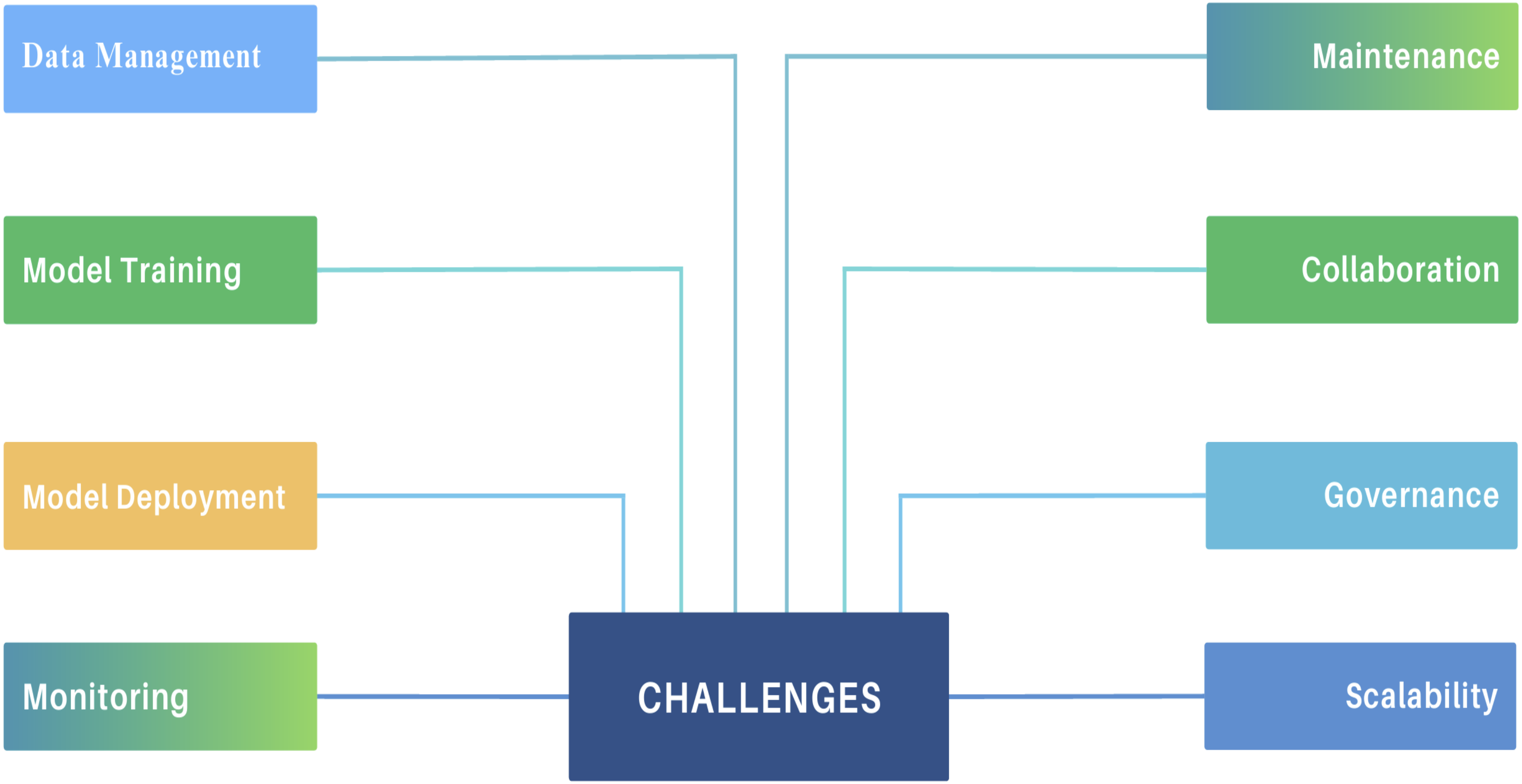
MLOPS

Challenges in ML Lifecycle



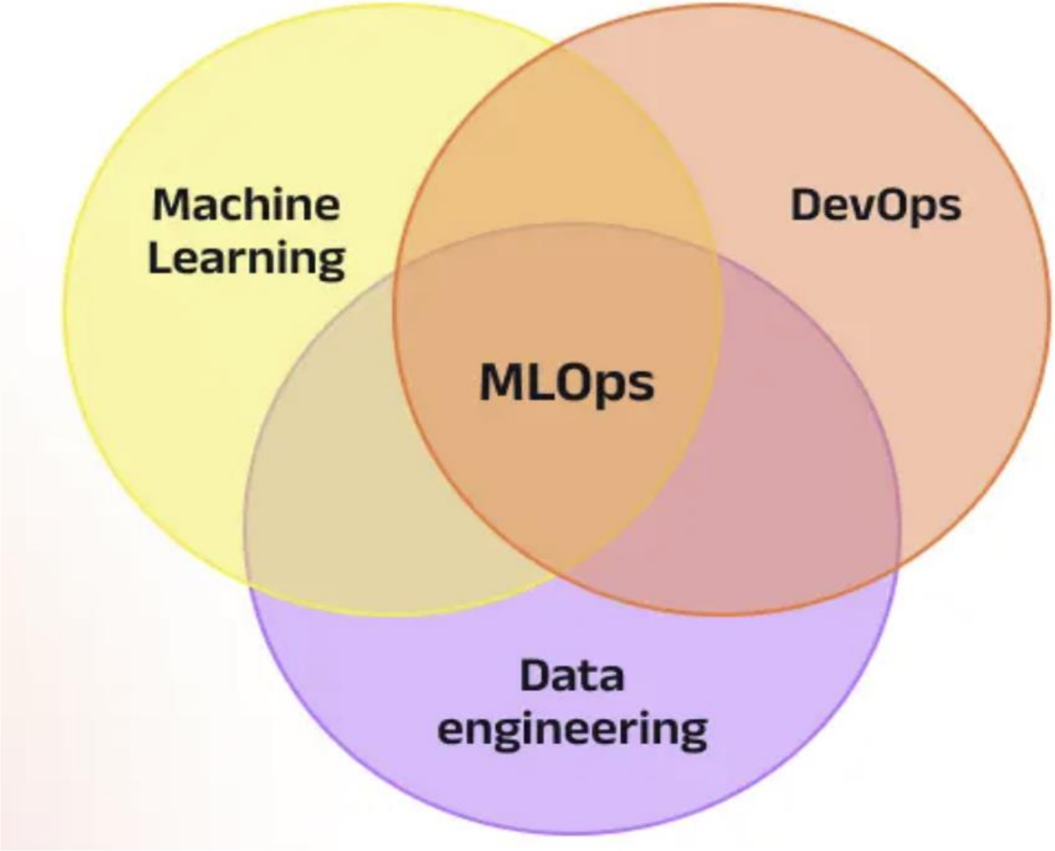
Tools and Techniques for MLOps

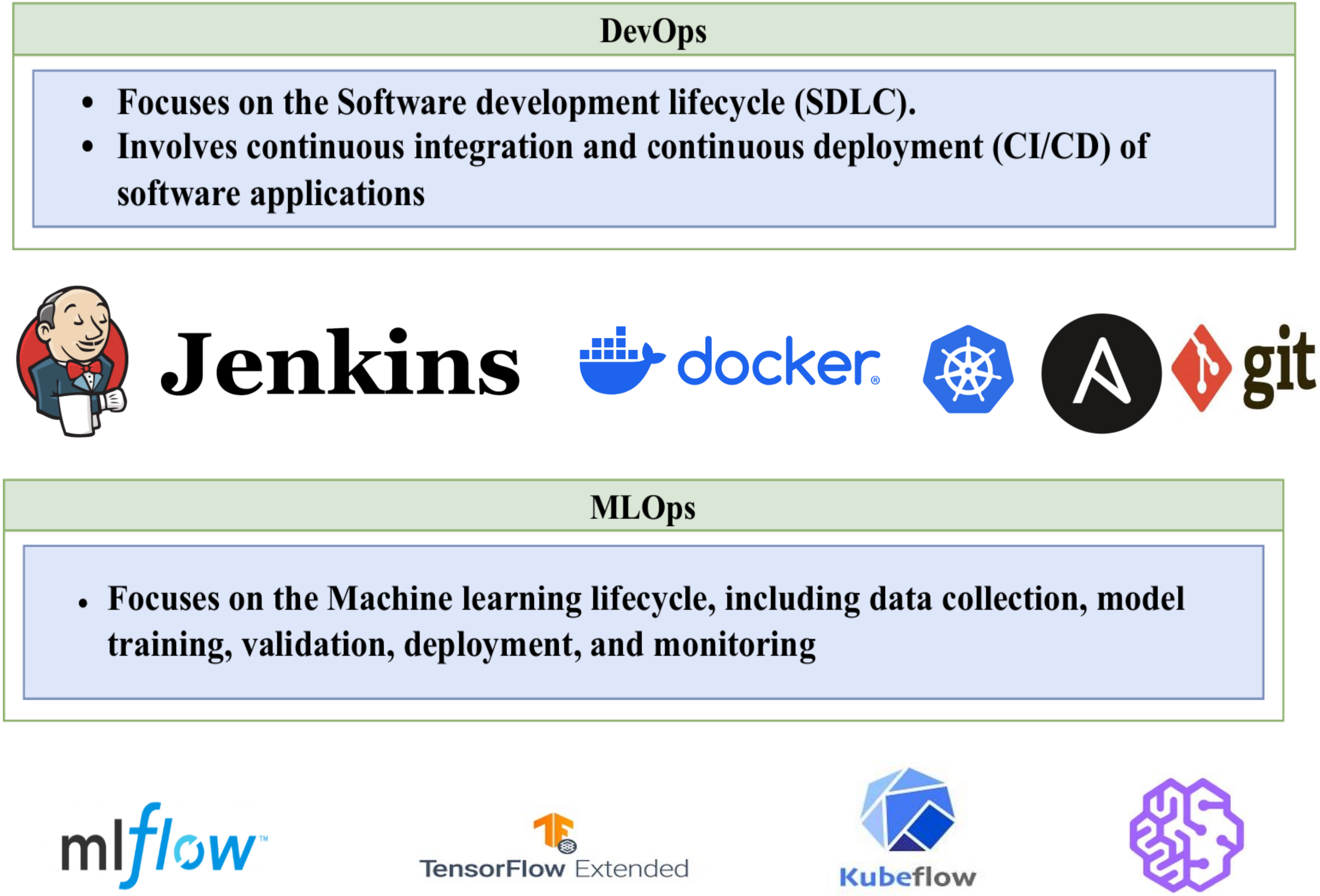
Tool / Platform	**Purpose**
Git	Version control for code.
DVC (Data Version Control)	Version control for datasets.
MLflow	**Model versioning and managing the ML lifecycle.**
Docker	Containerization of ML models and environments.
Kubernetes	Orchestration of containerized applications.
Jenkins / GitLab CI	Automating the testing and deployment of ML models.
Prometheus / Grafana	Monitoring model performance and tracking data drift.
Apache Airflow	Orchestrating and scheduling complex ML workflows.
Kubeflow	Managing and deploying ML workflows on Kubernetes.
Weights & Biases	Experiment tracking and management.
AWS / Google Cloud / Azure	Cloud-based services for ML operations and hosting.

Agenda

- MLOps Vs DevOps
- ML Engineer Hierarchy
- Mlflow
- Components of Mlflow
- Environment Setup
- Lab 1-Using MLflow to track CPU utilization and memory usage(System Monitoring)
- Lab 2:Track scikit-learn model training with MLflow
- Lab 3:Track Keras model training with MLflow

MlOps Vs DevOps





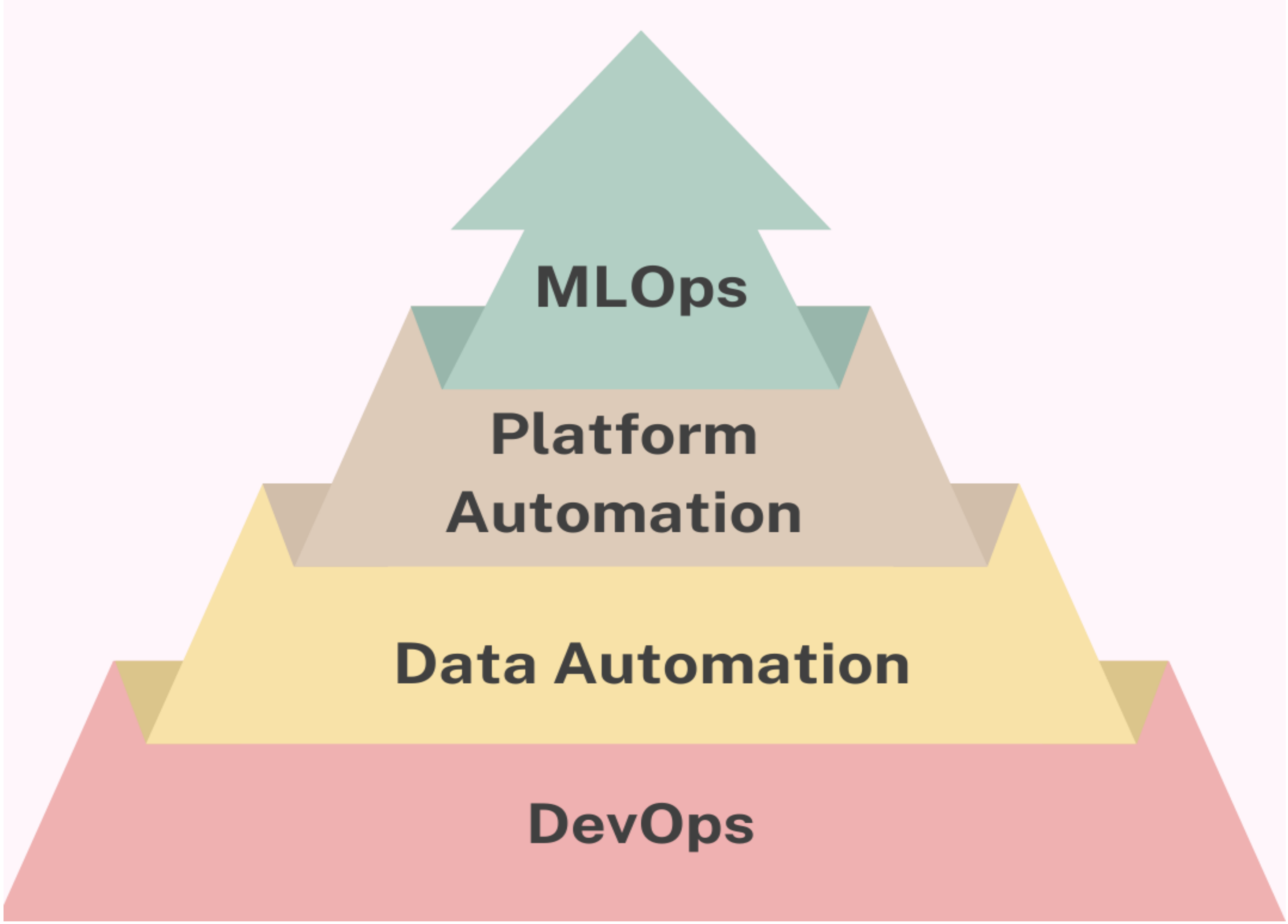
DevOps

- Focuses on the Software development lifecycle (SDLC).
- Involves continuous integration and continuous deployment (CI/CD) of software applications

MLOps

- Focuses on the Machine learning lifecycle, including data collection, model training, validation, deployment, and monitoring

ML Engineer Hierarchy



Rule of 25%

25% DevOps	25% Data
25% Models	25% Business

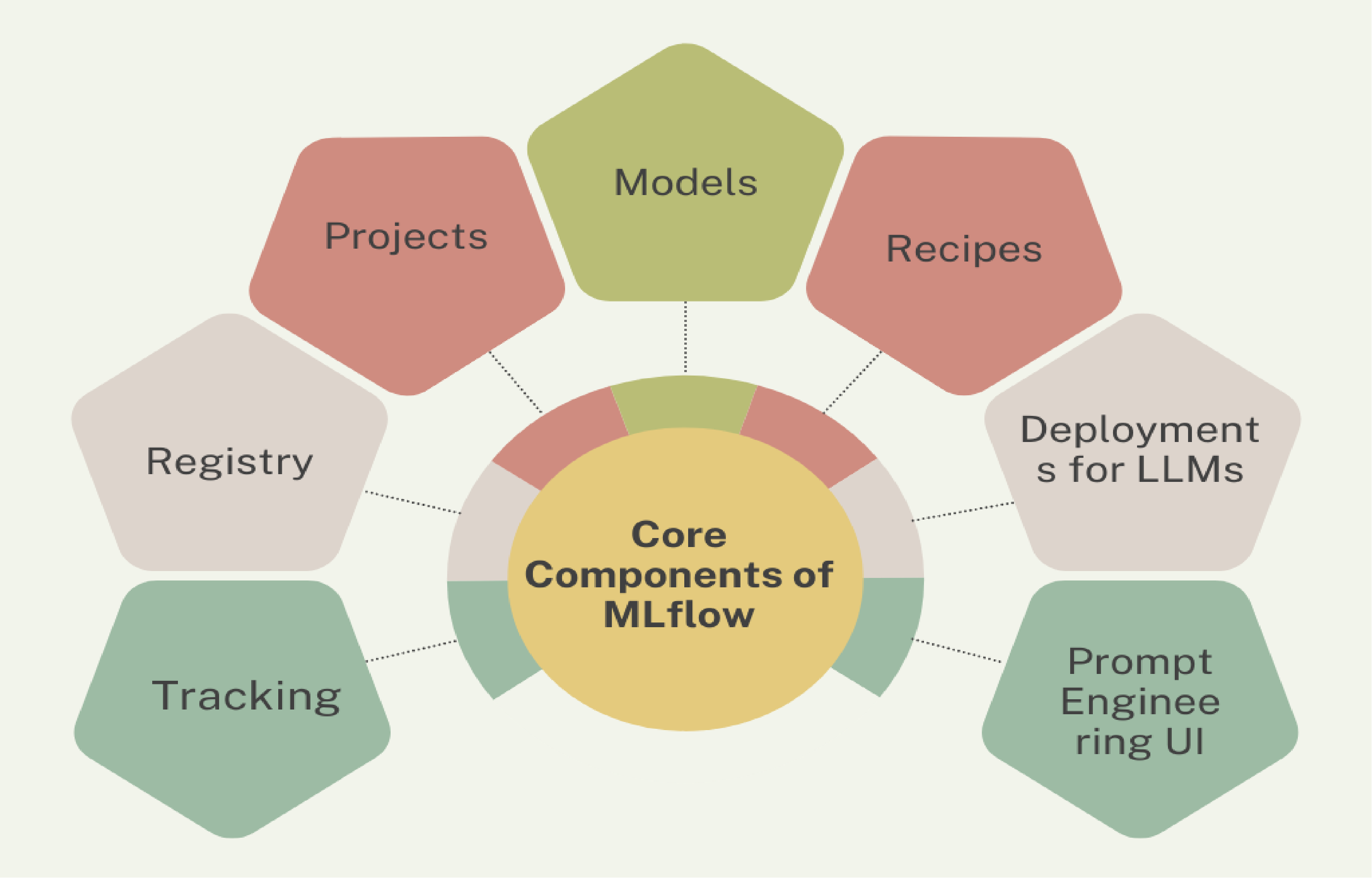
mlflow™

Mlflow

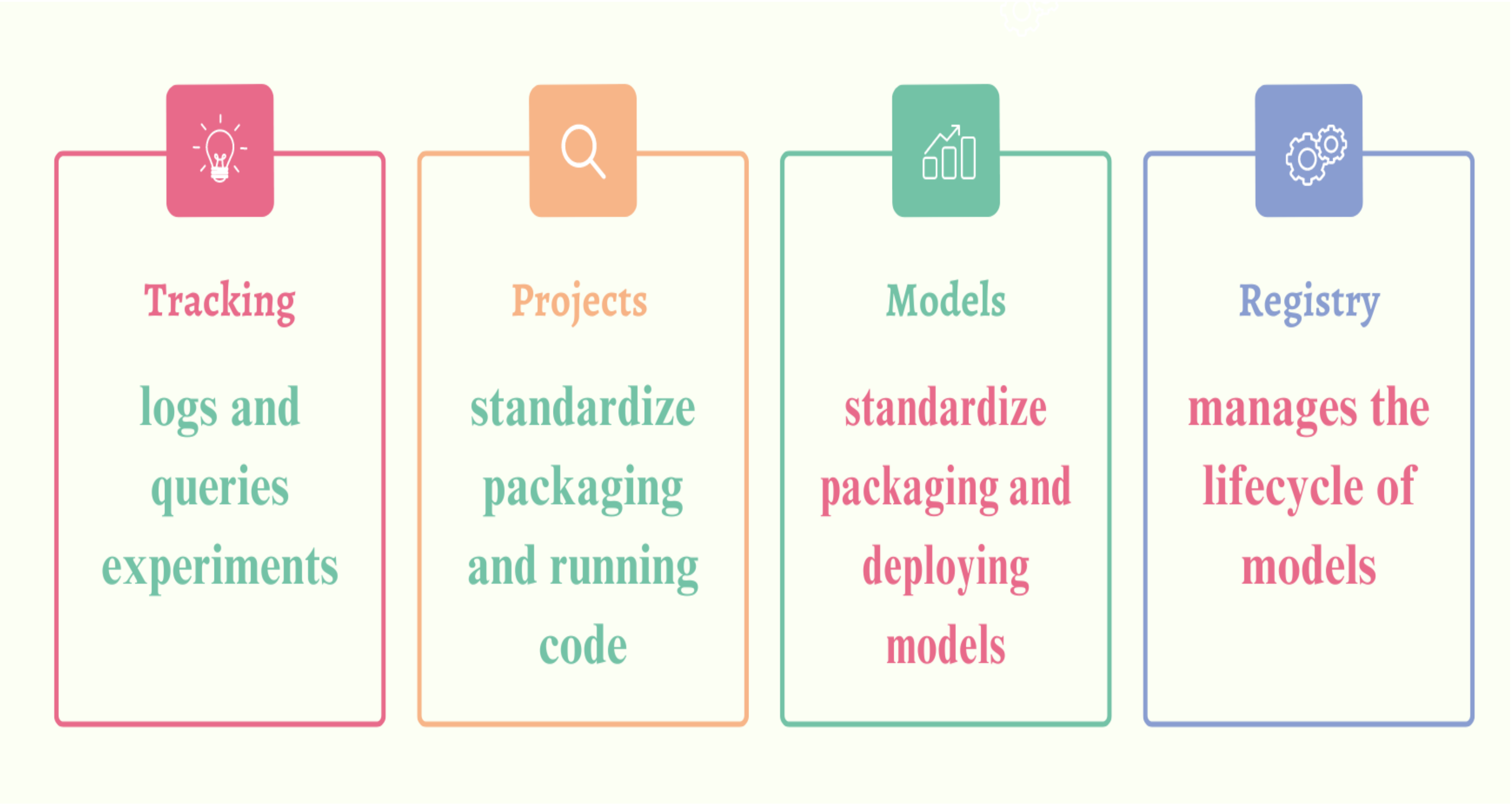
MLflow is an open-source platform designed to manage machine learning workflows, widely utilized by MLOps teams and data scientists.

It provides tools for experiment tracking, model management, and deployment

Core Components of MLflow



Key Components of MLflow



Tracking

logs and queries experiments

Projects

standardize packaging and running code

Models

standardize packaging and deploying models

Registry

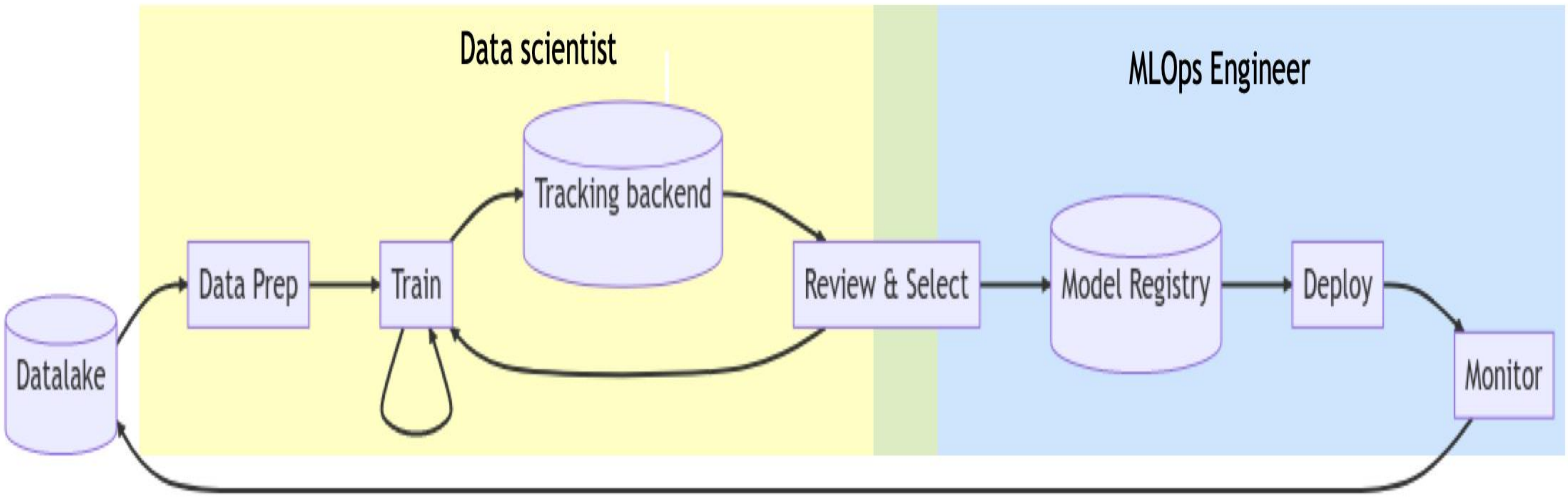
manages the lifecycle of models

MLflow Tracking

- MLflow Tracking allows data scientists to work with experiments.

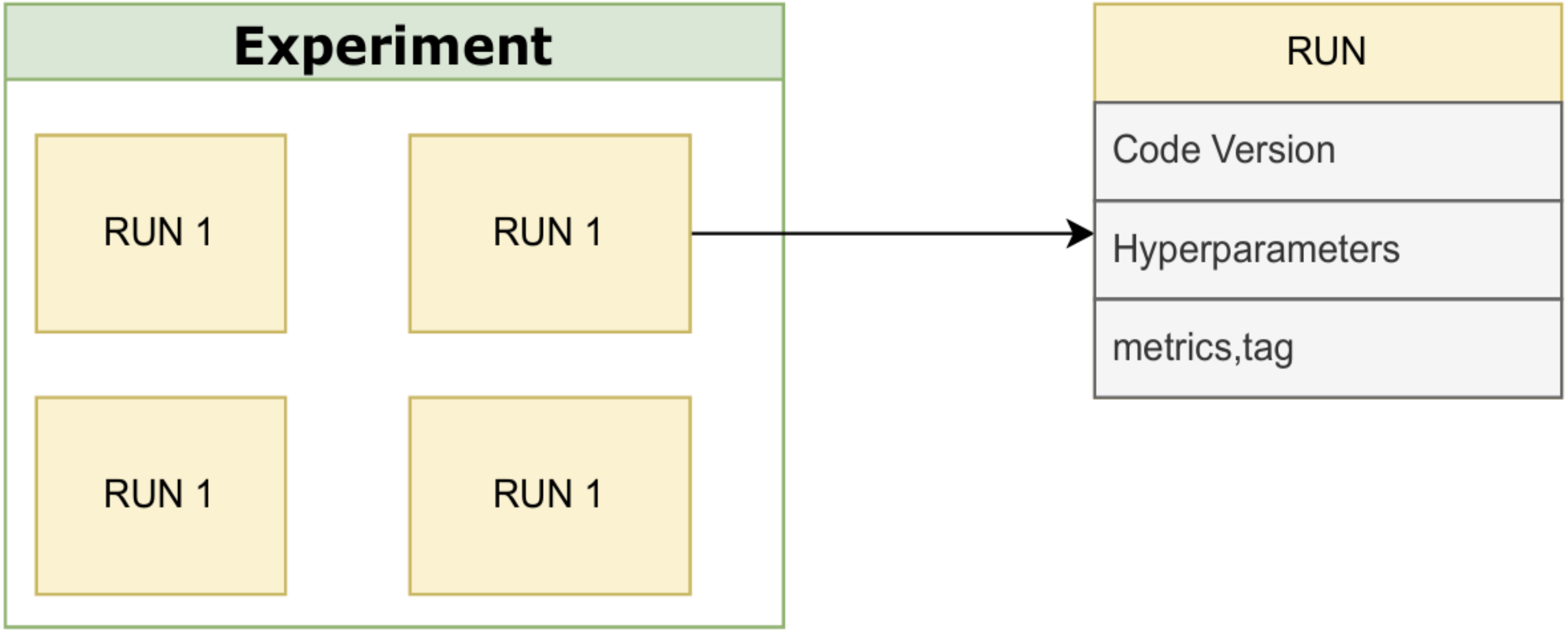
- MLflow Tracking is built around runs, that is, executions of code for a data science task.

MLflow Tracking



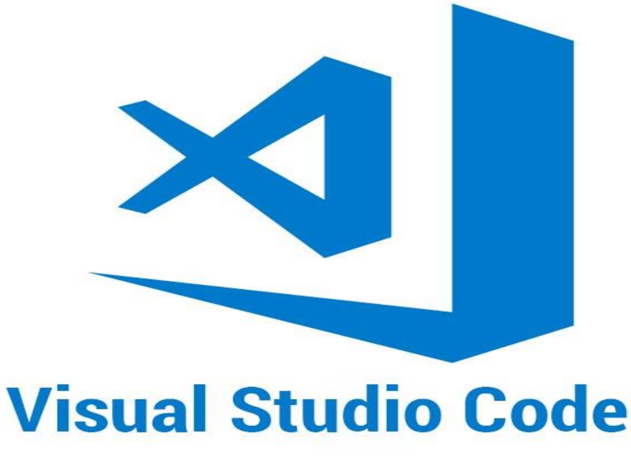
Experiment Tracking Capabilities

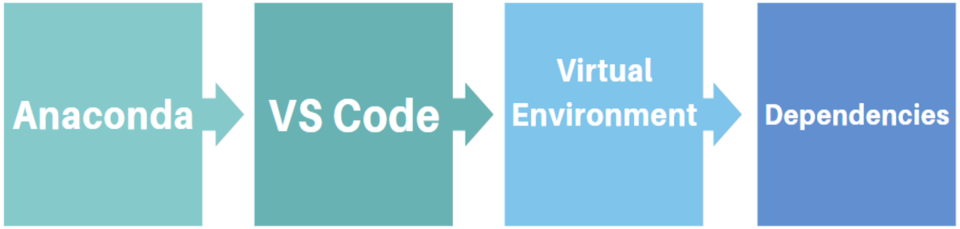
- Logging and Querying Experiments
- UI for Visualization
- Centralized Server
- APIs and Libraries Support


Experiment
RUN 1
RUN 1
RUN 1
RUN 1
RUN
Code Version
Hyperparameters
metrics,tag

Environment Setup

Installing Anaconda on Windows (youtube.com)





Anaconda

VS Code

Virtual Environment

Dependencies

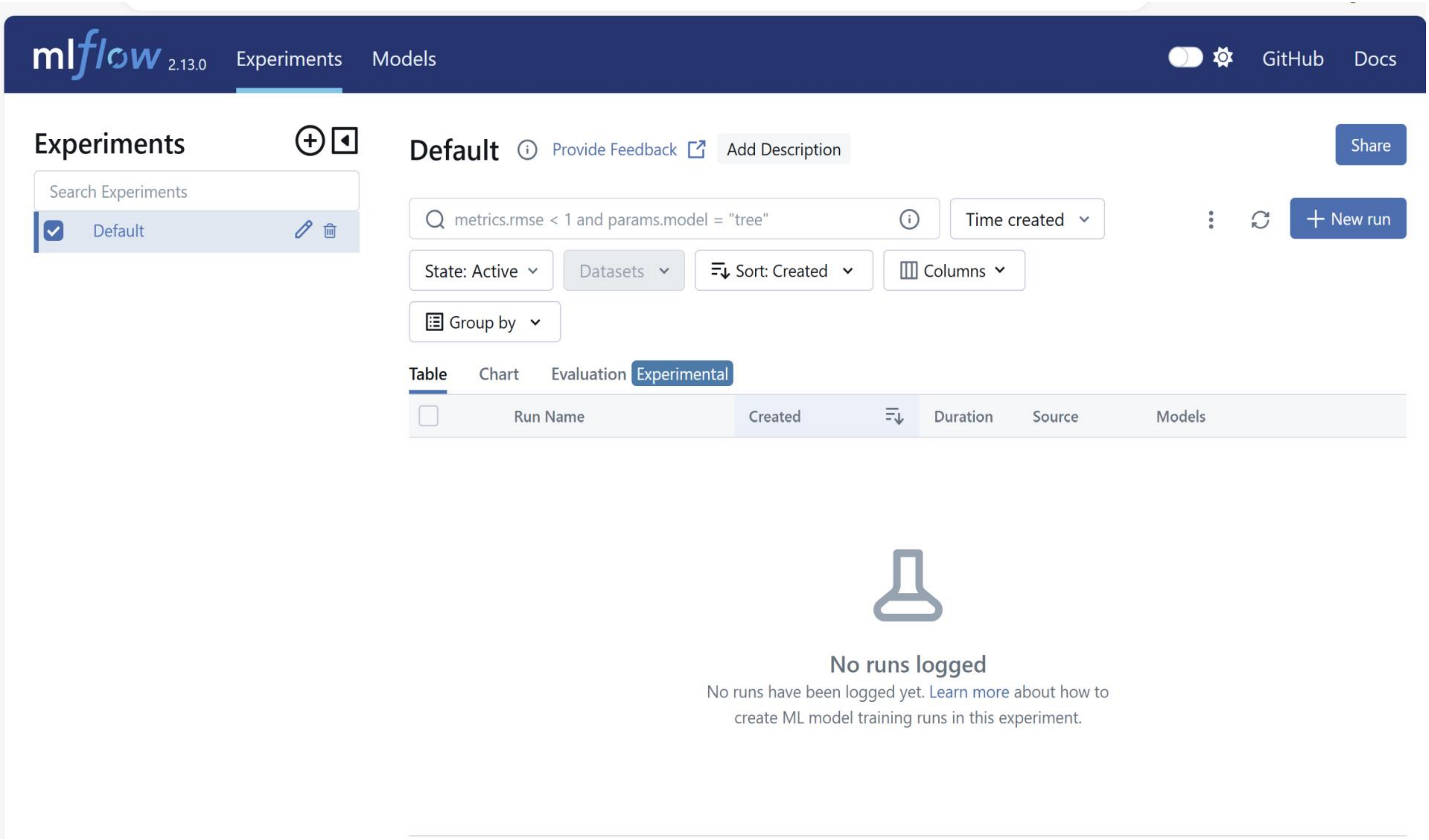
Virtual Environment

```
conda create --name mlops python=3.11
```

Dependencies

```
pip install -r requirements.txt
```

mlflow ui



Default

☑ Default

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

State: Active

Sort: Created

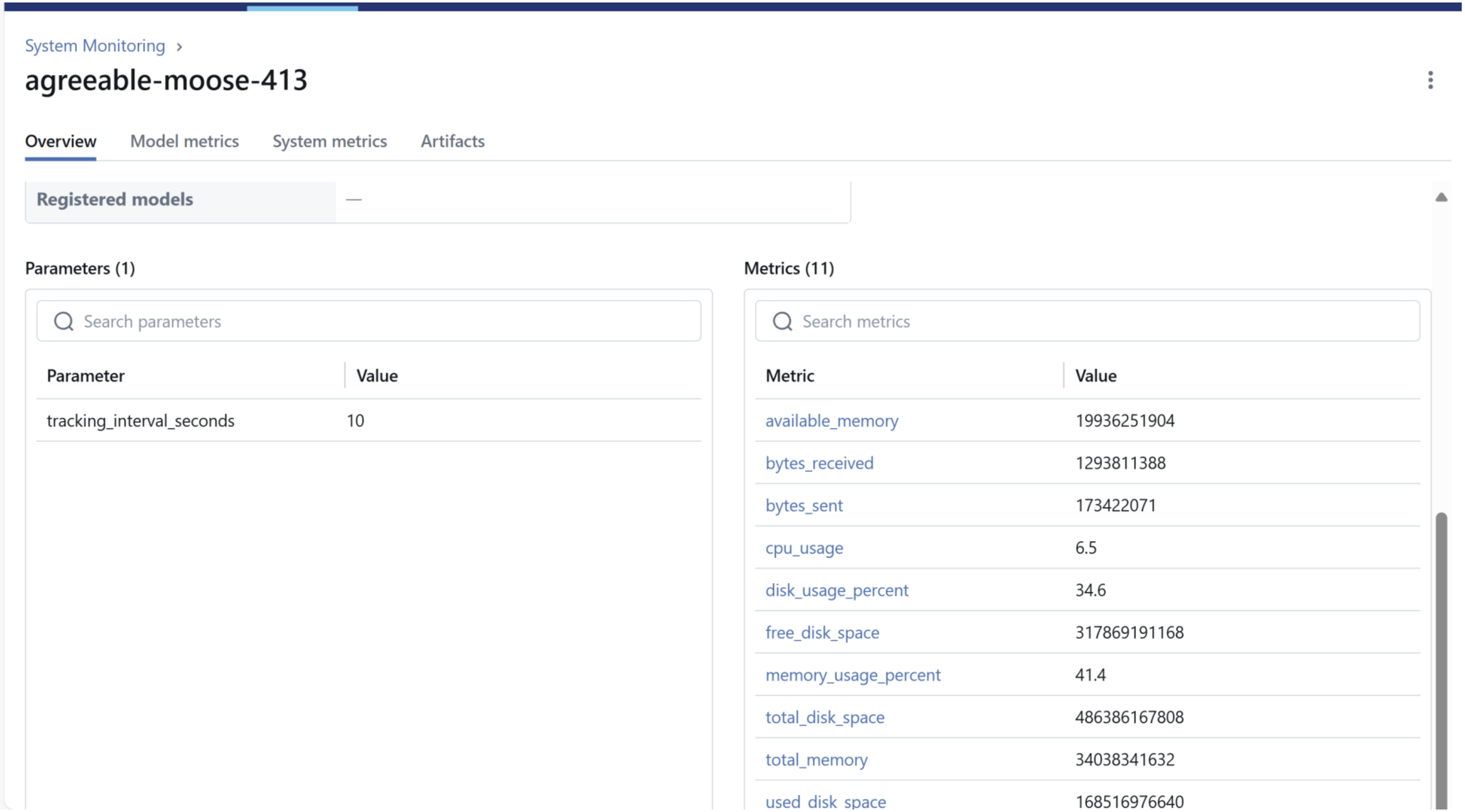
No runs logged

No runs have been logged yet. Learn more about how to create ML model training runs in this experiment.

Logging functions

Function Name	Purpose
mlflow.set_experiment	Sets the name of the experiment under which to log runs (optional).
mlflow.start_run	Starts a new MLflow run.
mlflow.log_param	Logs a parameter used by the model (e.g., hyperparameters).
mlflow.log_metric	Logs a metric (e.g., RMSE, accuracy) to evaluate the model's performance.
mlflow.log_artifact	Logs an artifact (e.g., a file, plot, or other outputs).
mlflow.sklearn.log_model	Logs a scikit-learn model.

System Monitoring



agreeable-moose-413

Registered models	—

Parameters (1)

Parameter	Value
tracking_interval_seconds	10

Metrics (11)

Metric	Value
available_memory	19936251904
bytes_received	1293811388
bytes_sent	173422071
cpu_usage	6.5
disk_usage_percent	34.6
free_disk_space	317869191168
memory_usage_percent	41.4
total_disk_space	486386167808
total_memory	34038341632
used_disk_space	168516976640