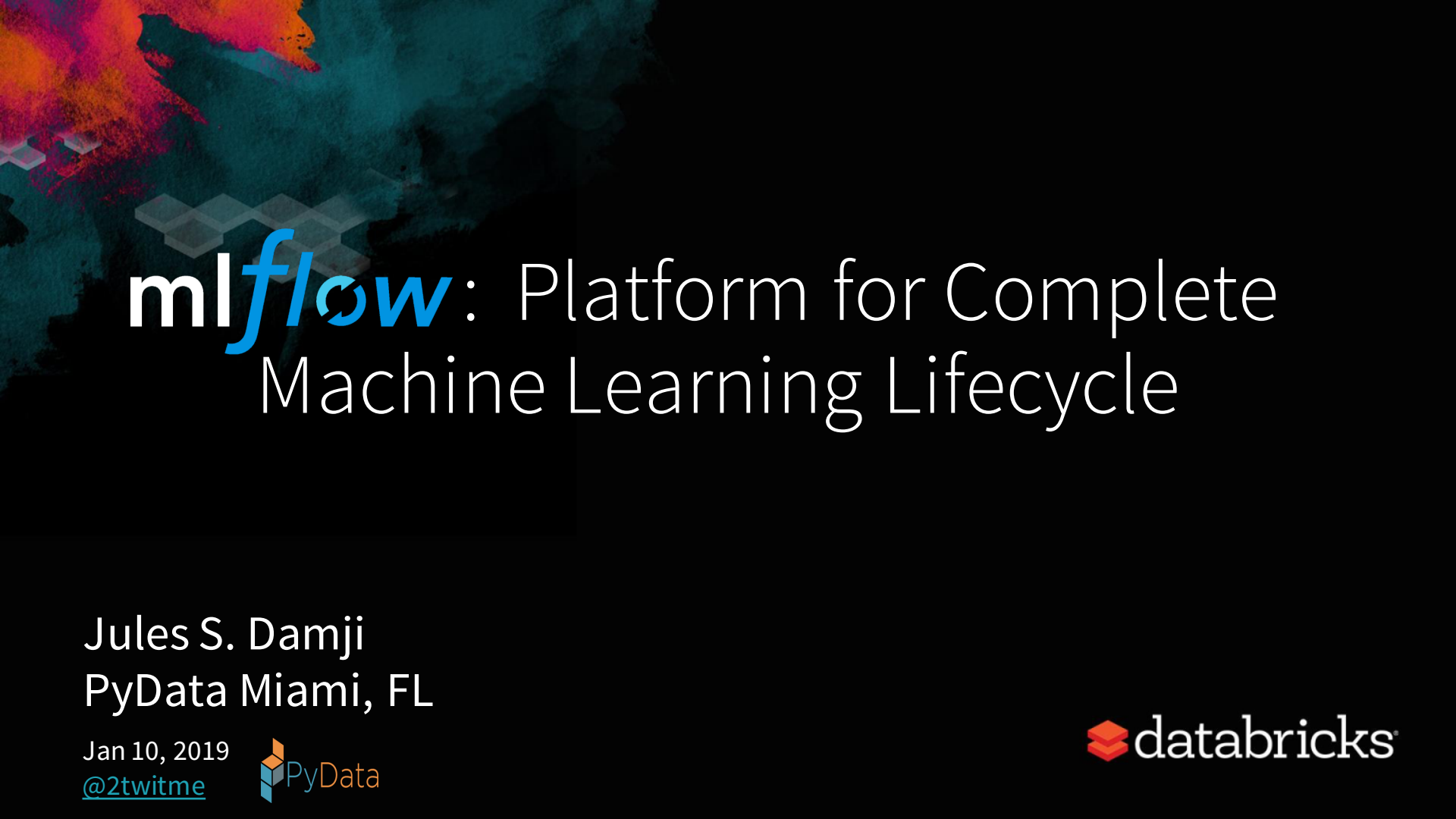

Jules S. Damji
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Jan 10, 2019
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Outline

Overview of ML development challenges

How MLflow tackles these

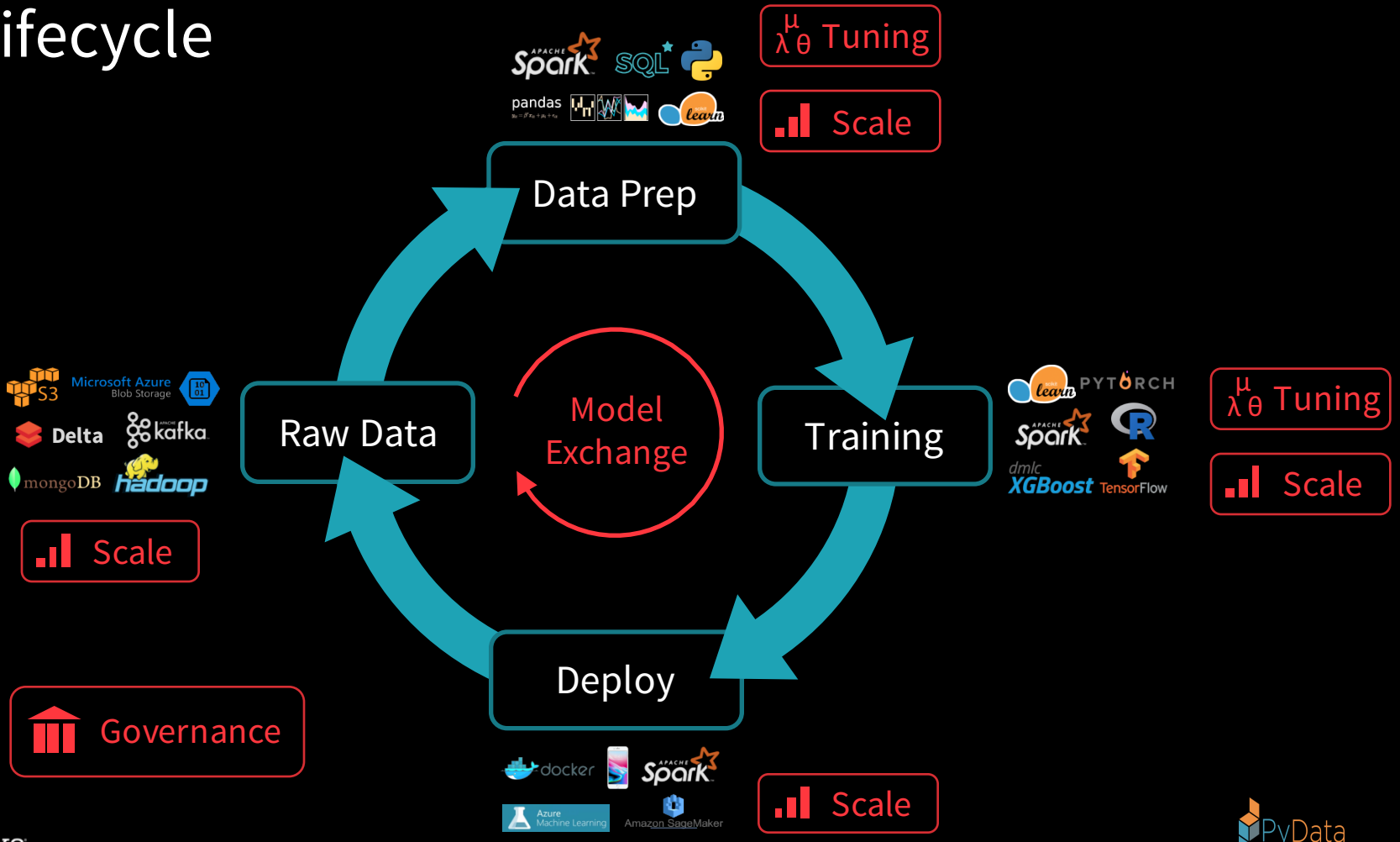
MLflow Components

Developer Experience & Demo

Ongoing Roadmap

Machine Learning Development is Complex

ML Lifecycle



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Example

“I build 100s of models/day to lift revenue, using any library: MLlib, PyTorch, R, etc. There’s no easy way to see what data went in a model from a week ago, tune it and rebuild it.”

-- Chief scientist at ad tech firm

Custom ML Platforms

Facebook FBLearner, Uber Michelangelo, Google TFX

- + **Standardize the data prep / training / deploy loop: if you work with the platform, you get these!**
- – **Limited to a few algorithms or frameworks**
- – **Tied to one company's infrastructure**
- – **Out of luck if you left the company….**

Can we provide similar benefits in an open manner?

Introducing mlflow

Open machine learning platform

- Works with any ML library & language
- Runs the same way anywhere (e.g., any cloud)
- Designed to be useful for 1 or 1000+ person orgs
- Simple, Easy-to-use, Developer Experience, and get started!

MLflow Design Philosophy

1. "API-first", open platform

- Allow submitting runs, models, etc from any library & language
- Example: a "model" can just be a lambda function that MLflow can then deploy in many places (Docker, Azure ML, Spark UDF, …)

Key enabler: built around REST APIs and CLI

MLflow Design Philosophy

2. Modular design

- Let people use different components individually (e.g., use MLflow's project format but not its deployment tools)
- Not monolithic, Distinctive and Selective

Key enabler: distinct components (Tracking/Projects/Models)

MLflow Components

mlflow Tracking

Record and query experiments: code, configs, results, …etc

mlflow Projects

Packaging format for reproducible runs on any platform

mlflow Models

General model format that supports diverse deployment tools

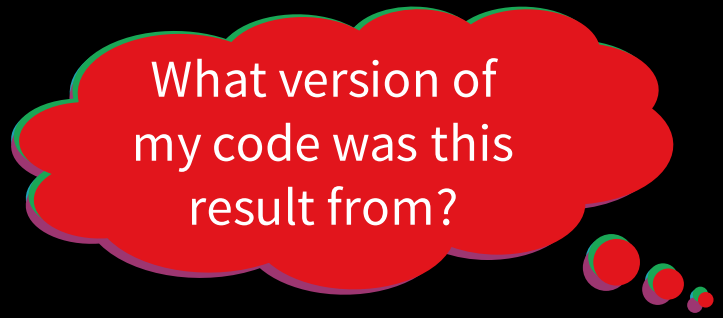
Model Development without MLflow

```
data   = load_text(file)
ngrams = extract_ngrams(data, N=n)
model  = train_model(ngrams,
             learning_rate=lr)
score  = compute_accuracy(model)

print("For n=%d, lr=%f: accuracy=%f"
      % (n, lr, score))

pickle.dump(model, open("model.pkl"))
```

```
For n=2, lr=0.1: accuracy=0.71
For n=2, lr=0.2: accuracy=0.79
For n=2, lr=0.5: accuracy=0.83
For n=2, lr=0.9: accuracy=0.79
For n=3, lr=0.1: accuracy=0.83
For n=3, lr=0.2: accuracy=0.82
For n=4, lr=0.5: accuracy=0.75
...
```



Key Concepts in Tracking

Parameters: key-value inputs to your code

Metrics: numeric values (can update over time)

Tags and Notes: information about a run

Artifacts: files, data and models

Source: what code ran?

Version: what of the code?

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MLflow Tracking API: *Simple!*

mlflow
Tracking

Record and query experiments: code, configs, results, …etc

```
import mlflow

 # log model's tuning parameters

with mlflow.start_run():
  mlflow.log_param("layers", layers)
  mlflow.log_param("alpha", alpha)

  # log model's metrics
  mlflow.log_metric("mse", model.mse())
  mlflow.log_artifact("plot", model.plot(test_df))
  mlflow.tensorflow.log_model(model)
```

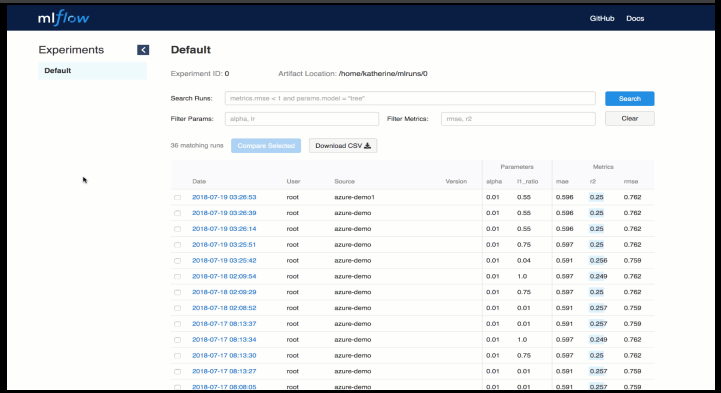
Model Development *with* MLflow is *Simple!*

```
data   = load_text(file)
ngrams = extract_ngrams(data, N=n)
model  = train_model(ngrams,
                     learning_rate=lr)
score  = compute_accuracy(model)

mlflow.log_param("data_file", file)
mlflow.log_param("n", n)
mlflow.log_param("learning_rate", lr)
mlflow.log_metric("score", score)

mlflow.sklearn.log_model(model)
```

```
$ mlflow ui
```



Track parameters, metrics, output files & code version

Search using UI or API

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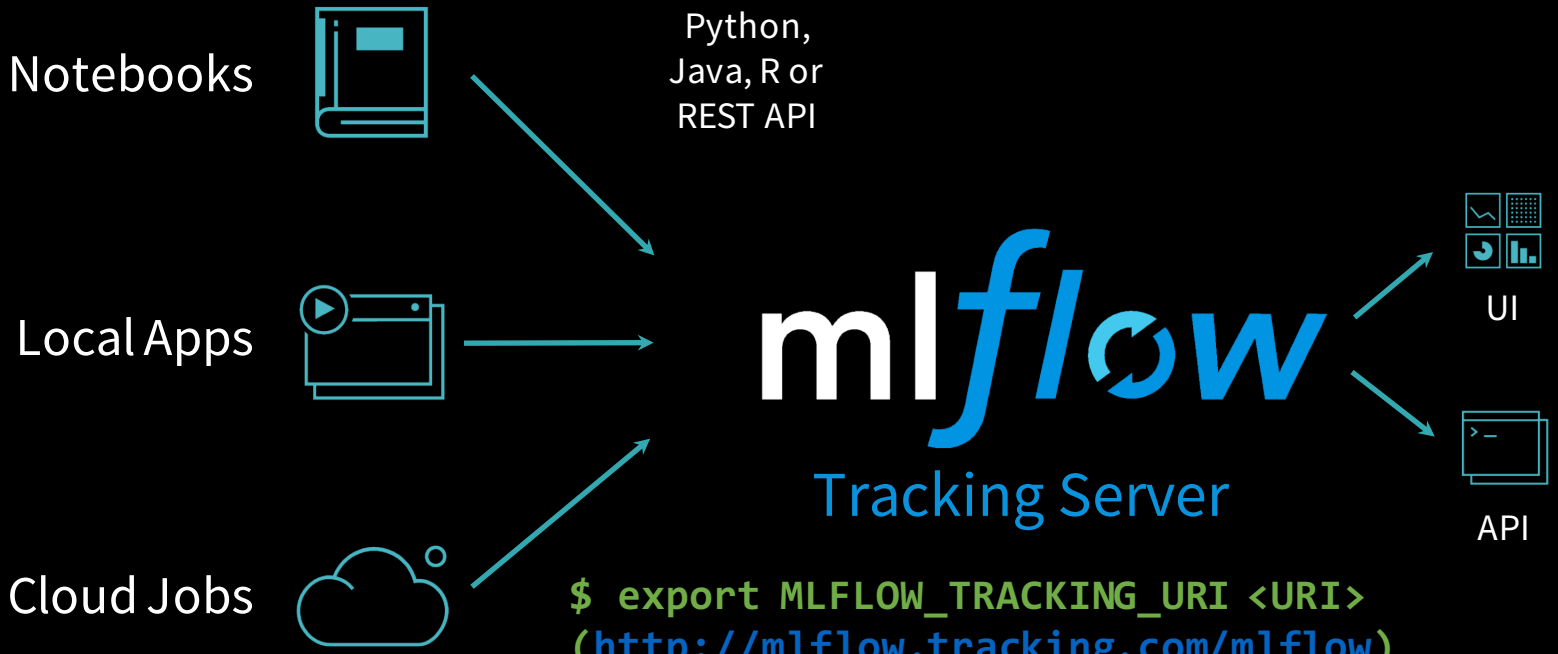
MLflow Tracking



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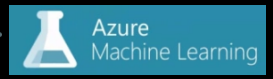
MLflow Projects Motivation

Diverse set of tools


Diverse set of environments





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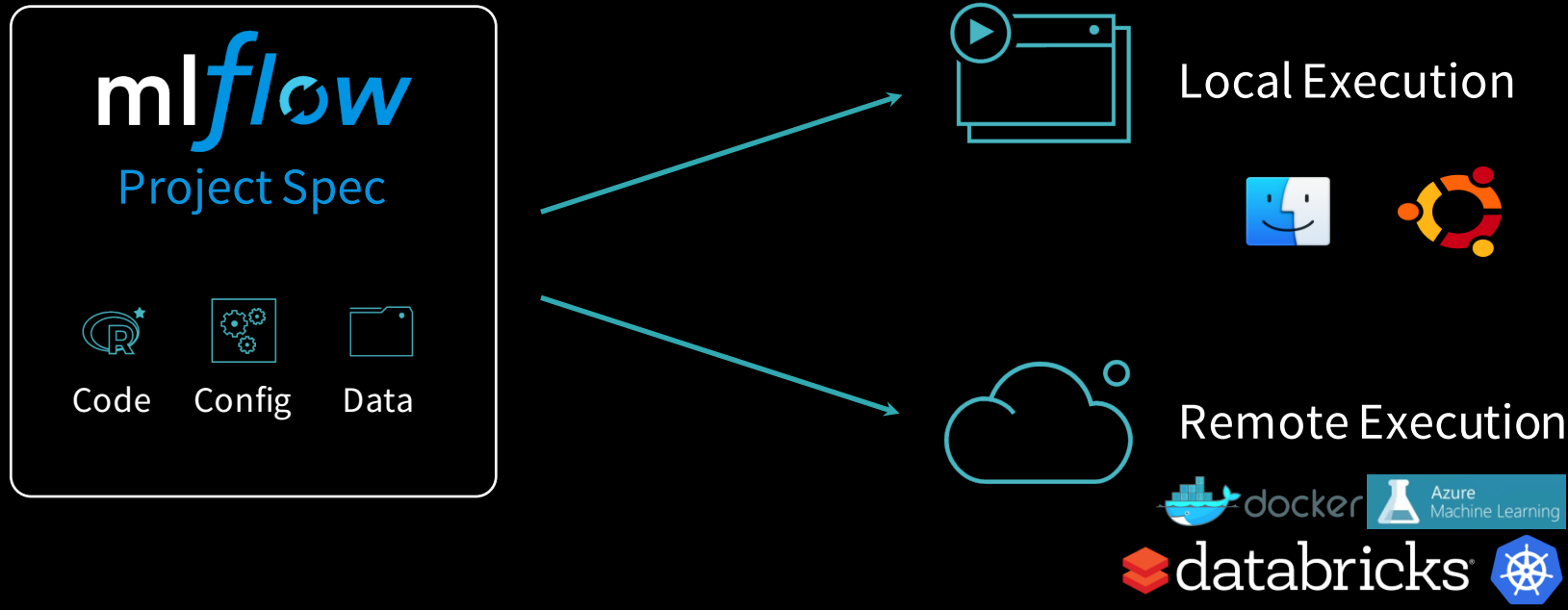
Projects

Packaging format
for reproducible
runs
on any platform

Result: It is difficult to productionize and share.

MLflow Projects



Example MLflow Project

```
my_project/
├── MLproject
│
│
│
│
│
│
├── conda.yaml
├── main.py
└── model.py
    ...
```

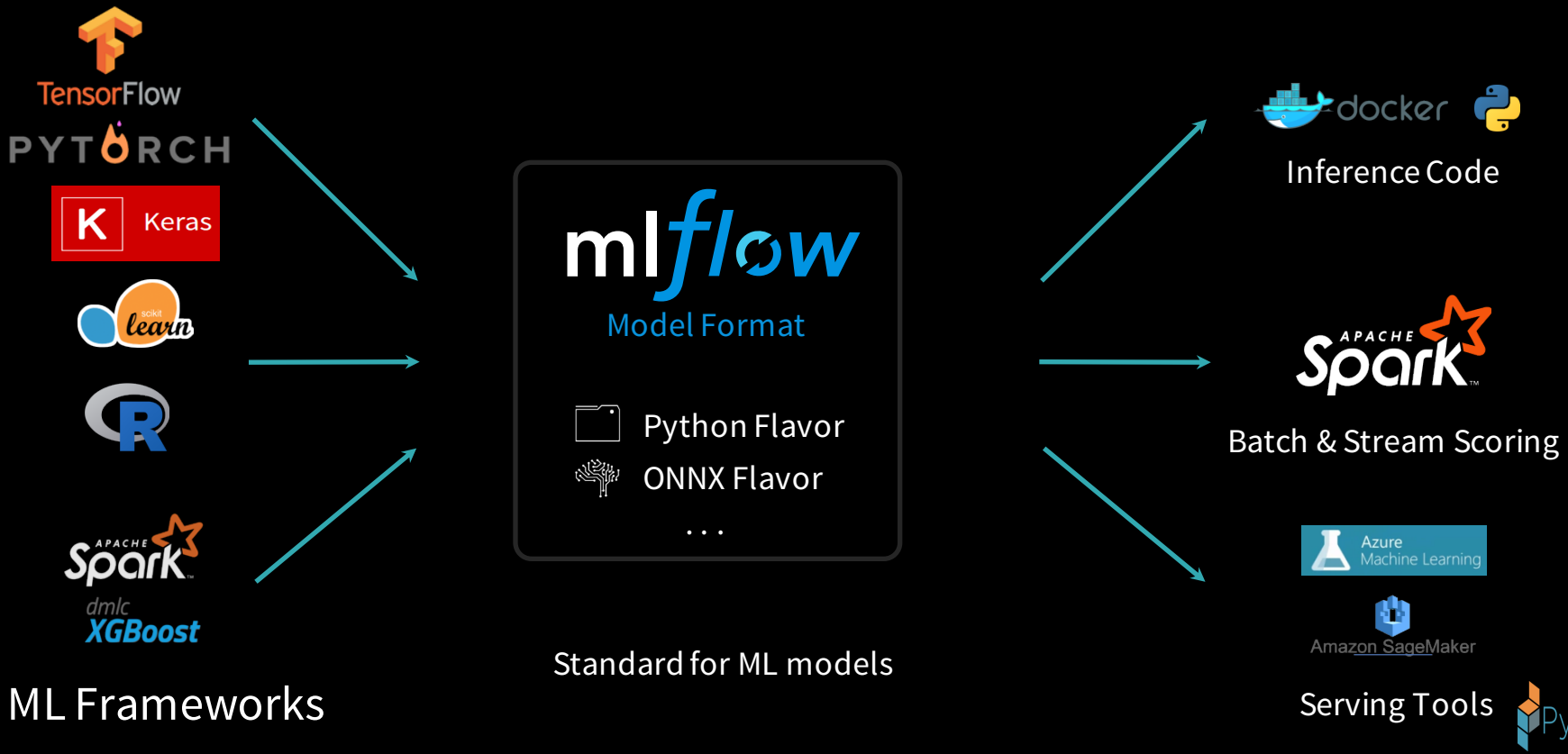
```
conda_env: conda.yaml

entry_points:
  main:
    parameters:
      training_data: path
      lambda: {type: float, default: 0.1}
    command: python main.py {training_data} {lambda}
```

```
$ mlflow run git://<my_project>
```

```
mlflow.run("git://<my_project>", ...)
```

MLflow Models



Example MLflow Model

```
my_model/
├── MLmodel
└── estimator/
    ├── saved_model.pb
    └── variables/
        ...
```

```
run_id: 769915006efd4c4bbd662461
time_created: 2018-06-28T12:34
flavors:
  tensorflow:
    saved_model_dir: estimator
    signature_def_key: predict
  python_function:
    loader_module: mlflow.tensorflow
```

Usable by tools that understand TensorFlow model format

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

```
>>> mlflow.tensorflow.log_model(...)
```

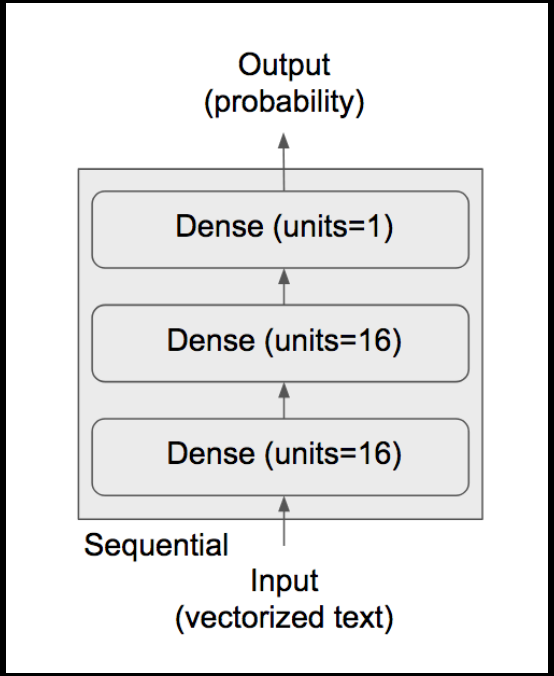
Developer Experience & Demo

Binary Classification of
IMDB Movie Reviews Using
Keras Neural Network Model

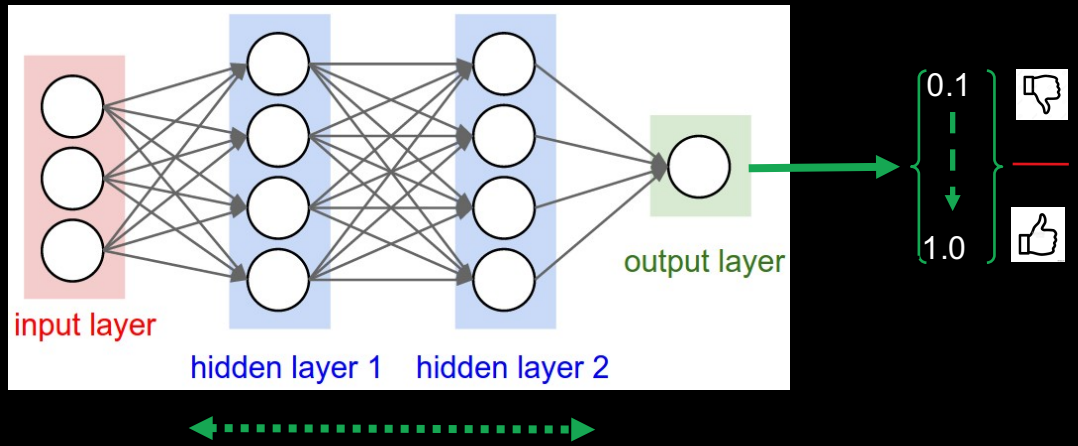
https://dbricks.co/keras_imdb
https://github.com/dmatrix/jsd-mlflow-examples/

MLflow Baseline & Experiment Models

Model	Units	Epochs	Loss Function	Hidden Layers
Base	16	20	binary_crosstropy	1
Experiment-1	32	30	binary_crosstropy	3
Experiment-2	32	20	mse	3



MLflow Baseline & Experiment Models



Ongoing MLflow Roadmap

- TensorFlow, Keras, PyTorch, H2O, MLlib integrations ✔
- Java and R MLflow Client language APIs ✔
- Multi-step workflows ✔
- Hyperparameter tuning ✔
- Integration with Databricks Tracking Server ✔
- Support for other Data Store (e.g., MySQL) ✔
- Data source API based on Spark data sources
- Model metadata & management

Just released v8.0.1

- Faster & Improved UI
- Extended Python Model as Spark UDF
- Persist model dependencies as Conda Environment

Learning More About MLflow

`pip install mlflow` to get started

Find docs & examples at **mlflow.org**

tinyurl.com/mlflow-slack

What Did We Talk About? mlflow

Workflow tools can greatly simplify the ML lifecycle

- Improve usability among data scientists and engineers
- Simplify lifecycle development
- Lightweight, open platform that integrates easily
- Available APIs: Python, Java & R
- Easy to install and use
- Develop locally and track locally or remotely

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15% Discount Code: PyDataMiami

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Thank You ☺

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