Introduction to MLOPS

Day 6 - Session 13 - 27/1/2025

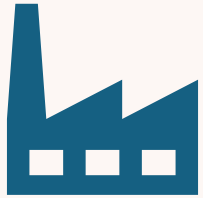
Machine learning (ML)

Operational workflows for ML include the following:

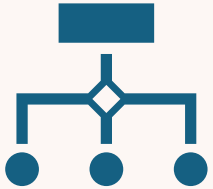
- Build
- Train
- Deploy
- Monitor
- Manage
- Re-train

Innovation

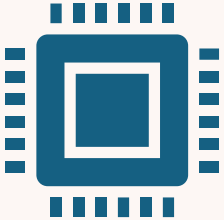
AI/ML Problems



More than 80% of projects were not able to reach production



Complexity of Data, Code, Development, Deployment and Monitoring



Different and Domain-specific in comparison to DevOps

Why MLOPS

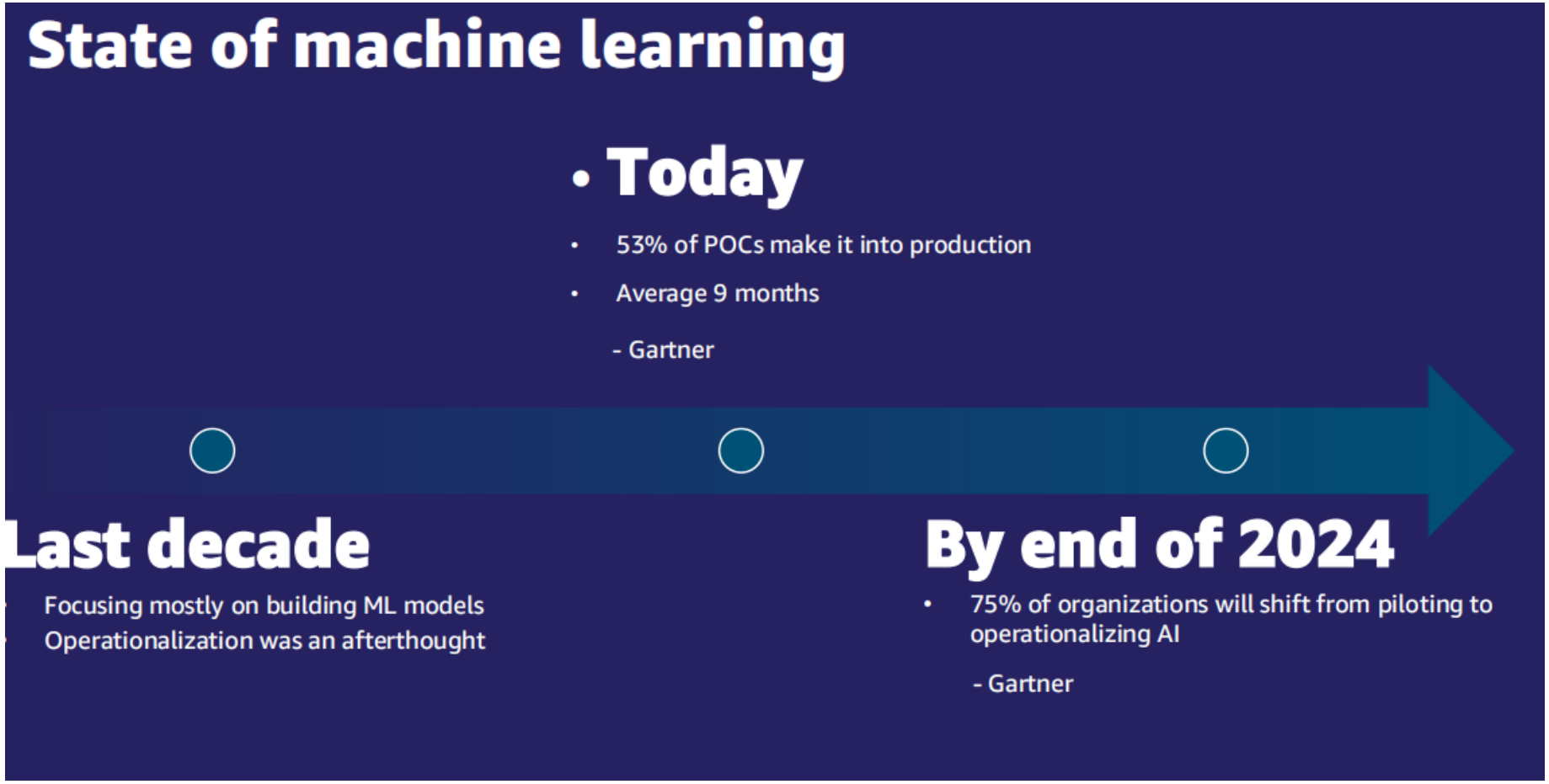
Main Challenges

- Publishing a ML model is not enough.
- Managing the published ML models is as important as developing them.

- *"IT leaders responsible for AI are discovering **'AI pilot paradox'**, where launching pilots is deceptively easy but deploying them into production is notoriously challenging."*

- **Chirag Dekate**, Vice President Analyst, Gartner

Current state of AI/ML



MLOPS

MLOps is shorthand for machine learning operations

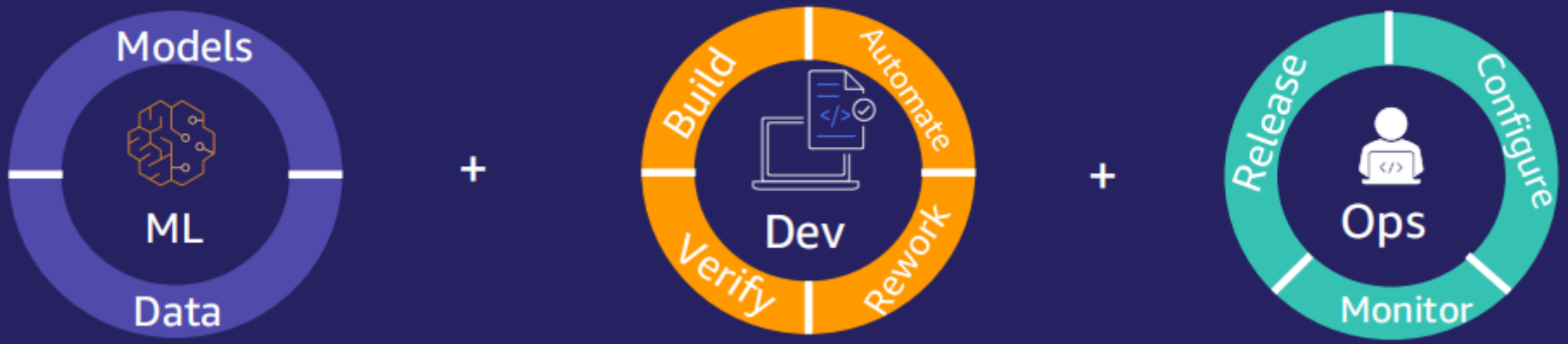
A set of best practices for organizations to build, test, validate, and deploy ML models successfully.

It encompasses the entire development cycle for machine learning models, from data collection to deployment to production.

MLOps – What?

ML + Dev + Ops = MLOps

Collaborative and experimental in nature | Automate as much as possible |
Continuous improvement of ML Models | Standardize and Scale



MLOP Benefits

MLOps tools and practices help guide the creation and quality of ML and AI

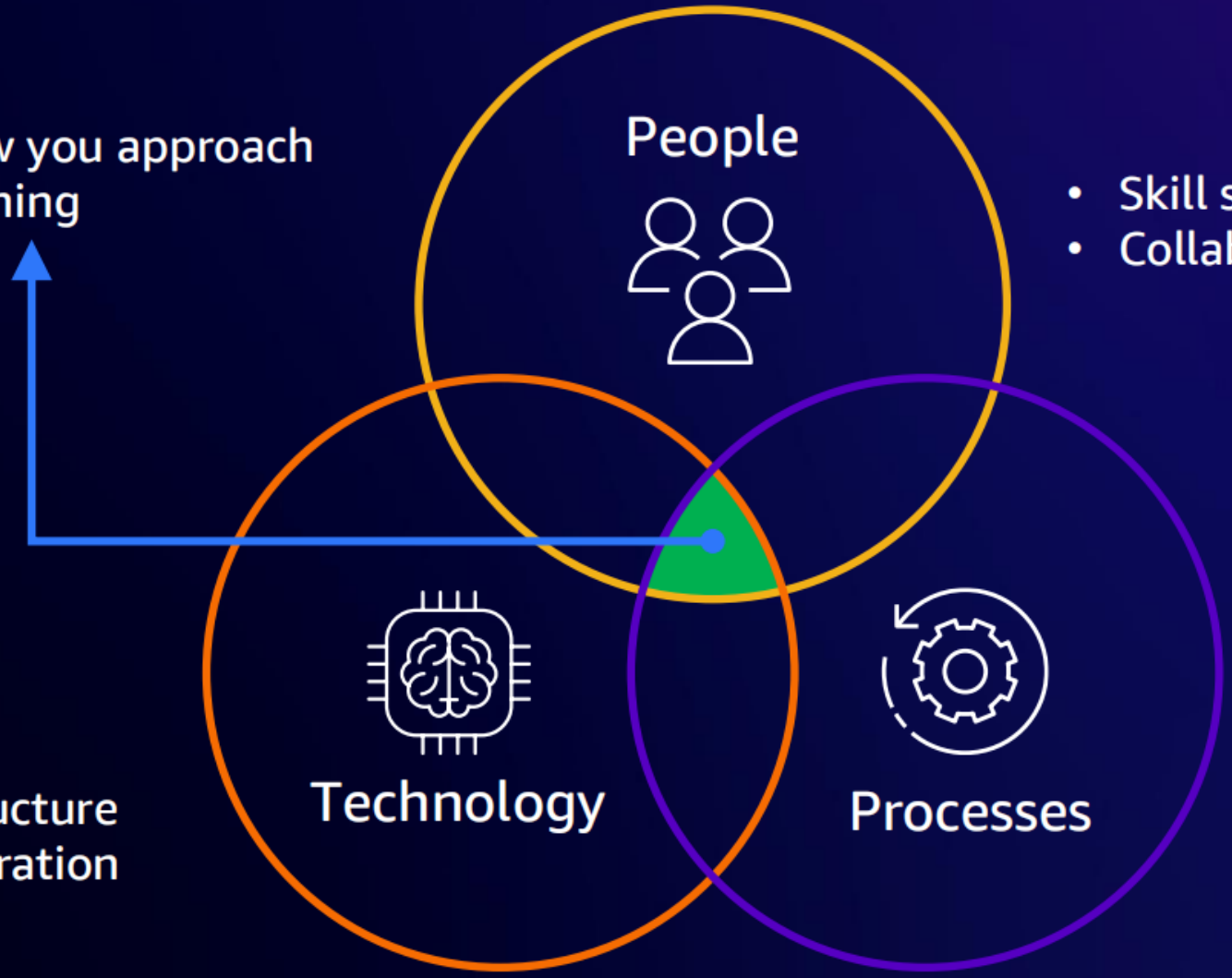
Allowing engineers to collaborate efficiently and increase the pace of model development and production.

It provides the framework for continuous integration and deployment (CI/CD) practices.

Allow for controlled experimentation to train models with the proper monitoring, validation, and governance required.

Machine learning operations (MLOps) approach

MLOps is how you approach machine learning



- Skill set
- Collaboration

- ML infrastructure
- Orchestration

- Key performance indicators (KPIs)
- Workflows

Table comparing features between DevOps and MLOps

Feature	DevOps	MLOps
Code versioning	✓	✓
Compute environment	✓	✓
Continuous integration and continuous delivery (CI/CD)	✓	✓
Monitoring in production	✓	✓
Data provenance		✓
Datasets		✓
Models		✓
Model building workflows		✓
Model deployment workflows		✓

Processes

Describe the ML workflow and how it relates to MLOps

People

List the roles that need to collaborate for MLOps

Technology

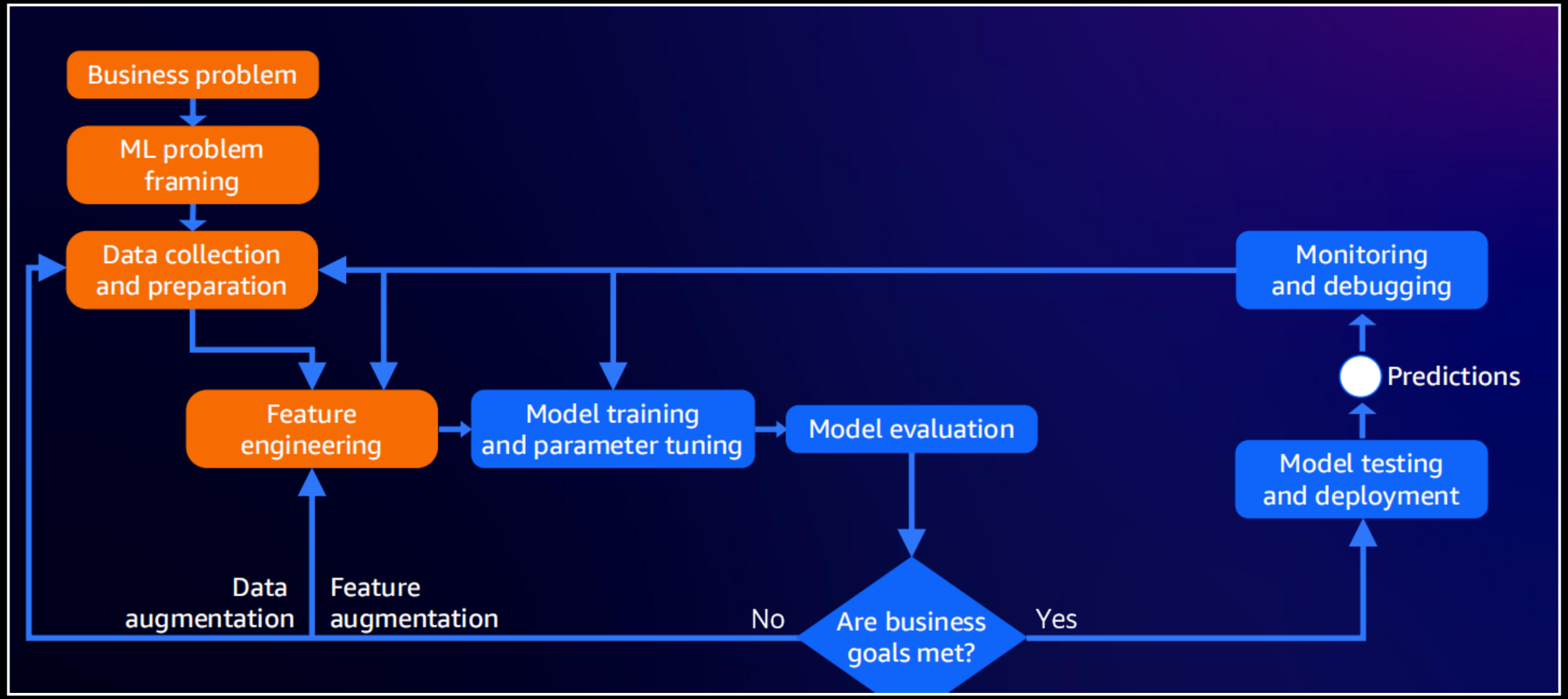
Describe the importance of ML training and deployment pipelines

Security and governance

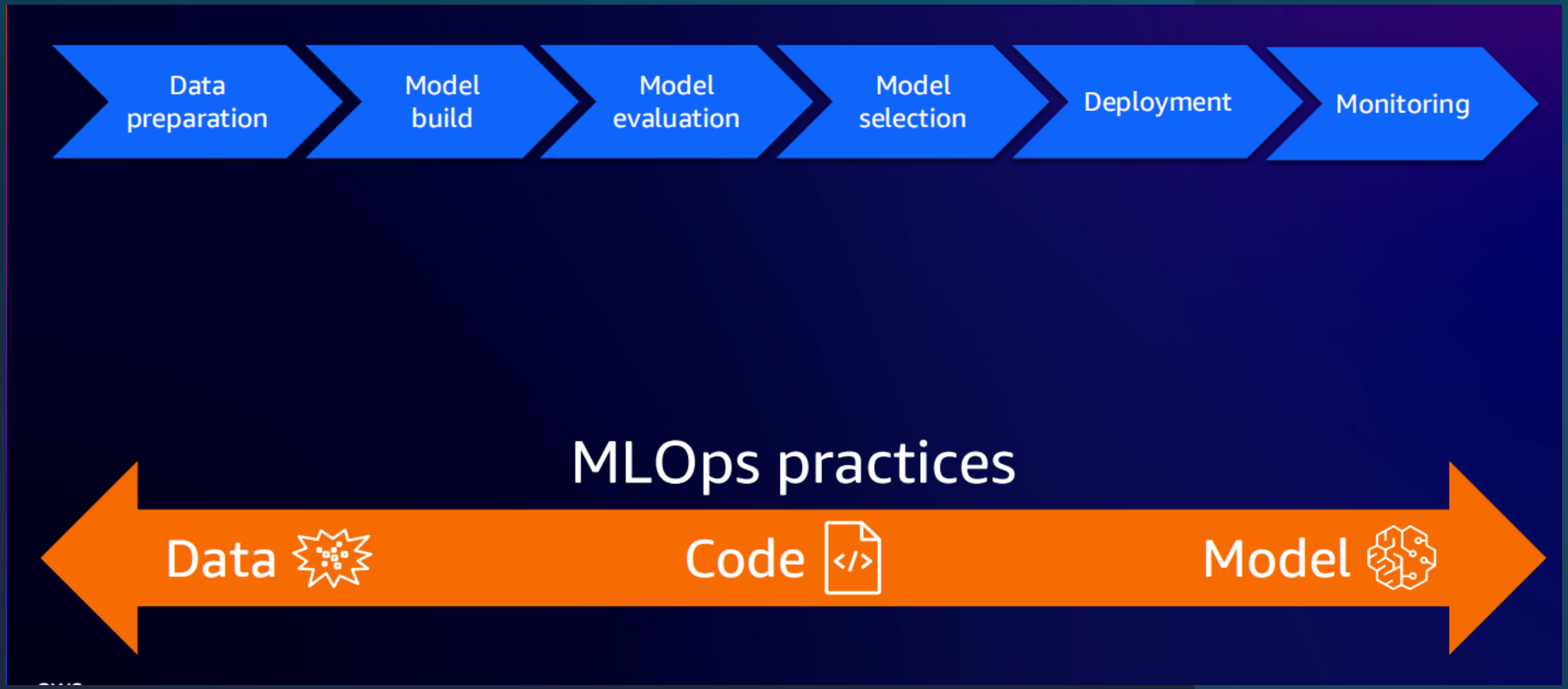
Define ML governance

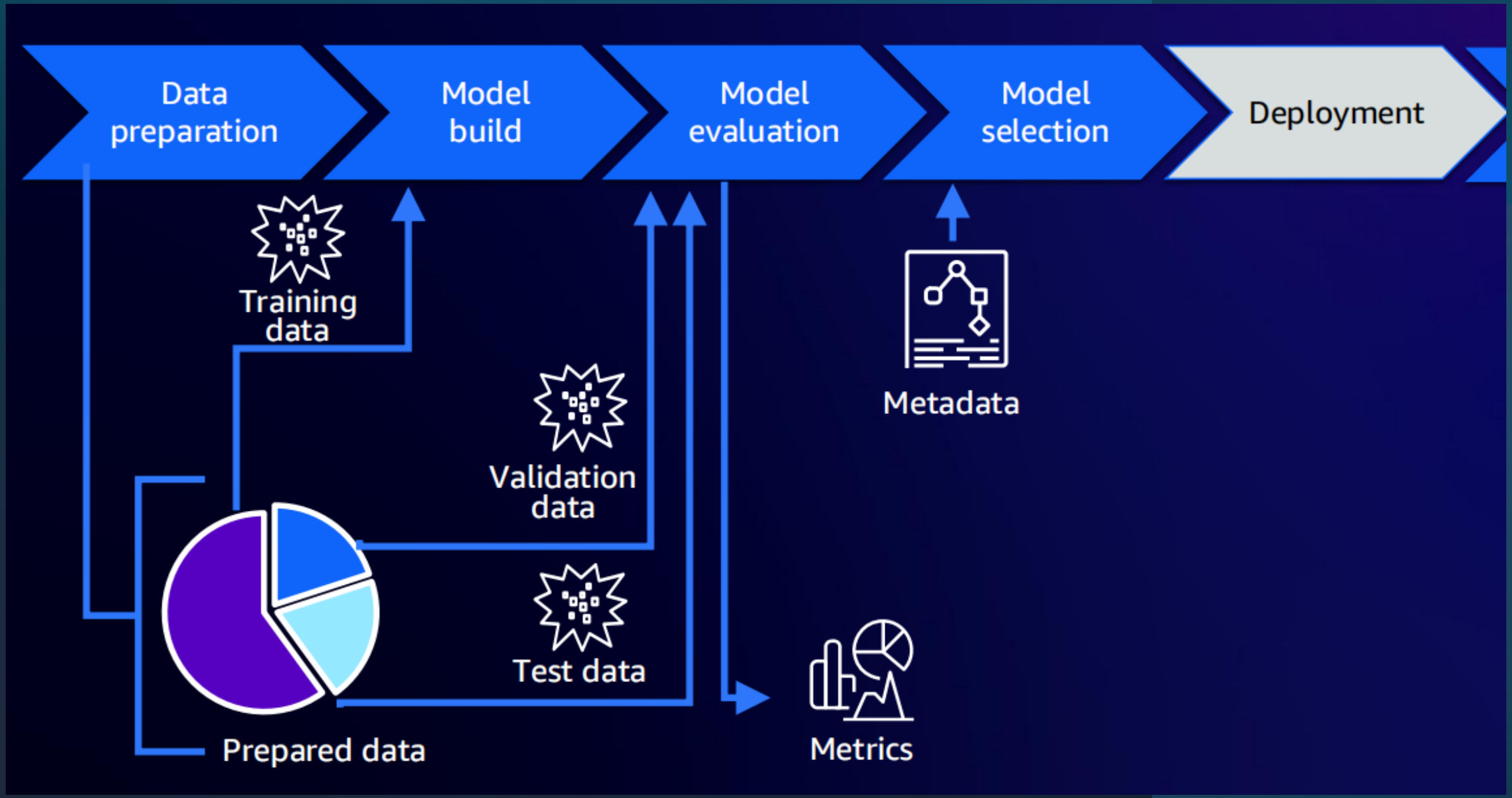
ML maturity model

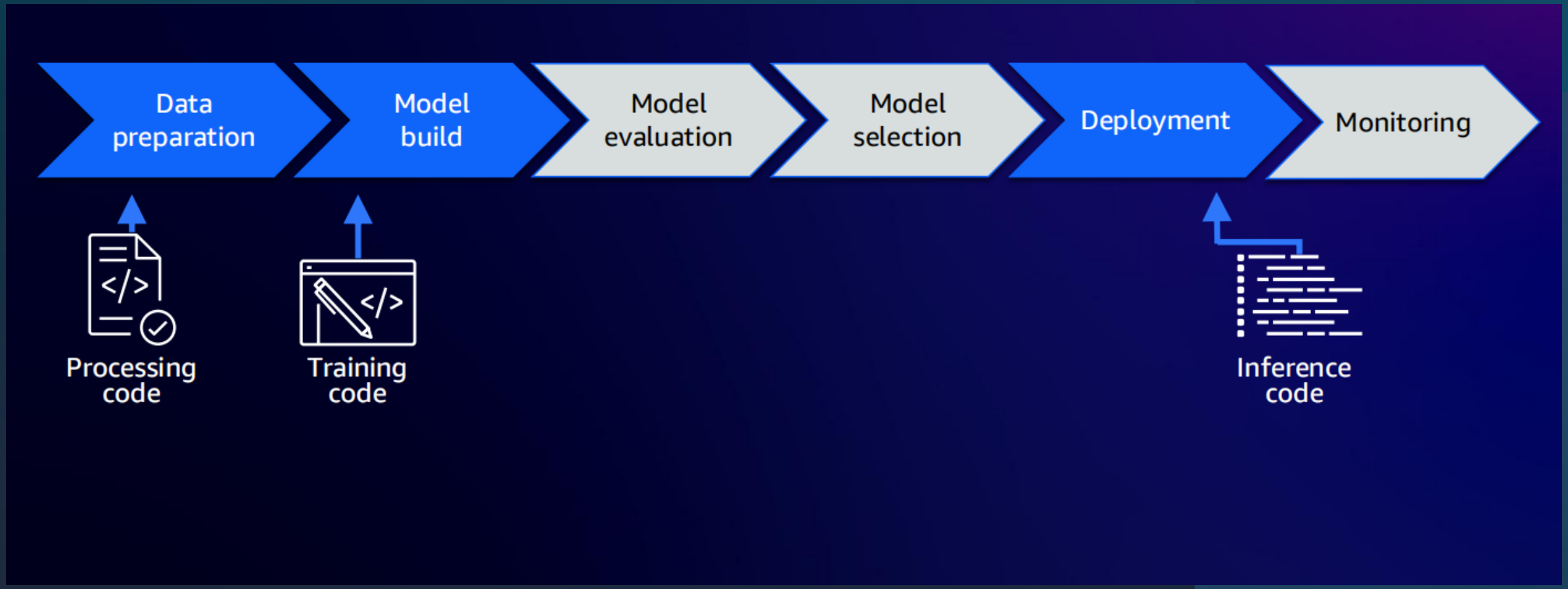
Describe the phases of the ML maturity model

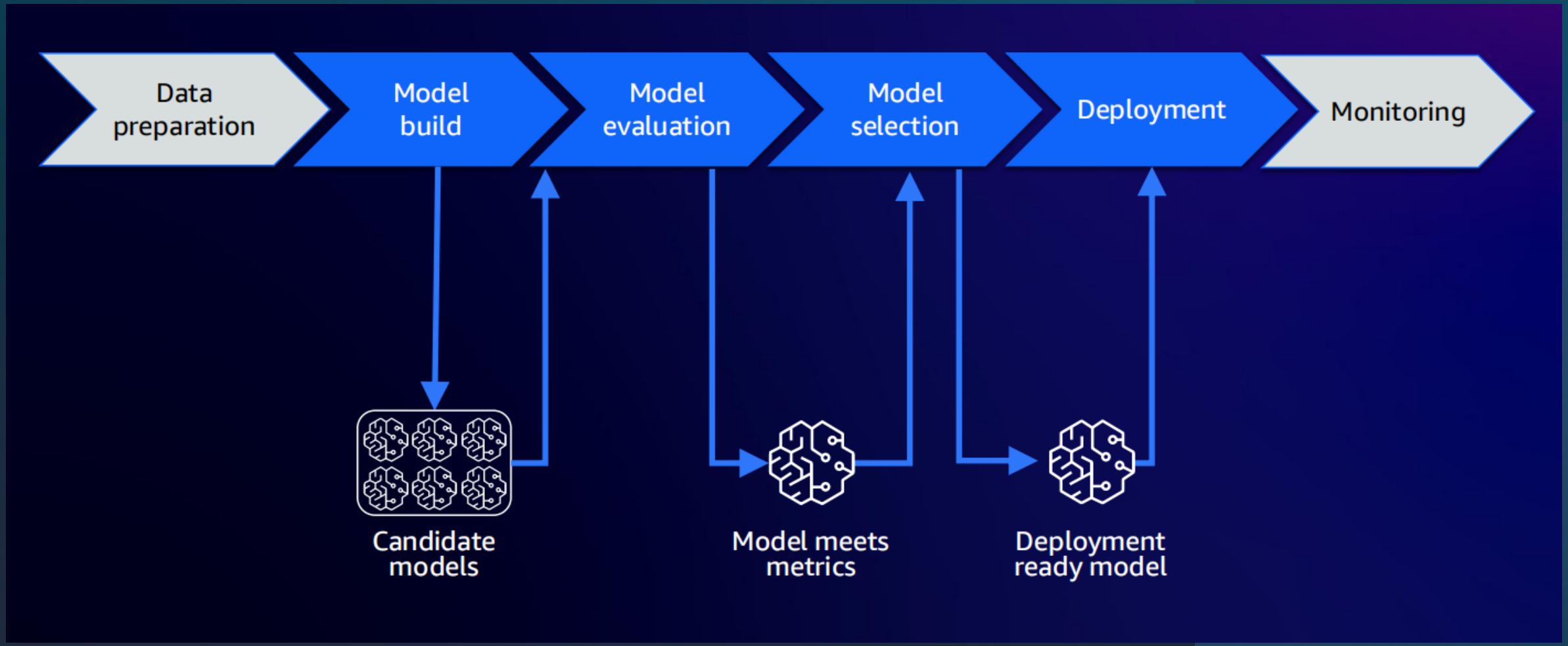

Business problem
ML problem framing
Data collection and preparation
Feature engineering
Model training and parameter tuning
Model evaluation
Are business goals met?
No
Yes
Data augmentation
Feature augmentation
Monitoring and debugging
Predictions
Model testing and deployment

ML Process

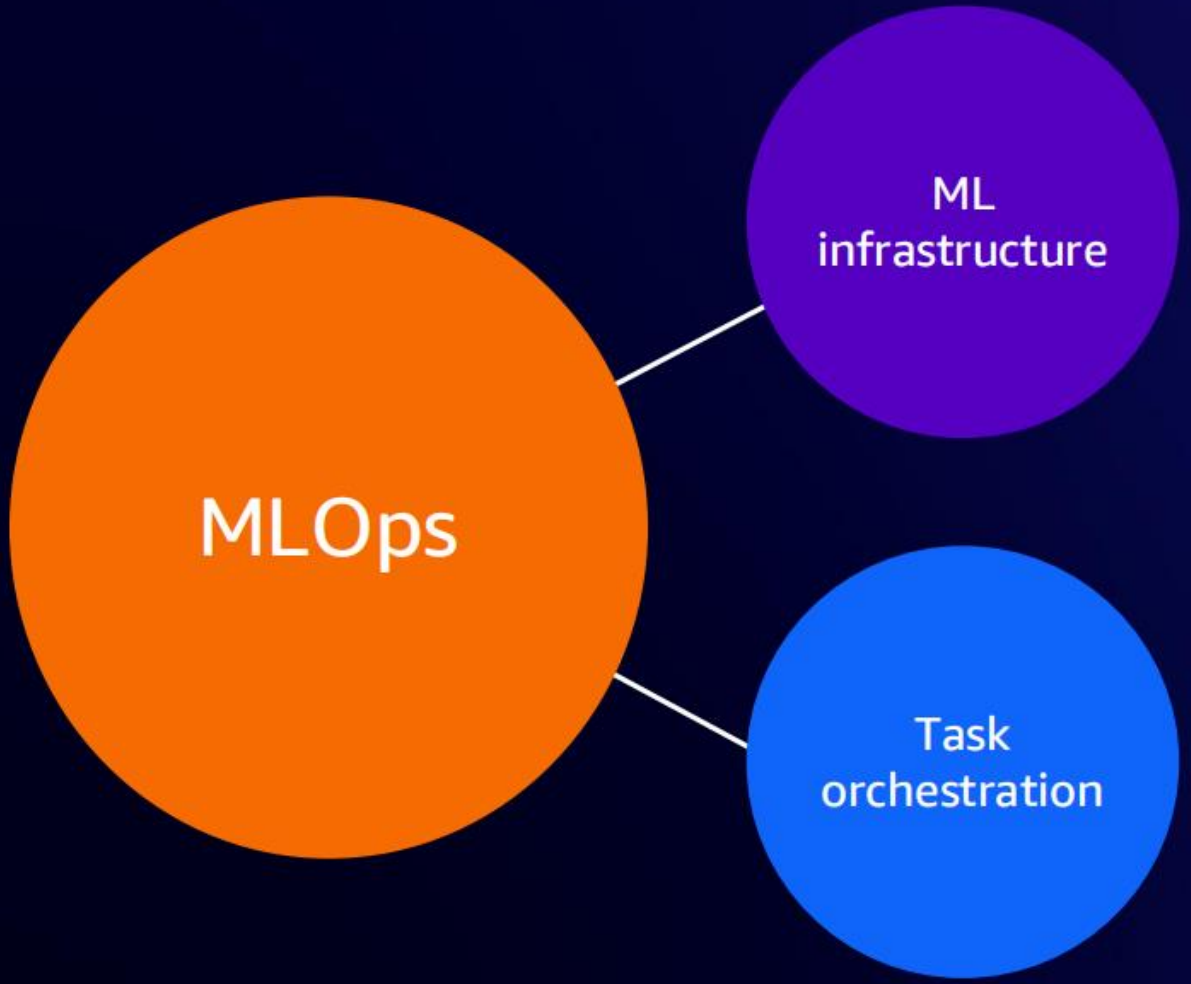

Data preparation
Model build
Model evaluation
Model selection
Deployment
Monitoring
MLOps practices
Data
Code
Model


Data preparation
Model build
Model evaluation
Model selection
Deployment
Training data
Validation data
Test data
Prepared data
Metadata
Metrics


Data preparation
Model build
Model evaluation
Model selection
Deployment
Monitoring
Processing code
Training code
Inference code


Data preparation
Model build
Model evaluation
Model selection
Deployment
Monitoring
Candidate models
Model meets metrics
Deployment ready model

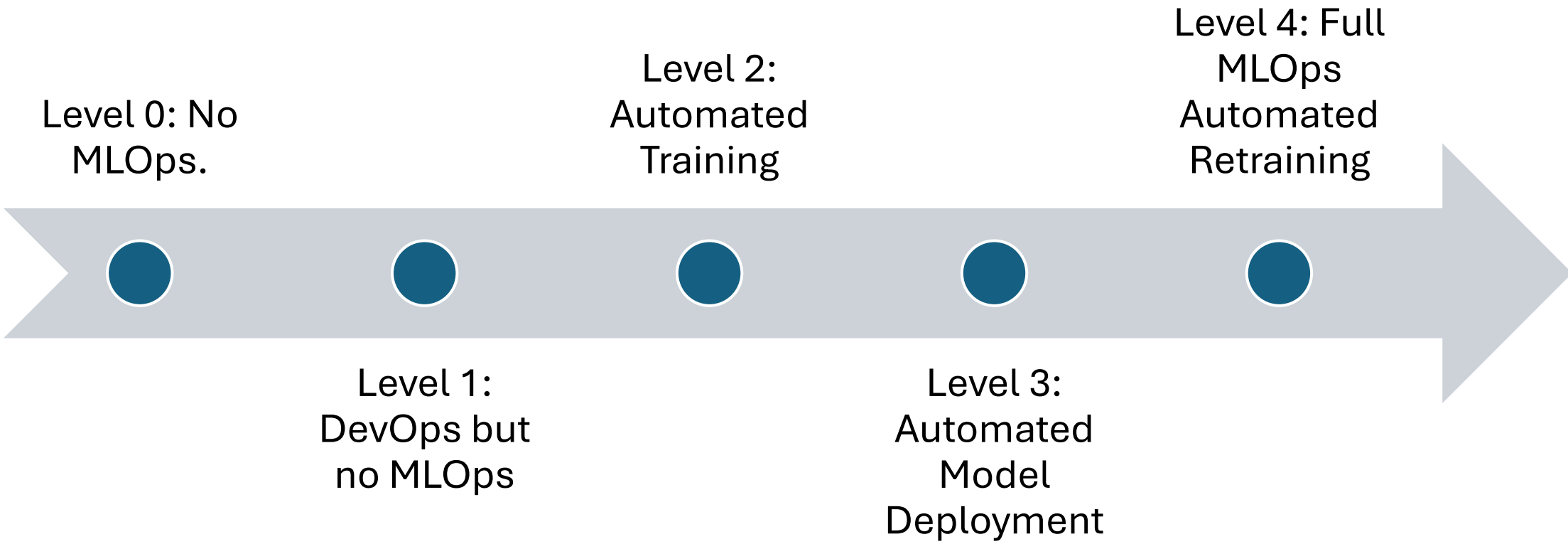
MLOps technology components



- Training environment
- Hyperparameter optimization
- Dataset management
- Model deployment
- Monitoring in production
- Repositories

- Create and manage workflows
- Automate ML steps by using pipelines
- Implement CI/CD practices

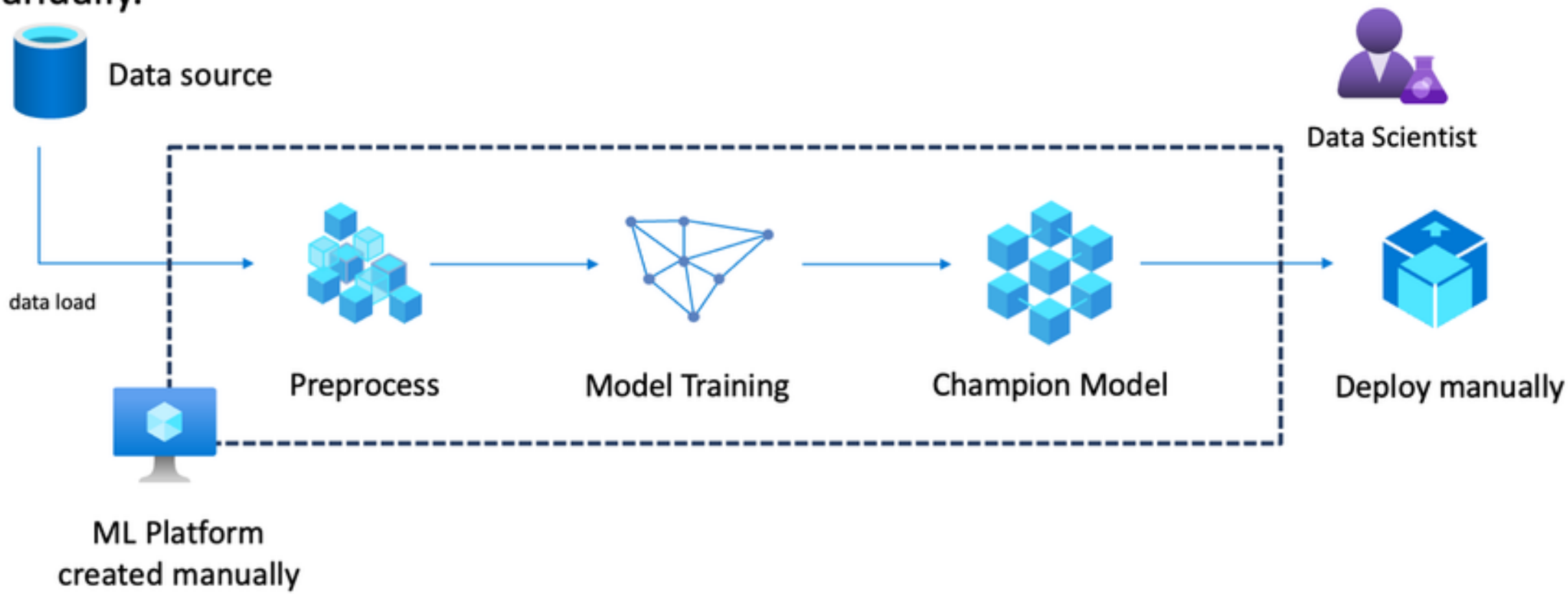
MLOps Maturity Model



https://learn.microsoft.com/en-us/training/paths/introduction-machine-learn-operations/

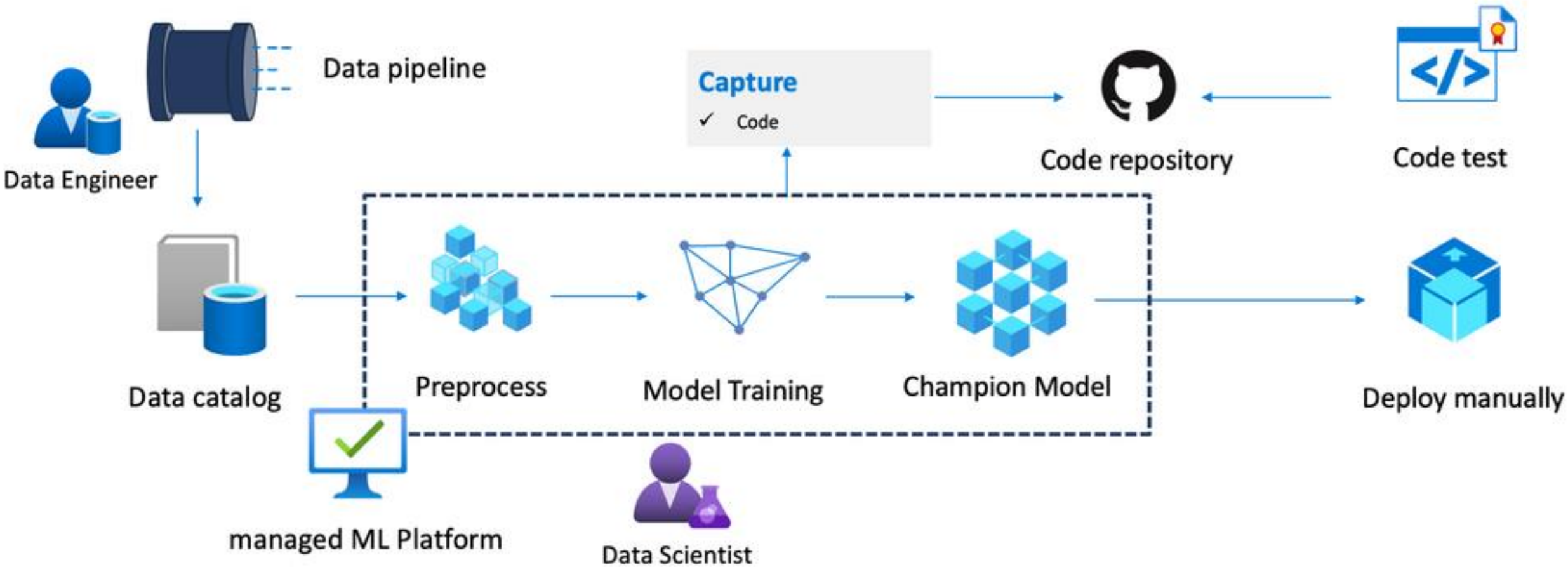
Level 0 – No MLOps

- Find best model interactively and exploratory.
- Create environment, gather and preprocess data, model training, deploy and test manually.



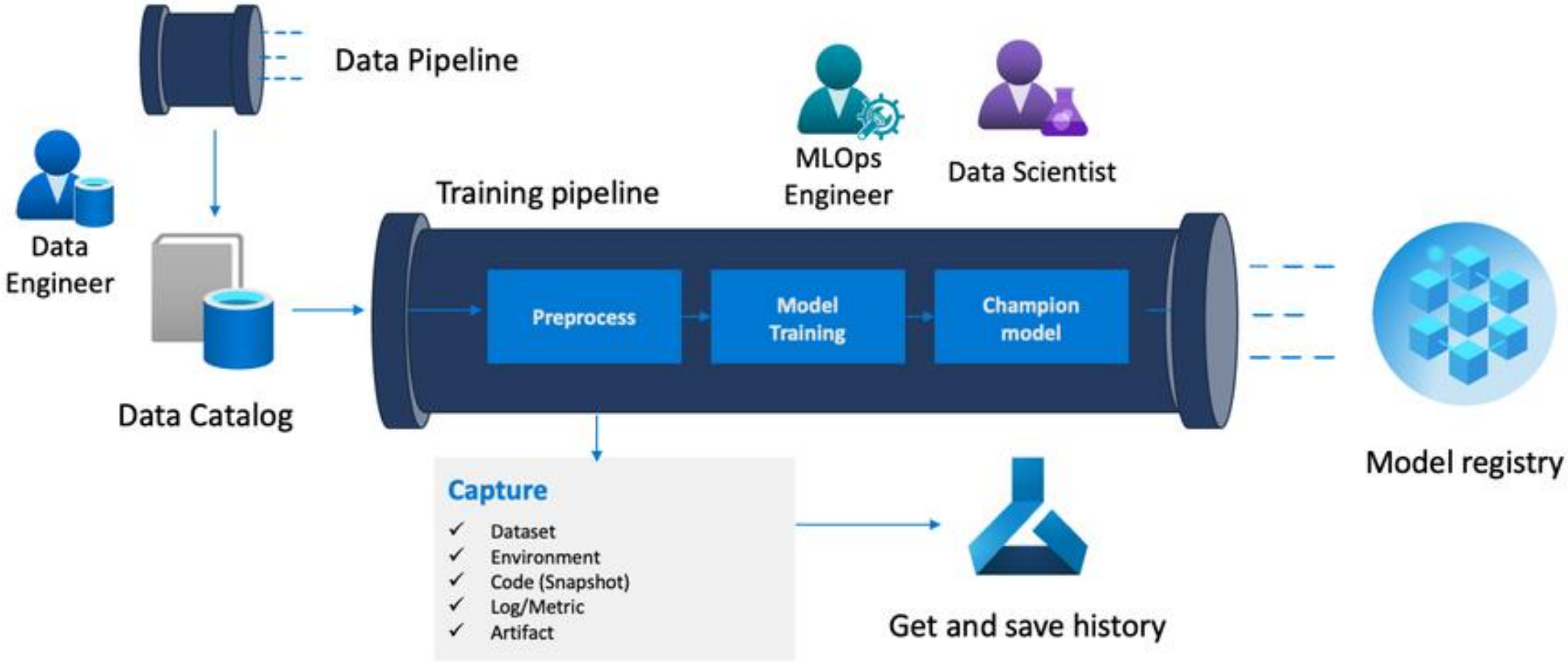
Level 1 – DevOps no MLOps

- Create managed ML platform.
- Maintain code test against application and training/inference scripts.



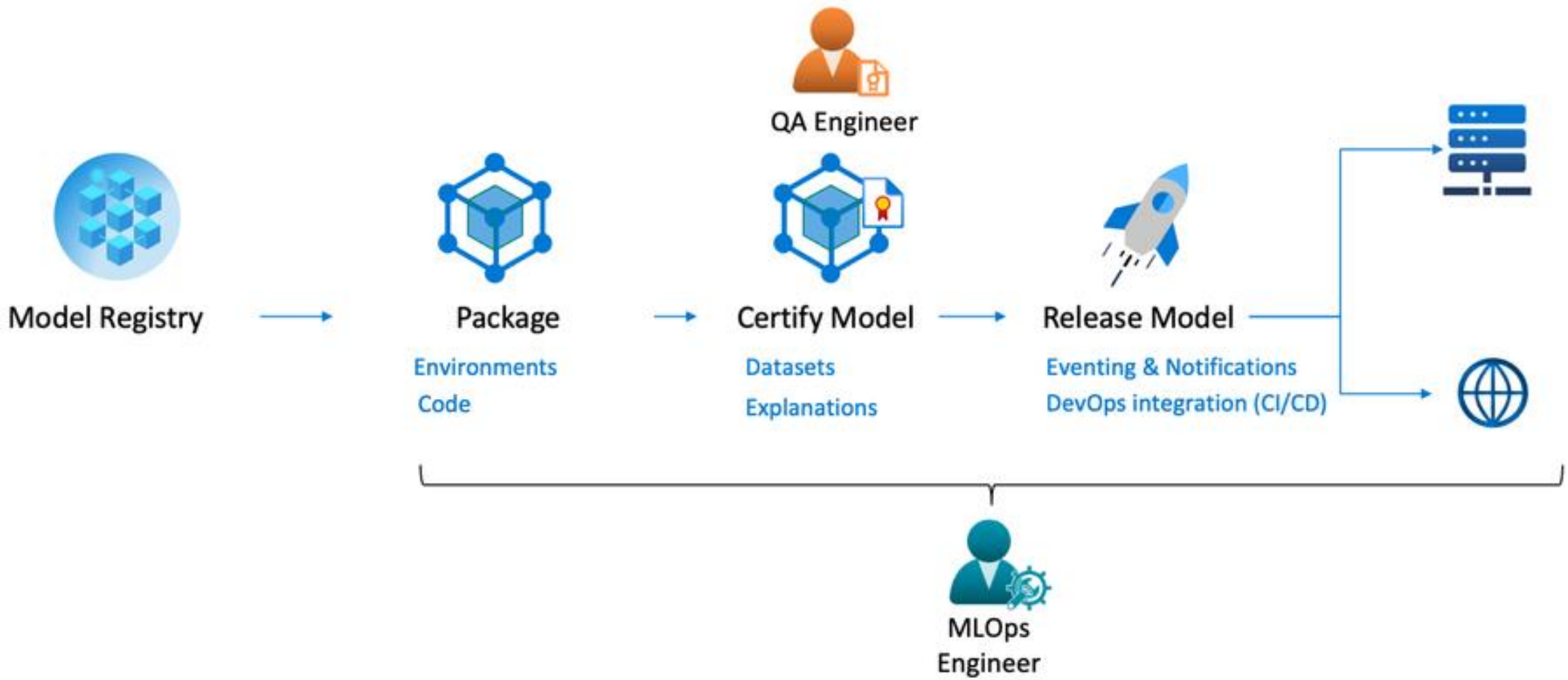
Level 2 – Automated Training

- Make Code, Data, Model tracked, saved and version controlled.
- Automate training process using pipeline.

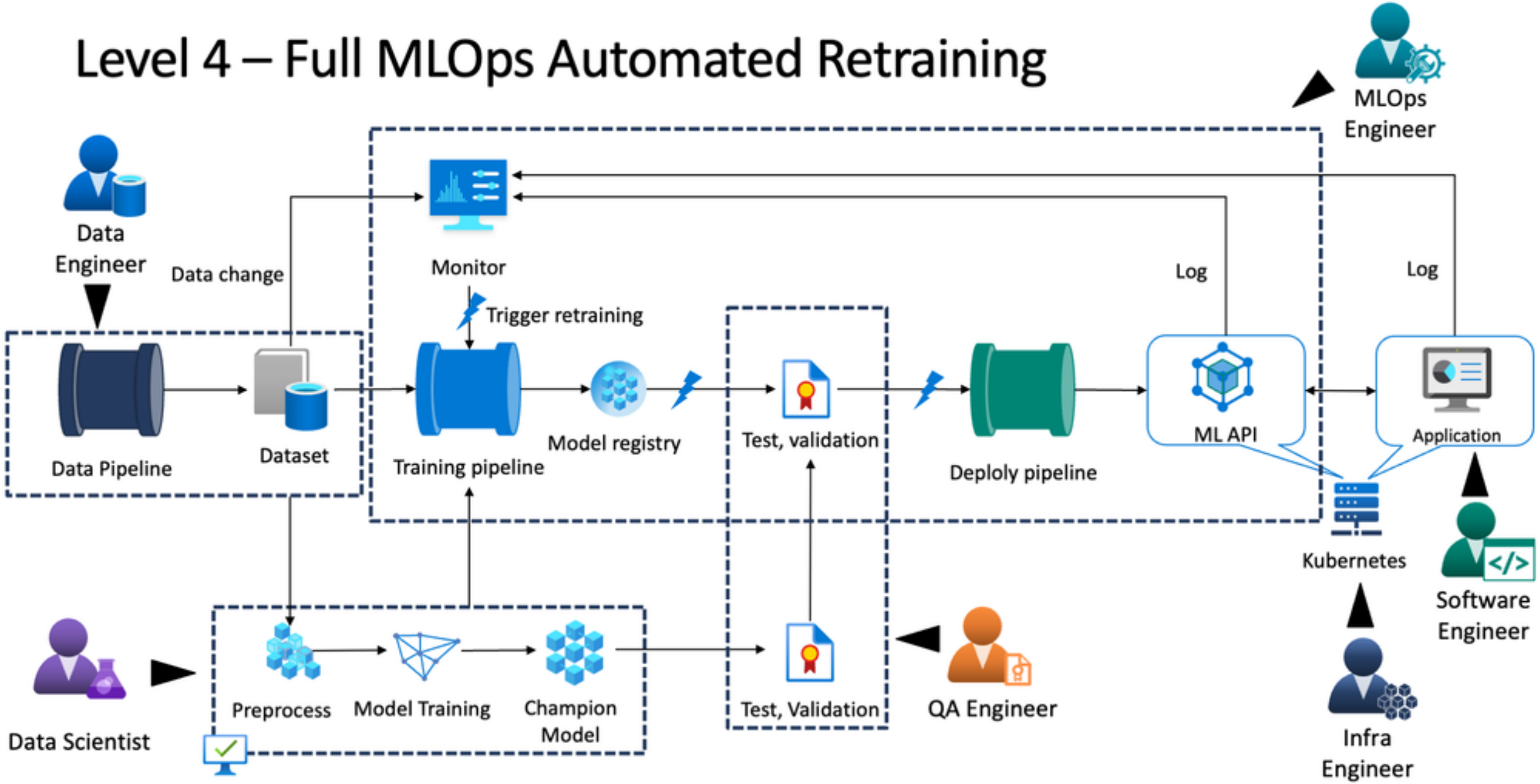


Level 3 – Automated Model Deployment

- Package model, Certify Model and release model are semi-automated.



Level 4 – Full MLOps Automated Retraining



MLOps Tools

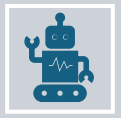
AutoML	Cron Jobs	Data Cataloging	Data Exploration	Data Management
Data Processing	Data Validation	Hyperparameter Tuning	Machine Learning Platforms	Model Interpretability
Model Lifecycle Management	Model Serving	Optimization and Simplification Tools	Visual Analysis/Debugging	Workflow Tools

https://github.com/kelvins/awesome-mlops

Advantages

- Organizations that invest in MLOps and other data science initiatives see significant gains.
- **Netflix reported its ML algorithm that drives its personalization engine is worth $1 billion.**
- Amazon's ML and AI apps that power robots and their pick, pack, and ship process in warehouses reduced the click-to-ship time by 225%. By automating the flow of inventory, Amazon estimates it improved productivity by 20%.
- A study by McKinsey found that companies successfully implementing machine learning and AI now report that 27% of their earnings are attributable to the technology.

Impacts / Outcomes



To be leader of AI technologies for Computer Vision, ITS Software, Vehicle Analytics in the region.

To provide high Precision / Accuracy Intelligent Vision System

Capability to Scale and Diversify.

Harness computer vision technology to transform video feeds and images into intelligence and actionable insights for new Vision Projects.


Questions
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Answers
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