MLOps = DevOps4AI

Conf. dr. Cristian KEVORCHIAN

University of Bucharest

Typical problems for ML projects

- https://xkcd.com/1838/

Problems with the “pile of scripts” approach

- No traceability of work
- No clear artifacts created
- No governance
  - **What data has been used?**
  - **What code?**
  - **What code + data resulted in my model?**
  - **What was the result for the model X?**
- No reproducibility
- Not possible to hand over

Why my model does not give the same great result it gave me just yesterday?

Nothing have changed!

Machine Learning Operations(MLOPS)

- MLOPS is based on DevOps principles and practices that increase the efficiency of workflows. For example, continuous integration, continuous delivery and deployment.

- MLOps applies these principles to the machine learning process, with the goal of:
  - Faster experimentation and development of models
  - Faster deployment of models into production
  - Quality assurance and end-to-end lineage tracking

Team Data Science Process

- The Team Data Science Process (TDSP) is an agile, iterative data science methodology that enables the efficient delivery of predictive analytics solutions and intelligent applications.
- TDSP improves team collaboration and learning by recommending how team roles should be combined.
- The TDSP incorporates best practices and structures from Microsoft and other industry leaders to assist in the successful implementation of data science initiatives.
- **The goal is to assist businesses in fully realizing the benefits of their analytics program.**

Key components of the TDSP

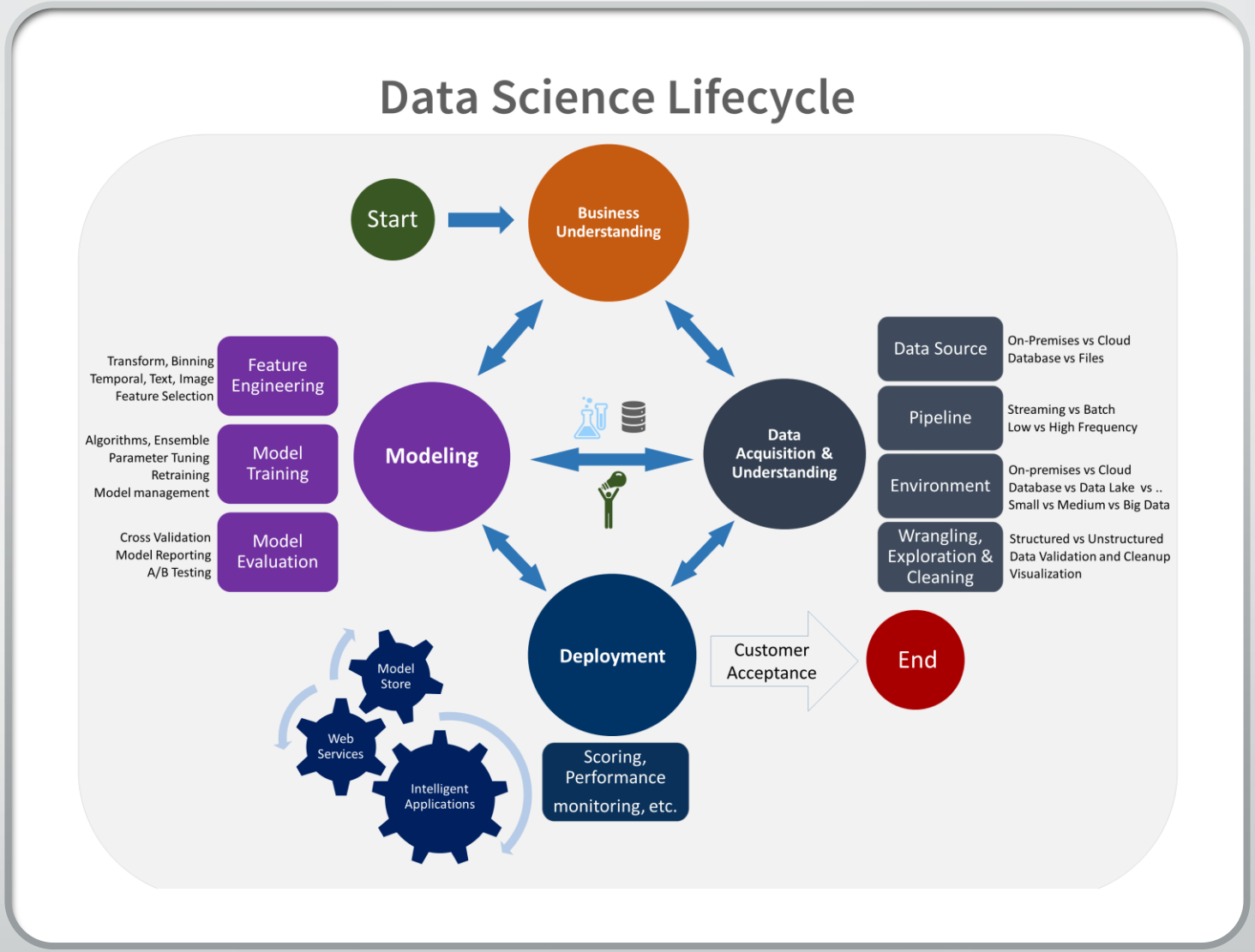
- Data science lifecycle definition
- A standardized project structure
- Infrastructure and resources recommended for data science projects
- Tools and utilities recommended for project execution

Data science lifecycle

- The Team Data Science Process (TDSP) establishes a lifecycle for the development of your data science projects. The lifecycle outlines the entire process that successful projects must go through.
- This lifecycle is intended for data science projects that are delivered as part of intelligent applications. For predictive analytics, these applications use machine learning or artificial intelligence models. This process can also be used for exploratory data science projects or improvised analytics projects. However, in such cases, some of the steps outlined may not be required.

ML Projects lifecycle

- **Business Understanding**
- **Data Acquisition and Understanding**
- **Modeling**
- **Deployment**



ML Project Roles

- Solution architect
- Project manager
- Data engineer
- Data scientist
- Application developer
- Project lead

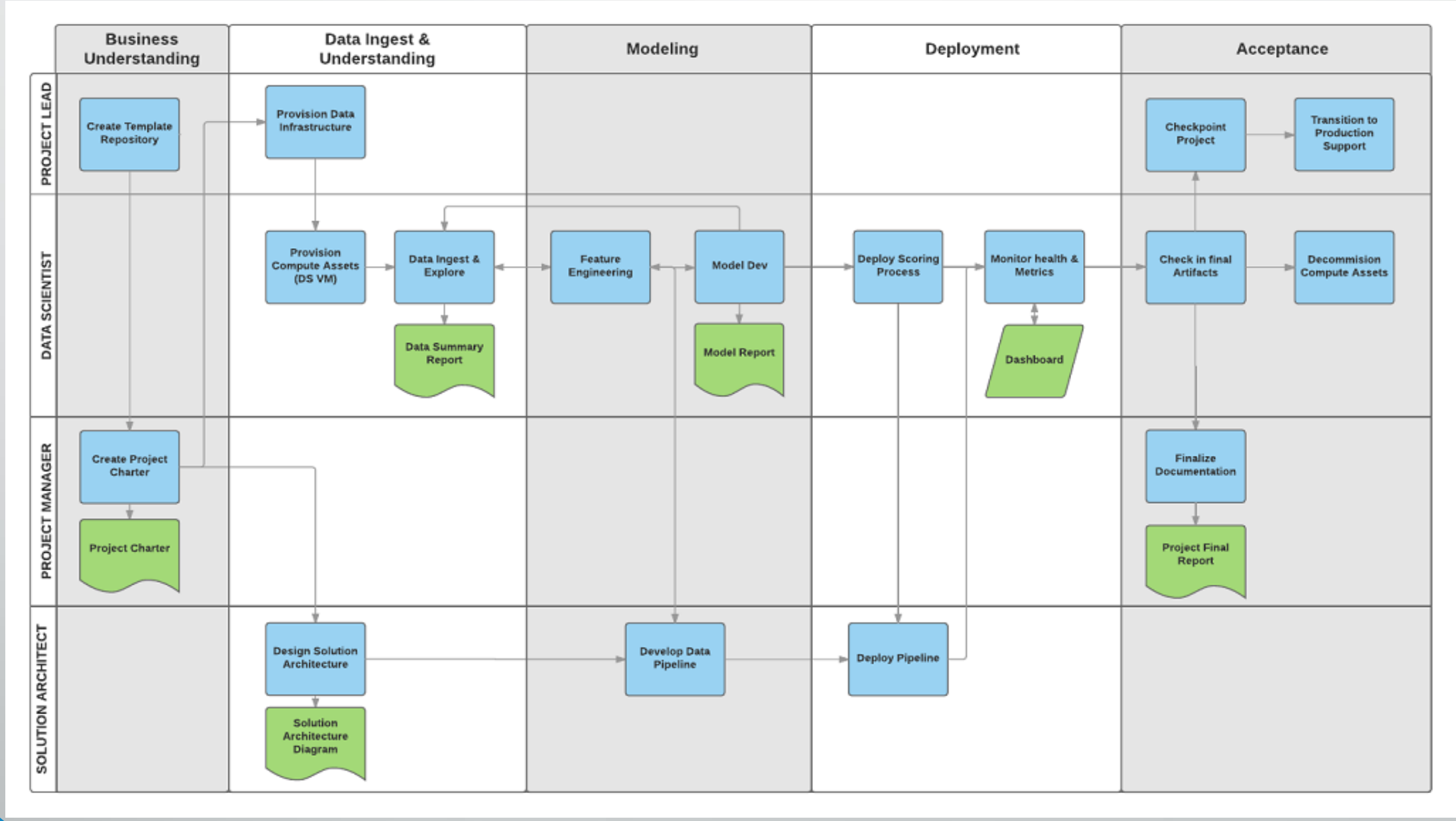
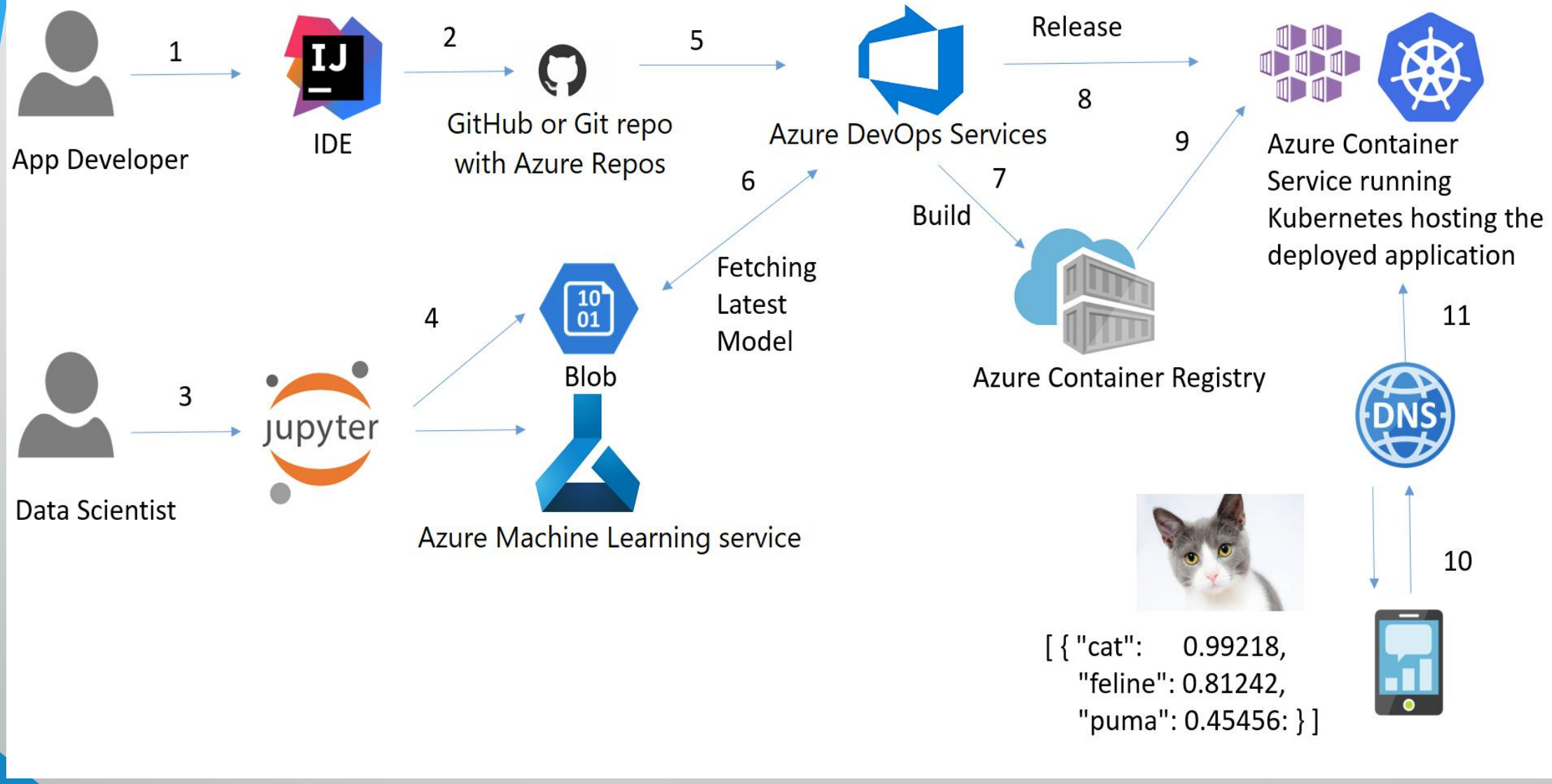


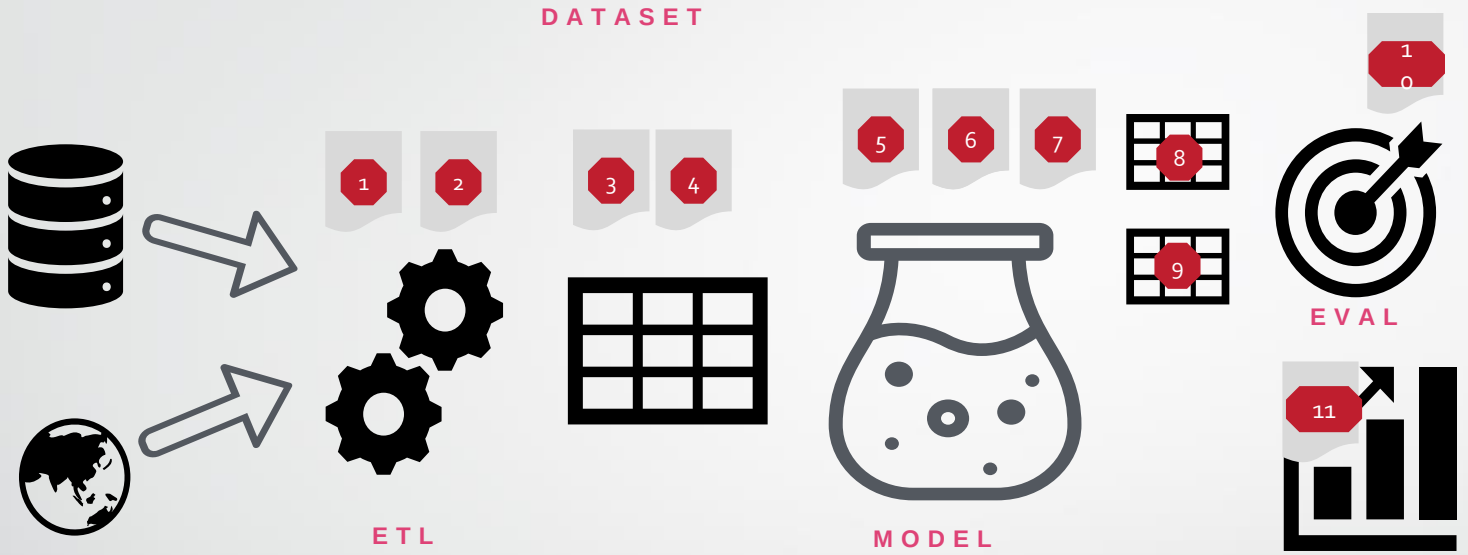
Diagram presents the tasks (in blue) and artifacts (in green) associated with each stage of the lifecycle (on the horizontal axis) for these roles (on the vertical axis).



https://aka.ms/TDSP

Developing Prod-ready ML

What makes an ML model (asset examples)



1. Source Tests
2. Feature gen / ETL
3. Cross validation code
4. Dataset tests
5. Training code
6. Inference code
7. Serialized model
8. Treatment group
9. Control group
10. Evaluation code
11. Model efficiency tests

MLOps Benefits

Reproducibility / Auditability

- Code drives **generation** and **deployments**
- Pipelines are **reproducible** and **verifiable**
- All artifacts can be **tagged** and **audited**

Validation

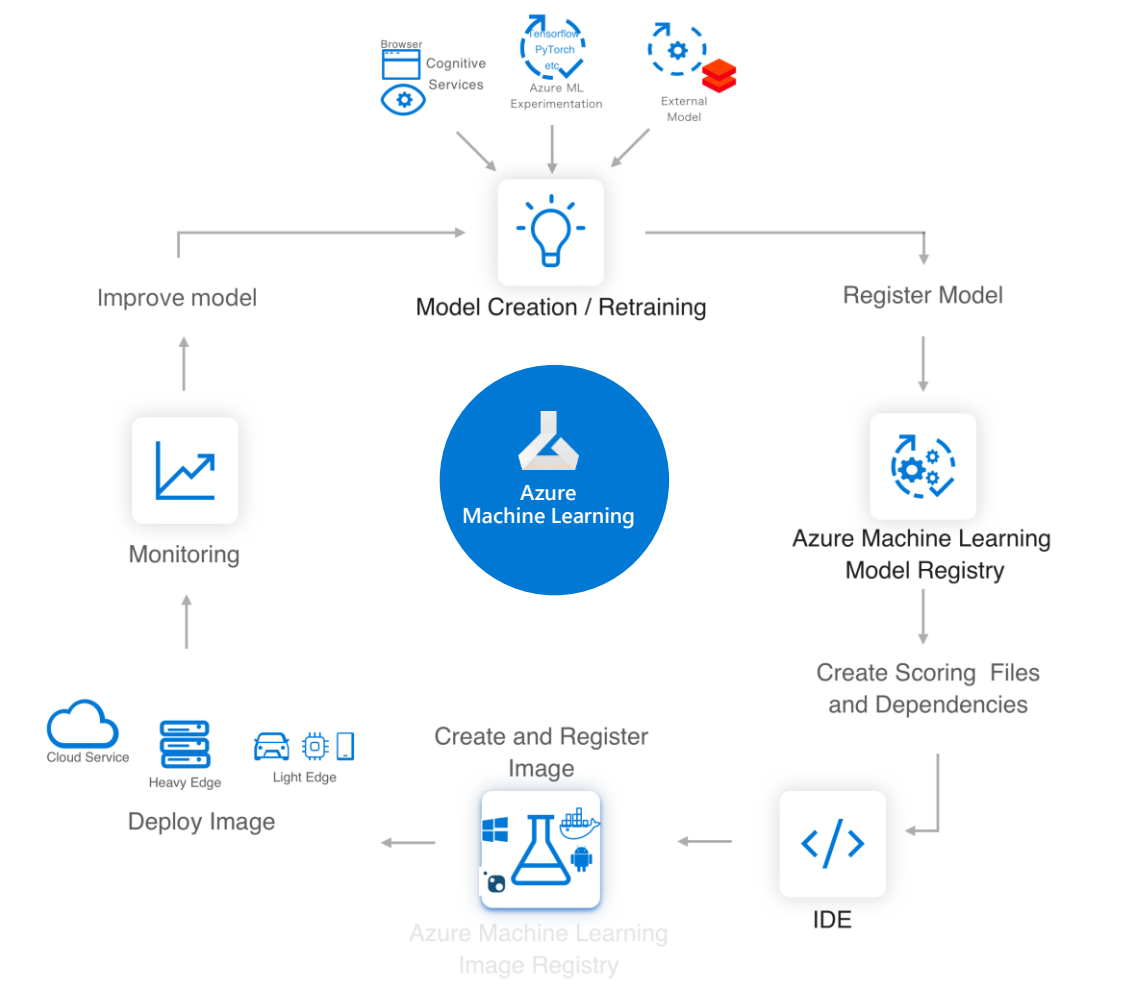
- SWE best practices for quality control
- Offline comparisons of model **quality**
- Minimize **bias** and enable **explainability**

Automation / Observability

- Controlled rollout capabilities
- Live comparison of predicted vs. expected performance
- Results fed back to watch for drift and improve model

Azure ML service

Lets you easily implement this AI/ML Lifecycle



Workflow Steps

Develop machine learning training scripts in Python.

Create and configure a compute target.

Submit the scripts to the configured compute target to run in that environment. During training, the compute target stores run records to a datastore. There the records are saved to an experiment.

Query the experiment for logged metrics from the current and past runs. If the metrics do not indicate a desired outcome, loop back to step 1 and iterate on your scripts.

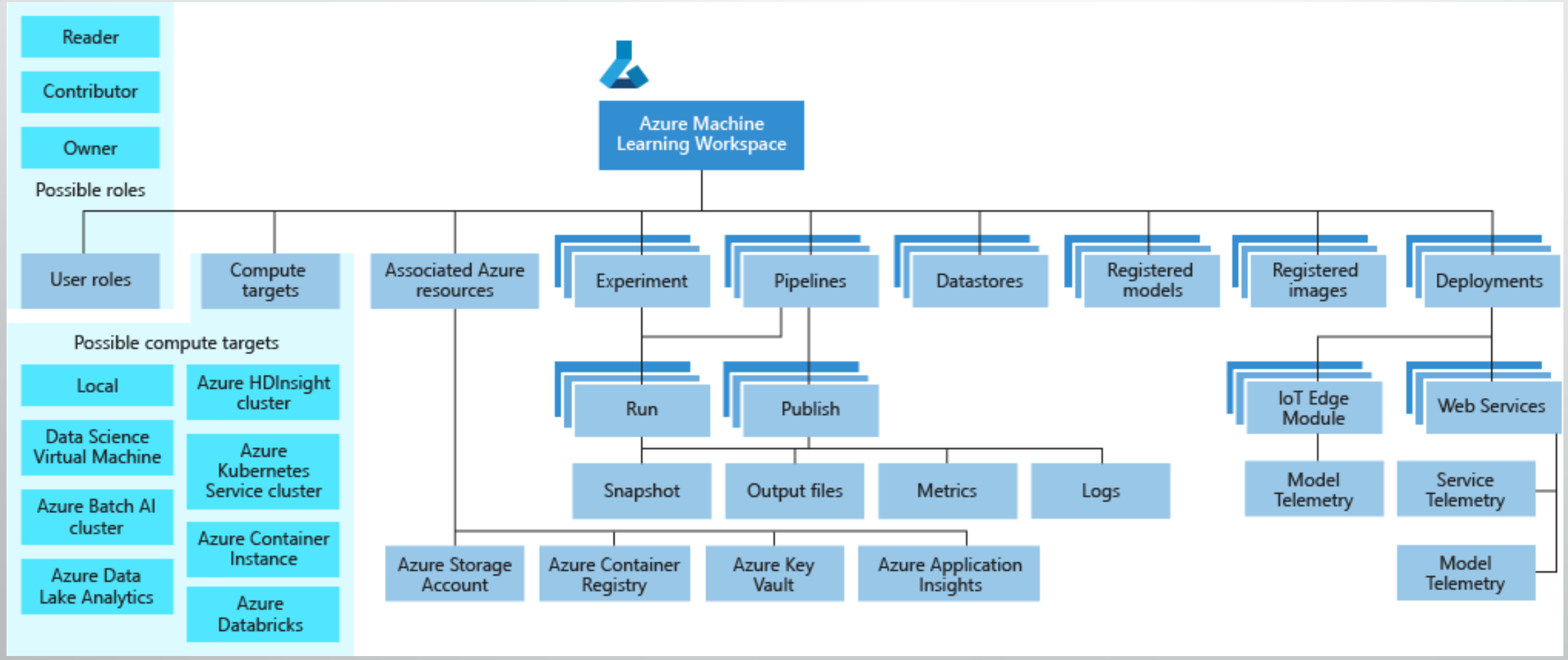
Once a satisfactory run is found, register the persisted model in the model registry.

Develop a scoring script.

Create an Image and register it in the image registry.

Deploy the image as a web service in Azure.

Azure ML service Workspace Taxonomy



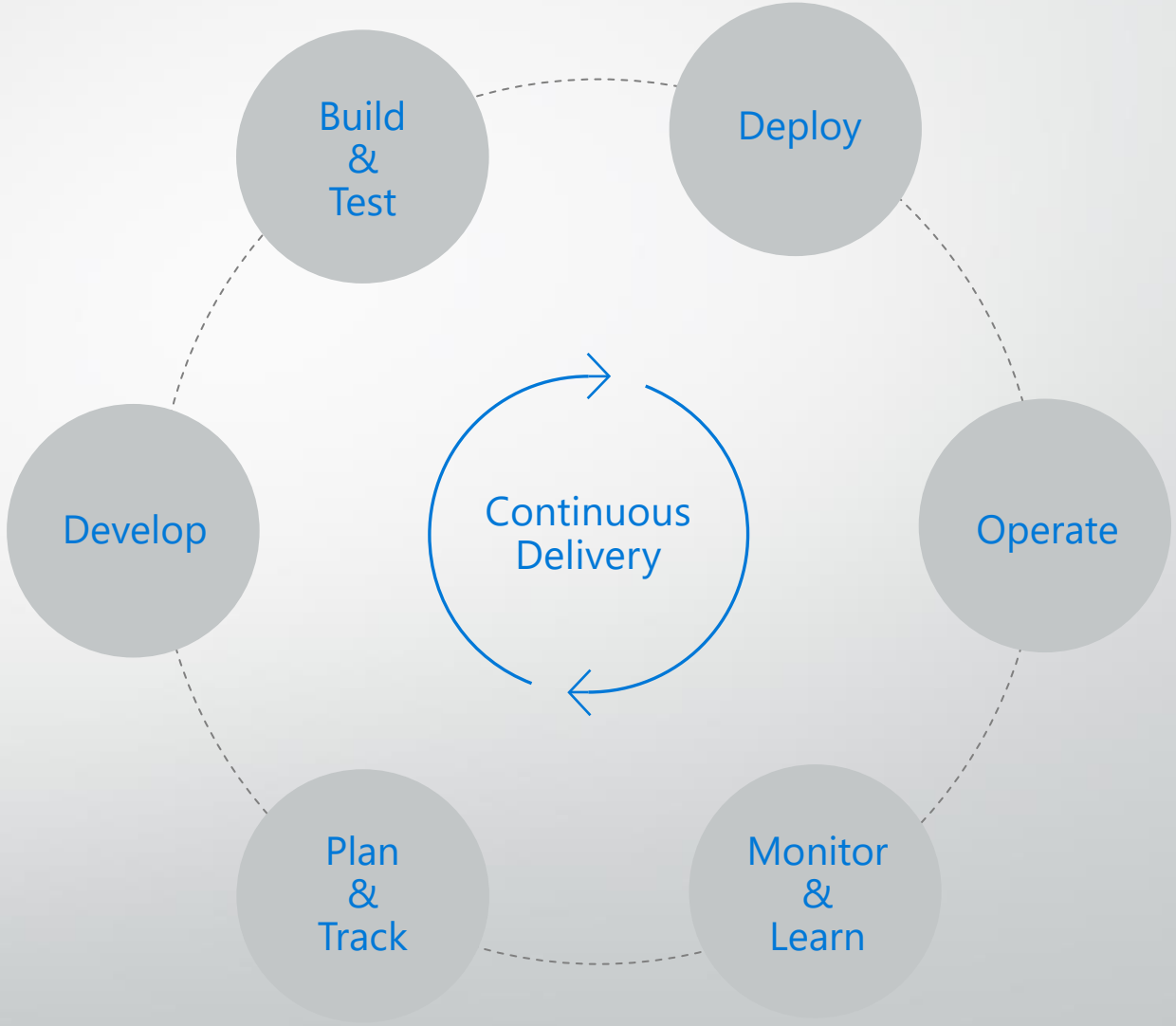
“Best kept secret of AI is how it is de-abbreviated. Today we are going to reveal it.”

Andrey Vykhodtsev

What is DevOps?

People. Process. Products.

> DevOps is the union of **people**, **process**, and **products** to enable continuous delivery of value to your end users.



Azure DevOps

Azure Boards

Deliver value to your users faster using proven agile tools to plan, track, and discuss work across your teams.

Azure Pipelines

Build, test, and deploy with CI/CD that works with any language, platform, and cloud. Connect to GitHub or any other Git provider and deploy continuously.

Azure Repos

Get unlimited, cloud-hosted private Git repos and collaborate to build better code with pull requests and advanced file management.

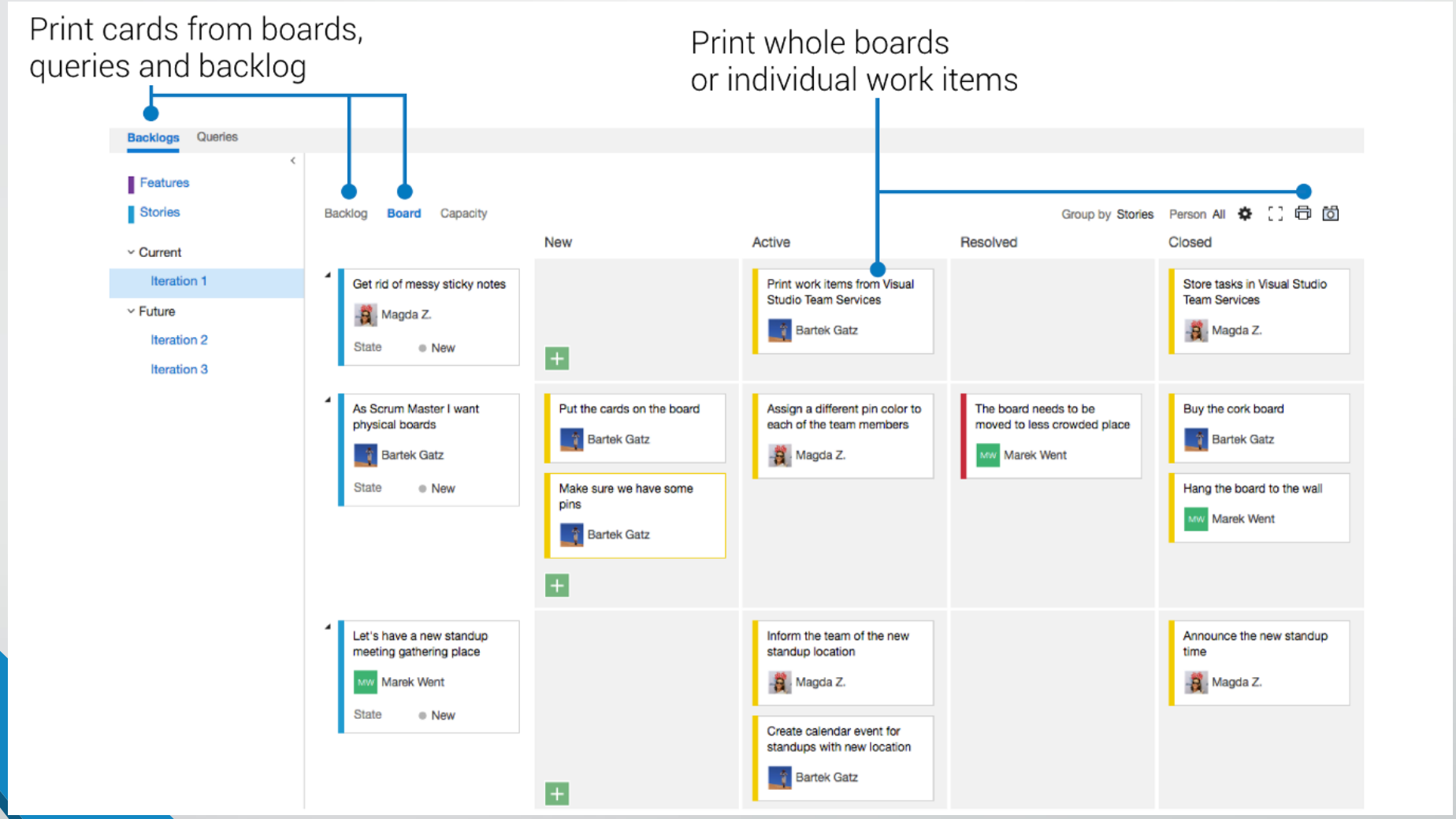
Azure Test Plans

Test and ship with confidence using manual and exploratory testing tools.

Azure Artifacts

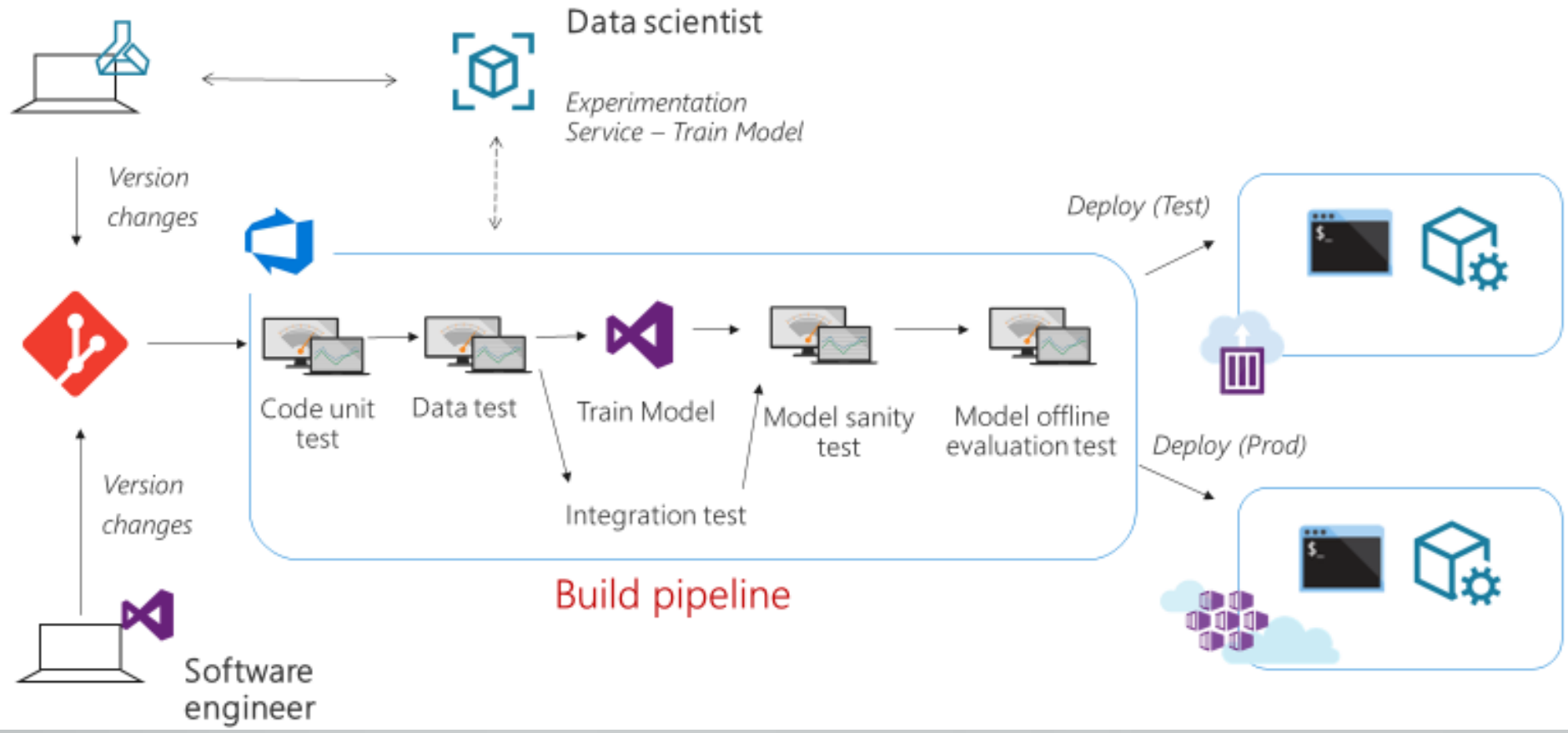
Create, host, and share packages with your team, and add artifacts to your CI/CD pipelines with a single click.

https://azure.com/devops

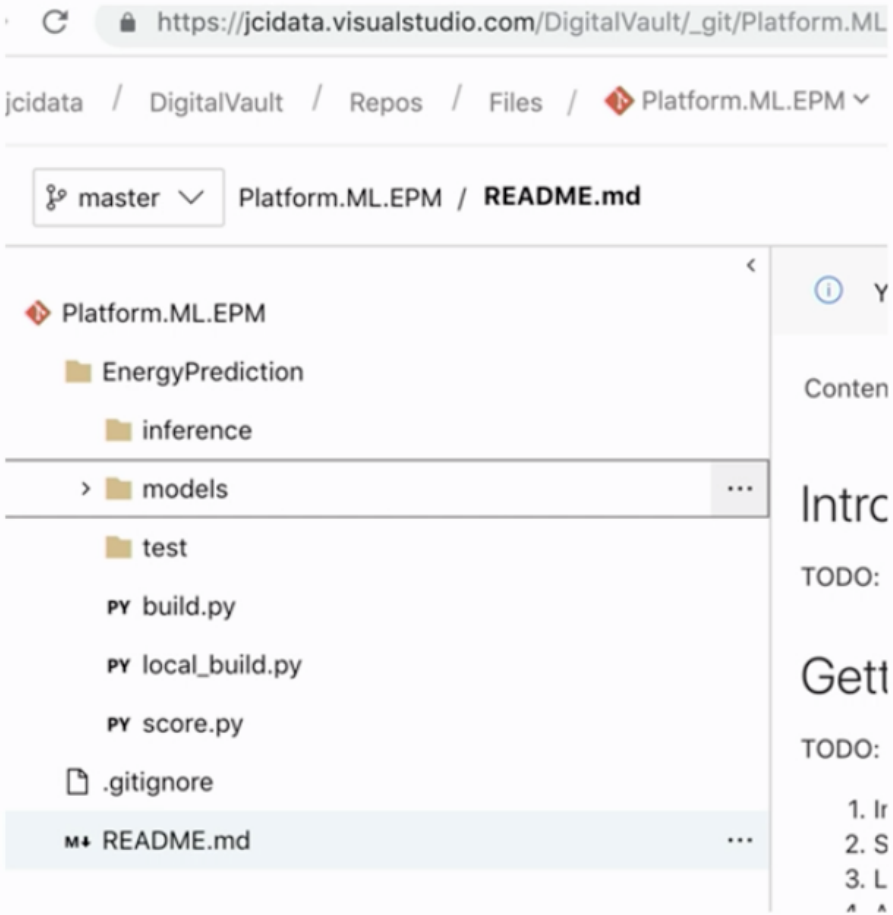


Agile Cards (VS Marketplace)

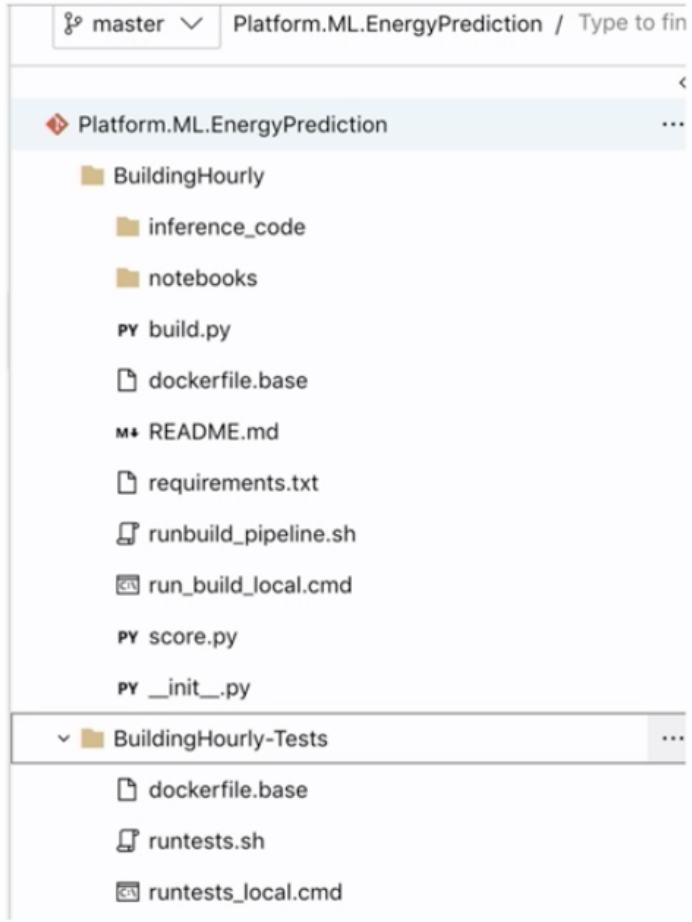
Integrated Pipeline for Data Scientists and Software Engineers



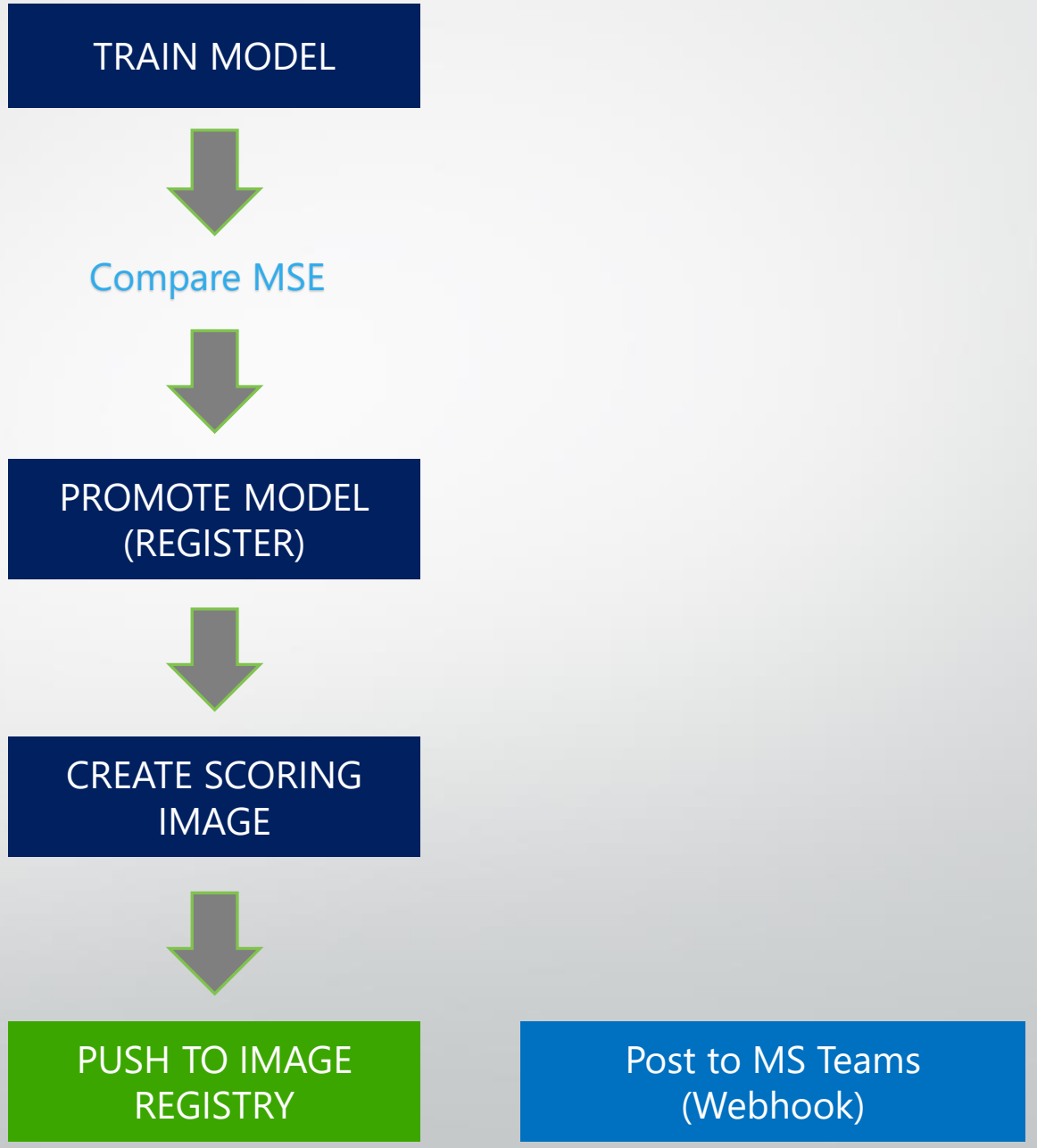
The “old way”…
…using git to be our “manager of models”



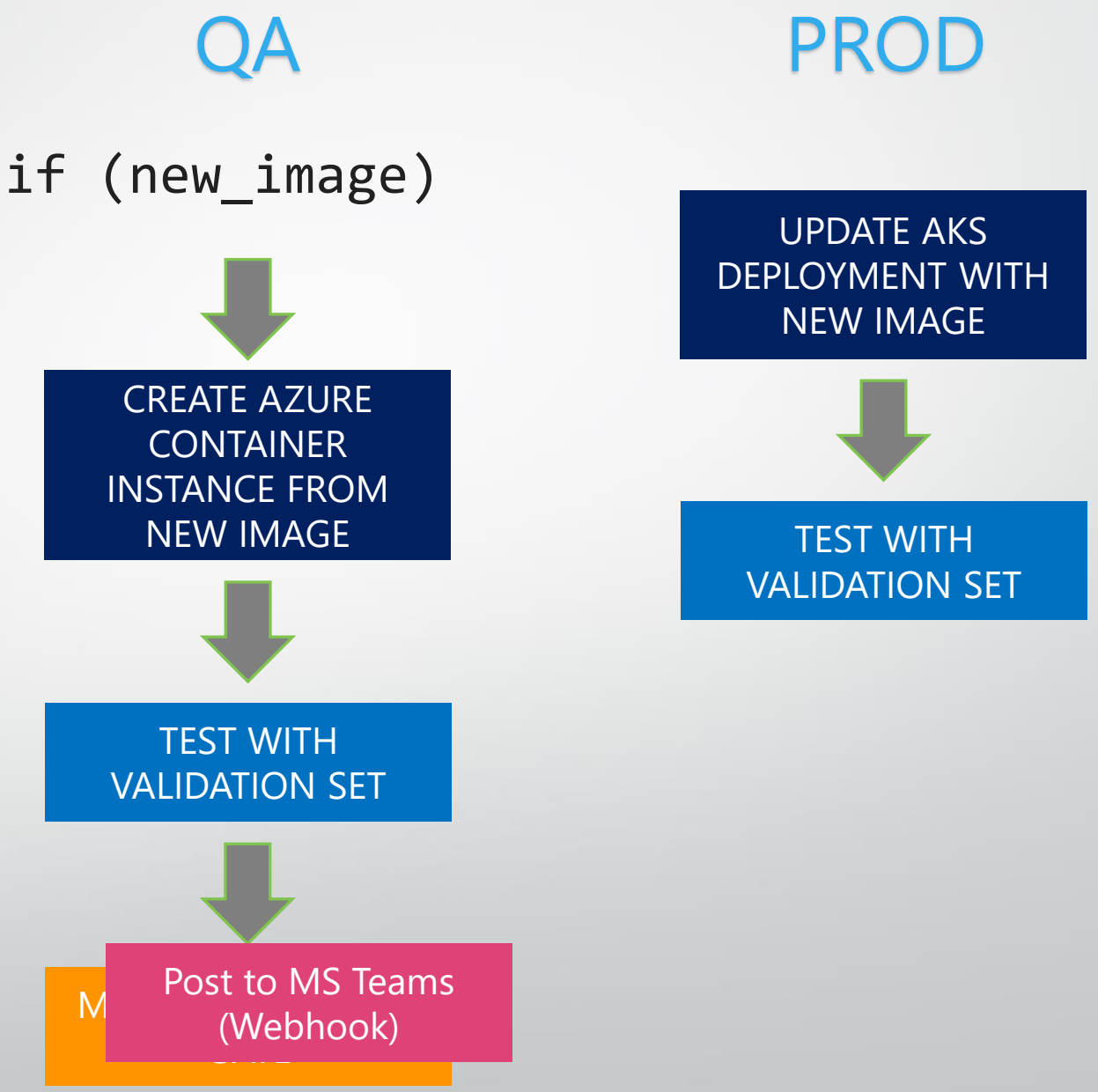
The “new way”…
….Full CI/CD! ZOMG!
Git is no longer the model manager



BUILD PIPELINE



RELEASE PIPELINE



Advanced analytics pattern in Azure

Data collection and understanding, modeling, and deployment