

mlflow

Platform for Machine Learning Lifecycle

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Outline – Introduction to MLflow: Model Registry Workflows Explained – Module 4

- Model Registry
- Concepts and Motivations
 - MLflow Model Registry
 - Model Registry UI & API Workflow
 - Tutorials on local host
 - Jupyter Lab
 - Google Colab
- Q & A

<https://github.com/dmatrix/tmls-workshop>

MLflow Components

mlflow Tracking

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

mlflow Projects

Package data science code in a format that enables reproducible runs on any platform

mlflow Models

Deploy machine learning models in diverse serving environments

new

mlflow Model Registry

Store, annotate and manage models in a central repository

databricks.com/mlflow



mlflow.org



github.com/mlflow



twitter.com/MLflow



The Model Management Problem

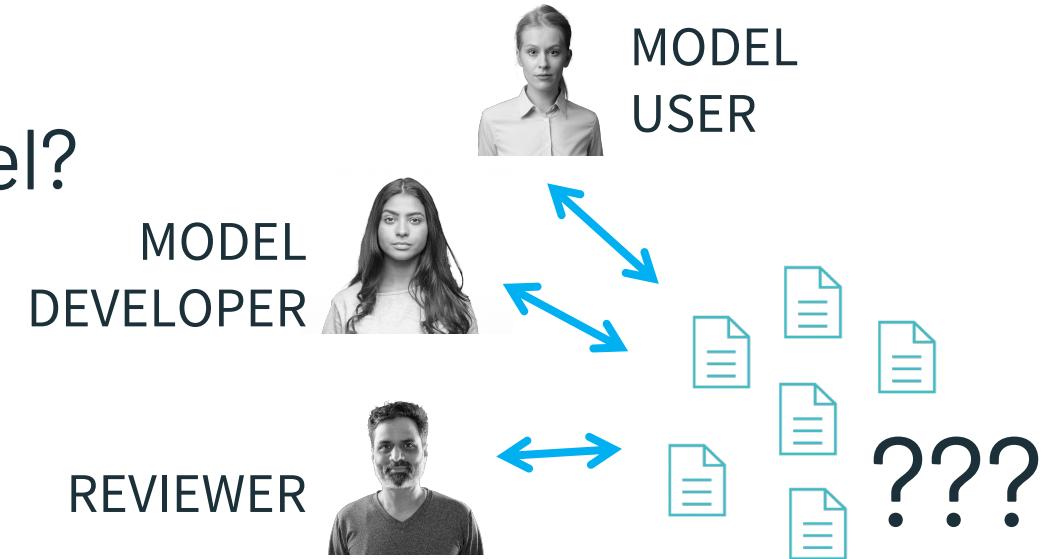
When you're working on one ML app alone, storing your models in files is manageable



The Model Management Problem

When you work in a large organization with many models, many data teams, management becomes a major challenge:

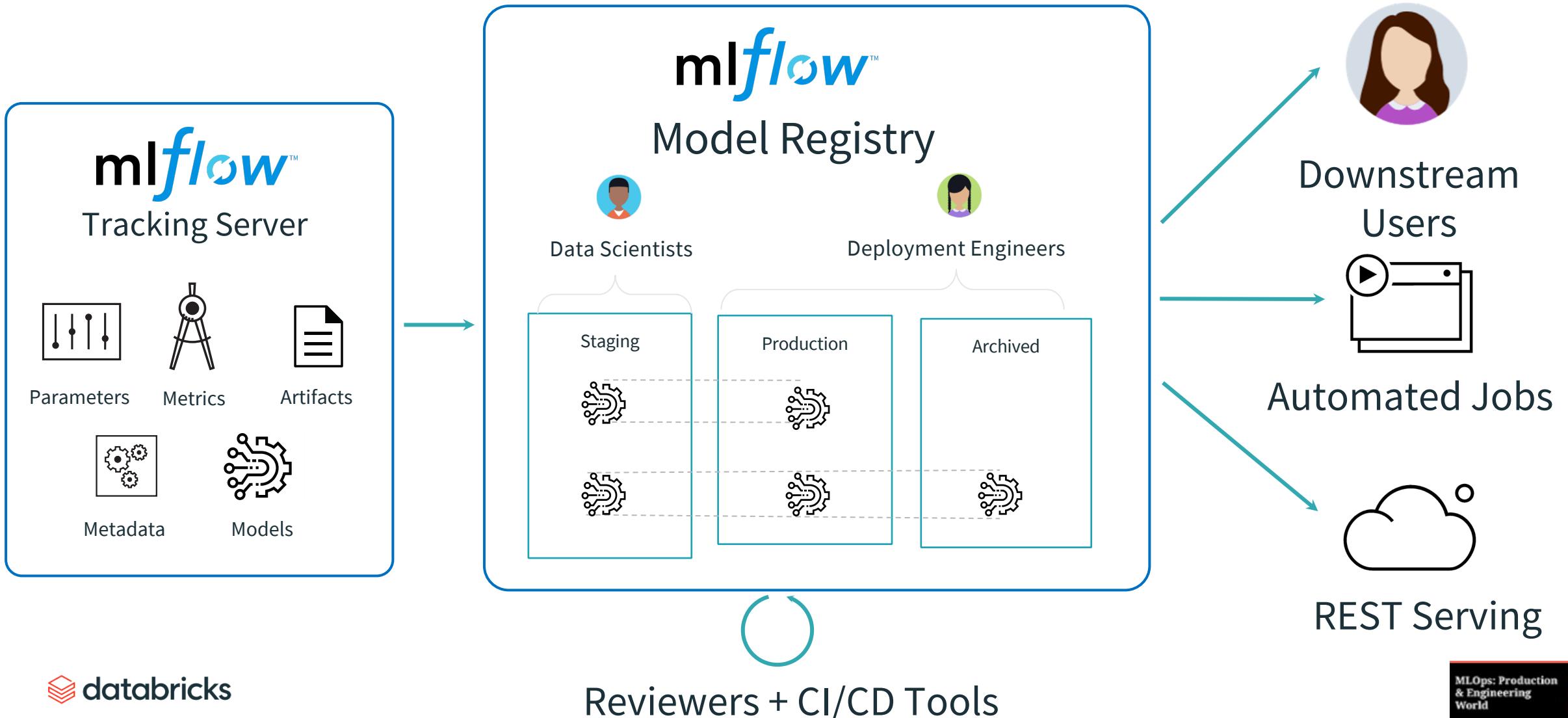
- Where can I find the best version of this model?
- How was this model trained?
- How can I track docs for each model?
- How can I review models?
- How can I integrate with CI/CD?





Model Registry

VISION: Centralized and collaborative model lifecycle management



MLflow Model Registry

- Repository of named, versioned models with controlled Access to Models
- Track each model's stage: none, staging, production, or archived
- Easily inspect a specific version and its run info
- Easily load a specific version
- Provides model description, lineage and activities

The screenshot shows the MLflow Model Registry interface. At the top, it displays the path "Registered Models > Airline_Delay_SparkML". Below this, it shows the "Created Time" as 2019-10-10 15:20:29 and the "Last Modified" time as 2019-10-14 12:17:04. A blue oval highlights the "Description" section, which contains the text: "Predicts airline delays (in minutes) using the best Spark RF model from the AutoML Toolkit." Another blue oval highlights the "Versions" section, which lists five versions of the model. The "All" tab is selected, and the "Active(1)" tab is shown. The table has columns for Version, Registered at, Created by, and Stage. The data is as follows:

Version	Registered at	Created by	Stage
Version 1	2019-10-10 15:20:30	clemens@demo.com	Archived
Version 2	2019-10-10 21:47:29	clemens@demo.com	Archived
Version 3	2019-10-10 23:39:43	clemens@demo.com	Production
Version 4	2019-10-11 09:55:29	clemens@demo.com	None
Version 5	2019-10-11 12:44:44	matei@demo.com	Staging

MLflow Model Registry

The MLflow Model Registry component is a centralized model store, set of APIs, and UI, to collaboratively manage the full lifecycle of an MLflow Model. It provides model lineage (which MLflow experiment and run produced the model), model versioning, stage transitions (for example from staging to production), and annotations.

Table of Contents

- [Concepts](#)
- [Model Registry Workflows](#)

- [UI Workflow](#)

- [Registering a Model](#)
- [Using the Model Registry](#)

- [API Workflow](#)

- [Adding an MLflow Model to the Model Registry](#)
- [Fetching an MLflow Model from the Model Registry](#)
- [Serving an MLflow Model from Model Registry](#)
- [Adding or Updating an MLflow Model Descriptions](#)
- [Renaming an MLflow Model](#)
- [Transitioning an MLflow Model's Stage](#)
- [Listing and Searching MLflow Models](#)
- [Archiving an MLflow Model](#)
- [Deleting MLflow Models](#)

Model Registry CRUD Operations MLflowClient()

```
create_model_version(name, source, run_id, tags=None, run_link=None, description=None) [source]
```

```
create_registered_model(name, tags=None, description=None) [source]
```

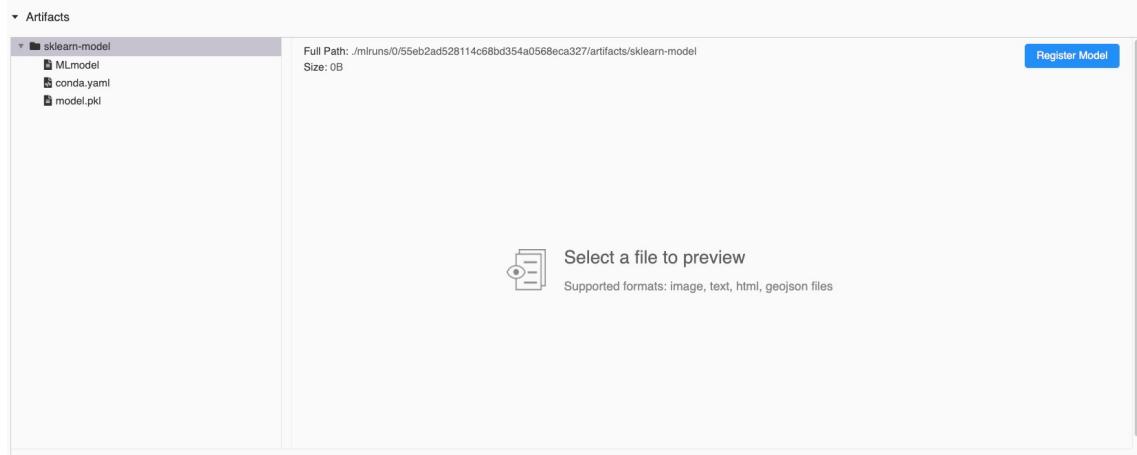
```
delete_model_version(name, version) [source]
```

```
get_latest_versions(name, stages=None) [source]
```

```
transition_model_version_stage(name, version, stage, archive_existing_versions=False) [source]
```



Model Registry Workflow UI



Artifacts

sklearn-model

- MLmodel
- conda.yaml
- model.pkl

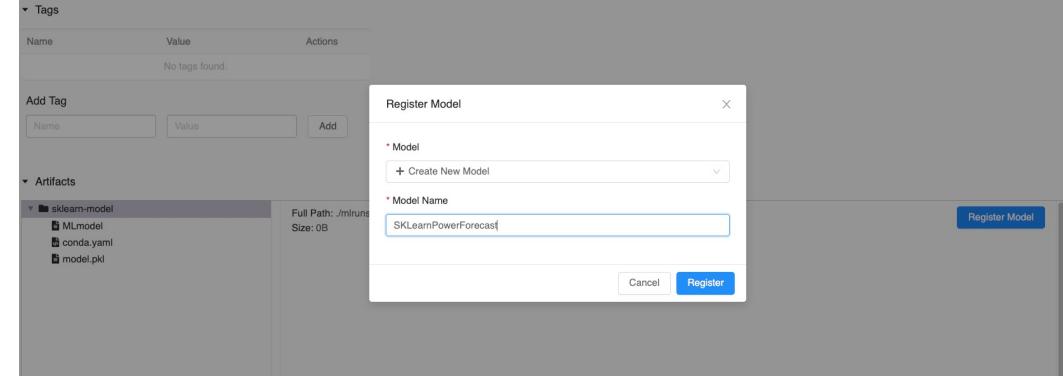
Full Path: ./mlruns/0/55eb2ad528114c68bd354a0568eca327/artifacts/sklearn-model
Size: 0B

Select a file to preview
Supported formats: image, text, html, geojson files

Register Model



MODEL
DEVELOPER



Tags

Name	Value	Actions
No tags found.		

Add Tag

Artifacts

sklearn-model

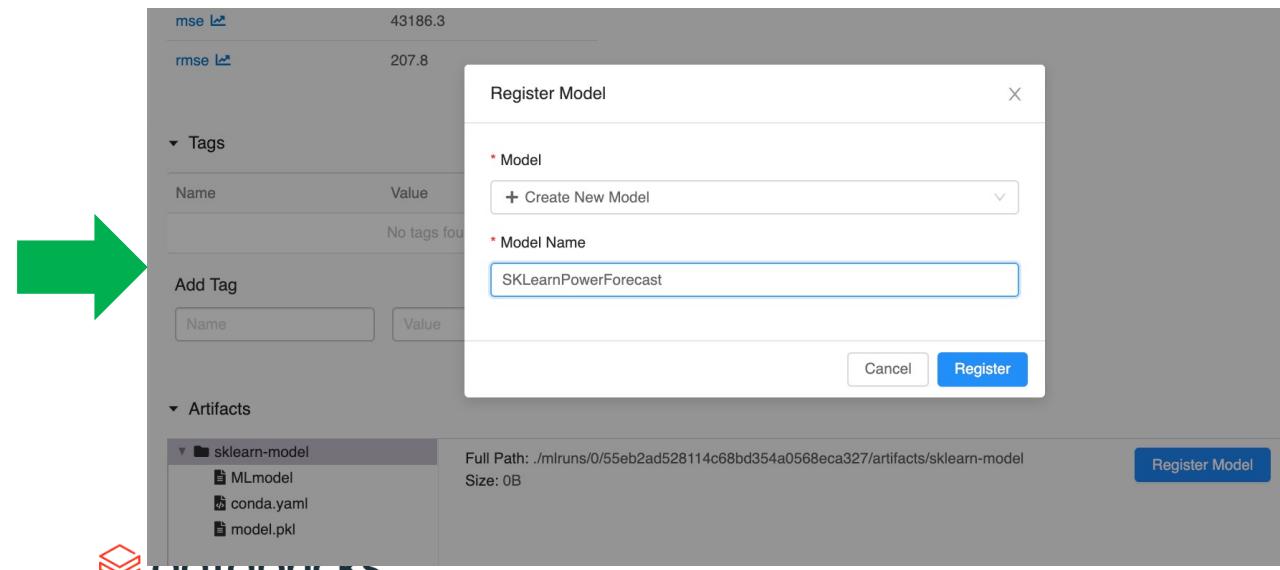
- MLmodel
- conda.yaml
- model.pkl

Full Path: ./mlruns/0/55eb2ad528114c68bd354a0568eca327/artifacts/sklearn-model
Size: 0B

Register Model

Model Name: SKLearnPowerForecast

Cancel Register



mse 43186.3

rmse 207.8

Tags

Name	Value
No tags found.	

Add Tag

Artifacts

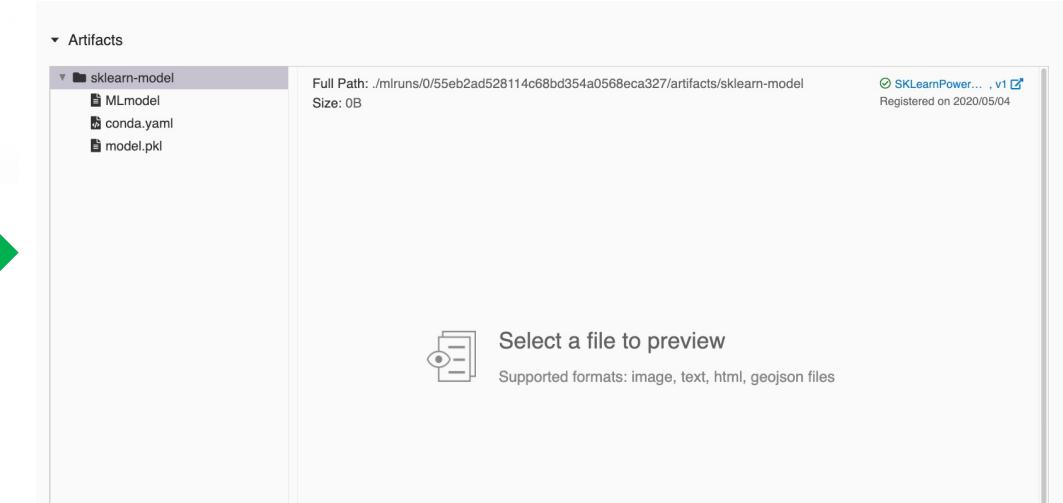
sklearn-model

- MLmodel
- conda.yaml
- model.pkl

Full Path: ./mlruns/0/55eb2ad528114c68bd354a0568eca327/artifacts/sklearn-model
Size: 0B

Select a file to preview
Supported formats: image, text, html, geojson files

Register Model



Artifacts

sklearn-model

- MLmodel
- conda.yaml
- model.pkl

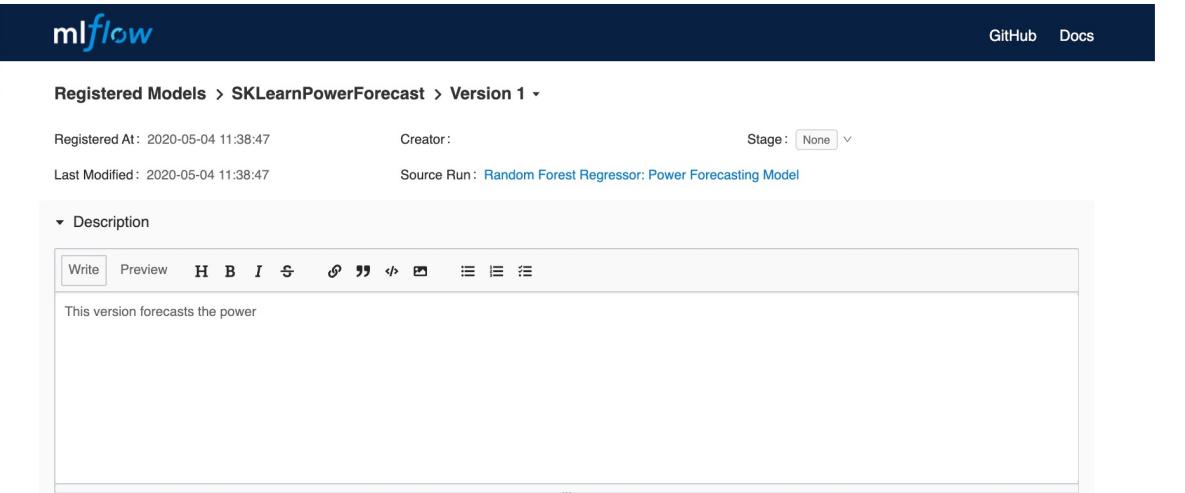
Full Path: ./mlruns/0/55eb2ad528114c68bd354a0568eca327/artifacts/sklearn-model
Size: 0B

SKLearnPowerForecast, v1
Registered on 2020/05/04

Select a file to preview
Supported formats: image, text, html, geojson files

Register Model

Model Registry Workflow UI



MODEL
REVIEWER



DOWNSTREAM USERS



AUTOMATED JOBS



REST SERVING



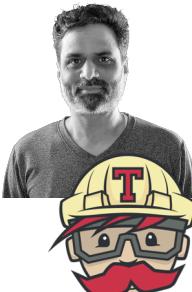
Model Registry Workflow API

```
mlflow.register_model(model_uri, "WeatherForecastModel")  
  
mlflow.sklearn.log_model(model,  
    artifact_path="sklearn_model",  
    registered_model_name= "WeatherForecastModel")
```

MODEL
DEVELOPER



REVIEWERS,
CI/CD TOOLS



```
client = mlflow.tracking.Mlflowclient()  
client.transition_model_version_stage(name="WeatherForecastModel",  
    version=5,  
    stage="Production")
```



```
model_uri= "models:/{{model_name}}/production".format(  
    model_name="WeatherForecastModel")  
model_prod = mlflow.sklearn.load_model(model_uri)  
model_prod.predict(data)
```

DOWNSTREAM
USERS



AUTOMATED JOBS



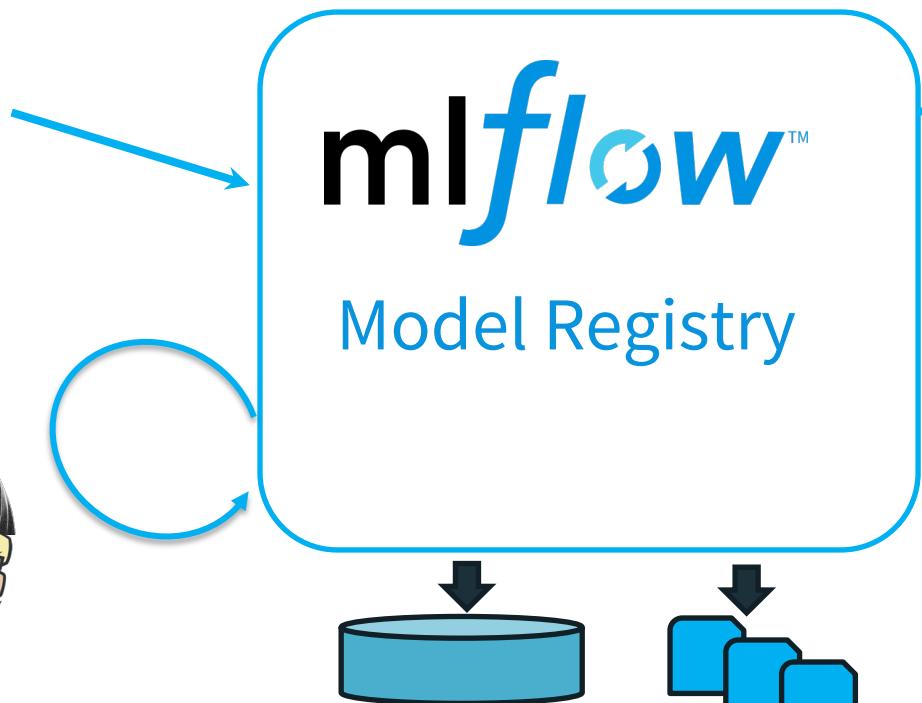
REST SERVING



Model Registry Workflow API

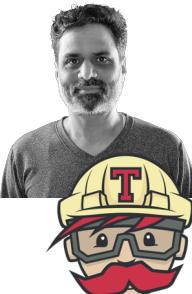
```
mlflow.register_model(model_uri, "WeatherForecastModel")  
  
mlflow.sklearn.log_model(model,  
    artifact_path="sklearn_model",  
    registered_model_name= "WeatherForecastModel")
```

MODEL
DEVELOPER

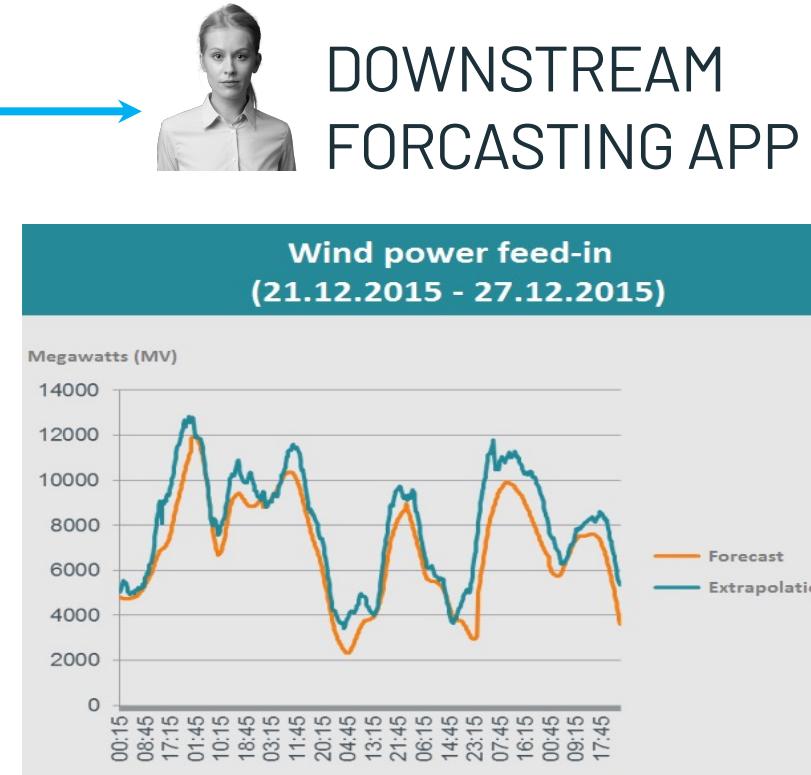


```
model_uri = "models:/{{model_name}}/production".format(  
    model_name="WeatherForecastModel")  
model_prod = mlflow.pyfunc.load_model(model_uri)  
model_prod.predict(data)
```

REVIEWERS,
CI/CD TOOLS

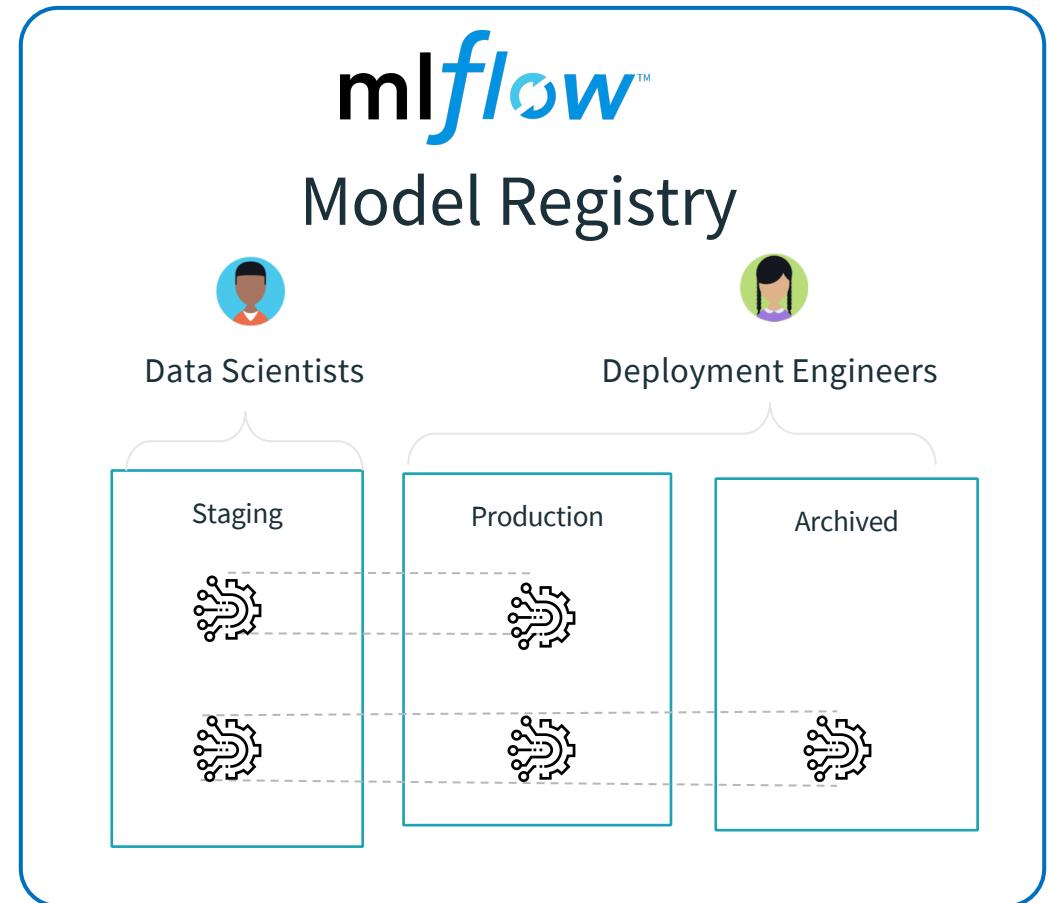


```
client = mlflow.tracking.MlflowClient()  
client.transition_model_version_stage(name="WeatherForecastModel",  
    version=5,  
    stage="Production")
```



MLflow Model Registry Recap

- **Central Repository:** Unique named registered models for discovery across data teams
- **Model Registry Workflow:** Provides UI and API for registry operations
- **Model Versioning:** Allow multiple versions of model in different stages
- **Model Stages:** Allow stage transition: none, staging, production, or archived
- **CI/CD Integration:** Easily load a specific version for testing and inspection
- **Model Lineage:** Provides model description, lineage and activities



mlflow Model Registry: Tag and Search APIs

Tags to track custom metadata for a model version, e.g. test results

Search API to automate model management and MLOps actions

The screenshot shows the mlflow Model Registry interface. The top navigation bar has tabs for 'Experiments' and 'Models'. The 'Models' tab is selected, showing a sub-menu with 'Models > KNN > Version 12'. Below this, detailed information is provided: 'Created at: 2018-12-04 17:11:06', 'User: test@example.com', 'Stage: Staging', 'Last Modified: 2018-12-04 17:11:06', and 'Source: Run 123'. A sidebar on the left includes links for 'Notes', 'Pending Requests', and 'Tags'. The 'Tags' section is expanded, showing two entries in a table:

Name	Value	Actions
passed-gdpr-review	true	
passed-performance-test	true	

A red arrow points to the delete icon for the second tag entry. At the bottom of the tags section is a blue 'Add Tag' button. Below the tags is an 'Activity' section showing two recent events: 'Alice requested a stage transition' and 'Carol approved a stage transition', both occurring 10 hours ago.

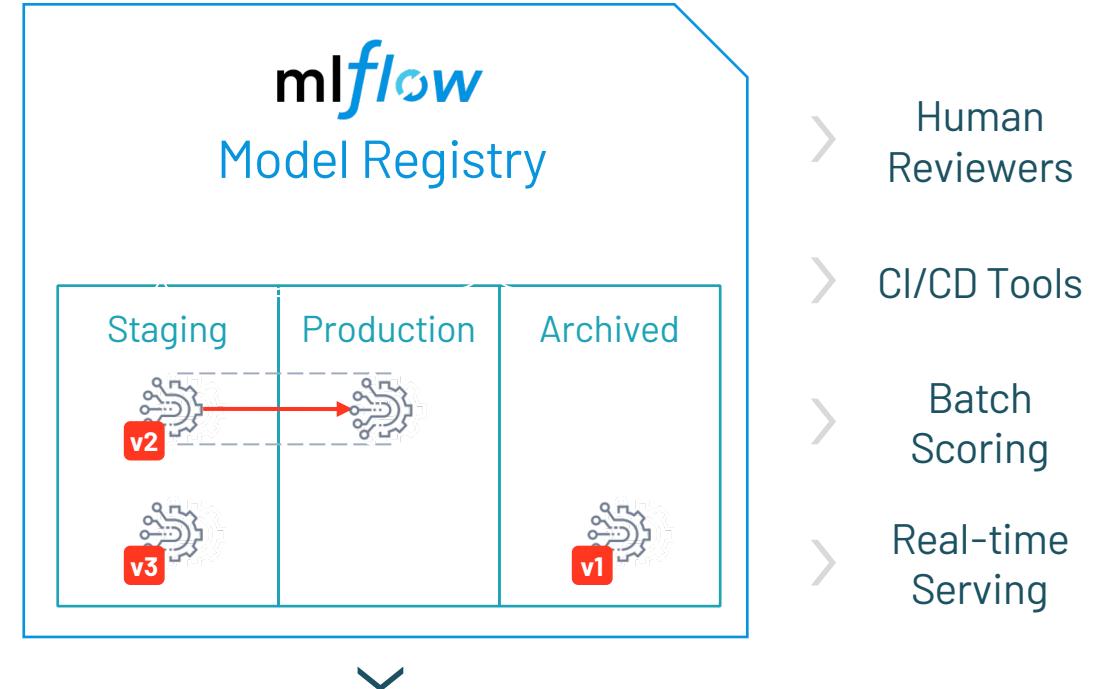
mlflow Model Registry: Webhooks

Databricks Webhooks allow setting callbacks on registry events like stage transitions to run CI/CD tools

MLflow Model Registry on Databricks
Simplifies MLOps With CI/CD Features



by Sue Ann Hong, Ankit Mathur, Jules Damji and Mani Parkhe
Posted in ENGINEERING BLOG | November 19, 2020



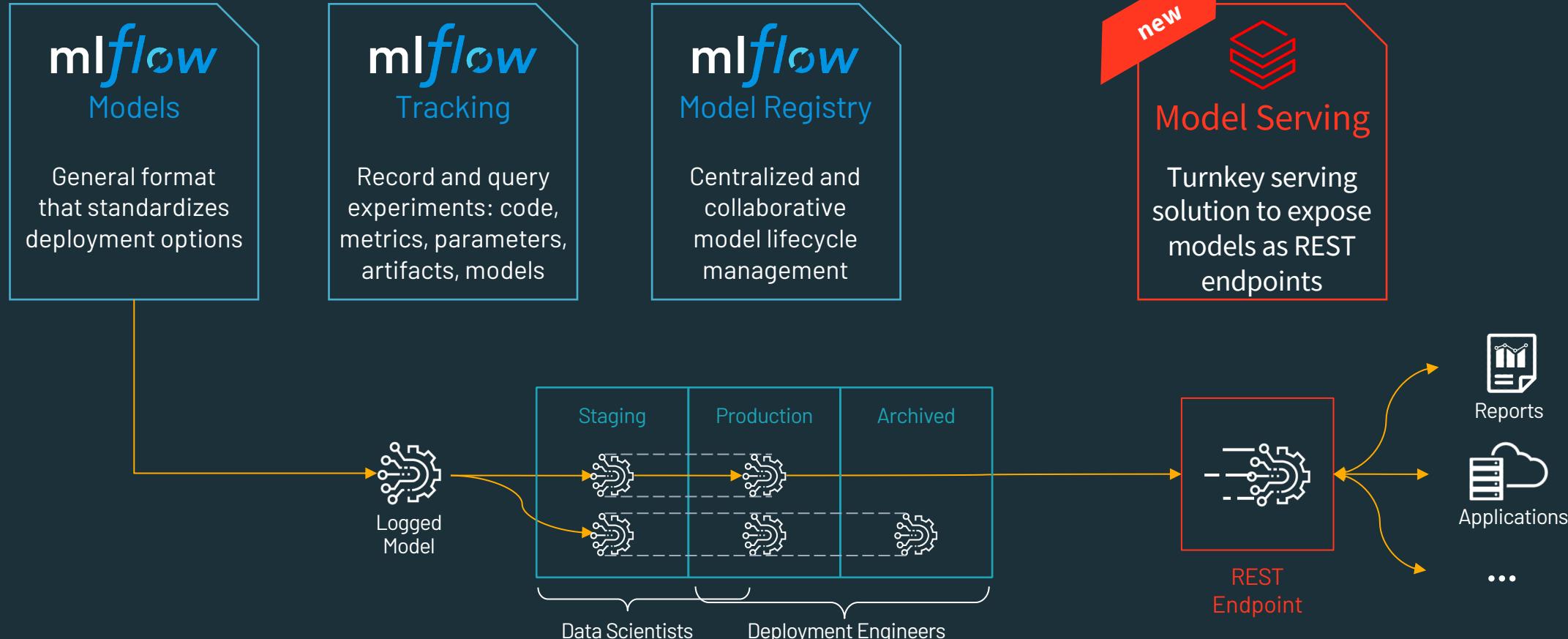
`VERSION_REGISTERED: MyModel, v2`

`TRANSITION_REQUEST: MyModel, v2, Staging→Production`

`TAG_ADDED: MyModel, v2, BacktestPassed`



Model Serving on Databricks



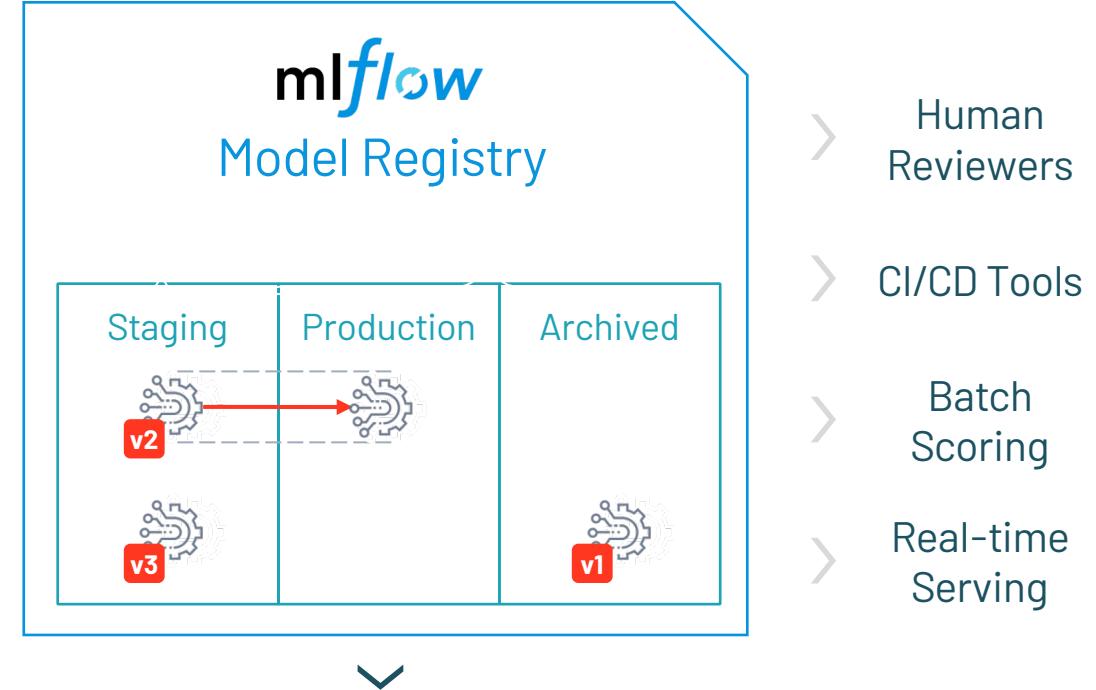
mlflow Model Registry: Webhooks on Databricks

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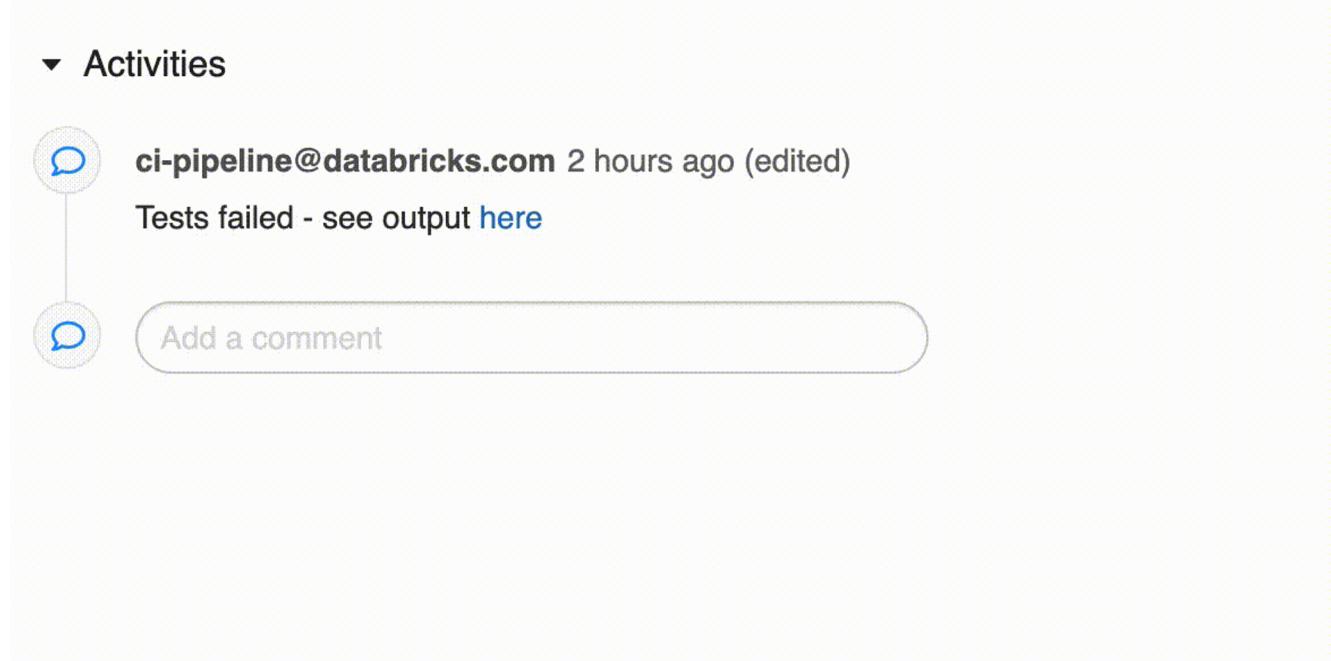
`VERSION_REGISTERED: MyModel, v2`

`TRANSITION_REQUEST: MyModel, v2, Staging→Production`

`TAG_ADDED: MyModel, v2, BacktestPassed`

mlflow Model Registry: Comments

Comments in the Databricks workspace can now be used to discuss changes on models



The screenshot shows a 'Activities' section with one comment. The comment is from 'ci-pipeline@databricks.com' 2 hours ago (edited). It states 'Tests failed - see output [here](#)'. Below the comment is a placeholder 'Add a comment'.

MLflow Model Registry on Databricks Simplifies MLOps With CI/CD Features



by Sue Ann Hong, Ankit Mathur, Jules Damji and Mani Parkhe
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Integrations with:



PyTorch

Keras



RAPIDS



python™



ONNX



XGBoost

LightGBM

spaCy

fast.ai



PYCARET

OPTUNA

RAY

CONDA

kubernetes

docker



ALGORITHMIK



Amazon SageMaker

Azure Machine Learning



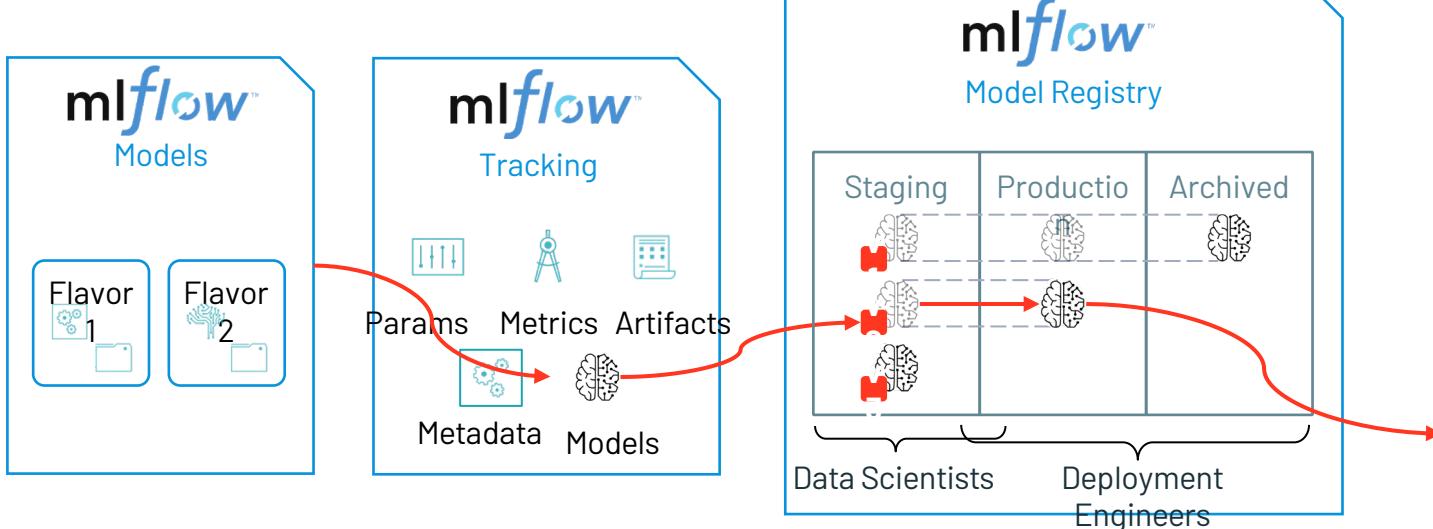
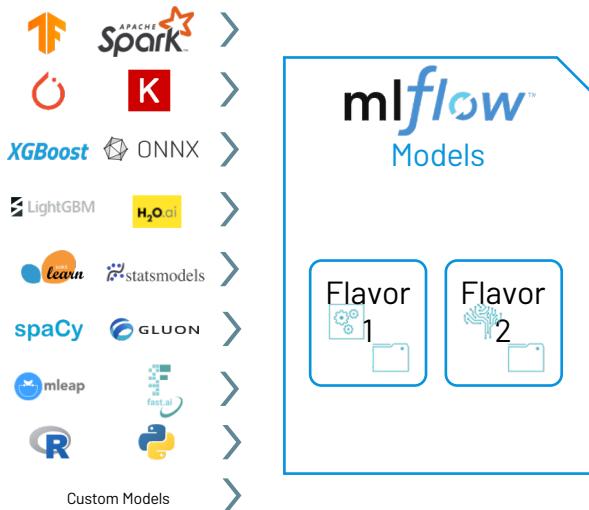
Google Cloud



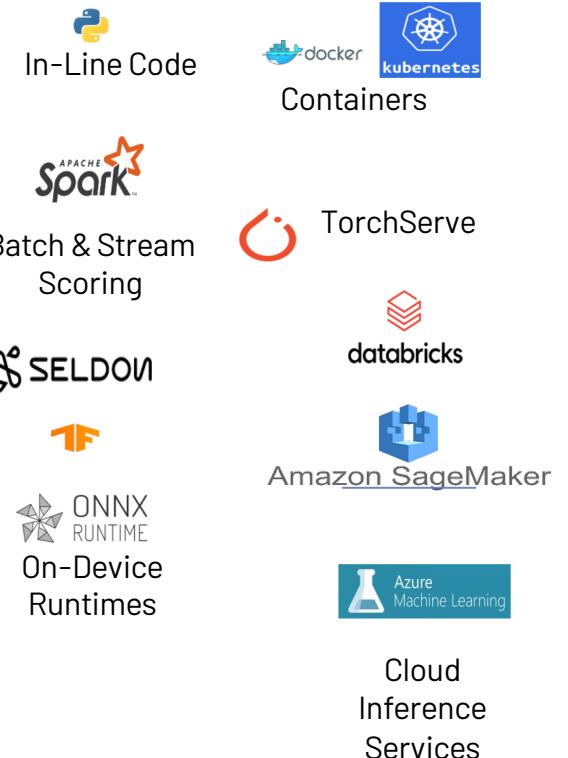
databricks

Open-Source ML Platform: MLflow

ML Frameworks



mlflow™
Model Deployments



What Did We Talk About?



- Modular Components greatly simplify the ML lifecycle
- Easy to install & Great Developer experience
- Develop & Deploy locally; track locally or remotely
- Available APIs: Python, Java & R (Soon Scala)
- REST APIs and CLI tools
- Visualize experiments and compare runs
- Centrally register and manage model lifecycle

Thank you! 😊

Q & A

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