Platform for Machine Learning Lifecycle

Jules S. Damji
@2twitme

Outline – Introduction to MLflow: How to Use MLflow Models - Module 3

- MLflow Models
  - Concepts and Motivations
  - Tour of the the MLflow Model API Documentation
  - How to create different model flavor
  - How to create Customized Models
  - Pyfunc Model Flavor: what and how to use it
  - Explore MLflow UI
  - Tutorials & Exercises
- Q & A

https://github.com/dmatrix/olt-mlflow

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 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

MLflow Model Motivations

ML Frameworks

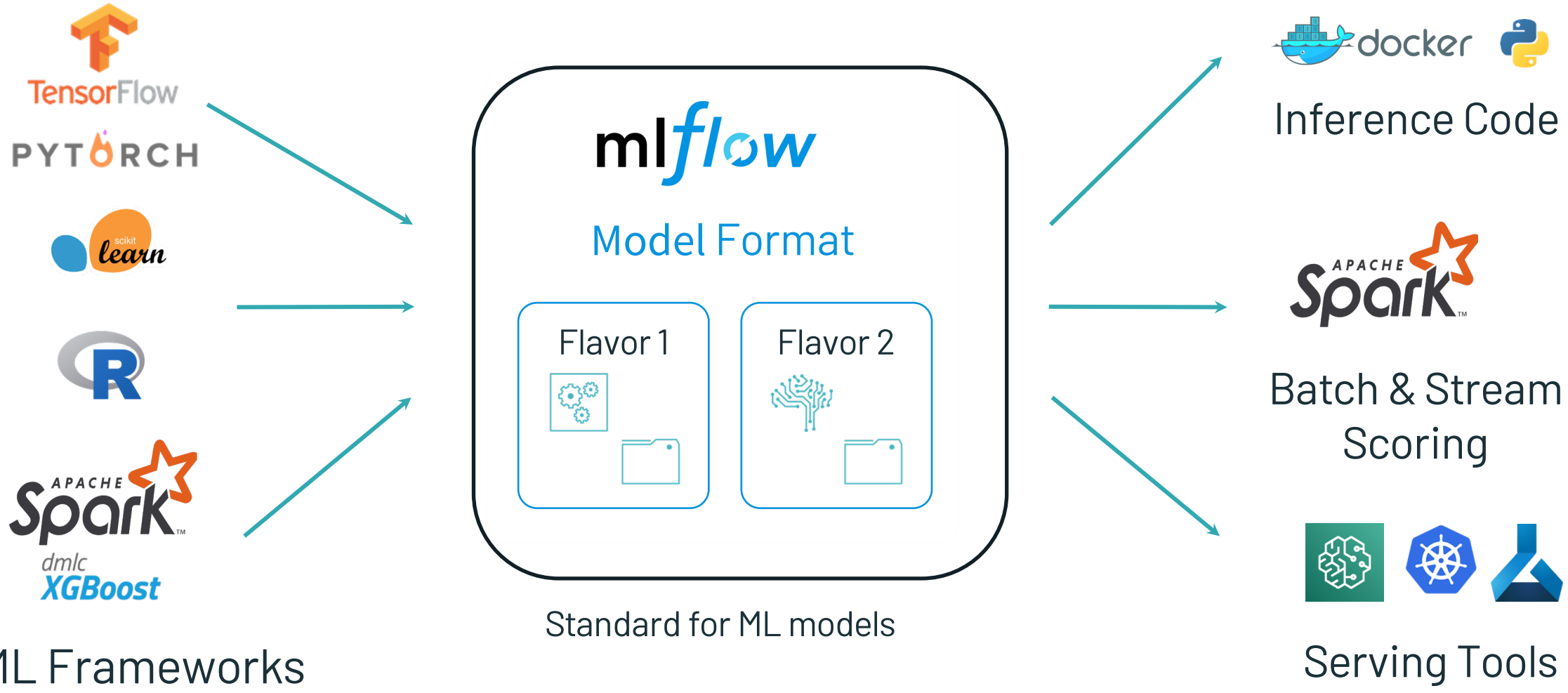
N x M
Combination of
Model support for
all Serving tools

Inference Code

Batch & Stream Scoring

Serving Tools

MLflow Models

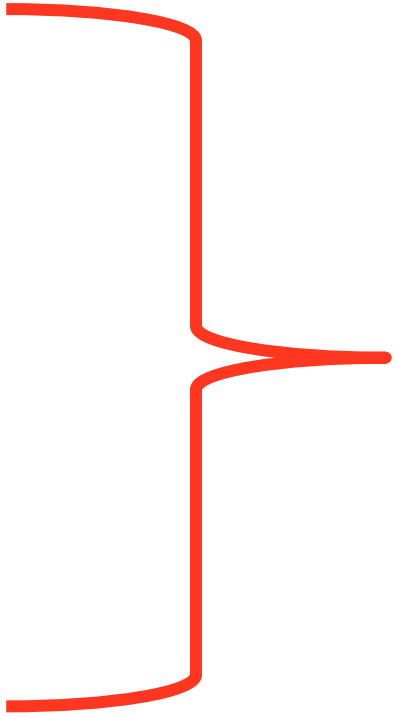


MLflow Model API Documentation

Built-In Model Flavors

MLflow provides several standard flavors that might be useful in your applications. Specifically, many of its deployment tools support these flavors, so you can export your own model in one of these flavors to benefit from all these tools:

- Python Function (`python_function`)
- R Function (`crate`)
- H_2O (`h2o`)
- Keras (`keras`)
- MLeap (`mleap`)
- PyTorch (`pytorch`)
- Scikit-learn (`sklearn`)
- Spark MLlib (`spark`)
- TensorFlow (`tensorflow`)
- ONNX (`onnx`)
- MXNet Gluon (`gluon`)
- XGBoost (`xgboost`)
- LightGBM (`lightgbm`)
- Spacy(`spaCy`)
- Fastai(`fastai`)



Model flavor has generic methods:

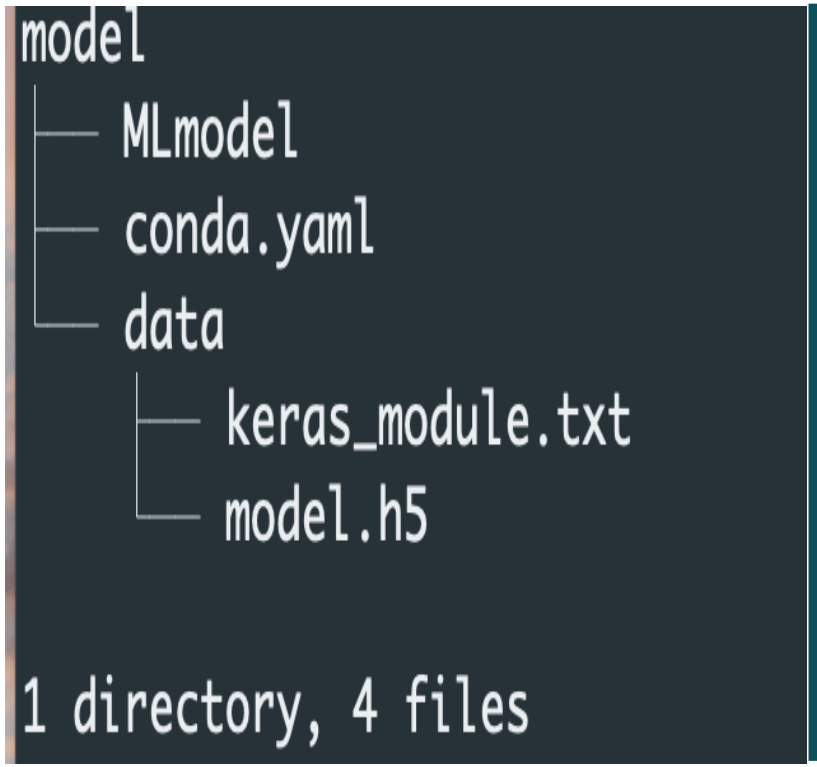
- log_model()
- save_model()
- load_model()
- add_model_flavor()
- auto_log() *

* Only some model flavors

https://mlflow.org/docs/latest/models.html#built-in-model-flavors

1. Example MLflow Model

```
mlflow.keras.log_model(...)
```

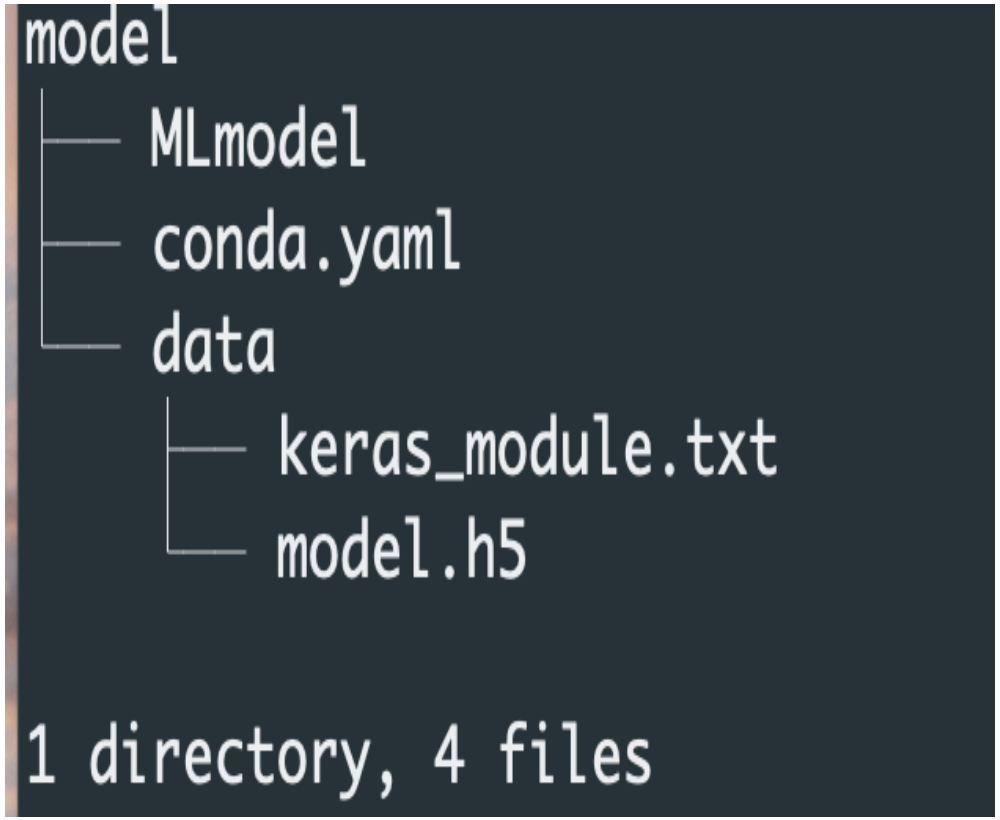



```
artifact_path: model
flavors:
  keras:
    data: data
    keras_module: keras
    keras_version: 2.3.1
  python_function:
    data: data
    env: conda.yaml
    loader_module: mlflow.keras
    python_version: 3.7.5
…
run_id: 714d418027bc43bd8adc768f0f9ecb51
utc_time_created: '2020-08-25 19:04:53.887587'
```

Usable by tools that understand Keras model format

Usable by any tool that can run Python (Docker, Spark, etc!)

2. Example Conda.yaml




```
channels:
- defaults
- conda-forge
dependencies:
- python=3.7.5
- pip
- pip:
  - mlflow
  - keras==2.3.1
  - tensorflow==2.0.0
name: mlflow-env
```

Model Keras Flavor Example

Train a model

`mlflow.keras.log_model(…)`

mlflow

Model Format

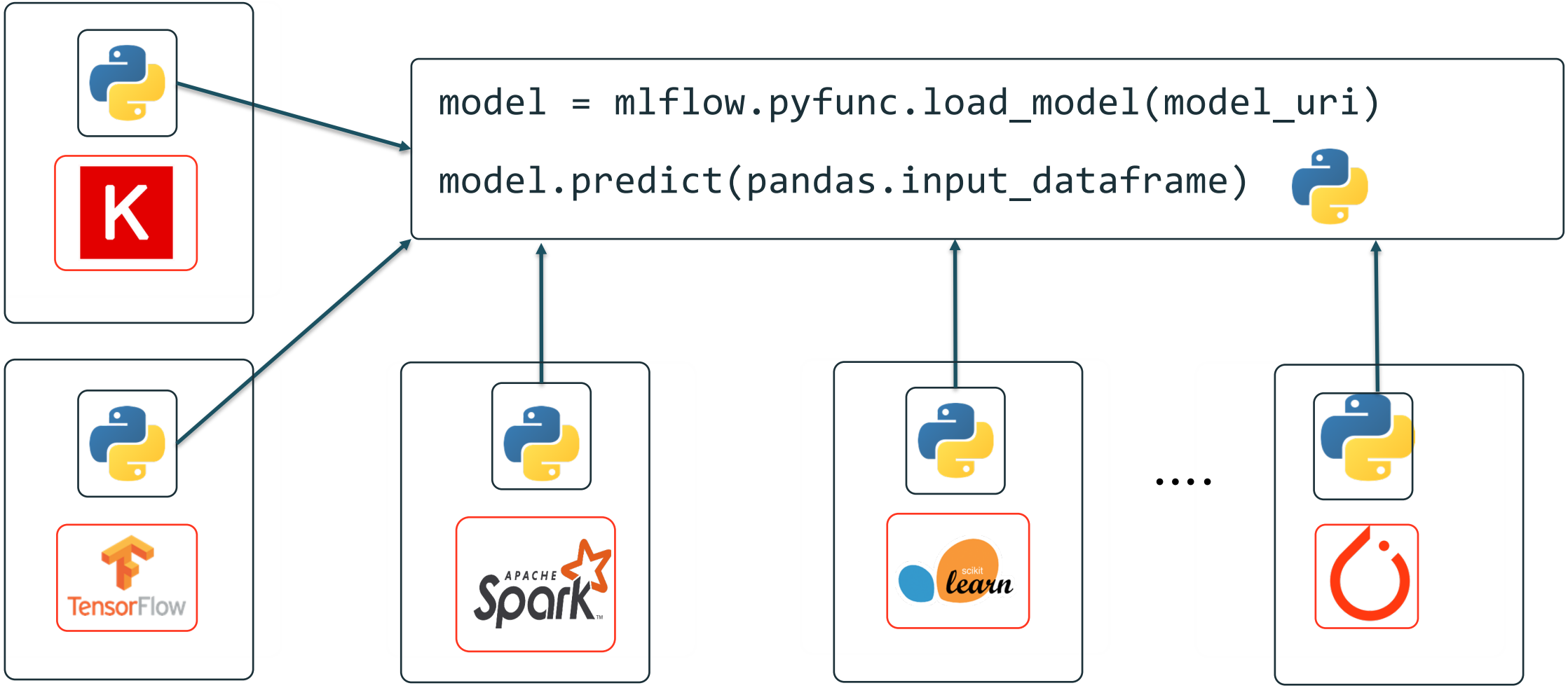
Flavor 1: Pyfunc

Flavor 2: Keras

```
model = mlflow.pyfunc.load_model(…)
Model.predict(pandas.input_dataframe
```

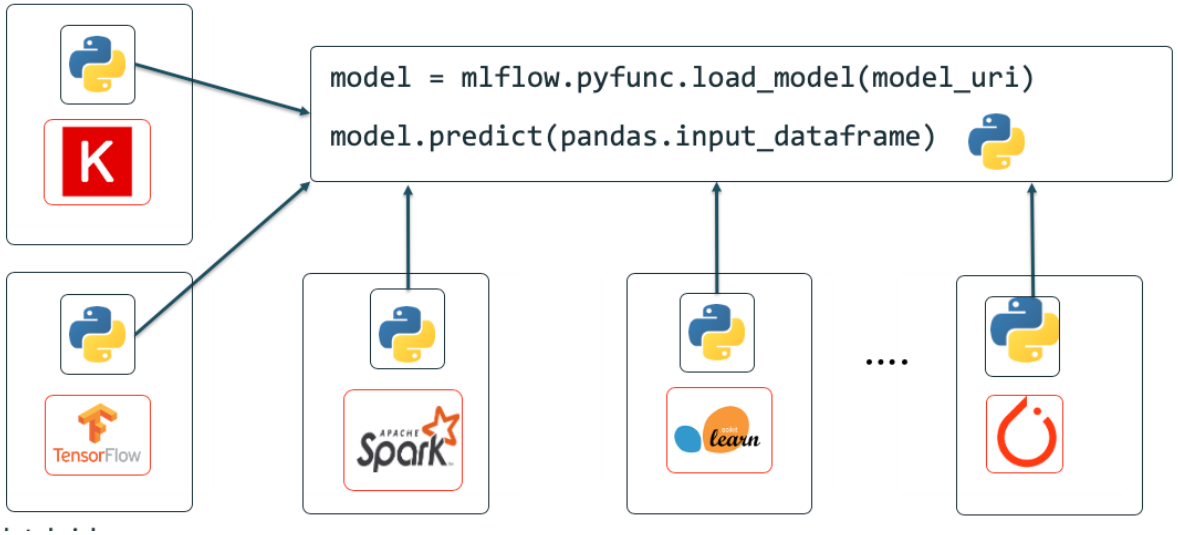
```
model = mlflow.keras.load_model(…)
model.predict(keras.Input(…))
```

Model Flavors Example



MLflow PythonModel

- Serves as Generic Python model interface



- Use with Spark UDFs

```
predict = mlflow.pyfunc.spark_udf(spark, ”runs://run_id/model")
df.withColumn("prediction", predict("name", "age")).show()
```

MLflow PythonModel

- Use ML framework not supported
  - For example, HuggingFace, SparkNLP, VaderSentiment etc

```
16  class SocialMediaAnalyserModel(mlflow.pyfunc.PythonModel):
17
18      def __init__(self):
19          self._analyser = SentimentIntensityAnalyzer()
20
21      def _score(self, text):
22          scores = self._analyser.polarity_scores(text)
23          return scores
24
25      def predict(self, context, model_input):
26          model_output = model_input.apply(lambda col: self._score(col))
27          return model_output
```

MLflow PyFuncModel

```
30 ▶ if __name__ == "__main__":
31       model_path = "vader"
32       vader_model = SocialMediaAnalyserModel()
33       with mlflow.start_run(run_name="Vader Sentiment Analysis") as run:
34           mlflow.pyfunc.log_model(model_path, python_model=vader_model)
35
36           # load back the model
37           model_uri = f"runs:/{run.info.run_uuid}/{model_path}"
38           loaded_model = mlflow.pyfunc.load_model(model_uri)
39           mlflow.log_param("algorithm", "VADER")
40           mlflow.log_param("total_sentiments", len(INPUT_TEXTS))
41
42           # Use inference to predict output from the model
43           for i in range(len(INPUT_TEXTS)):
44               text = INPUT_TEXTS[i]['text']
45               mlflow.log_param(f"text_{i}", text)
46               model_input = pd.DataFrame([text])
47               scores = loaded_model.predict(model_input)
48               print(f"<{text}> ------- {str(scores[0])}>")
49               for index, value in scores.items():
50                   [mlflow.log_metric(f"{key}_{i}", value) for key, value in value.items()]
51
```

Recap: MLflow Models

Packaging format for ML Models

- Any directory with MLmodel file

Defines dependencies for reproducibility

- Conda environment can be specified in MLmodel configuration

Model creation and loading utilities

- mlflow.<model_flavor>.save_model(...) or log_model(...) or autolog()
- mlflow.<model_flavor>.load_model(...)

Deployment APIs

- CLI / Python / R / Java
- mlflow models [OPTIONS] COMMAND [ARGS]...
  - mlflow models serve [OPTIONS [ARGS] ....
  - mlflow models predict [OPTIONS [ARGS] ...
  - mlflow sagemaker –help
  - mlflow azureml --help

MLflow Models Tutorials

Tutorials: https://github.com/dmatrix/olt-mlflow