Platform for Machine Learning Lifecycle

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Outline – Introduction to MLflow: How to Use MLflow Projects - Module 1

- MLFlow Component
  - MLflow Projects
  - Concepts and Motivations
  - Executing MLflow projects in (DCE)
  - Building MLFlow Projects
  - 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 many 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

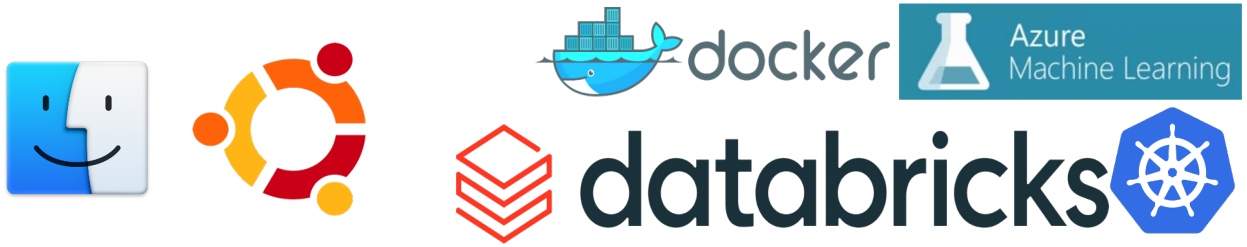
databricks

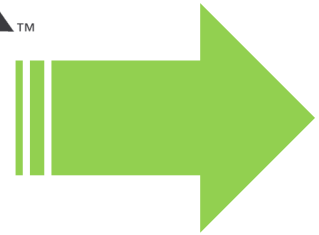
O'REILLY

MLflow Projects Motivation

Diverse set of tools

Diverse set of environments





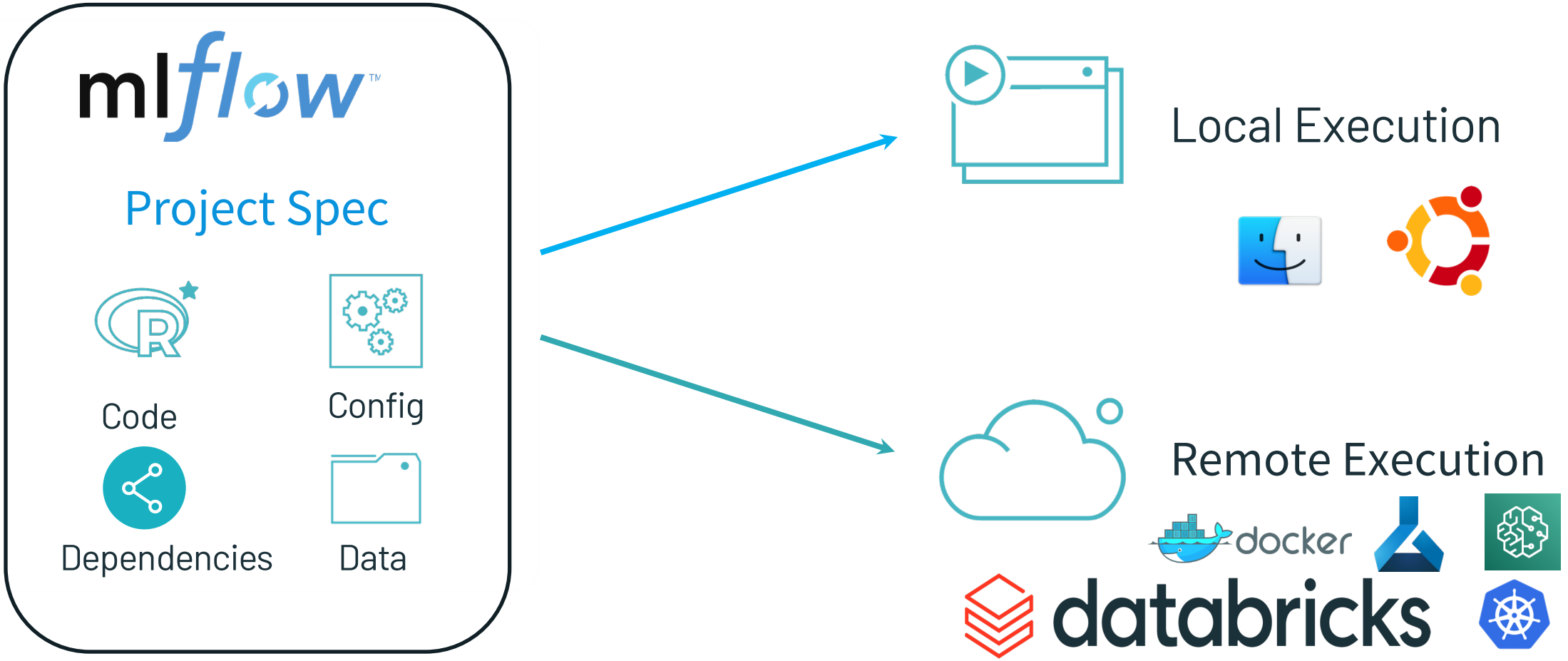
mlflow™

Projects

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

Challenge: ML results difficult to reproduce

MLflow Projects



MLflow Projects Environments

- MLflow Supports three software environments
  - Environments to Execute your Entry point code

  - Conda for Python Packages
  - Docker for non-Python Packages
  - Current System environment

1. Example MLflow Project File

my_projectject/
- MLproject
- conda.yaml
- main.py
- model.py
- …

```
name: tutorial

conda_env: conda.yaml

entry_points:
  main:
    parameters:
      batch_size: {type: int, default: 10}
      epochs: {type: int, default: 100}
    command: "python train_keras.py {batch_size} {epochs}
```

```
$ mlflow run git://<my_project>.git -P epochs=200

mlflow.run("git://<my_project>", parameters={..})

mlflow run . -e main -P epochs=200
```

2. Example Conda.yaml

my_project/
- MLproject
- conda.yaml
- main.py
- model.py

....

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

MLflow Projects

Packaging format for reproducible ML runs

- Any code folder or GitHub repository
- MLproject file with project configuration

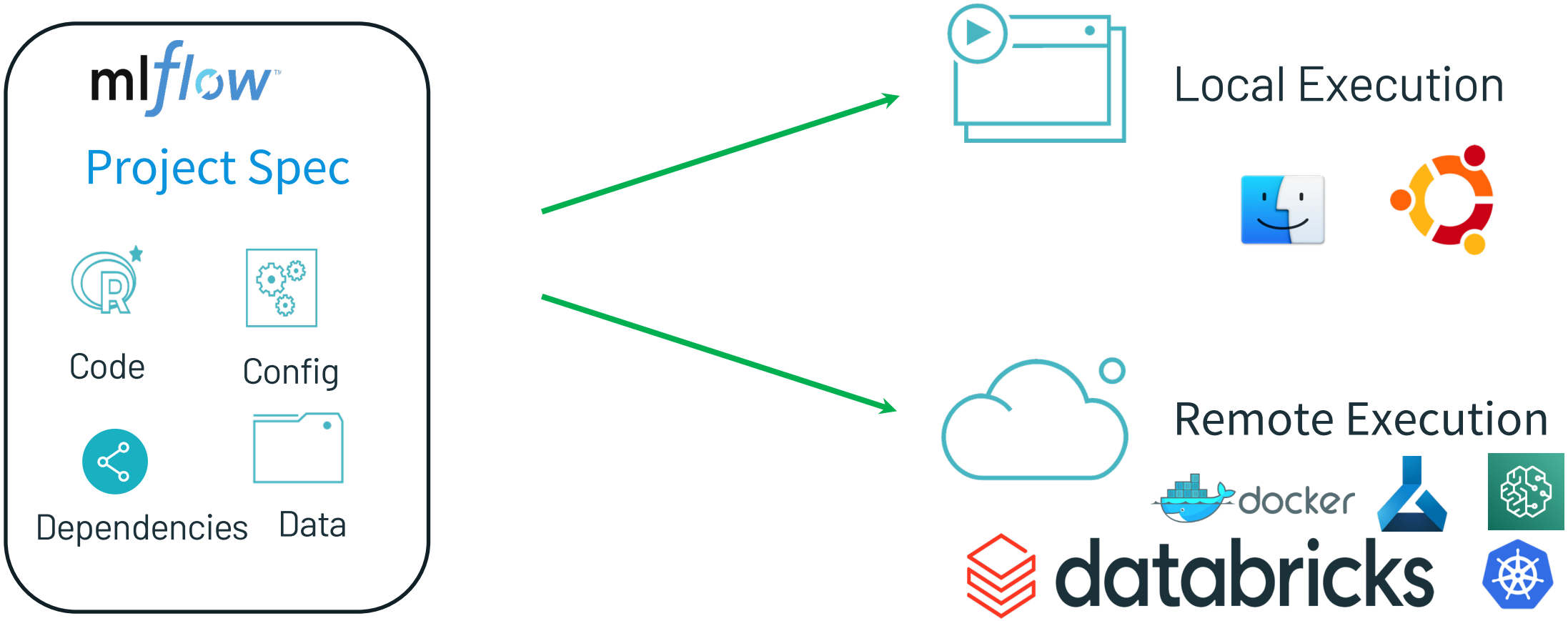
Defines dependencies for reproducibility

- Conda (+ R, Docker, ...) dependencies can be specified in MLproject
- Reproducible in (almost) any environment

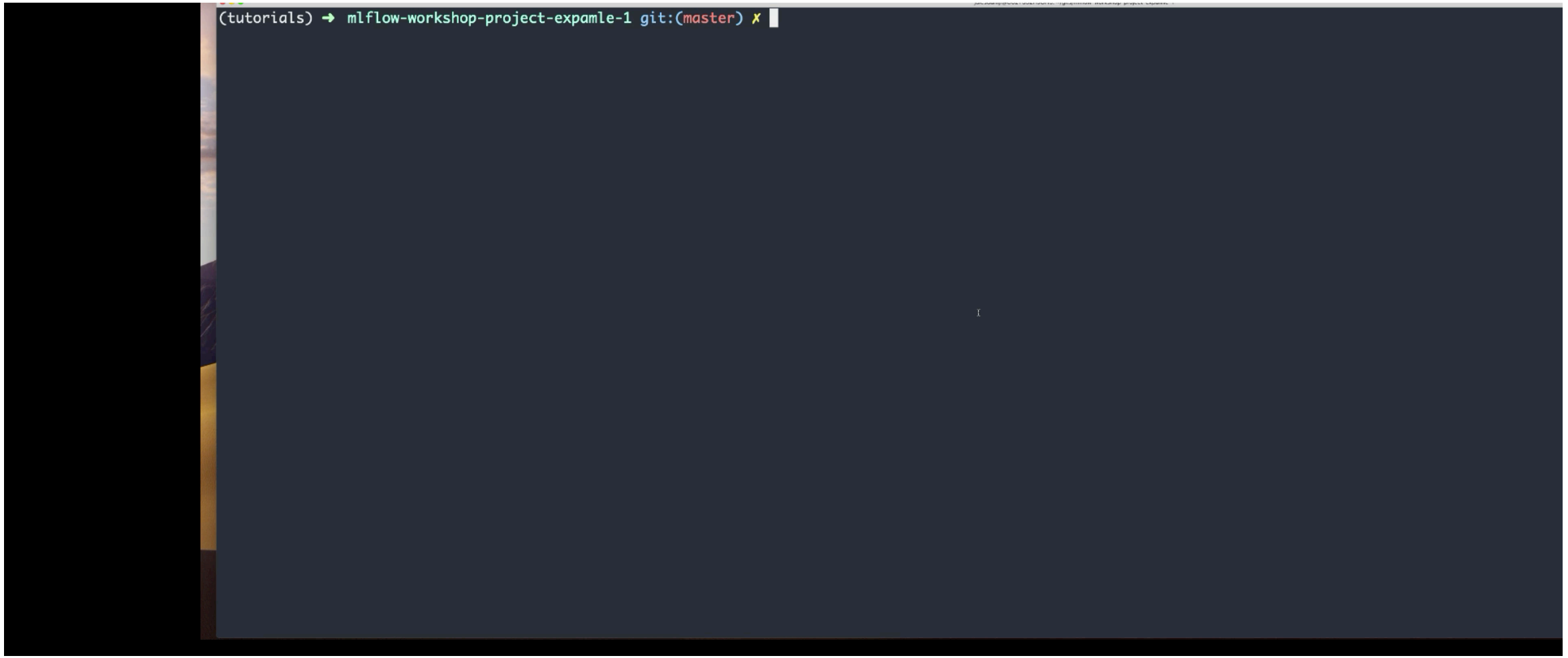
Execution API for running projects

- CLI / Python / R / Java
- Supports local and remote execution
  - mlflow run –help (CLI)
  - mlflow run https://github.com/dmatrix/jsd-mlflow-examples.git#keras/imdbclassifier (CLI)
  - mlflow.run (<project_uri>, parameters={}) or mlflow.projects.run((<project_uri>, parameters={}) (API)

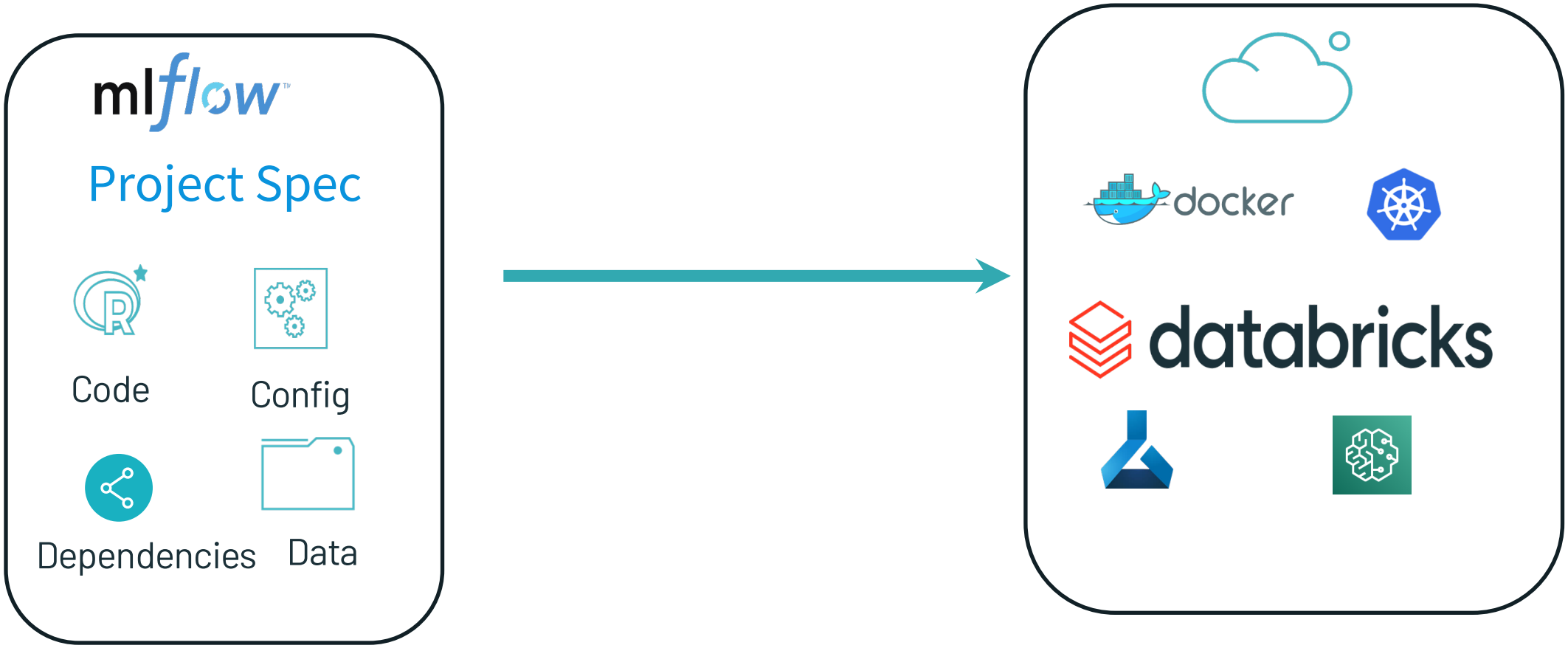
MLflow Project Execution



MLflow Project Local Execution



MLflow Project Remote Execution



MLflow Project Remote Execution: Databricks

```
{ "new_cluster":
   { "spark_version": “7.0.x-scala2.12",
   "node_type_id": "i3.xlarge",
   "aws_attributes": {"availability": "ON_DEMAND"},
   "num_workers": 4 },
   "libraries": [
       { "pypi": {
            "package": "tensorflow" }
       }
     ]
 }
```

1

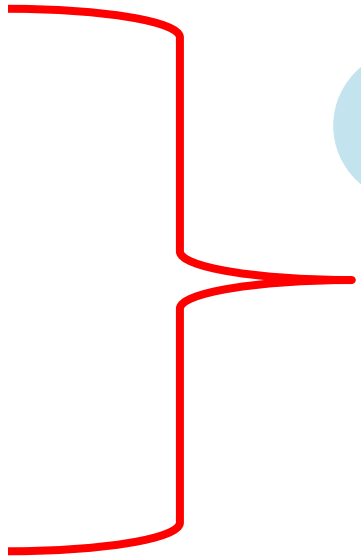
Databricks Cluster Config Specification
dbr_project_spec.json

2

```
mlflow run git://github.com/mlflow/mlflow-example.git -b databricks --backend-config dbr_project_spec.json
```

MLflow Project Remote Execution: Kubernetes (Experimental)

```
FROM continuumio/miniconda:4.5.4

RUN pip install mlflow>=1.0 \
  && pip install azure-storage-blob==12.3.0 \
  && pip install numpy==1.14.3 \
  && pip install scipy \
  && pip install pandas==0.22.0 \
  && pip install scikit-learn==0.19.1 \
  && pip install cloudpickle
```



1

Create a Dockerfile

2

```
docker build -t mlflow-docker-example -f Dockerfile .
```

3

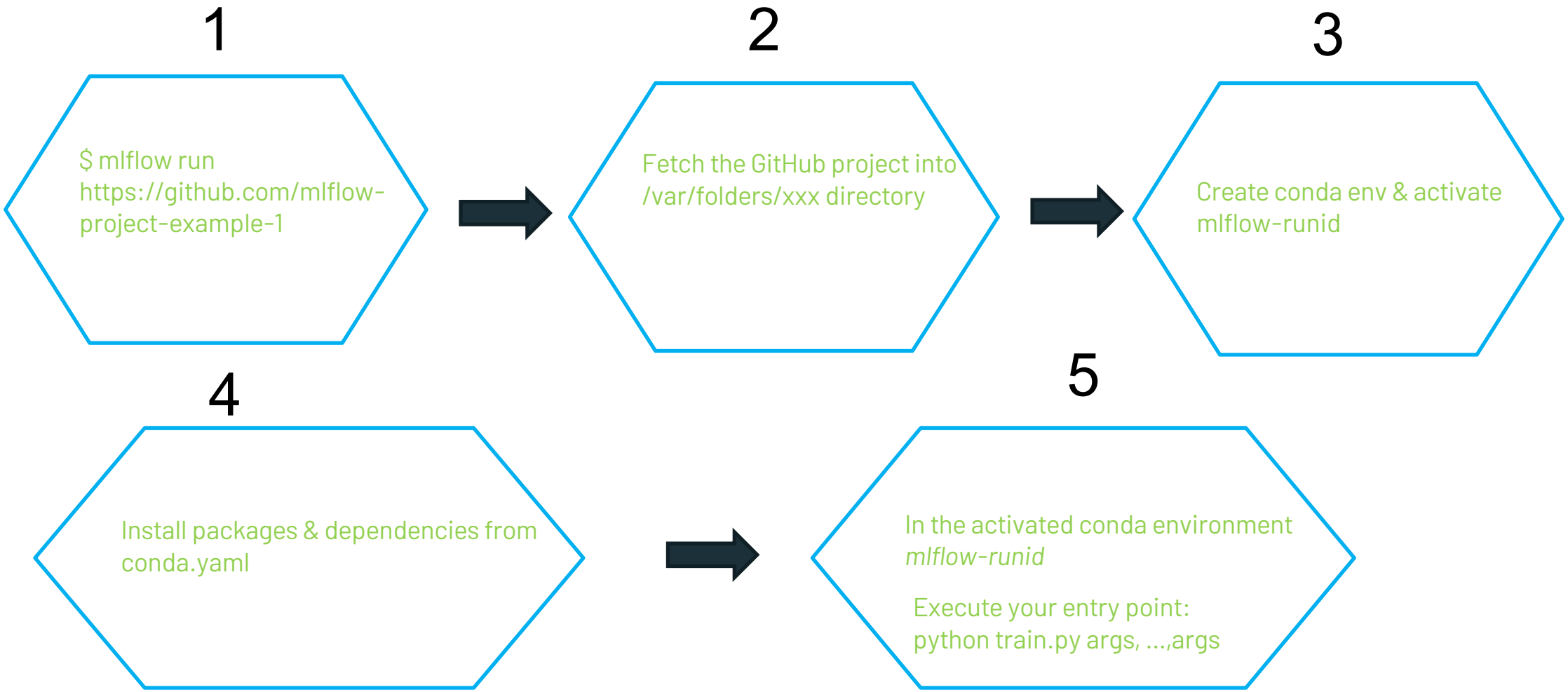
```
Create MLproject
```

4

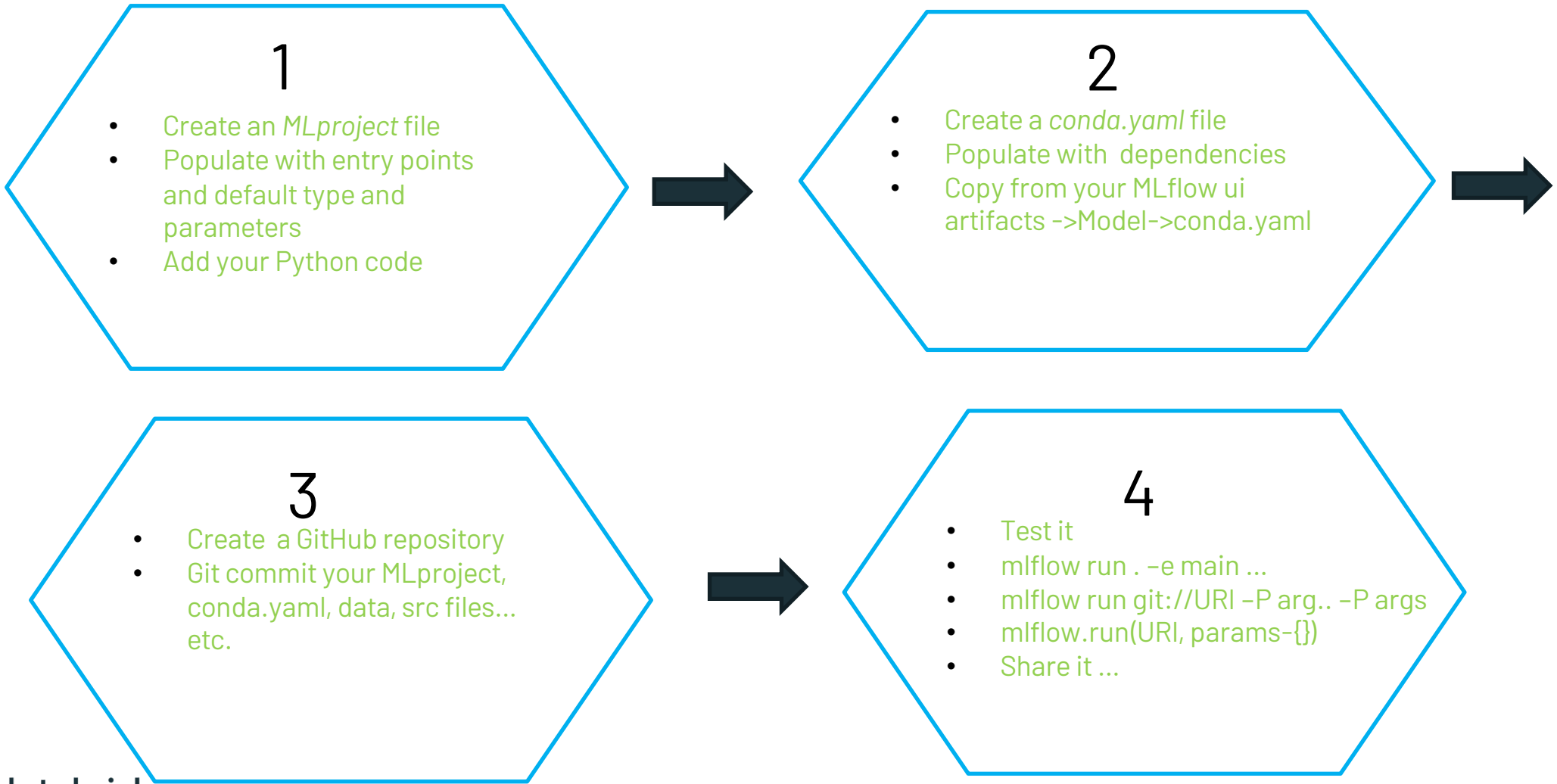
```
mlflow run . -e main
```

https://github.com/mlflow/mlflow/tree/master/examples/docker

Anatomy of MLflow Project Execution



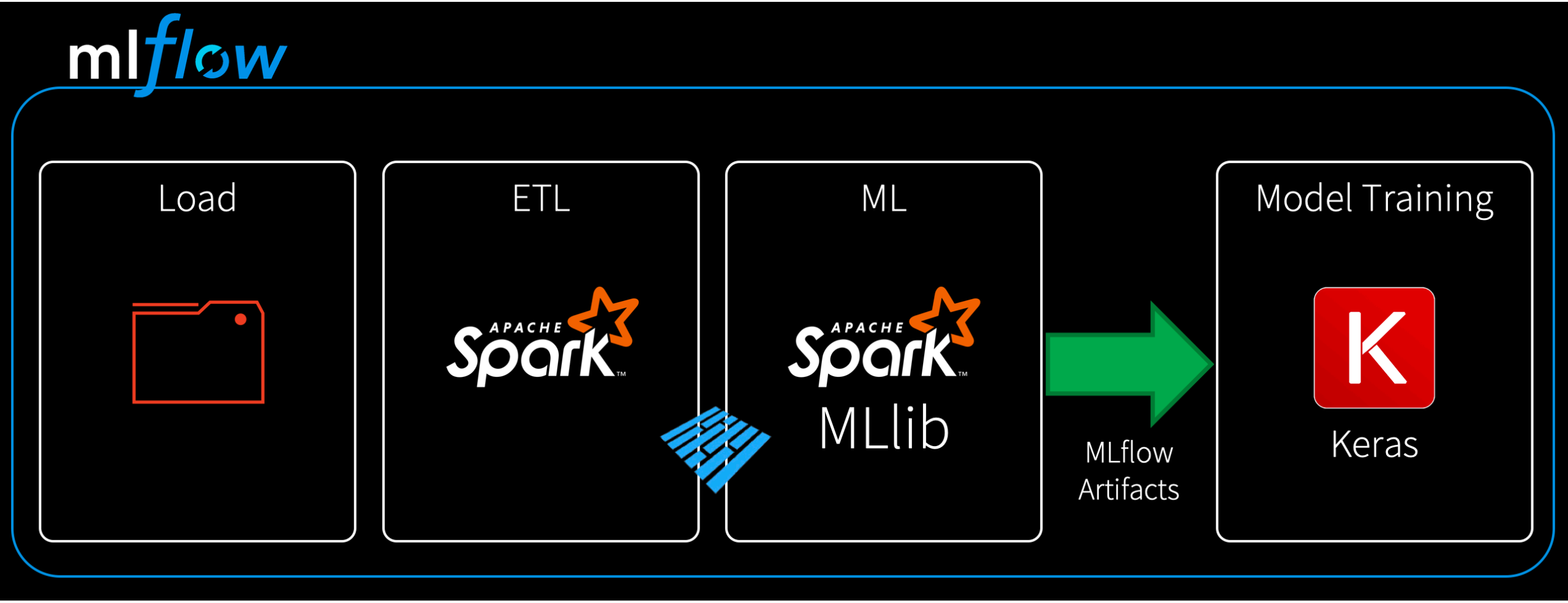
How to build an MLflow Project



MLflow Projects Usage

- Reproducibility and Experimentation
  - Reproduce experiments in a target environment without inst ✓ ıg software dependencies
  - Experiment with different hyperparameters locally or remotely
  - Use of CLI and Programmatic interface
- Shareability ✓
  - Use other people's models and experiment via a MLFlow Project GitHub
- Flexibility ✓
  - Execute on three different software environments
    - Conda
    - Docker
    - System
- Extensibility
  - Create complicated Project Workflows

MLflow Project: Create Multi-Step Workflow



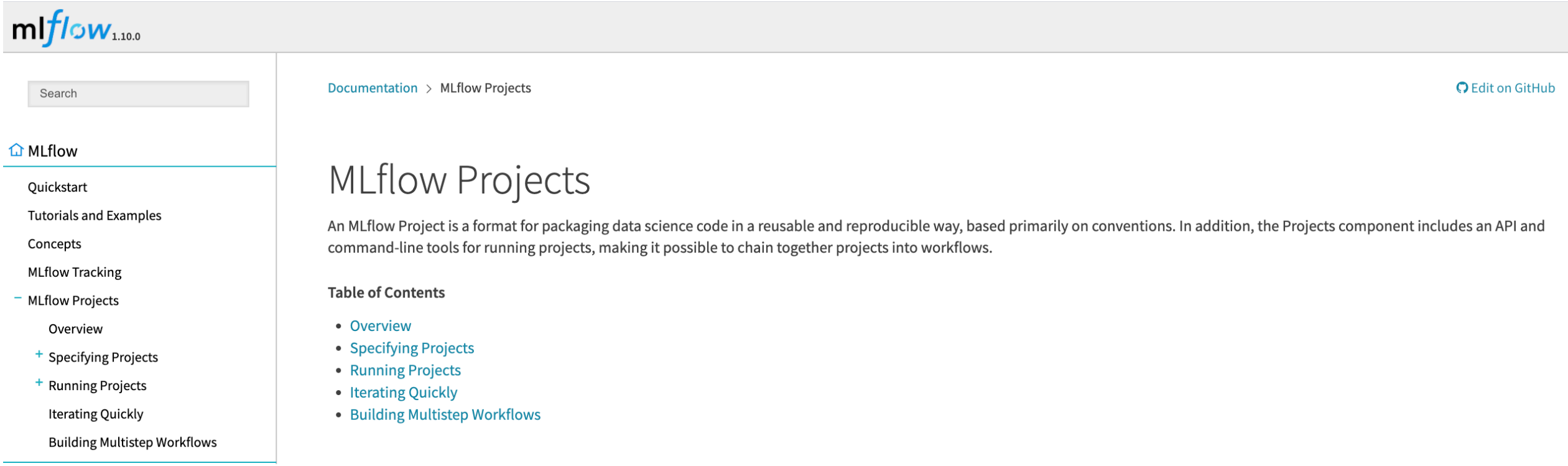
https://github.com/mlflow/mlflow/tree/master/examples/multistep_workflow

37 lines (30 sloc) | 1.17 KB

Raw | Blame | History

```
name: multistep_example

conda_env: conda.yaml

entry_points:
  load_raw_data:
    command: "python load_raw_data.py"

  etl_data:
    parameters:
      ratings_csv: path
      max_row_limit: {type: int, default: 100000}
    command: "python etl_data.py --ratings-csv {ratings_csv} --max-row-limit {max_row_limit}"

  als:
    parameters:
      ratings_data: path
      max_iter: {type: int, default: 10}
      reg_param: {type: float, default: 0.1}
      rank: {type: int, default: 12}
    command: "python als.py --ratings-data {ratings_data} --max-iter {max_iter} --reg-param {reg_param} --rank {rank}"

  train_keras:
    parameters:
      ratings_data: path
      als_model_uri: string
      hidden_units: {type: int, default: 20}
    command: "python train_keras.py --ratings-data {ratings_data} --als-model-uri {als_model_uri} --hidden-units {hidden_units}

  main:
    parameters:
      als_max_iter: {type: int, default: 10}
      keras_hidden_units: {type: int, default: 20}
      max_row_limit: {type: int, default: 100000}
    command: "python main.py --als-max-iter {als_max_iter} --keras-hidden-units {keras_hidden_units}
                             --max-row-limit {max_row_limit}"

```

MLflow Project Documentation



https://mlflow.org/docs/latest/projects.html

MLflow Projects

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

Thank you! ☺

Q & A

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