.

Resources object

Models may define a resources object which overrides the amount of resources to allocate per Model deployment.

Click Show to see the list of fields.

Field Name	Type	Example	Description
cpu	number	1.0	The number of CPU virtual cores to allocate per Model deployment.
memory	number	2.0	The amount of memory in GB to allocate per Model deployment.
gpu	integer	0	The amount of GPU to allocate per Model deployment.

For example:

```
resources:
  cpu: 1
```

```
memory: 2
```

### Replication policy object

Models may define a replication policy object which overrides the default replication policy for Model deployments.

Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	fixed	Must be fixed if present.
num_replicas	integer	1	The number of replicas to create per Model deployment.

For example:

```
replication_policy:
  type: fixed
  num_replicas: 1
```

### Model examples list

Models may include examples, which is a list of objects containing a request and response field, each containing a valid object inside, as shown in the example:

```
examples:
- request:
  name: Ofek
  age: 21
  response:
  greeting: Hello Ofek (21)
- request:
  name: Jimothy
  age: 43
  response:
  greeting: Hello Coy (43)
```

Click Show to see the list of fields.

Field Name	Type	Example	Description
request	string	See above	Required: An example request object.
response	string	See above	Required: The response to the above example request object.

### Create Model

Example:

```
- type: create_model
  name: Say hello to me
  entity_label: says-hello
  description: This model says hello to you
```

```

short_summary: Deploying a sample model that you can use to greet you
access_key_environment_variable: SHTM_ACCESS_KEY
default_resources:
  cpu: 1
  memory: 2

```

Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	create_model	Required: Must be create_model.
name	string	Say hello to me	Required: Model name
entity_label	string	says-hello	Required: Uniquely identifies this model for future tasks, i.e. build_model and deploy_model tasks. Entity labels must be lowercase alphanumeric, and may contain hyphens or underscores.
access_key_environment_variable	string	SHTM_ACCESS_KEY	Saves the model's access key to an environment variable with the specified name.
default_resources	resources object	See above	The default amount of resources to allocate per Model deployment.
default_replication_policy	replication policy object	See above	The default replication policy for Model deployments.
description	string	This model says hello to you	Model description.
visibility	string	private	The default visibility for this Model.

### Build Model

#### Example

```

- type: build_model
  entity_label: says-hello
  comment: Some comment about the model
  examples:
    - request:
        name: Ofek
        age: 21
      response:
        greeting: Hello Ofek (21)

```



```
target_file_path: greeting.py
target_function_name: greet_me
kernel: python3
environment_variables:
  SAMPLE_ENVIRONMENT_VARIABLE: CREATE/BUILD/DEPLOY_MODEL
```

Field Name	Type	Example	Description
type	string	build_model	Required: Must be build_model.
entity_label	string	says-hello	Required: Must match an entity_label of a previous create_model task.
target_file_path	string	greeting.py	Required: Path to file that will be run by Model.
target_function_name	string	greet_me	Required: Name of function to be called by Model.
kernel	string	python3	What kernel this Model should use. Acceptable values are python2, python3, r, and scala. Note that scala might not be supported for every cluster.
comment	string	Some comment about the model	A comment about the Model.
examples	<a href="#">model examples list</a>	See above	A list of request/response example objects.
environment_variables	<a href="#">environment variables object</a>	See above	See above

## Deploy Model

Example:

```
- type: deploy_model
  entity_label: says-hello
  environment_variables:
    SAMPLE_ENVIRONMENT_VARIABLE: CREATE/BUILD/DEPLOY_MODEL
```

Most deploy model tasks should just contain the type and entity\_label fields. Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	deploy_model	Required: Must be deploy_model.

Field Name	Type	Example	Description
entity_label	string	says-hello	Required: Must match an entity_label of a previous deploy_model task.

However, they can optionally override previously defined fields. Click Show to see the list of fields.

Field Name	Type	Example	Description
cpu	number	1.0	The number of CPU virtual cores to allocate for this Model deployment.
memory	number	2.0	The amount of memory in GB to allocate for this Model deployment.
gpu	integer	0	The amount of GPU to allocate for this Model deployment.
replication_policy	<a href="#">replication policy object</a>	See above	The replication policy for this Model deployment.
environment_variables	<a href="#">environment variables object</a>	See above	Overrides environment variables for this Model deployment.

## Applications

Start Application

Example:

```
- type: start_application
  subdomain: greet
  script: greeting.py
  environment_variables:
    SAMPLE_ENVIRONMENT_VARIABLE: START_APPLICATION
  kernel: python3
```

Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	start_application	Required: Must be start_application.
subdomain	string	greet	Required: Application subdomain, which must be unique per Application, and must be alphanumeric and hyphen-delimited. Application subdomains

Field Name	Type	Example	Description
			are also converted to lowercase.
kernel	string	python3	Required: What kernel this Application should use. Acceptable values are python2, python3, r, and scala. Note that scala might not be supported for every cluster.
entity_label	string	greeter	Uniquely identifies this application for future tasks. Entity labels must be lowercase alphanumeric, and may contain hyphens or underscores.
script	string	greeting.py	Script for this Application to run.
name	string	Greeter	Application name, defaults to 'Untitled application'.
description	string	Some description about the Application	Application description, defaults to 'No description for the app'.
cpu	number	1.0	The number of CPU virtual cores to allocate for this Application.
memory	number	1.0	The amount of memory in GB to allocate for this Application.
gpu	integer	0	The amount of GPU to allocate for this Application.
shared_memory_limit	number	0.0625	Limits the additional shared memory in GB that can be used by this application, the default is 0.0625 GB (64MB).
environment_variables	<a href="#">environment variables object</a>	See above	See above

## Experiments

Run Experiment

Example:

```
- type: run_experiment
  script: greeting.py
  arguments: Ofek 21
  kernel: python3
```

Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	run_experiment	Required: Must be run_experiment.
script	string	greeting.py	Required: Script for this Experiment to run.
entity_label	string	test-greeter	Uniquely identifies this experiment for future tasks. Entity labels must be lowercase alphanumeric, and may contain hyphens or underscores.
arguments	string	Ofek 21	Command line arguments to be given to this Experiment when running.
kernel	string	python3	What kernel this Experiment should use. Acceptable values are python2, python3, r, and scala. Note that scala might not be supported for every cluster.
comment	string	Comment about the experiment	A comment about the Experiment.
cpu	number	1.0	The amount of CPU virtual cores to allocate for this Experiment.
memory	number	1.0	The amount of memory in GB to allocate for this Experiment.
gpu	number	0	The amount of GPU to allocate for this Experiment.

## Sessions

Run Sessions

Example:

```
- type: run_session
  name: How to be greeted interactively
  code: |
    import os
    os.environ['SAMPLE_ENVIRONMENT_VARIABLE'] = 'SESSION'

    !python3 greeting.py Ofek 21

    import greeting
    greeting.greet_me({'name': 'Ofek', 'age': 21})
  kernel: python3
  memory: 1
  cpu: 1
  gpu: 0
```

Click Show to see the list of fields.

Field Name	Type	Example	Description
type	string	run_session	Required: Must be run_session.
	string	See above for code, greeting.py for script	Required: Either the code or script field is required to exist for the run Session task, not both. code is a direct block of code that will be run by the Session, while script is a script file that will be executed by the Session.
kernel	string	python3	Required: What kernel this Session should use. Acceptable values are python2, python3, r, and scala. Note that scala might not be supported for every cluster.
cpu	number	1.0	Required: The amount of CPU virtual cores to allocate for this Session.
memory	number	1.0	Required: The amount of memory in GB to allocate for this Session.
entity_label	string	greeter	Uniquely identifies this session for future tasks. Entity labels must be lowercase alphanumeric, and may contain hyphens or underscores.

<b>Field Name</b>	<b>Type</b>	<b>Example</b>	<b>Description</b>
name	string	How to be greeted interactively	Session name.
gpu	integer	0	The amount of GPU to allocate for this Session.