AI4EOSC Platform User Workshop 2023– 15-16/11/2023

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MLflow and its usage

L. Berberi, V. Kozlov, K. Alibabaei, B. Esteban

Co-funded by the European Union

Overview

- MLOps Requirements
- Introduction to MLflow
- MLflow Components
- MLflow Tracking Server deployed
- Conclusions

MLOps (use case) requirements

UC1.Req02/UC2.Req09/UC3.Req07- Organize and track all training experiments

Level 2

- **MLflow** - first free and open-source MLOps product selected/tested after the landscaping activity (results presented at EGI Conf.)
    - Enhanced Experiment Management
        - facilitates efficient tracking and retrieval of historical experiments

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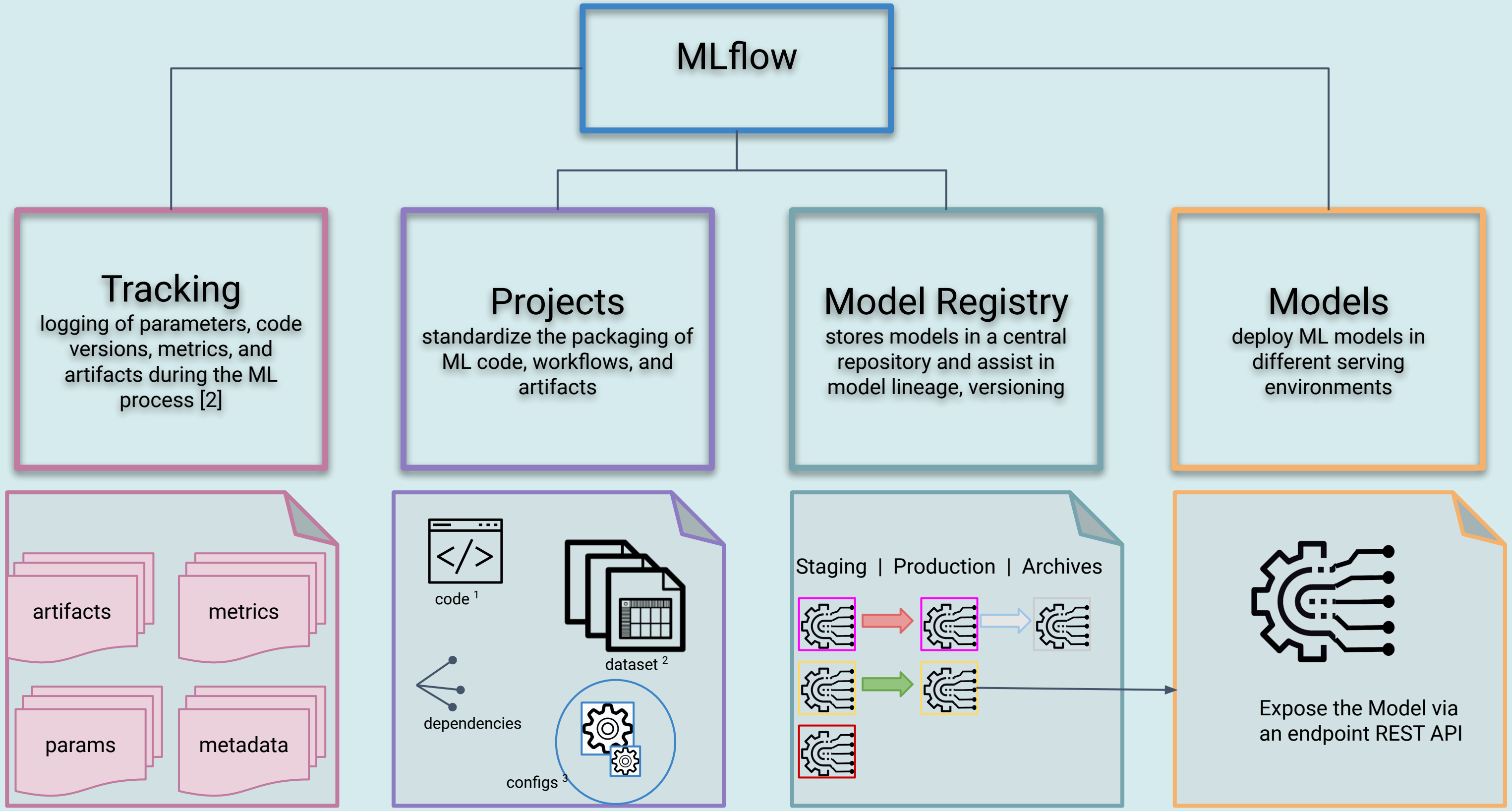
Introduction to MLflow

- An open source platform for the machine learning lifecycle
- mlflow 2.8.0 (latest release)


MLflow
Tracking
logging of parameters, code versions, metrics, and artifacts during the ML process [2]
Projects
standardize the packaging of ML code, workflows, and artifacts
Model Registry
stores models in a central repository and assist in model lineage, versioning
Models
deploy ML models in different serving environments
artifacts
metrics
params
metadata
code 1
dataset 2
dependencies
configs 3
Staging | Production | Archives
Expose the Model via an endpoint REST API

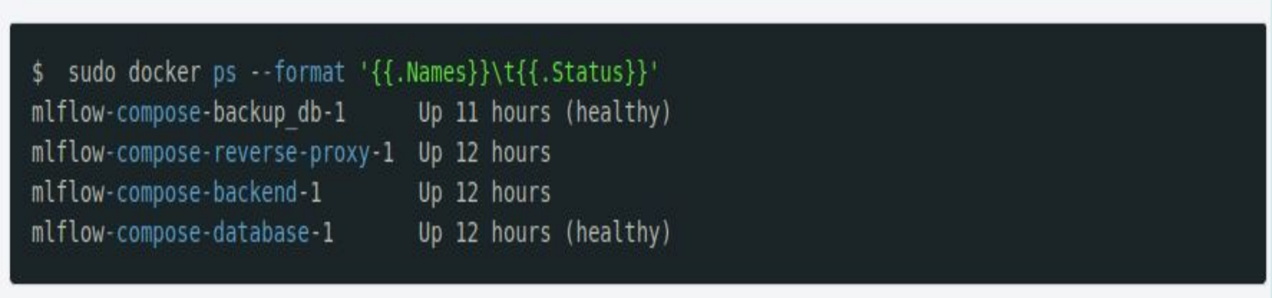
MLFlow Components

[1] Code Icon by zaiour mohcine licensed under the CC BY 3.0 license
[2] Data set icon by H Alberto Gongora under the license CC BY 3.0 license
[3] Config icon by Madalin Jefferson under the license CC BY 3.0 license

MLflow server instance deployment

- https://mlflow.dev.ai4eosc.eu
- Service capacity: 40 GB /root and 91GB GB mnt disk space
  - Backend:
    - Postgres SQL dB (store models, metrics, exp)
    - SQLite dB (store users, permissions of experiments and Registered Models)
  - Frontend: MLflow UI (experiment/running info, metrics, analyze and compare runs/exps e
- Developed a new dockerized MLFlow tracking server solution [3]
  - automatic backups and manually restore operations are written for both dBs.
  - traefik as reverse proxy + SSL certificates enabled
  - custom auth(oidc integration) plugin is under developm
- In [5]: instructions how to setup your own MLflow server instan

Built containers:



```
$  sudo docker ps --format '{{.Names}}\t{{.Status}}'
mlflow-compose-backup_db-1      Up 11 hours (healthy)
mlflow-compose-reverse-proxy-1  Up 12 hours
mlflow-compose-backend-1        Up 12 hours
mlflow-compose-database-1       Up 12 hours (healthy)
```

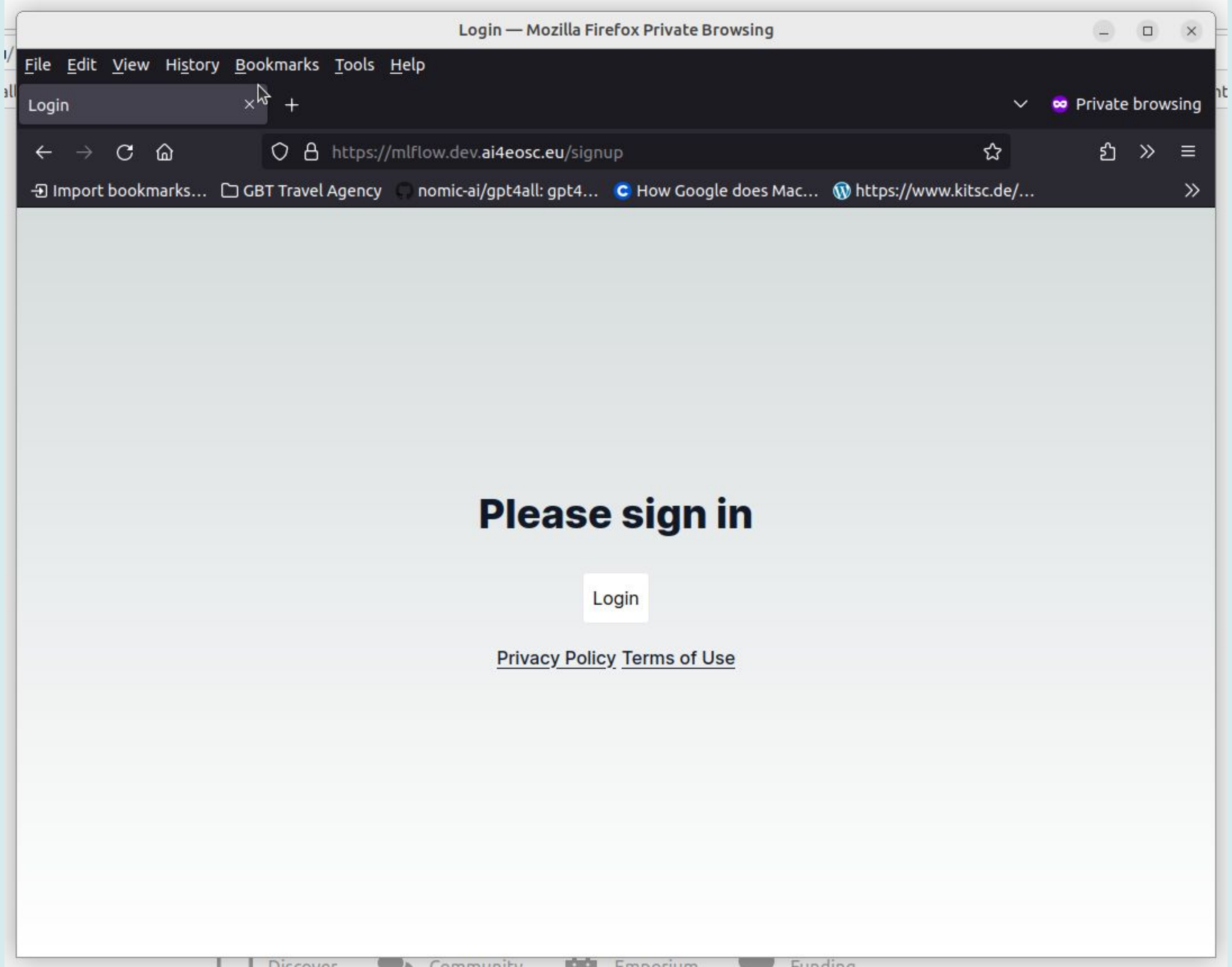
- MLflow Authentication (basic-auth) as a plugin
  - username and password (= credentials you provided from the self-registration with oidc auth)

MLflow self-user registration

Click **Login** button, login via EGI Check-In the same way as you registered for vo.ai4eosc.eu (click your Institute name/

You have to be member of vo.ai4eosc.eu to get access to this registration!

Authenticate in the MLFlow UI (frontend interface) with your credentials (via email)


Login — Mozilla Firefox Private Browsing
File Edit View History Bookmarks Tools Help
Login
Private browsing
https://mlflow.dev.ai4eosc.eu/signup
Import bookmarks... GBT Travel Agency nomic-ai/gpt4all: gpt4... How Google does Mac... https://www.kitsc.de/...

Please sign in

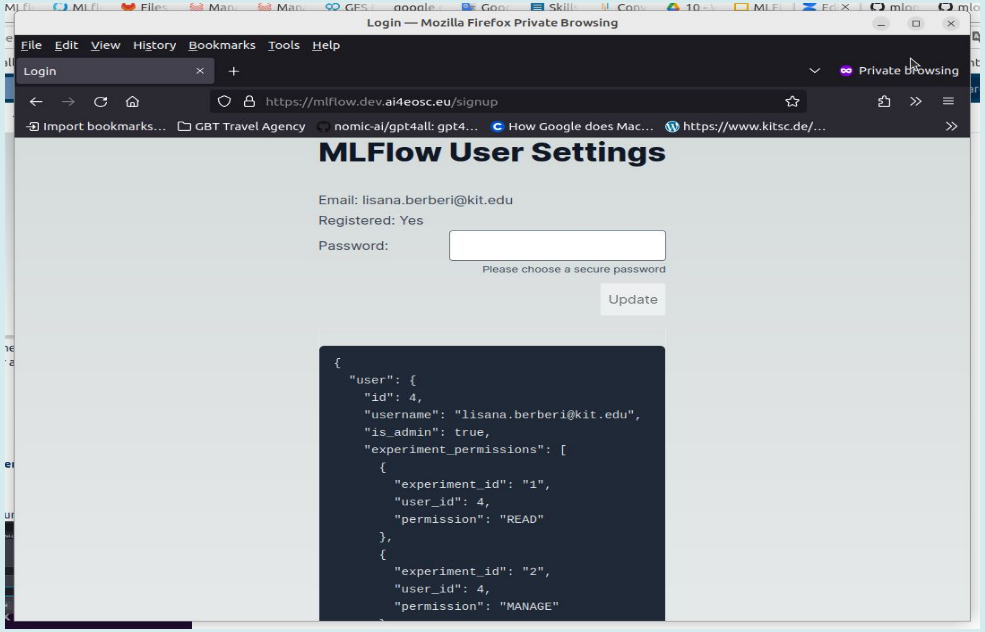
Login

Privacy Policy Terms of Use

MLflow self-user registration

Click **Login** button, login via EGI Check-In the same way as you registered for vo.ai4eosc.eu (click your Institute name/

Enter a new password in the textbox "**Password**" and then click Update button.



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Login
Private browsing
https://mlflow.dev.ai4eosc.eu/signup
Import bookmarks...
GBT Travel Agency
nomic-ai/gpt4all: gpt4...
How Google does Mac...
https://www.kitsc.de/...
Update

MLFlow User Settings

Email: lisana.berberi@kit.edu

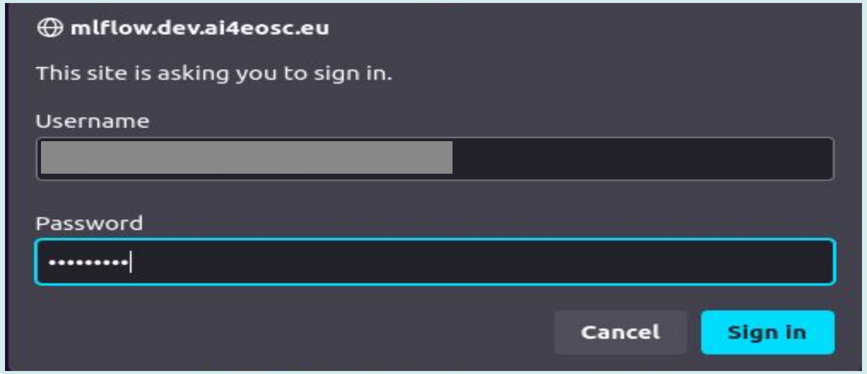
Registered: Yes

Password:

Please choose a secure password

```
{
  "user": {
    "id": 4,
    "username": "lisana.berberi@kit.edu",
    "is_admin": true,
    "experiment_permissions": [
      {
        "experiment_id": "1",
        "user_id": 4,
        "permission": "READ"
      },
      {
        "experiment_id": "2",
        "user_id": 4,
        "permission": "MANAGE"
```

Authenticate in the **MLFlow UI** (frontend interface) with your credentials (via email)



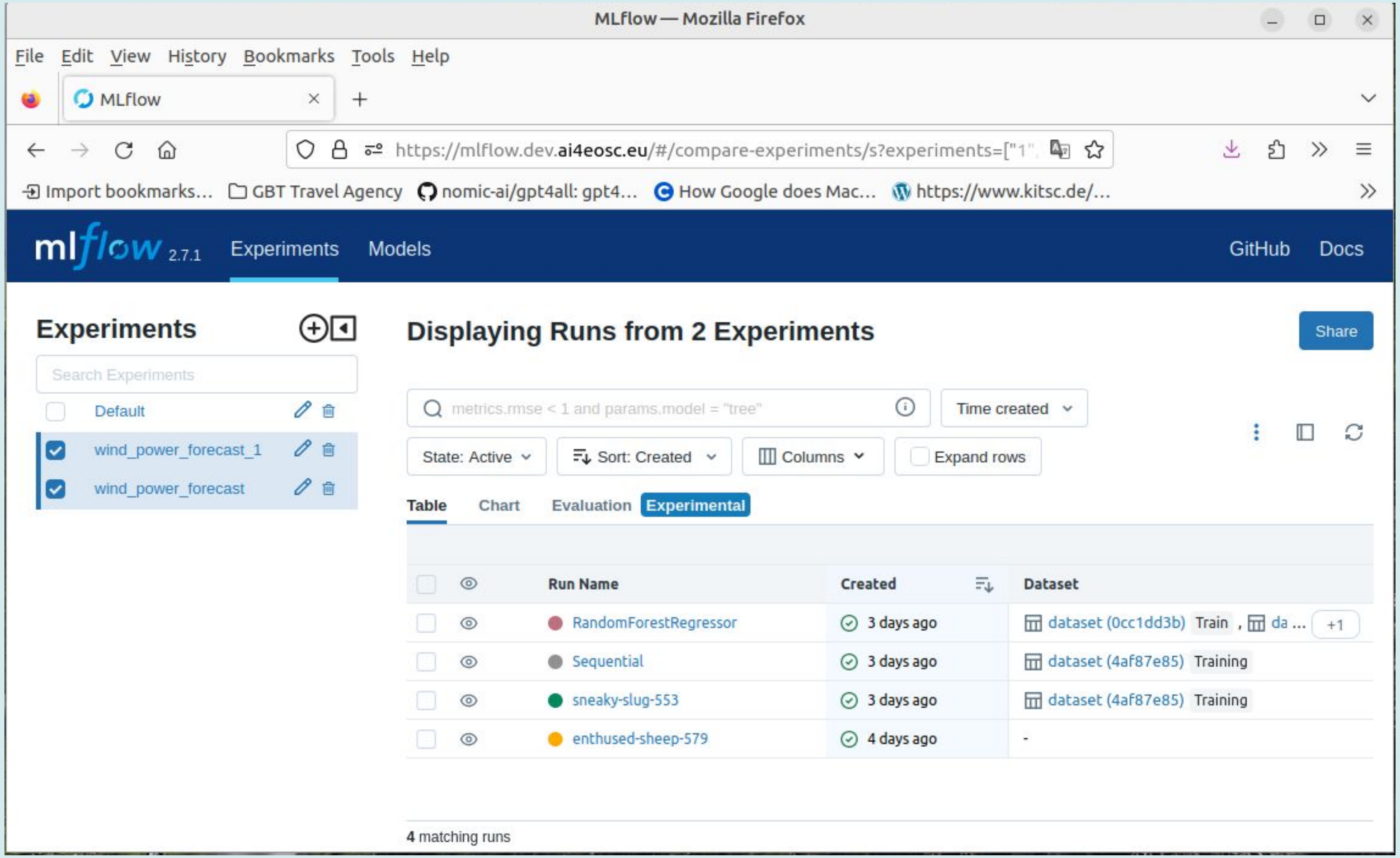
mlflow.dev.ai4eosc.eu

This site is asking you to sign in.

Username: [redacted]

Password: ••••••••••

Tracking Experiments



Experiments

Search Experiments

- □ Default
- ☑ wind_power_forecast_1
- ☑ wind_power_forecast

Displaying Runs from 2 Experiments

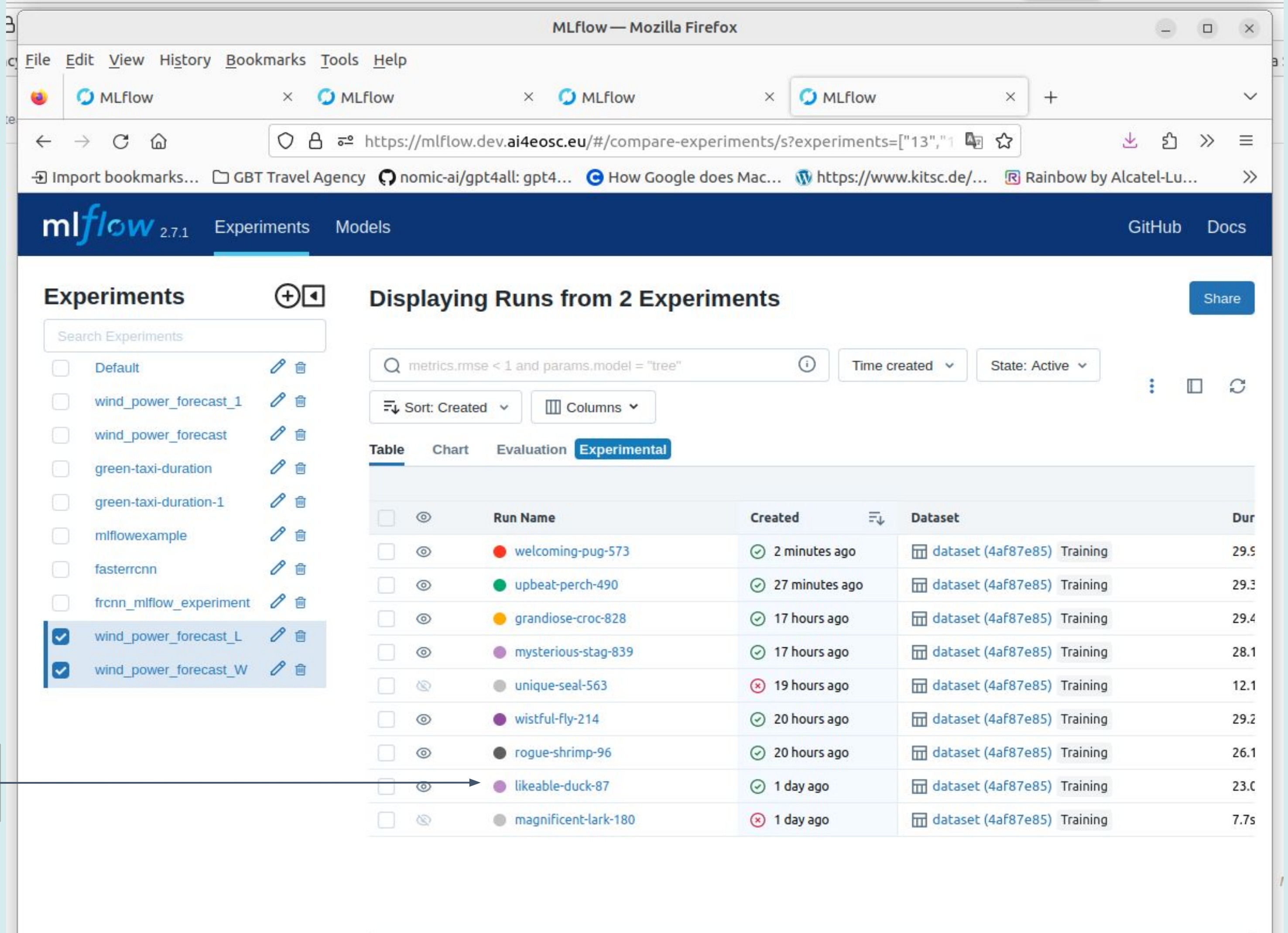
metrics.rmse < 1 and params.model = "tree"

□	Run Name	Created	Dataset
□	● RandomForestRegressor	✓ 3 days ago	dataset (0cc1dd3b) Train , da … +1
□	● Sequential	✓ 3 days ago	dataset (4af87e85) Training
□	● sneaky-slug-553	✓ 3 days ago	dataset (4af87e85) Training
□	● enthused-sheep-579	✓ 4 days ago	-

4 matching runs

Tracking Experiments/Runs

- MLflow Experiment: *is the primary unit of organization and access control for MLflow runs*; all MLflow runs belong to an experiment.
- Run: is a *collection of parameters, metrics, tags, and artifacts associated with a machine* learning model training process.



MLflow — Mozilla Firefox

File Edit View History Bookmarks Tools Help

MLflow | MLflow | MLflow | MLflow

https://mlflow.dev.ai4eosc.eu/#/compare-experiments/s?experiments=["13","1

Import bookmarks... | GBT Travel Agency | nomic-ai/gpt4all: gpt4... | How Google does Mac... | https://www.kitsc.de/... | Rainbow by Alcatel-Lu...

mlflow 2.7.1 Experiments Models GitHub Docs

Experiments

Search Experiments

- ☐ Default
- ☐ wind_power_forecast_1
- ☐ wind_power_forecast
- ☐ green-taxi-duration
- ☐ green-taxi-duration-1
- ☐ mlflowexample
- ☐ fasterrcnn
- ☐ frcnn_mlflow_experiment
- ☑ wind_power_forecast_L
- ☑ wind_power_forecast_W

Displaying Runs from 2 Experiments

Share

metrics.rmse < 1 and params.model = "tree" | Time created | State: Active

Sort: Created | Columns

Table | Chart | Evaluation | Experimental

		Run Name	Created	Dataset	Dur
☐		● welcoming-pug-573	✓ 2 minutes ago	dataset (4af87e85) Training	29.9
☐		● upbeat-perch-490	✓ 27 minutes ago	dataset (4af87e85) Training	29.3
☐		● grandiose-croc-828	✓ 17 hours ago	dataset (4af87e85) Training	29.4
☐		● mysterious-stag-839	✓ 17 hours ago	dataset (4af87e85) Training	28.1
☐		● unique-seal-563	☒ 19 hours ago	dataset (4af87e85) Training	12.1
☐		● wistful-fly-214	✓ 20 hours ago	dataset (4af87e85) Training	29.2
☐		● rogue-shrimp-96	✓ 20 hours ago	dataset (4af87e85) Training	26.1
☐		● likeable-duck-87	✓ 1 day ago	dataset (4af87e85) Training	23.0
☐		● magnificent-lark-180	☒ 1 day ago	dataset (4af87e85) Training	7.7s

Experiment_name

runs_name (default: randomly generated)

Examples:

`mlflow.tensorflow` → module provides an API for logging and loading TensorFlow models.

`mlflow.pytorch` → module provides an API for logging and loading PyTorch models.

Tracking Experiments/Runs

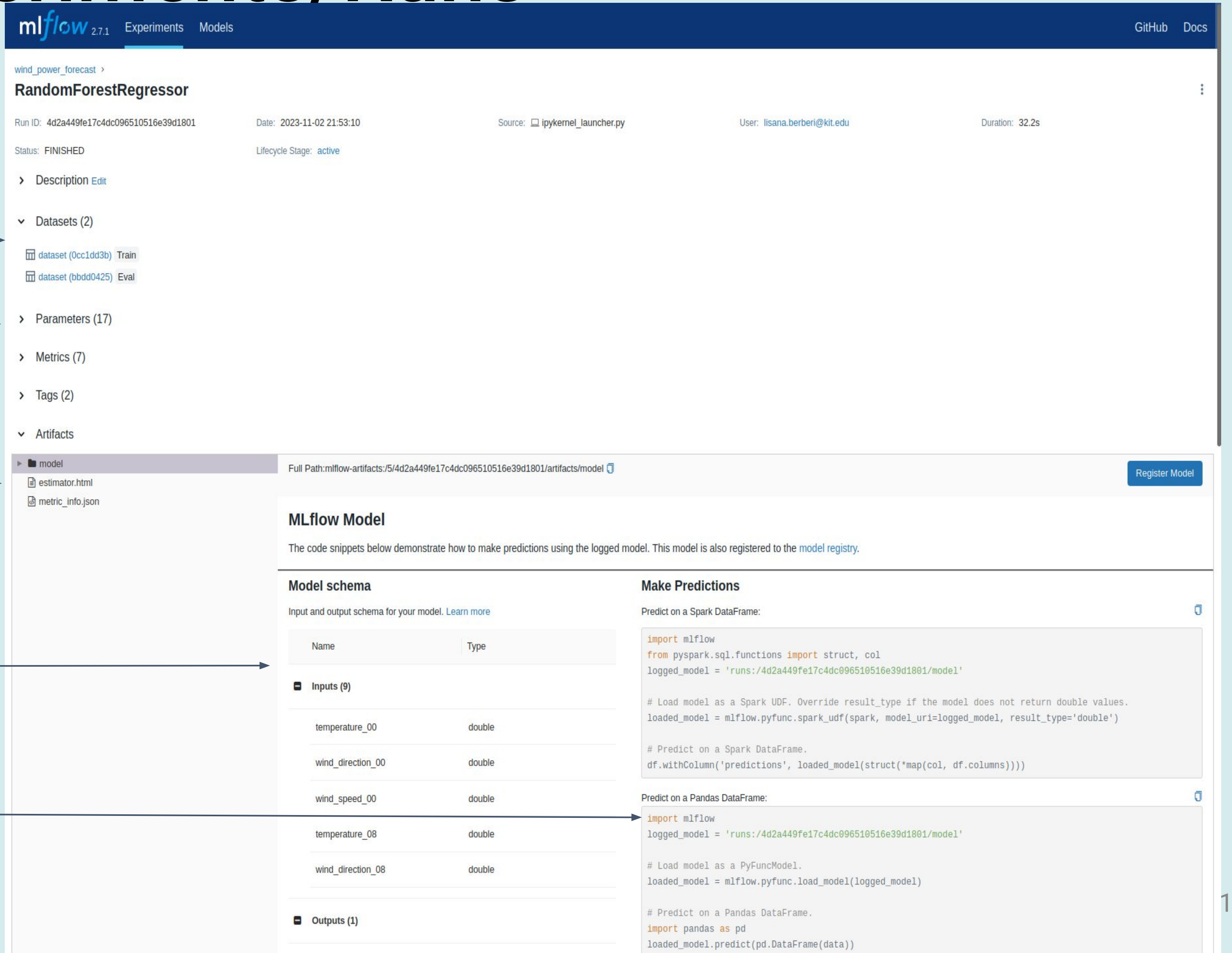
datasets

params/metrics

Artifacts

MLflow signature

Code snippets



wind_power_forecast ›

RandomForestRegressor

Run ID: 4d2a449fe17c4dc096510516e39d1801 Date: 2023-11-02 21:53:10 Source: ipykernel_launcher.py User: lisana.berberi@kit.edu Duration: 32.2s

Status: FINISHED Lifecycle Stage: active

› Description Edit

⌄ Datasets (2)

- dataset (0cc1dd3b) Train
- dataset (bbdd0425) Eval

› Parameters (17)

› Metrics (7)

› Tags (2)

⌄ Artifacts

- model
- estimator.html
- metric_info.json

Full Path:mlflow-artifacts:/5/4d2a449fe17c4dc096510516e39d1801/artifacts/model

Register Model

MLflow Model

The code snippets below demonstrate how to make predictions using the logged model. This model is also registered to the model registry.

Model schema

Input and output schema for your model. Learn more

Name	Type
Inputs (9)	
temperature_00	double
wind_direction_00	double
wind_speed_00	double
temperature_08	double
wind_direction_08	double
Outputs (1)	

Make Predictions

Predict on a Spark DataFrame:

```
import mlflow
from pyspark.sql.functions import struct, col
logged_model = 'runs:/4d2a449fe17c4dc096510516e39d1801/model'

# Load model as a Spark UDF. Override result_type if the model does not return double values.
loaded_model = mlflow.pyfunc.spark_udf(spark, model_uri=logged_model, result_type='double')

# Predict on a Spark DataFrame.
df.withColumn('predictions', loaded_model(struct(*map(col, df.columns))))
```

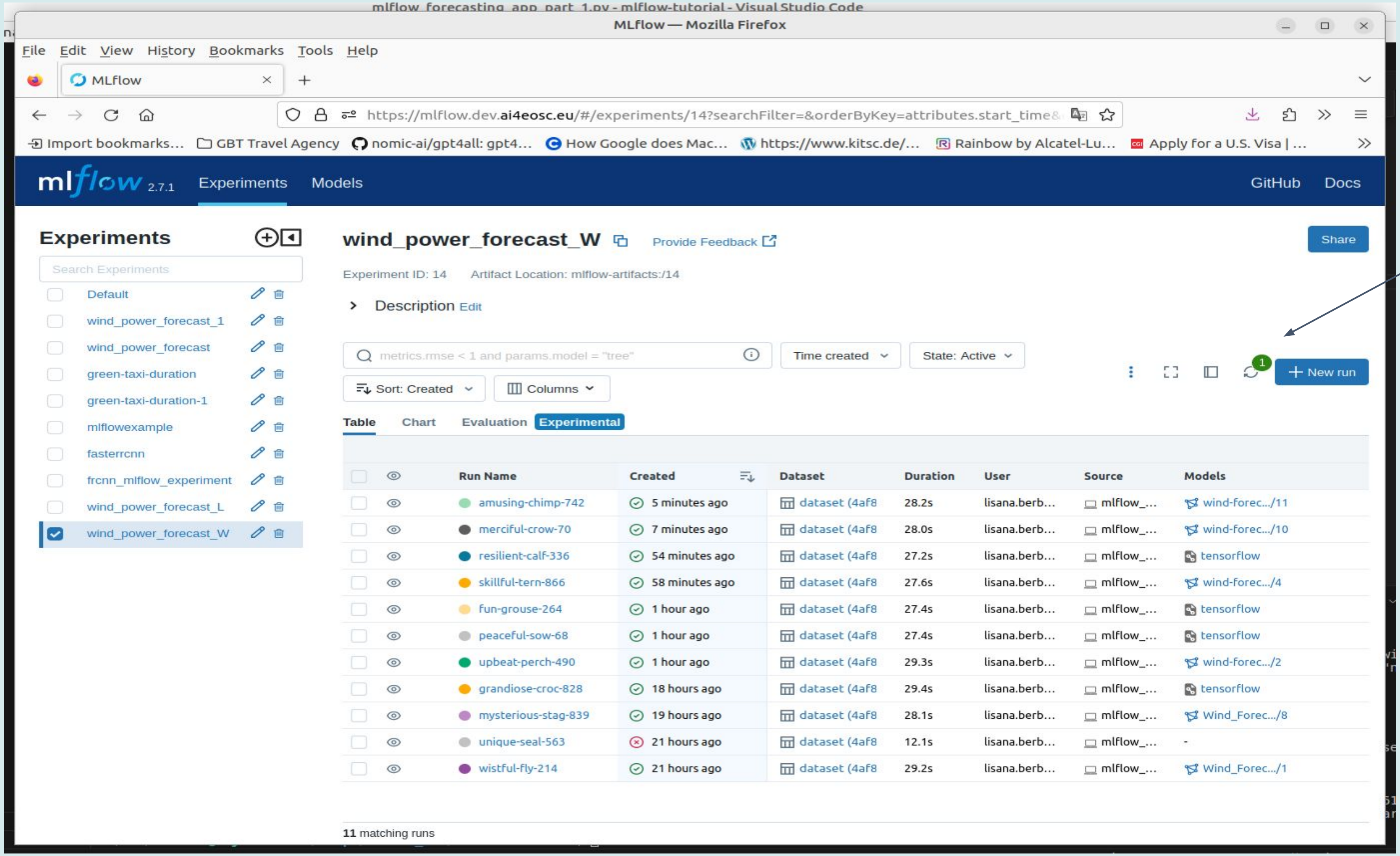
Predict on a Pandas DataFrame:

```
import mlflow
logged_model = 'runs:/4d2a449fe17c4dc096510516e39d1801/model'

# Load model as a PyFuncModel.
loaded_model = mlflow.pyfunc.load_model(logged_model)

# Predict on a Pandas DataFrame.
import pandas as pd
loaded_model.predict(pd.DataFrame(data))
```

Tracking Experiments/Runs


mlflow_forecasting_app_part_1.py - mlflow-tutorial - Visual Studio Code
MLflow — Mozilla Firefox
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MLflow
https://mlflow.dev.ai4eosc.eu/#/experiments/14?searchFilter=&orderByKey=attributes.start_time&
Import bookmarks... GBT Travel Agency nomic-ai/gpt4all: gpt4... How Google does Mac... https://www.kitsc.de/... Rainbow by Alcatel-Lu... Apply for a U.S. Visa | ...
mlflow 2.7.1 Experiments Models GitHub Docs
Share
Time created
State: Active
Sort: Created
Columns
+ New run
Table Chart Evaluation Experimental

Experiments

Search Experiments

- Default
- wind_power_forecast_1
- wind_power_forecast
- green-taxi-duration
- green-taxi-duration-1
- mlflowexample
- fasterrcnn
- frcnn_mlflow_experiment
- wind_power_forecast_L
- ☑ wind_power_forecast_W

wind_power_forecast_W Provide Feedback

Experiment ID: 14 Artifact Location: mlflow-artifacts:/14

Description Edit

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

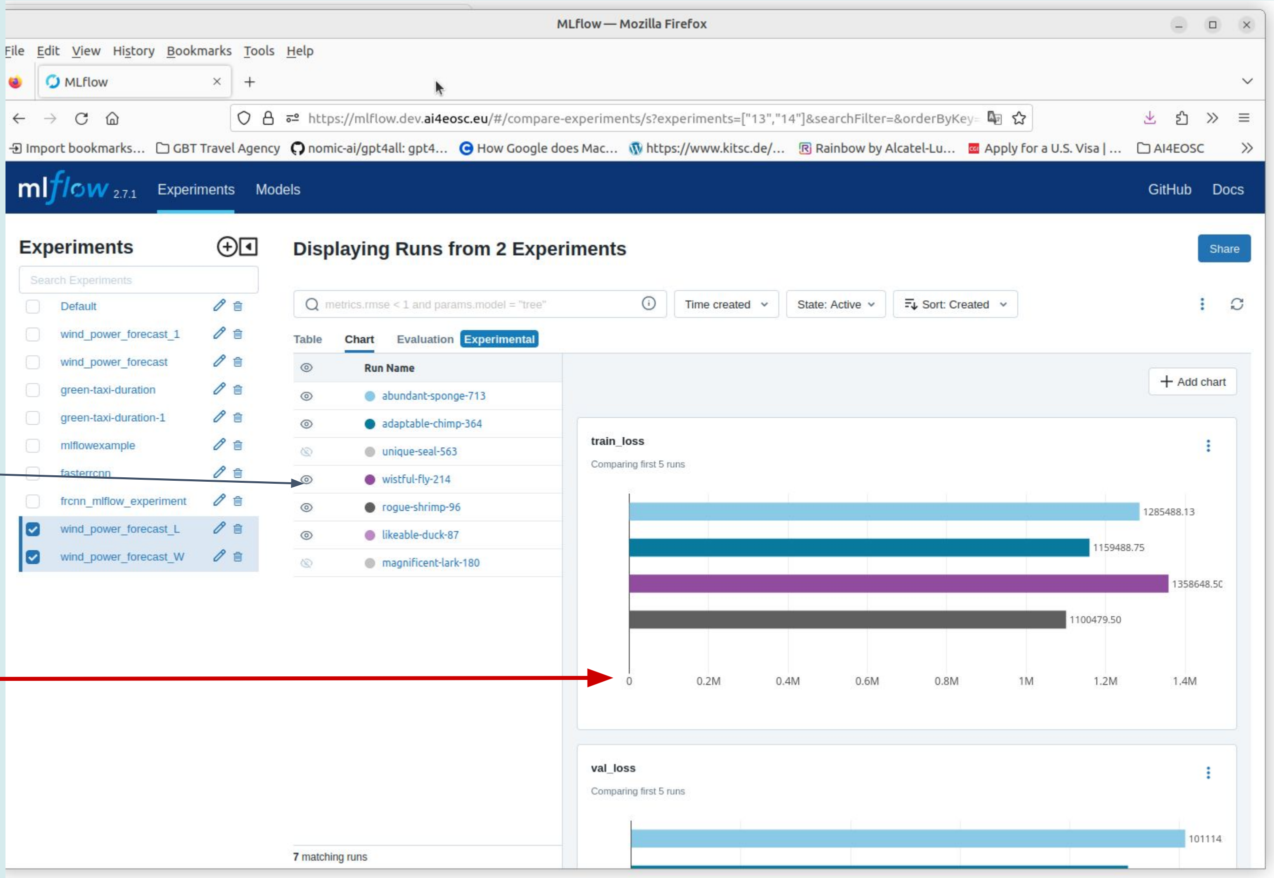
Run Name	Created	Dataset	Duration	User	Source	Models
amusing-chimp-742	5 minutes ago	dataset (4af8	28.2s	lisana.berb...	mlflow_...	wind-forec.../11
merciful-crow-70	7 minutes ago	dataset (4af8	28.0s	lisana.berb...	mlflow_...	wind-forec.../10
resilient-calf-336	54 minutes ago	dataset (4af8	27.2s	lisana.berb...	mlflow_...	tensorflow
skillful-tern-866	58 minutes ago	dataset (4af8	27.6s	lisana.berb...	mlflow_...	wind-forec.../4
fun-grouse-264	1 hour ago	dataset (4af8	27.4s	lisana.berb...	mlflow_...	tensorflow
peaceful-sow-68	1 hour ago	dataset (4af8	27.4s	lisana.berb...	mlflow_...	tensorflow
upbeat-perch-490	1 hour ago	dataset (4af8	29.3s	lisana.berb...	mlflow_...	wind-forec.../2
grandiose-croc-828	18 hours ago	dataset (4af8	29.4s	lisana.berb...	mlflow_...	tensorflow
mysterious-stag-839	19 hours ago	dataset (4af8	28.1s	lisana.berb...	mlflow_...	Wind_Forec.../8
unique-seal-563	21 hours ago	dataset (4af8	12.1s	lisana.berb...	mlflow_...	-
wistful-fly-214	21 hours ago	dataset (4af8	29.2s	lisana.berb...	mlflow_...	Wind_Forec.../1

11 matching runs

new run

Comparing Experiments runs

- Select experiments you want to compare and the runs you want to show in the chart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MLflow
https://mlflow.dev.ai4eosc.eu/#/compare-experiments/s?experiments=["13","14"]&searchFilter=&orderByKey
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mlflow 2.7.1 Experiments Models GitHub Docs
Share
Time created
State: Active
Sort: Created
Table Chart Evaluation Experimental
+ Add chart
train_loss
Comparing first 5 runs
1285488.13
1159488.75
1358648.5C
1100479.50
0 0.2M 0.4M 0.6M 0.8M 1M 1.2M 1.4M
val_loss
Comparing first 5 runs
101114

Experiments

Search Experiments

- ☐ Default
- ☐ wind_power_forecast_1
- ☐ wind_power_forecast
- ☐ green-taxi-duration
- ☐ green-taxi-duration-1
- ☐ mlflowexample
- ☐ fasterrcnn
- ☐ frcnn_mlflow_experiment
- ☑ wind_power_forecast_L
- ☑ wind_power_forecast_W

Displaying Runs from 2 Experiments

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

Run Name
- abundant-sponge-713
- adaptable-chimp-364
- unique-seal-563
- wistful-fly-214
- rogue-shrimp-96
- likeable-duck-87
- magnificent-lark-180

7 matching runs

runs (hide)

chart visualisations

Packaging projects

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package ML code
in a format to reproduce
runs on any platform

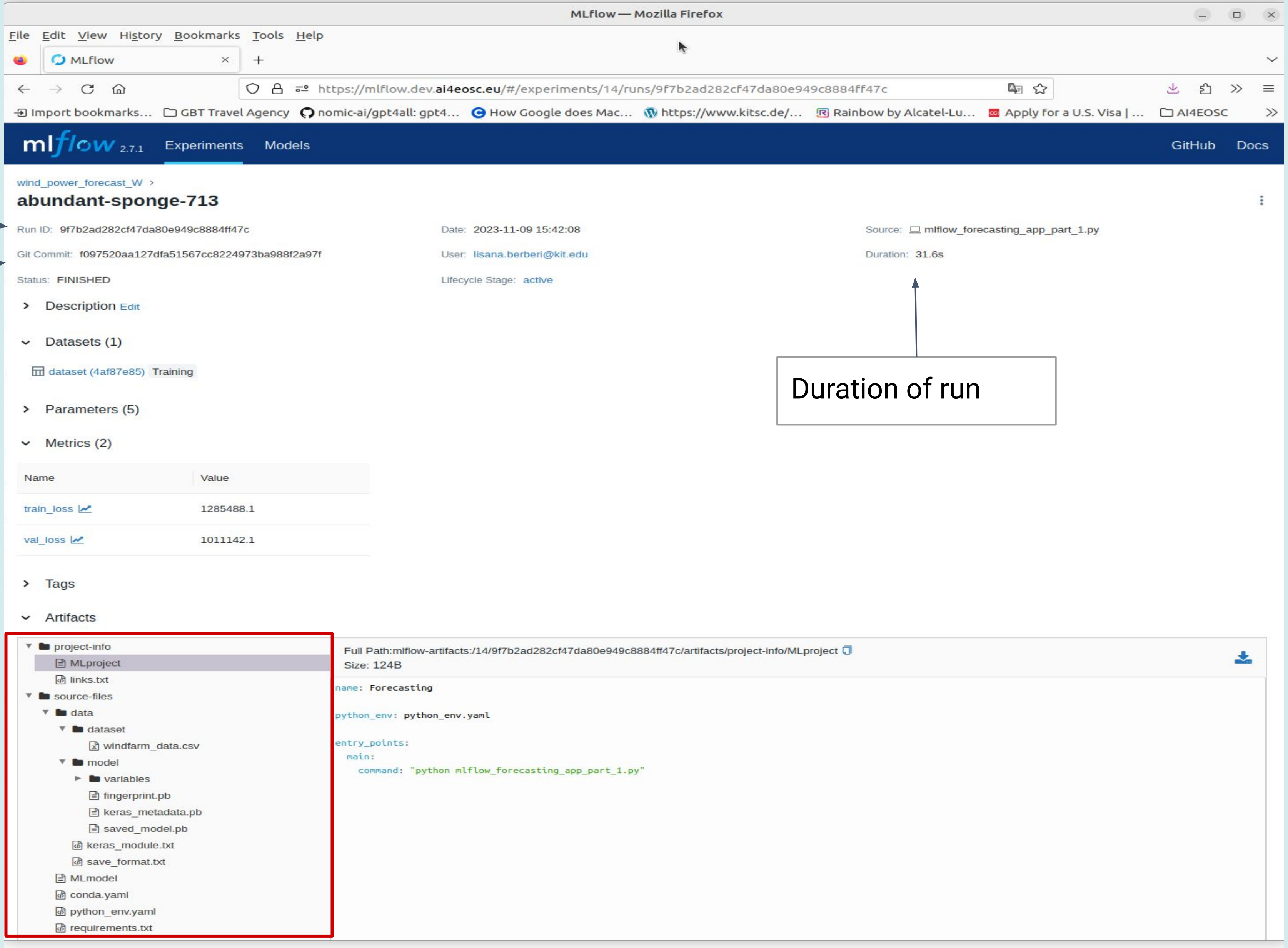
Run_ID

Git Commit hash

MLproject.yaml file

Duration of run

`mlflow.projects` → module provides an API for running MLflow projects locally or remotely[7]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MLflow
https://mlflow.dev.ai4eosc.eu/#/experiments/14/runs/9f7b2ad282cf47da80e949c8884ff47c
Import bookmarks… GBT Travel Agency nomic-ai/gpt4all: gpt4… How Google does Mac… https://www.kitsc.de/… Rainbow by Alcatel-Lu… Apply for a U.S. Visa | … AI4EOSC
mlflow 2.7.1 Experiments Models GitHub Docs

wind_power_forecast_W >

abundant-sponge-713

Run ID: 9f7b2ad282cf47da80e949c8884ff47c
Git Commit: f097520aa127dfa51567cc8224973ba988f2a97f
Status: FINISHED

Date: 2023-11-09 15:42:08
User: lisana.berberi@kit.edu
Lifecycle Stage: active

Source: mlflow_forecasting_app_part_1.py
Duration: 31.6s

> Description Edit

⌄ Datasets (1)

dataset (4af87e85) Training

> Parameters (5)

⌄ Metrics (2)

Name	Value
train_loss	1285488.1
val_loss	1011142.1

> Tags

⌄ Artifacts

```
▼ project-info
    MLproject
    links.txt
▼ source-files
  ▼ data
    ▼ dataset
        windfarm_data.csv
    ▼ model
      ► variables
        fingerprint.pb
        keras_metadata.pb
        saved_model.pb
      keras_module.txt
      save_format.txt
    MLmodel
    conda.yaml
    python_env.yaml
    requirements.txt
```

Full Path:mlflow-artifacts:/14/9f7b2ad282cf47da80e949c8884ff47c/artifacts/project-info/MLproject
Size: 124B

```
name: Forecasting

python_env: python_env.yaml

entry_points:
  main:
    command: "python mlflow_forecasting_app_part_1.py"
```

Model Registry

centralized model store

-Register a new model

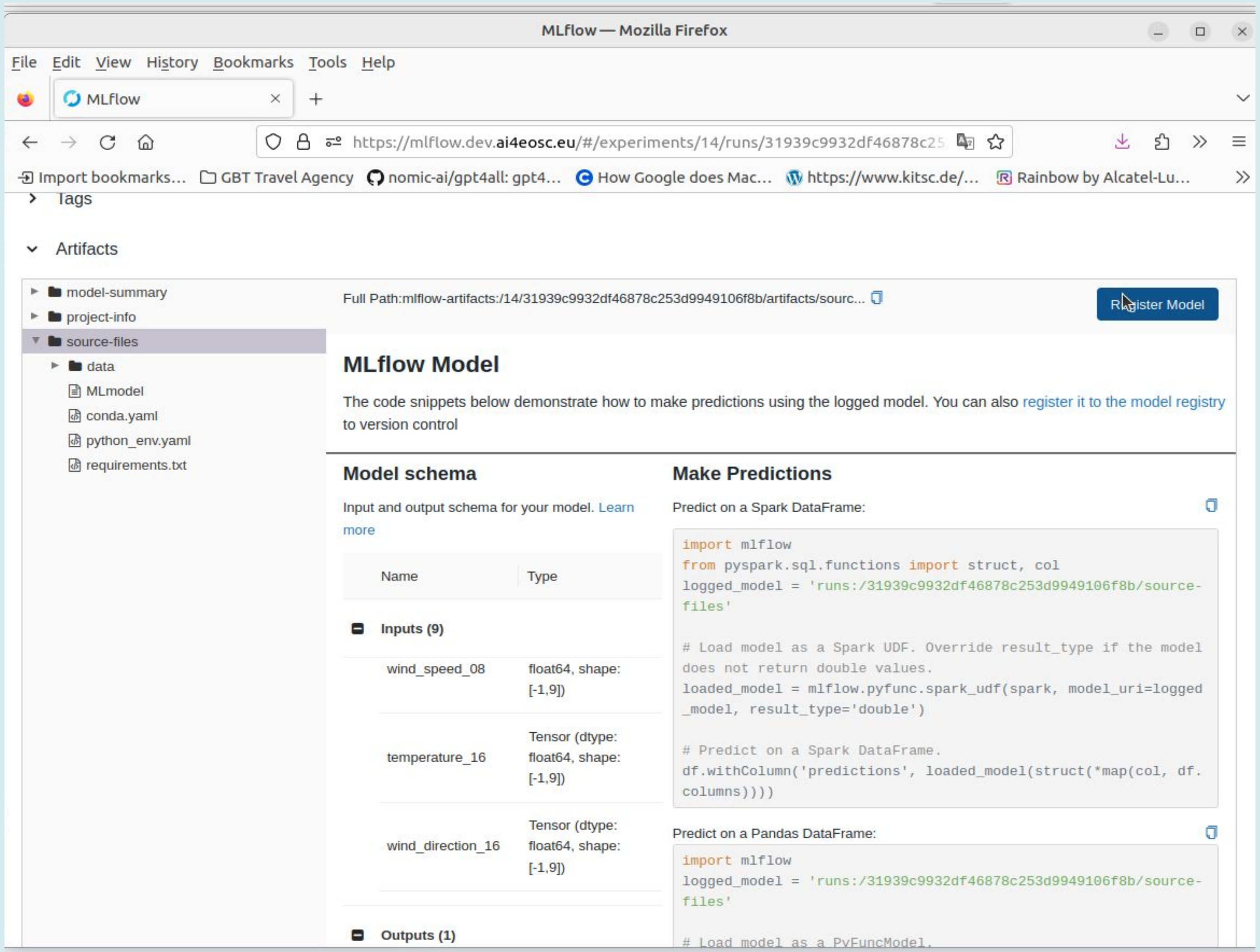
Model_name must be unique
!!! a new version of that model will be created (auto increment version nr)

- during MLflow experiment run or

```
mlflow.<flavor>.log_model(model,
artifact_path="source-files",
                                   signature=signature,
             registered_model_name=MLFLOW_MODEL_NAME)
```

- after your experiment runs.

```
mlflow.register_model(
    f"runs:/{run_id}/artifacts/source-files", MLFLOW_MODEL_NAME
)
```



- model-summary
- project-info
- source-files
  - data
  - MLmodel
  - conda.yaml
  - python_env.yaml
  - requirements.txt

Full Path:mlflow-artifacts:/14/31939c9932df46878c253d9949106f8b/artifacts/sourc...

MLflow Model

The code snippets below demonstrate how to make predictions using the logged model. You can also register it to the model registry to version control

Model schema

Input and output schema for your model. Learn more

Name	Type
Inputs (9)	
wind_speed_08	float64, shape: [-1,9])
temperature_16	Tensor (dtype: float64, shape: [-1,9])
wind_direction_16	Tensor (dtype: float64, shape: [-1,9])
Outputs (1)	

Make Predictions

Predict on a Spark DataFrame:

```
import mlflow
from pyspark.sql.functions import struct, col
logged_model = 'runs:/31939c9932df46878c253d9949106f8b/source-
files'

# Load model as a Spark UDF. Override result_type if the model
does not return double values.
loaded_model = mlflow.pyfunc.spark_udf(spark, model_uri=logged
_model, result_type='double')

# Predict on a Spark DataFrame.
df.withColumn('predictions', loaded_model(struct(*map(col, df.
columns))))
```

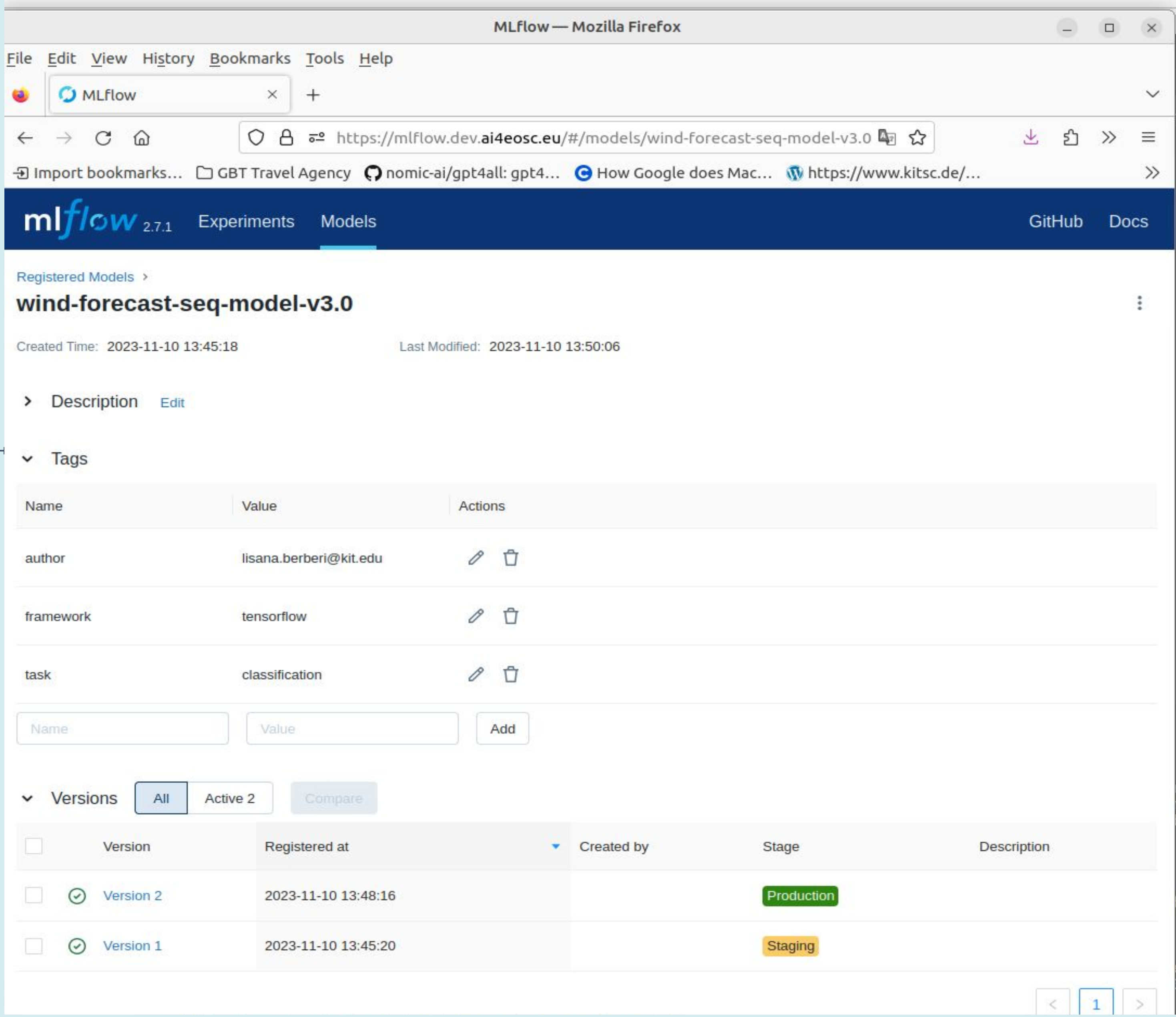
Predict on a Pandas DataFrame:

```
import mlflow
logged_model = 'runs:/31939c9932df46878c253d9949106f8b/source-
files'

# Load model as a PyFuncModel.
```

Model Registry

model tags


MLflow — Mozilla Firefox
File Edit View History Bookmarks Tools Help
MLflow
https://mlflow.dev.ai4eosc.eu/#/models/wind-forecast-seq-model-v3.0
Import bookmarks... GBT Travel Agency nomic-ai/gpt4all: gpt4... How Google does Mac... https://www.kitsc.de/...
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Registered Models ›

wind-forecast-seq-model-v3.0

Created Time: 2023-11-10 13:45:18 Last Modified: 2023-11-10 13:50:06

Name	Value	Actions
author	lisana.berberi@kit.edu	
framework	tensorflow	
task	classification	

Name
Value
Add
Versions
All
Active 2
Compare

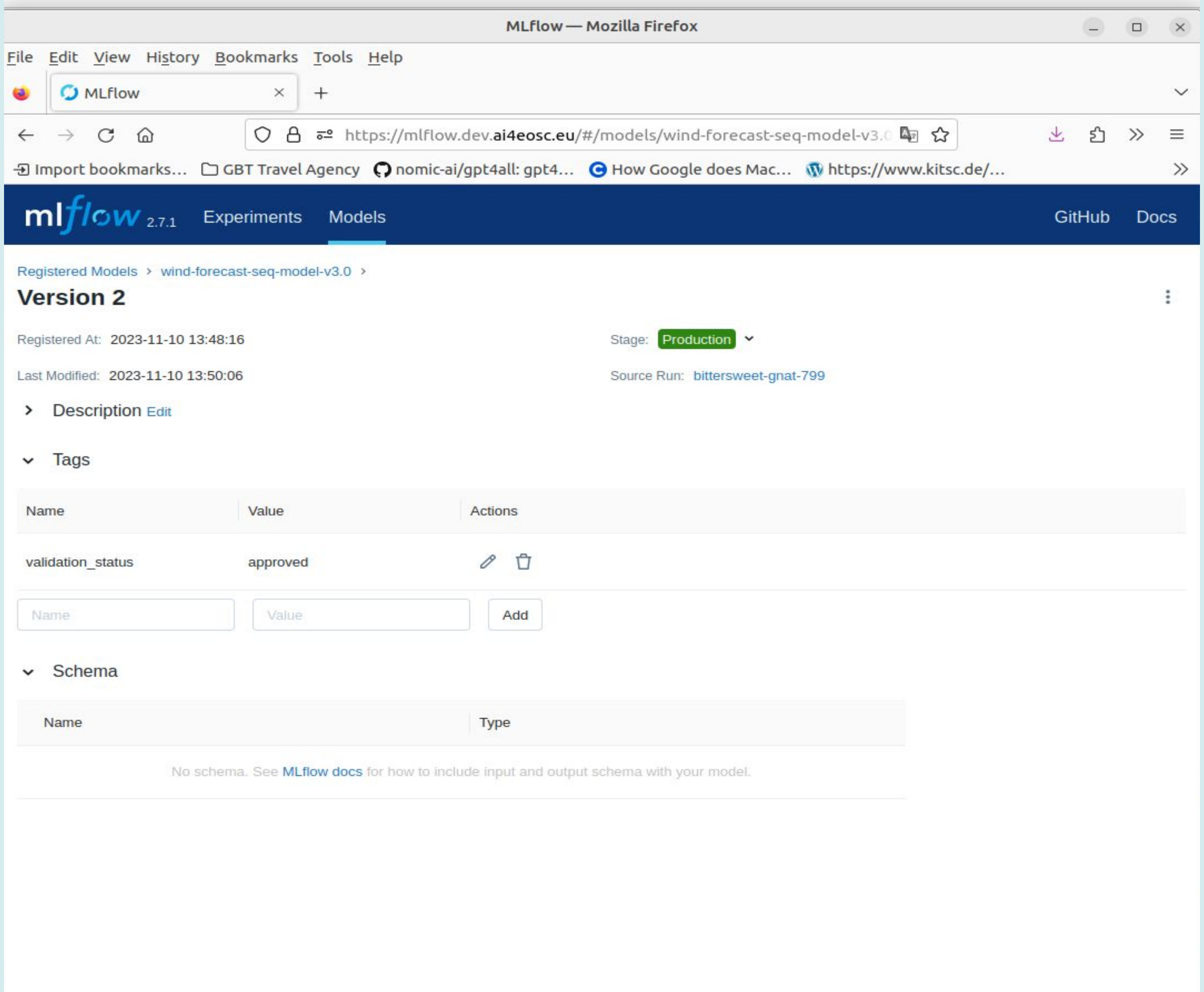
	Version	Registered at	Created by	Stage	Description
□	Version 2	2023-11-10 13:48:16		Production	
□	Version 1	2023-11-10 13:45:20		Staging	

Model Registry

- fetch the model

`mlflow.<model_flavor>.load_model()`, or more generally, `load_model()`. You can use the loaded model for one off predictions or in inference workloads such as batch inference.

model version tags



Version 2

Registered At: 2023-11-10 13:48:16

Stage: Production

Last Modified: 2023-11-10 13:50:06

Source Run: bittersweet-gnat-799

› Description Edit

⌄ Tags

Name	Value	Actions
validation_status	approved	✎ 🗑

⌄ Schema

Name	Type

No schema. See MLflow docs for how to include input and output schema with your model.

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Model Serving

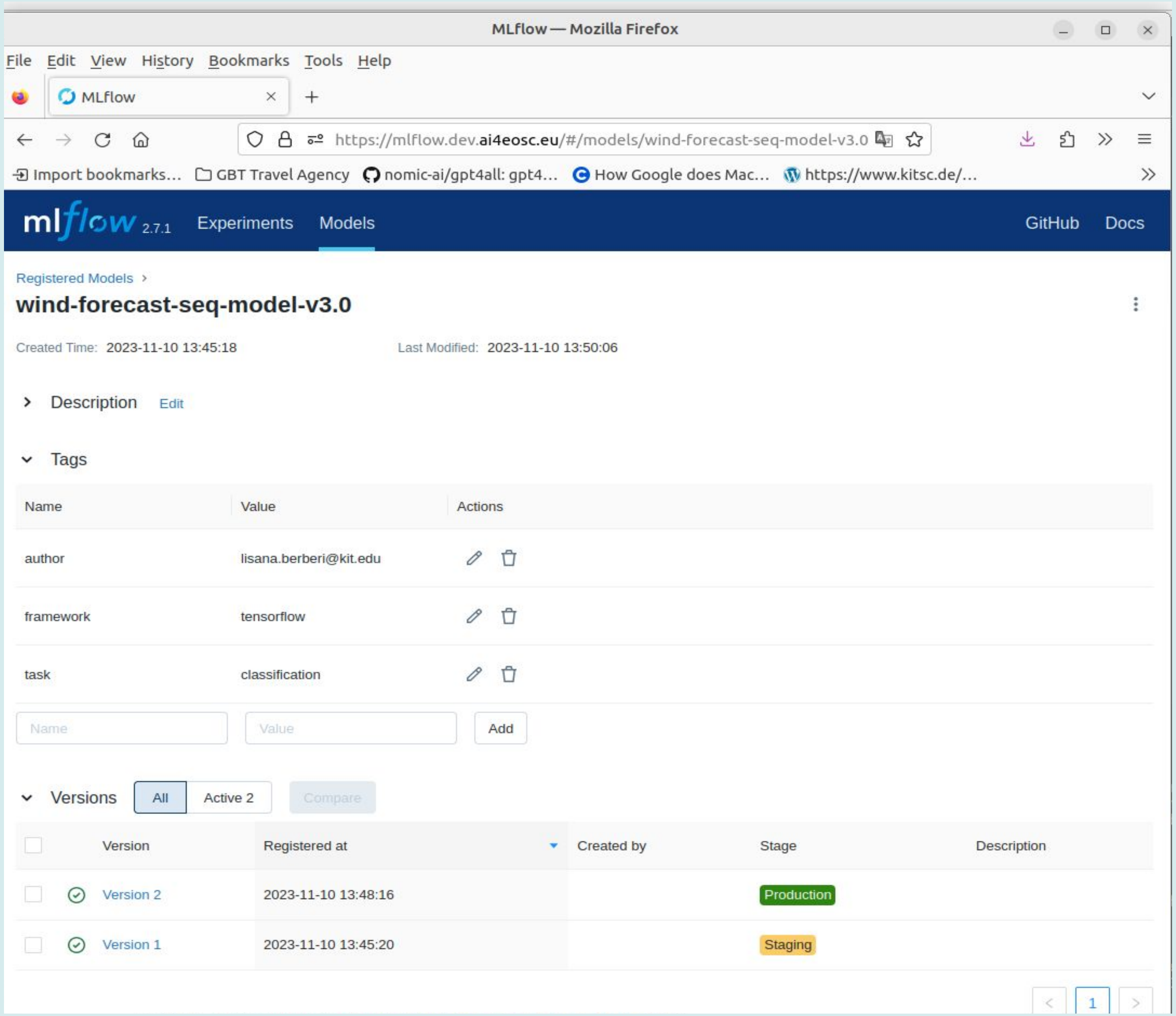
- fetch the model

`mlflow.<model_flavor>.load_model()`, or more generally, `load_model()`. You can use the loaded model for one off predictions or in inference workloads such as batch inference.

```
client = MlflowClient()
model_version = client.get_latest_versions(model_name,
stages=[model_stage])[0].version
model_uri = F"models:/{model_name}/{model_stage}"
model = mlflow.pyfunc.load_model(model_uri)
```

- serve the model (deploy)
  - to run model inference

mlflow models serve --model-uri models:/<model-name>/Production -h <hostname> -p 5001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MLflow
https://mlflow.dev.ai4eosc.eu/#/models/wind-forecast-seq-model-v3.0
Import bookmarks... GBT Travel Agency nomic-ai/gpt4all: gpt4... How Google does Mac... https://www.kitsc.de/...
mlflow 2.7.1
Experiments
Models
GitHub
Docs
Edit
Add
All
Active 2
Compare
Name
Value

Registered Models ›

wind-forecast-seq-model-v3.0

Created Time: 2023-11-10 13:45:18 Last Modified: 2023-11-10 13:50:06

› Description

⌄ Tags

Name	Value	Actions
author	lisana.berberi@kit.edu	
framework	tensorflow	
task	classification	

⌄ Versions

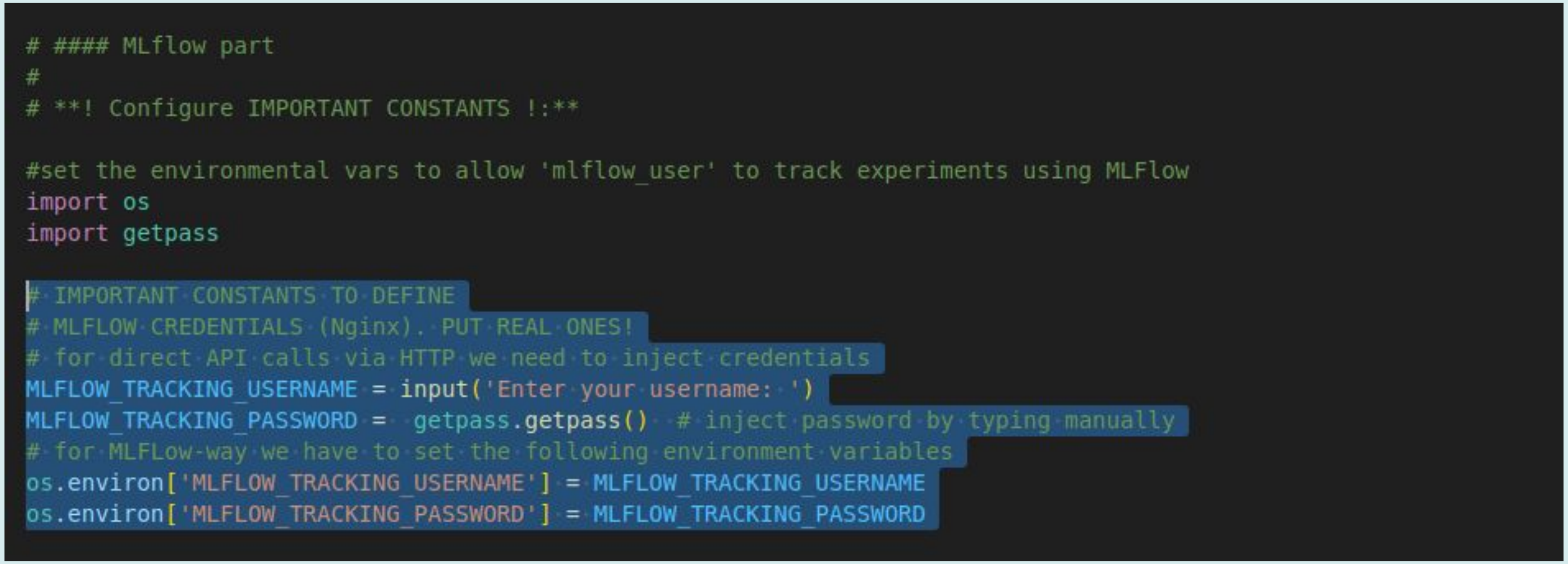
□	Version	Registered at	Created by	Stage	Description
□	Version 2	2023-11-10 13:48:16		Production	
□	Version 1	2023-11-10 13:45:20		Staging	

How to log your own experiment?

Example app: *Predict the power output information for a wind farm in the US*

```
git url:  https://git.scc.kit.edu/m-team/ai/mlflow-tutorial.git
pip install -r requirements.txt;
python mlflow-example/mlflow_forecasting_app_part_1.py
```

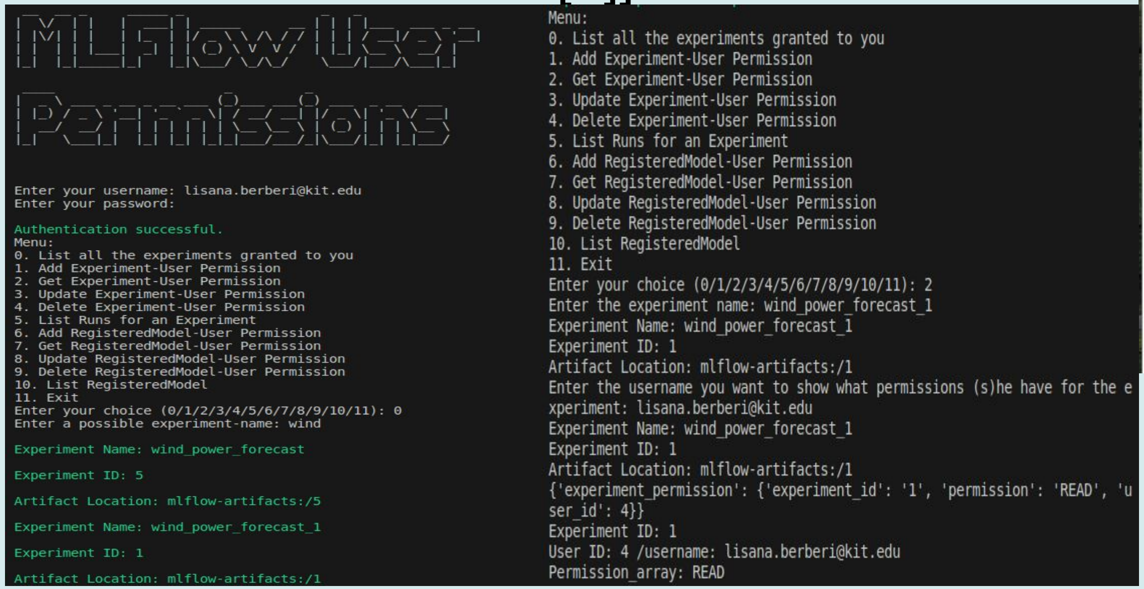
or launch the notebook **mlflow_forecasting_app_v1.2.ipynb**



```python
# #### MLflow part
#
# **! Configure IMPORTANT CONSTANTS !:**

#set the environmental vars to allow 'mlflow_user' to track experiments using MLFlow
import os
import getpass

# IMPORTANT CONSTANTS TO DEFINE
# MLFLOW CREDENTIALS (Nginx). PUT REAL ONES!
# for direct API calls via HTTP we need to inject credentials
MLFLOW_TRACKING_USERNAME = input('Enter your username: ')
MLFLOW_TRACKING_PASSWORD =  getpass.getpass()  # inject password by typing manually
# for MLFLow-way we have to set the following environment variables
os.environ['MLFLOW_TRACKING_USERNAME'] = MLFLOW_TRACKING_USERNAME
os.environ['MLFLOW_TRACKING_PASSWORD'] = MLFLOW_TRACKING_PASSWORD
```

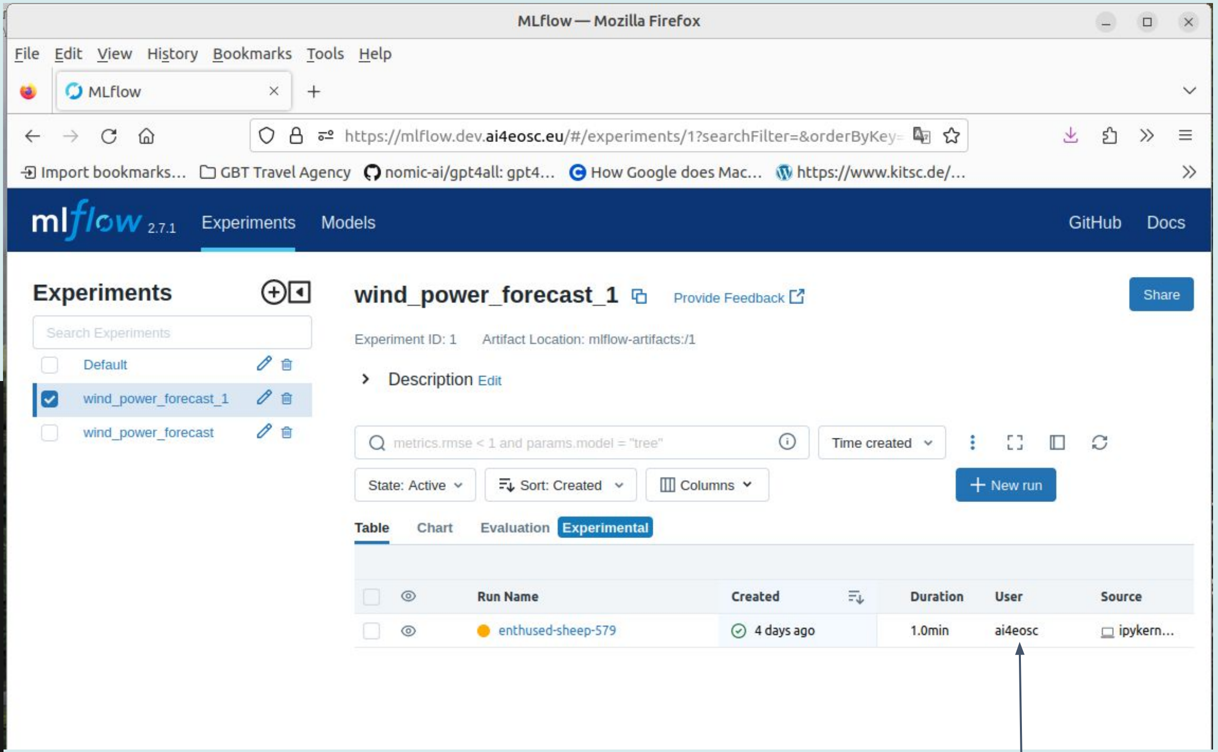
How to share your experiment?

- Once you logged your experiment, you can control user access and permissions to it.
- Follow instructions in [5] how to grant/revoke specific permissions to user for an experiment [scripts available in [6]]



```
Enter your username: lisana.berberi@kit.edu
Enter your password:

Authentication successful.
Menu:
0. List all the experiments granted to you
1. Add Experiment-User Permission
2. Get Experiment-User Permission
3. Update Experiment-User Permission
4. Delete Experiment-User Permission
5. List Runs for an Experiment
6. Add RegisteredModel-User Permission
7. Get RegisteredModel-User Permission
8. Update RegisteredModel-User Permission
9. Delete RegisteredModel-User Permission
10. List RegisteredModel
11. Exit
Enter your choice (0/1/2/3/4/5/6/7/8/9/10/11): 0
Enter a possible experiment-name: wind

Experiment Name: wind_power_forecast

Experiment ID: 5

Artifact Location: mlflow-artifacts:/5

Experiment Name: wind_power_forecast_1

Experiment ID: 1

Artifact Location: mlflow-artifacts:/1
```

```
Menu:
0. List all the experiments granted to you
1. Add Experiment-User Permission
2. Get Experiment-User Permission
3. Update Experiment-User Permission
4. Delete Experiment-User Permission
5. List Runs for an Experiment
6. Add RegisteredModel-User Permission
7. Get RegisteredModel-User Permission
8. Update RegisteredModel-User Permission
9. Delete RegisteredModel-User Permission
10. List RegisteredModel
11. Exit
Enter your choice (0/1/2/3/4/5/6/7/8/9/10/11): 2
Enter the experiment name: wind_power_forecast_1
Experiment Name: wind_power_forecast_1
Experiment ID: 1
Artifact Location: mlflow-artifacts:/1
Enter the username you want to show what permissions (s)he have for the e
xperiment: lisana.berberi@kit.edu
Experiment Name: wind_power_forecast_1
Experiment ID: 1
Artifact Location: mlflow-artifacts:/1
{'experiment_permission': {'experiment_id': '1', 'permission': 'READ', 'u
ser_id': 4}}
Experiment ID: 1
User ID: 4 /username: lisana.berberi@kit.edu
Permission_array: READ
```


MLflow — Mozilla Firefox
File Edit View History Bookmarks Tools Help
MLflow
https://mlflow.dev.ai4eosc.eu/#/experiments/1?searchFilter=&orderByKey=
Import bookmarks... GBT Travel Agency nomic-ai/gpt4all: gpt4... How Google does Mac... https://www.kitsc.de/...
mlflow 2.7.1 Experiments Models GitHub Docs
Experiments
Search Experiments
☐ Default
☑ wind_power_forecast_1
☐ wind_power_forecast
Provide Feedback
Share
Description Edit
metrics.rmse < 1 and params.model = "tree"
Time created
State: Active
Sort: Created
Columns
New run
Table Chart Evaluation Experimental

wind_power_forecast_1

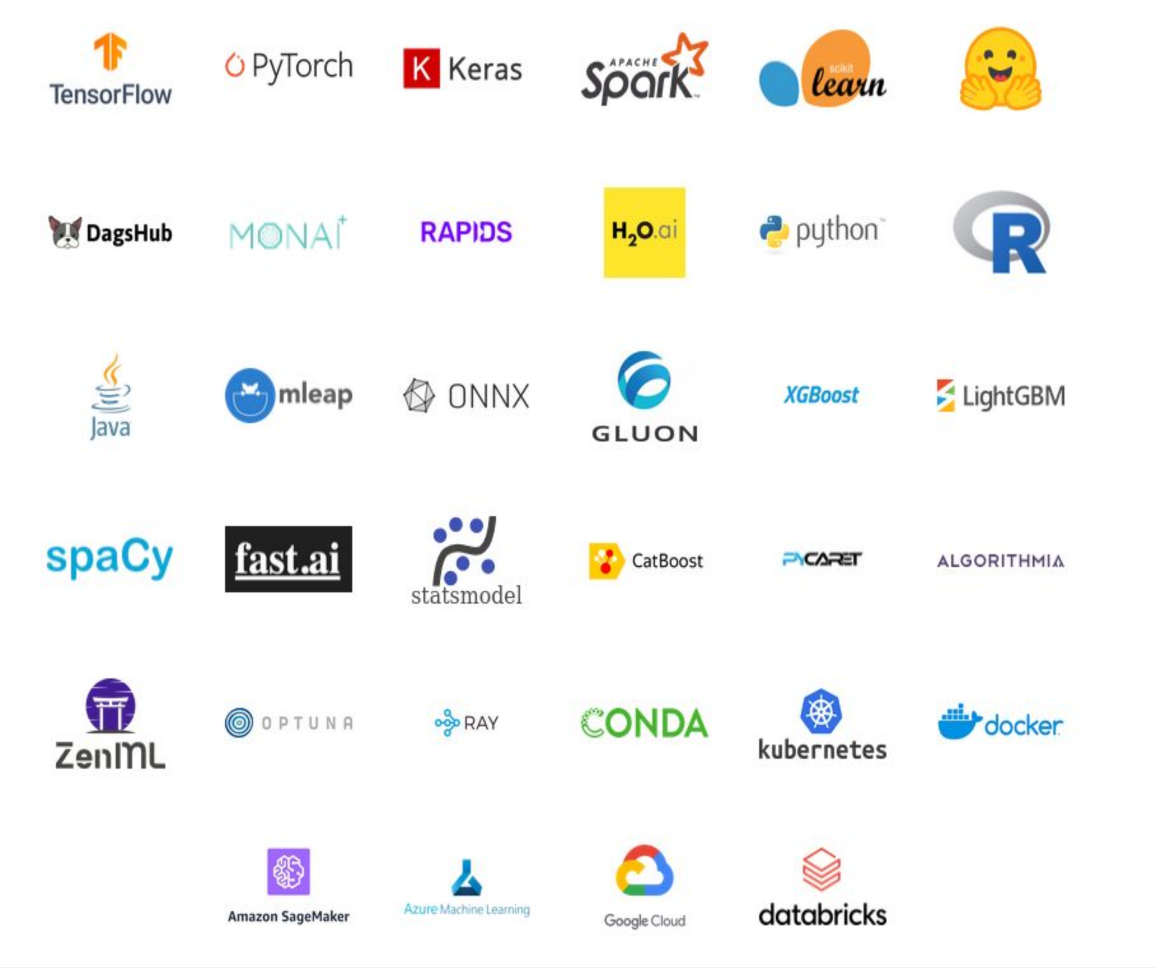
Experiment ID: 1 Artifact Location: mlflow-artifacts:/1

		Run Name	Created	Duration	User	Source
☐		● enthused-sheep-579	✓ 4 days ago	1.0min	ai4eosc	ipykern...

User with only “Read” permission to that experiment

User who logged the experiment run

MLflow integrations and community support



MLFlow Integrations Logos by MLflow Project, a Series of LF Projects, LLC licensed under the CC BY 4.0 license

Booking.com
DagsHub
TOYOTA
Zillow
SK telecom
accenture
criteo
Outreach
splice machine
TEKION
Bering
WiX.com
ABRAXAS
virtusa
mined.ai
dL
SYSTEMATIC
despegar.com
ModelWorks
Brandfolder
ASML
fractal
Acerta
ENABLE AI
Linde
plain concepts
xpand it
Kobalt
CognitOps
DATA INSIGHTS
MOTOROLA SOLUTIONS
TIGER ANALYTICS
JULO
publicis sapient
agremo
servian
landscape
solocal
nunam
Kardiolabs
STRATIO
Quantmetry
modzy
Insider
AIbusters
ML Centric
InfinStor
FILAMENT
DevSamurai
genpact
BRIDGEi2i
Composable
MTC
cabify
Reinsight
AMD TELECOM
Routee
WayMore

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MLflow limitations

- Security concerns
- UI simple design
- Lack of user (!fixed partly in the new version) and group management
- Scalability and performance concerns
- Configuration and maintenance overhead

MLOps (paid) alternatives

- AzureML
- Weight & Biases
- Neptune.ai
- Comet ML
- etc..

Conclusions

- **Improved Efficiency**: MLflow's streamlined experiment tracking and management significantly reduce the time spent on manual record-keeping
- **Cross-Team Collaboration and Knowledge Sharing**: The centralized approach of MLflow has fostered collaboration among diverse teams involved in the ML process
- **Reproducibility**: comprehensive experiment tracking and versioning capabilities provide a robust foundation for reproducibility

References

1. MLflow server: https://mlflow.dev.ai4eosc.eu
2. MLflow core components: https://www.mlflow.org/docs/latest/introduction/index.html#core-components-of-mlflow
3. MLflow docker compose: https://git.scc.kit.edu/m-team/ai/mlflow-compose
4. MLflow GitHub repo: https://github.com/mlflow/mlflow
5. MLflow server docker installation instructions: https://confluence.ifca.es/x/HQDRC
6. MLflow user and control access/permissions: https://git.scc.kit.edu/m-team/ai/mlflow_auth/-/tree/main?ref_type=heads
7. MLflow Project- Python API: https://mlflow.org/docs/latest/python_api/mlflow.projects.html

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AI4EOSC

ai4eosc-wp6@listas.csic.es

ai4eosc.eu

Thank you! Any questions?