Introduction to MLflow Projects

INTRODUCTION TO MLFLOW

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MLflow Projects

- Reproducible
- Reusable
- Portable

[1] unsplash.com

MLproject

```
project/
    MLproject
    train_model.py
    python_env.yaml
    requirements.txt
```

[1] github.com

MLproject file

- `name:` - Name of the Project
- `entry_points:`
  - Command(s) to run
  - `.py` and `.sh` files
  - Workflows
- `python_env:`
  - Python environment
  - `conda.yaml` or `python_env.yaml`

[1] wikipedia.org

MLproject example

```
name: salary_model
entry_points:
  main:
    command: "python train_model.py"
python_env: python_env.yaml
```

train_model.py

```
# Import libraries and modules
import mlflow
import mlflow.sklearn
import pandas as pd
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

# Training Data
df = pd.read_csv('Salary_predict.csv')
X = df[["experience", "age", "interview_score"]]
y = df[["Salary"]]
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=0.7,random_state=0)
```

train_model.py

```
# Set Auto logging for Scikit-learn flavor
mlflow.sklearn.autolog()


# Train the model
lr = LinearRegression()
lr.fit(X_train, y_train)
```

python_env.yaml

```
python: 3.10.8
build_dependencies:
- pip
- setuptools
- wheel
dependencies:
- -r requirements.txt
```

requirements.txt

```
mlflow
scikit-learn
```

Let's practice!

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Running MLflow Projects

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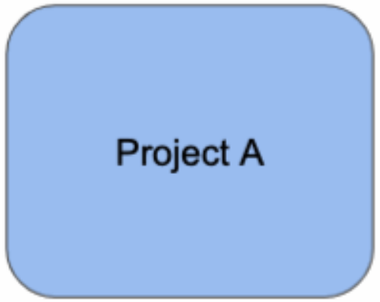
API and command line



Projects API

```
mlflow.projects
```

`mlflow.projects.run()`

- `uri` - URI to MLproject file
- `entry_point` - Entry point to start run from MLproject
- `experiment_name` - Experiment to track training run
- `env_manager` - Python environment manager: `local`, `virtualenv`, or `conda`

```
# Run MLflow Project
mlflow.projects.run(
    uri='./',
    entry_point='main',
    experiment_name='My Experiment',
    env_manager='conda'
)
```

MLproject

```
name: salary_model
python_env: python_env.yaml
entry_points:
  main:
    command: "python train_model.py"
```

train_model.py

```
# Import libraries and modules
import mlflow
import mlflow.sklearn
import pandas as pd
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

# Training Data
df = pd.read_csv('Salary_predict.csv')
X = df[["experience", "age", "interview_score"]]
y = df[["Salary"]]
```

train_model.py

```
# Train test split
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=0.7,
                                                    random_state=0)


# Set Auto logging for Scikit-learn flavor
mlflow.sklearn.autolog()

# Train model
lr = LinearRegression()
lr.fit(X_train, y_train)
```

Projects run

```
# Import MLflow Module
import mlflow

# Run local Project
mlflow.projects.run(uri='./', entry_point='main',
                    experiment_name='Salary Model')
```

Run output

```
# Run local Project
mlflow.projects.run(uri='./', entry_point='main',
                    experiment_name='Salary Model')
```

```
2023/04/02 14:33:23 INFO mlflow.projects: 'Salary Model' does not exist.
Creating a new experiment
2023/04/02 14:33:23 INFO mlflow.utils.virtualenv: Installing python 3.10.8 if it
does not exist
2023/04/02 14:33:23 INFO mlflow.utils.virtualenv: Creating a new environment
/.mlflow/envs/mlflow-44f5094bba686a8d4a5c772
created virtual environment CPython3.10.8.final.0-64 in 236ms
2023/04/02 14:33:23 INFO mlflow.utils.virtualenv: Installing dependencies
```

Run output

```
2023/04/02 14:33:59 INFO mlflow.projects.backend.local: === Running command
'source /.mlflow/envs/mlflow-44f5094bba686a8d4a5c772/bin/activate && python
train_model.py' in run with ID '562916d45aeb48ec84c1c393d6e3f5b6' ===
2023/04/02 14:34:34 INFO mlflow.projects: === Run (ID
'562916d45aeb48ec84c1c393d6e3f5b6') succeeded ===
```

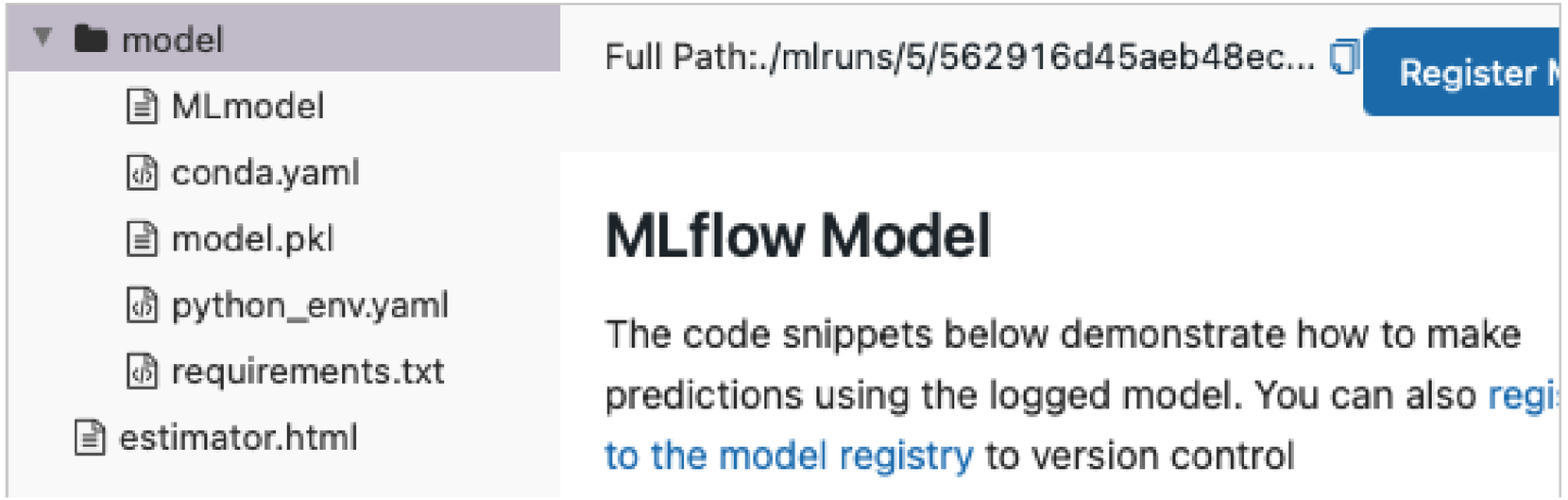
MLflow Tracking

> Parameters (4)

> Metrics (5)

> Tags (2)

v Artifacts



Command line

```
mlflow run
```

- `--entry-point` - Entry point to start run from MLproject
- `--experiment-name` - Experiment to track training run
- `--env-manager` - Python environment manager: `local`, `virtualenv`, or `conda`
- `URI` - URI to MLproject file

Run command

```
# Run main entry point from Salary Model experiment
mlflow run --entry-point main --experiment-name "Salary Model" ./
```

```
2023/04/02 15:23:34 INFO mlflow.utils.virtualenv: Installing python 3.10.8 if it
does not exist
2023/04/02 15:23:34 INFO mlflow.utils.virtualenv: Environment
/.mlflow/envs/mlflow-44f5094bba686a8d4a5c772 already exists
2023/04/02 15:23:34 INFO mlflow.projects.backend.local: === Running command 'source
/Users/weston/.mlflow/envs/mlflow-44f5094bba686a8d4a5c772/bin/activate && python
train_model.py' in run with ID 'da5b37b6f53245e5bca59ba8ed6d7dc1' ===
2023/04/02 15:23:38 INFO mlflow.projects: === Run
(ID 'da5b37b6f53245e5bca59ba8ed6d7dc1') succeeded ===
```

Let's practice!

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Specifying parameters

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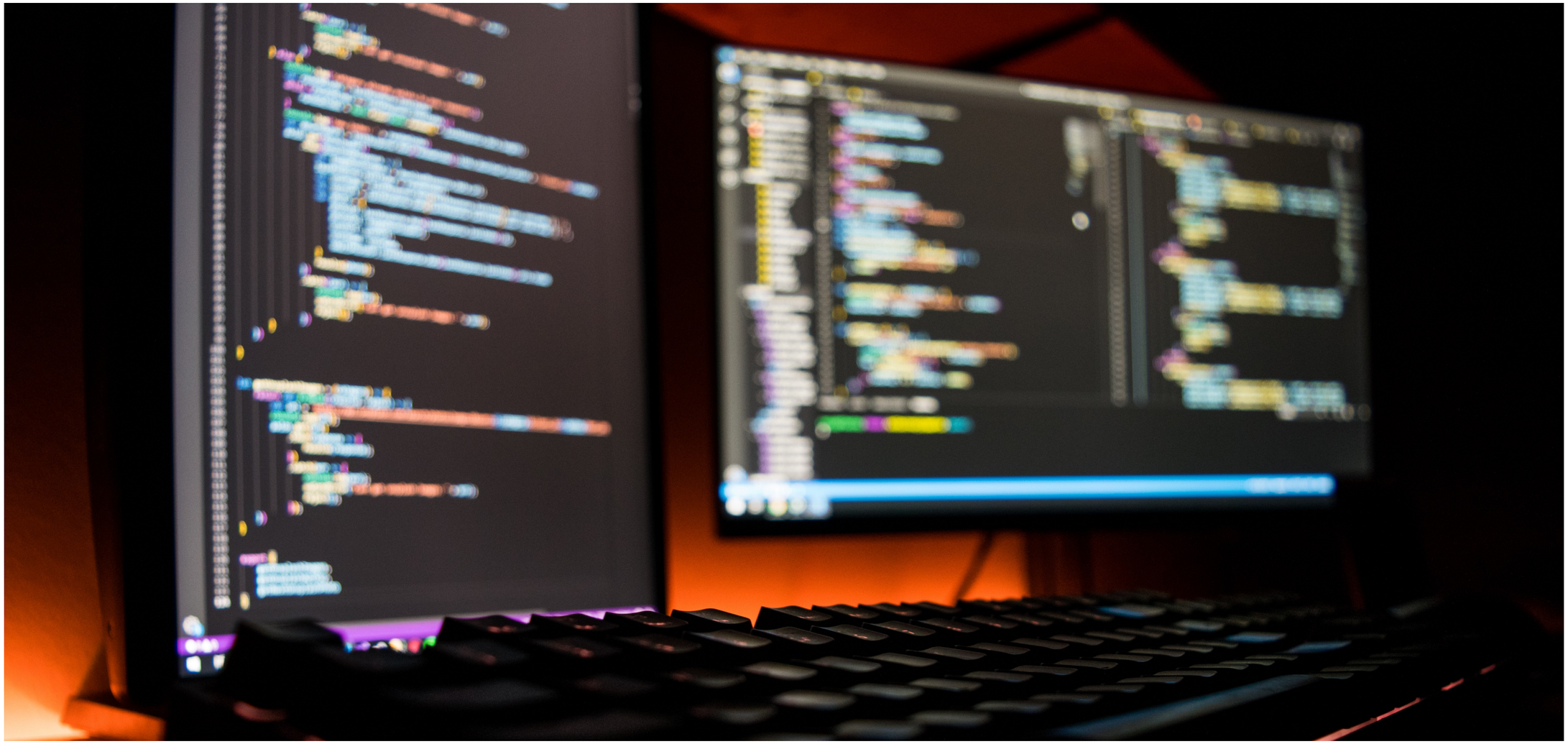
Parameters



[1] unsplash.com

Specifying parameters

```
parameter_1_name:
    type: data_type
    default: default_value
parameter_2_name:
    type: data_type
    default: default_value
```

Specifying parameters

Data types

- float, string, etc...
- defaults to string

Default value

- parameter value if nothing specified during run
- True, False, None, etc...

Parameters block

```
name: project_name
conda_env: python_env.yaml
entry_points:
  main:
    parameters:
      parameter_1:
        type: data_type
        default: default_value
      parameter_2:
        type: data_type
        default: default_value
    command: "python train.py {parameter_1_name} {parameter_2_name}"
```

train_model.py

```
# Import libraries and modules
import mlflow
import mlflow.sklearn
import pandas as pd
import sys
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split

# Training Data
df = pd.read_csv('Salary_predict.csv')
X = df[["experience", "age", "interview_score"]]
y = df[["Salary"]]
```

train_model.py

```
# Train test split
X_train, X_test, y_train, y_test = train_test_split(X, y, train_size=0.7,
                                                    random_state=0)


# Set Auto logging for Scikit-learn flavor
mlflow.sklearn.autolog()
# Parameters
n_jobs = int(sys.argv[1])
fit_intercept = bool(sys.argv[2])
# Train model
lr = LinearRegression(n_jobs=n_jobs, fit_intercept=fit_intercept)
lr.fit(X_train, y_train)
```

MLproject

```
name: salary_model
python_env: python_env.yaml
entry_points:
  main:
    parameters:
      n_jobs:
        type: int
        default: 1
      fit_intercept:
        type: bool
        default: True
    command: "python train_model.py {n_jobs_param} {fit_intercept_param}"
```

Running parameters

Python

```
mlflow.projects.run()
```

```
parameters={
        'parameter_1': data_value,
        'parameter_2': data_value,
    }
```

CLI

```
mlflow run
```

```
-P parameter_1=parameter_1_value
```

```
-P parameter_2=parameter_2_value
```

Projects run

```
# Import MLflow Module
import mlflow

# Run local Project
mlflow.projects.run(
    uri='./', entry_point='main',
    experiment_name='Salary Model',
    parameters={
        'n_jobs': 2,
        'fit_intercept': False
})
```

Output

```
2023/04/07 18:50:22 INFO mlflow.projects.backend.local: === Running command 'source
/.mlflow/envs/mlflow/bin/activate && python train_model.py 2 False' in run with ID
'422a6f589c984049ac03698efec8a286' ===
2023/04/07 18:50:28 INFO mlflow.projects: === Run (ID
'422a6f589c984049ac03698efec8a286') succeeded ===
```

Run command

```
# Run main entry point from Salary Model experiment
mlflow run --entry-point main --experiment-name "Salary Model" \
    -P n_jobs=3 -P fit_intercept=True ./
```

Output

```
# Run main entry point from Salary Model experiment
mlflow run --entry-point main --experiment-name "Salary Model" \
    -P n_jobs=3 -P fit_intercept=True ./
```

```
2023/04/07 19:08:51 INFO mlflow.projects.backend.local: === Running command 'source
/.mlflow/envs/mlflow/bin/activate && python train_model.py 3 True' in run with ID
'7c0a8885a3c7475a9aafc43c6fcae04d' ===
```

Let's practice!

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Workflows

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MLflow Projects

[1] unsplash.com

MLproject

```
name: project_name
python_env: python_env.yaml
entry_points:
  step_1:
    command: "python train_model.py"
  step_2:
    command: "python evaluate_model.py {run_id}"
    parameters:
        run_id:
            type: str
            default: None
```

Workflows

```
import mlflow


# Step 1
step_1 = mlflow.projects.run(
    uri='./',
    entry_point='step_1'
)
# Step 2
step_2 = mlflow.projects.run(
    uri='./',
    entry_point='step_2'
)
```

Projects run

```
import mlflow


# Step 1
step_1 = mlflow.projects.run(
    uri='./',
    entry_point='step_1'
)


print(step_1)
```

```
<mlflow.projects.submitted_run.LocalSubmittedRun object at 0x125eac8b0>
```

Projects run

`step_1.cancel()` - Terminate a current run

`step_1.get_status()` - Get the status of a run

`step_1.run_id` - `run_id` of the run

`step_1.wait()` - Wait for the run to finish

Projects run

```
import mlflow

# Step 1
step_1 = mlflow.projects.run(
    uri='./',
    entry_point='step_1'
)

# Set variable for step_1 run_id
step_1_run_id = step_1.run_id
```

```
# Step 2
step_2 = mlflow.projects.run(
    uri='./',
    entry_point='step_2',
    parameters={
        'run_id': step_1_run_id
    }
)
```

ML Lifecycle

Let's practice!

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Wrap-up

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MLflow Components

MLflow Tracking

Record and query experiments: code, data, config, and results

Read more

MLflow Projects

Package data science code in a format to reproduce runs on any platform

Read more

MLflow Models

Deploy machine learning models in diverse serving environments

Read more

Model Registry

Store, annotate, discover, and manage models in a central repository

Read more

[1] mlflow.org

Chapter 1 - MLflow Tracking

LR Experiment

Share

Experiment ID: 37 Artifact Location: ./mlruns/37

Description Edit

metrics.rmse < 1 and params.model = "tree"

Sort: Created

Refresh

Columns

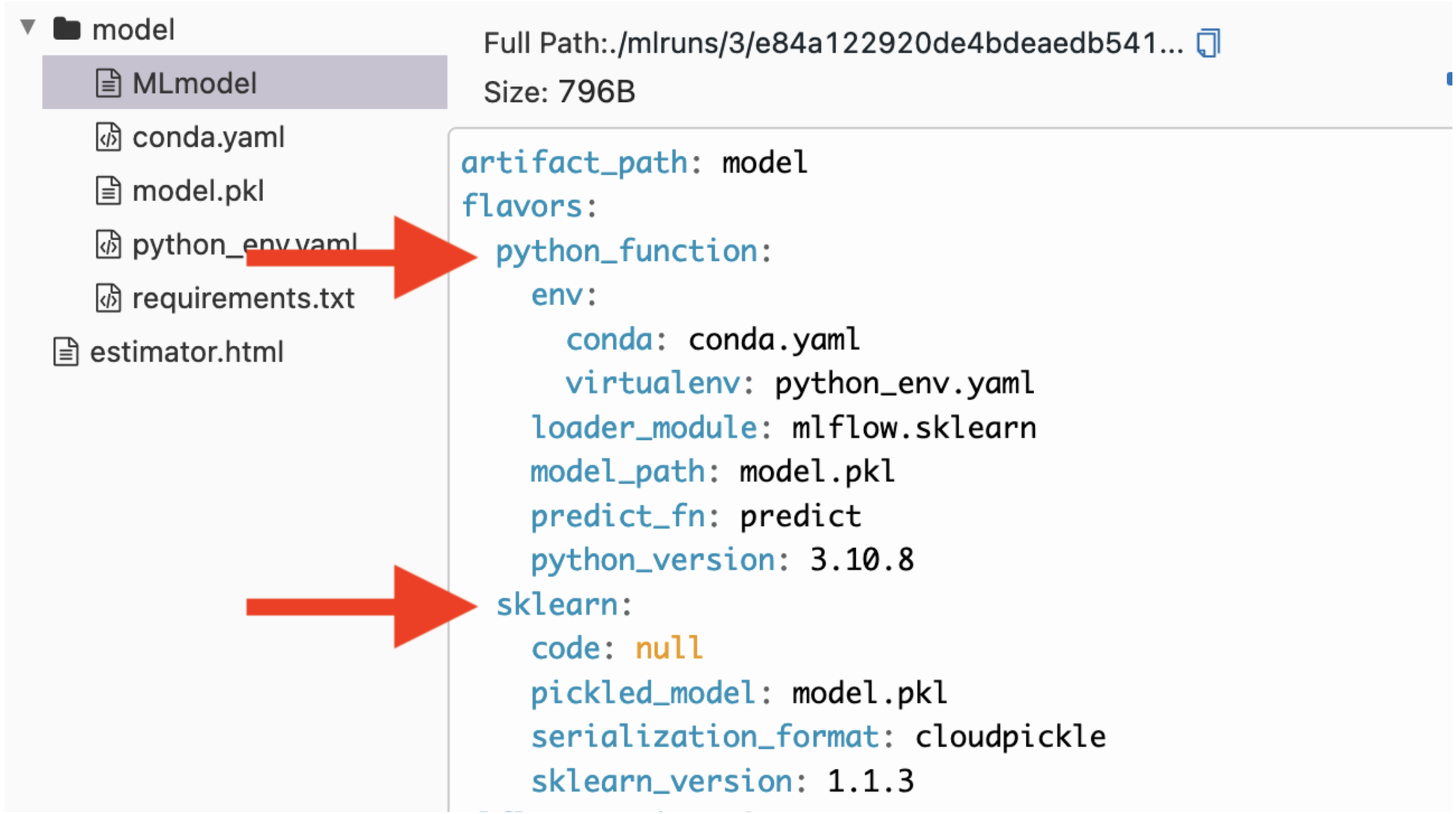
Time created: All time

State: Active

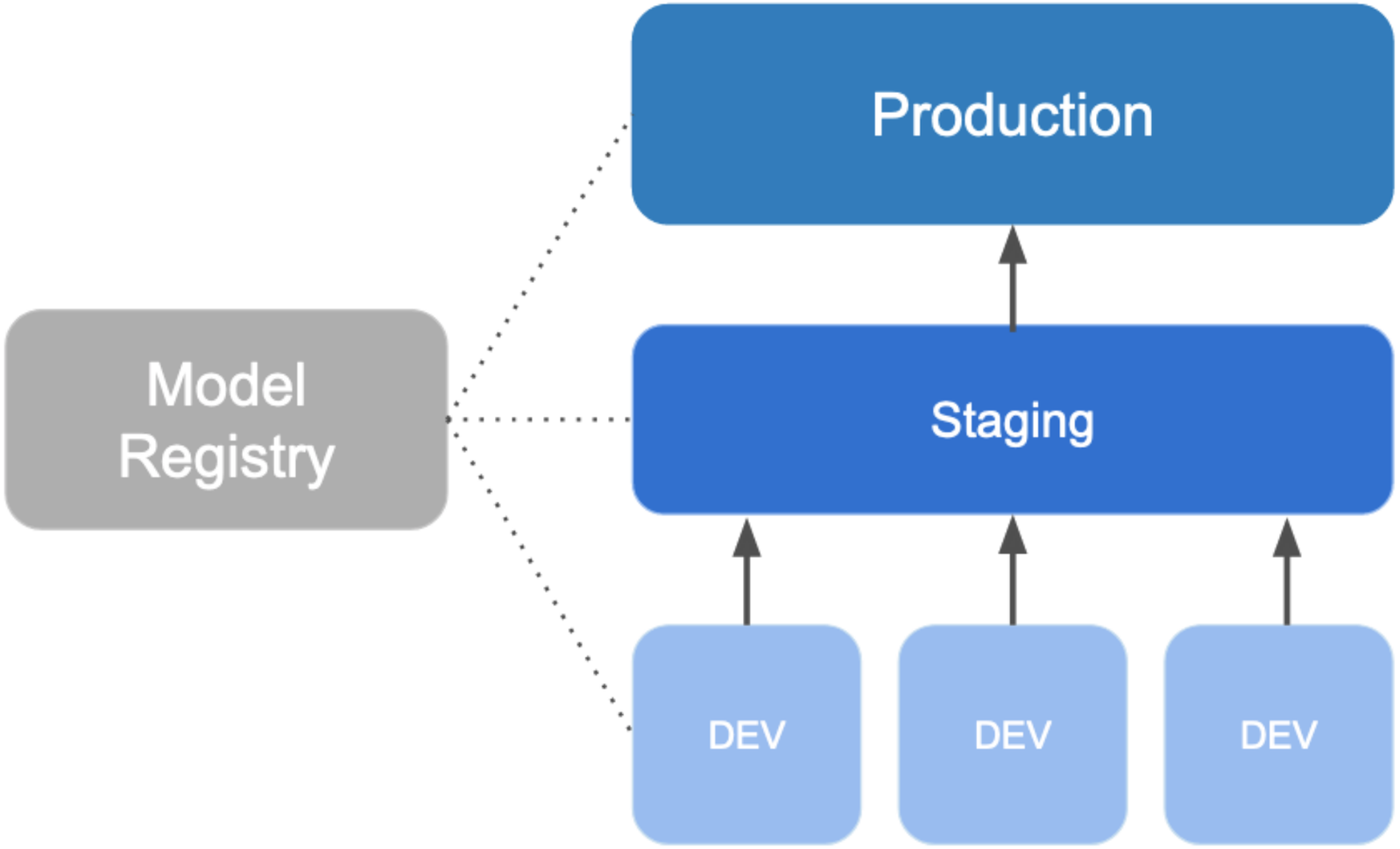
Showing 1 matching run

			Metrics	Parameters
Run Name	Created	Models	score	n_jobs
silent-slug-662	1 minute ago	-	0.951	1

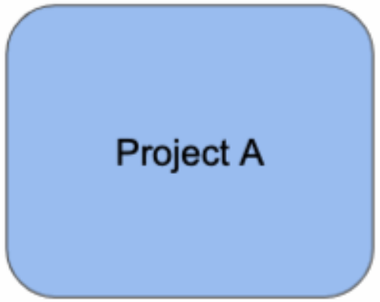
Chapter 2 - MLflow Models



Chapter 3 - Model Registry



Chapter 4 - MLflow Projects



Congratulations!

[1] giphy.com

Thank you!

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