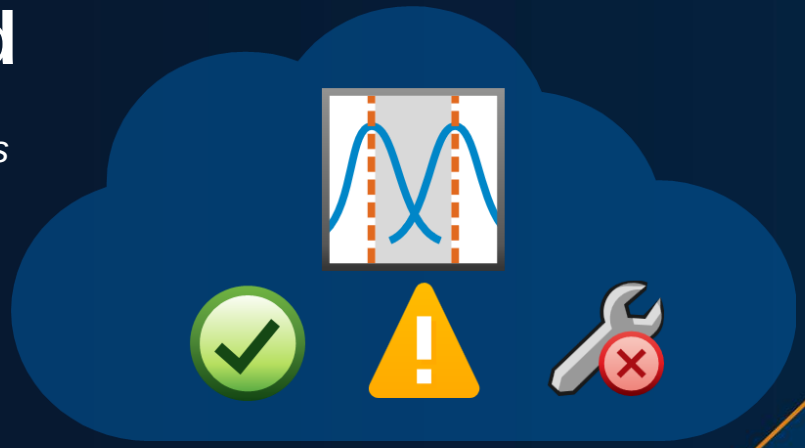
MATLAB EXPO

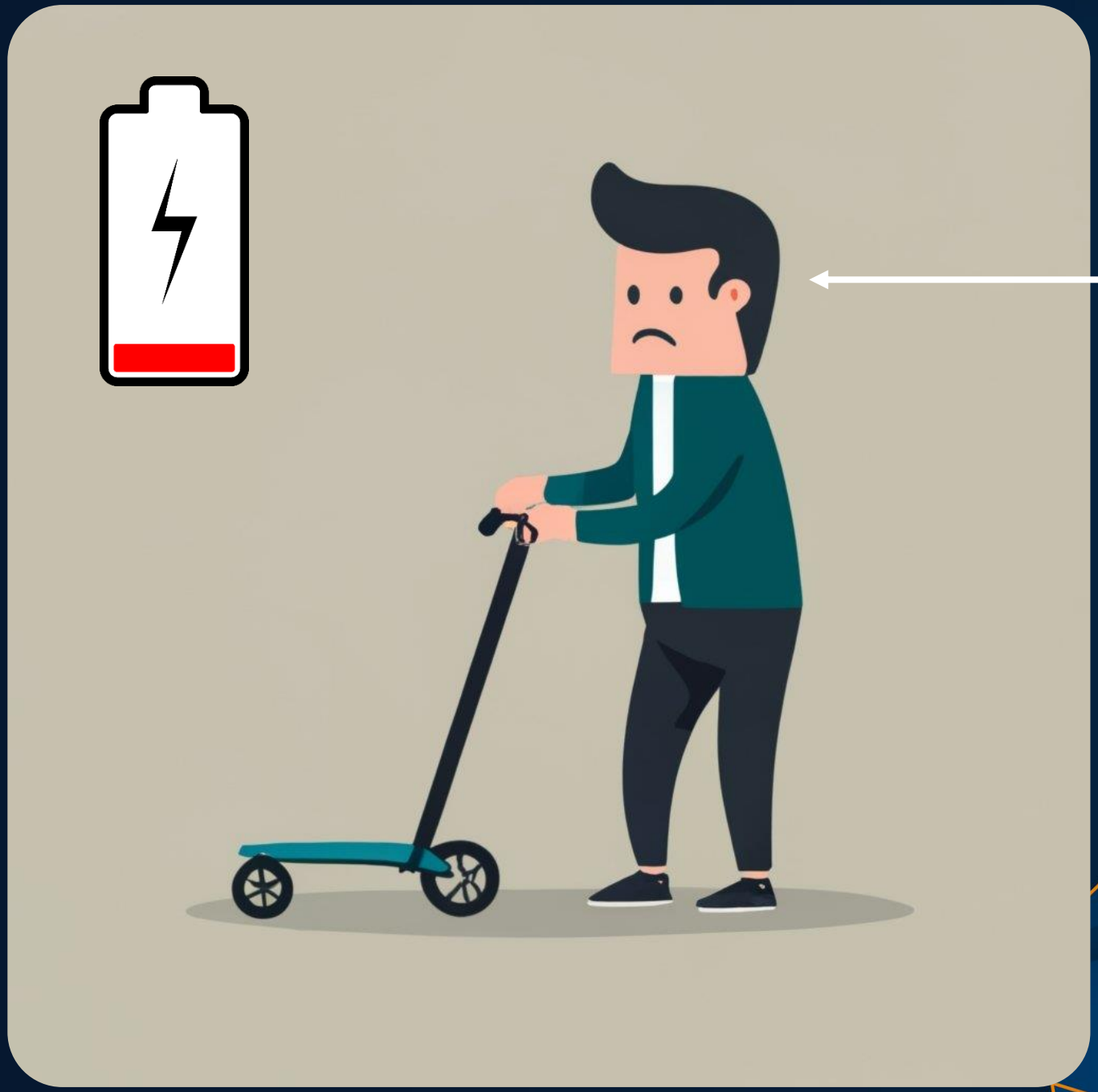
FRANCE

Déploiement d’algorithmes de dérive de données et de modèles dans le cloud

Pierre Harouimi, MathWorks



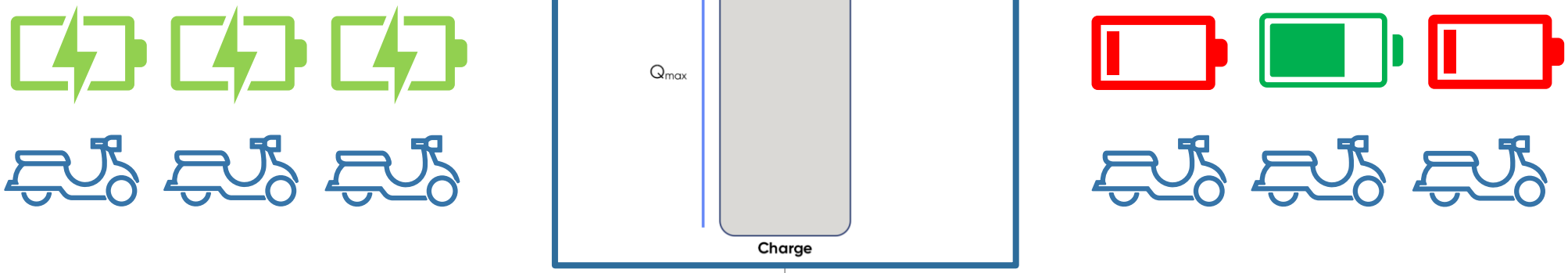
MathWorks


Me

*“More than **half** of AI Models Never Make It To Production”*

Source: Gartner 2021

How much longer can you drive before recharging?



State of Charge (SoC) cannot be directly measured x

No observed data x

Need to embed model for real-time data x

How to handle data drifting from baseline x

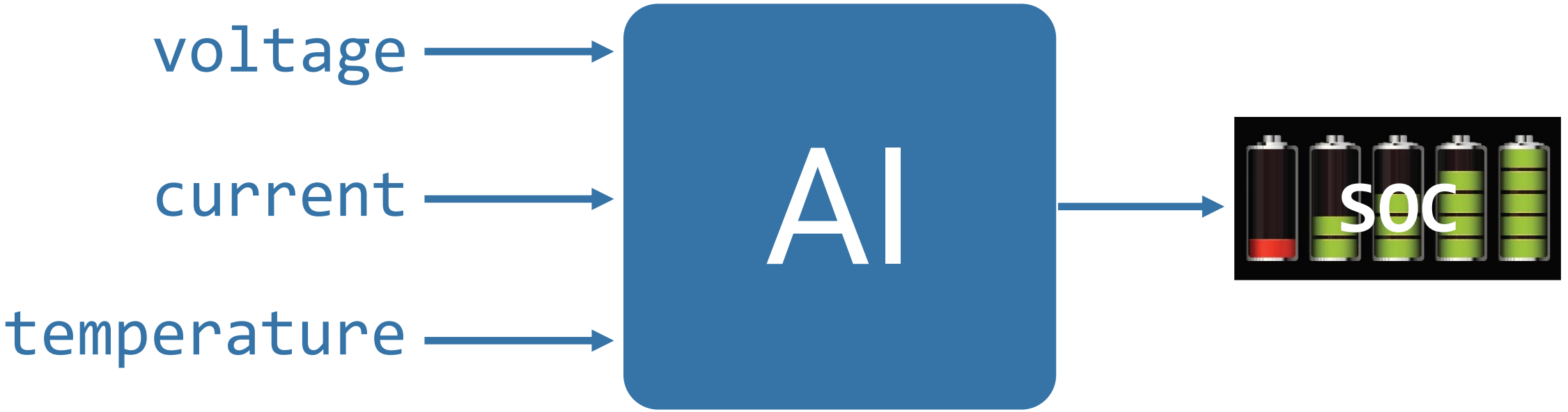
✓ *Predict battery SoC using AI with MATLAB & python*

✓ *Generate realistic data with Simulink*

✓ *Convert python model into MATLAB to generate code*

✓ *Deploy MATLAB algos and Simulink model in the cloud*

Battery State-of-Charge (SoC) estimation using AI



AI-driven system design and collaboration

Data Preparation

- Data cleansing and preparation
- Human insight
- Simulation-generated data

AI Modeling

- Model design and tuning
- Hardware accelerated training
- Interoperability

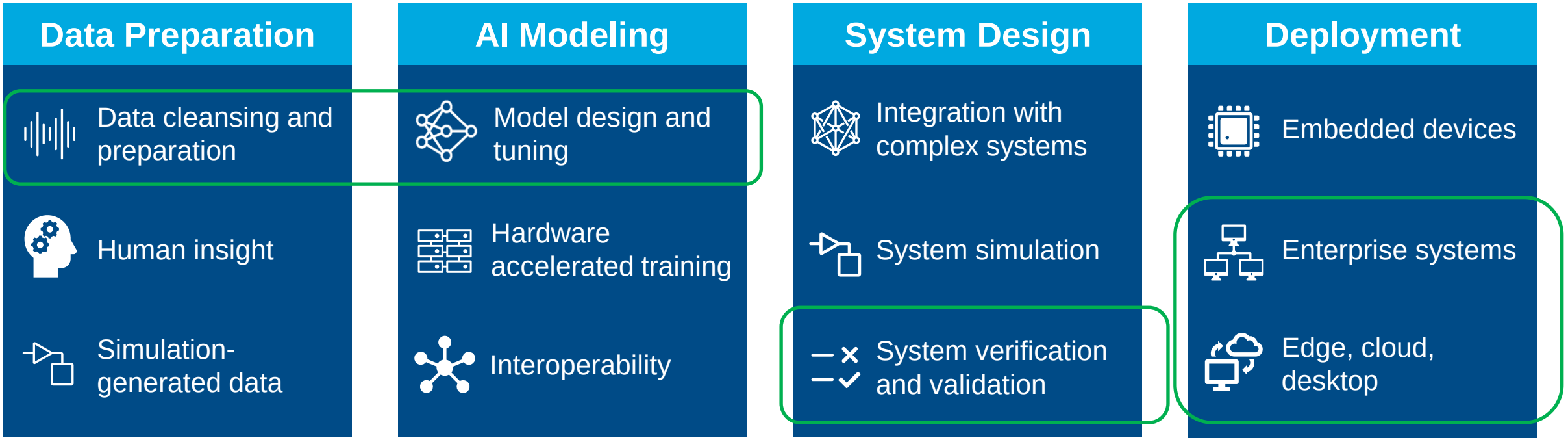
System Design

- Integration with complex systems
- System simulation
- System verification and validation

Deployment

- Embedded devices
- Enterprise systems
- Edge, cloud, desktop

AI-driven system design and collaboration



Predictive Maintenance and data drifting

From development to production

Testing and CI/CD deployment

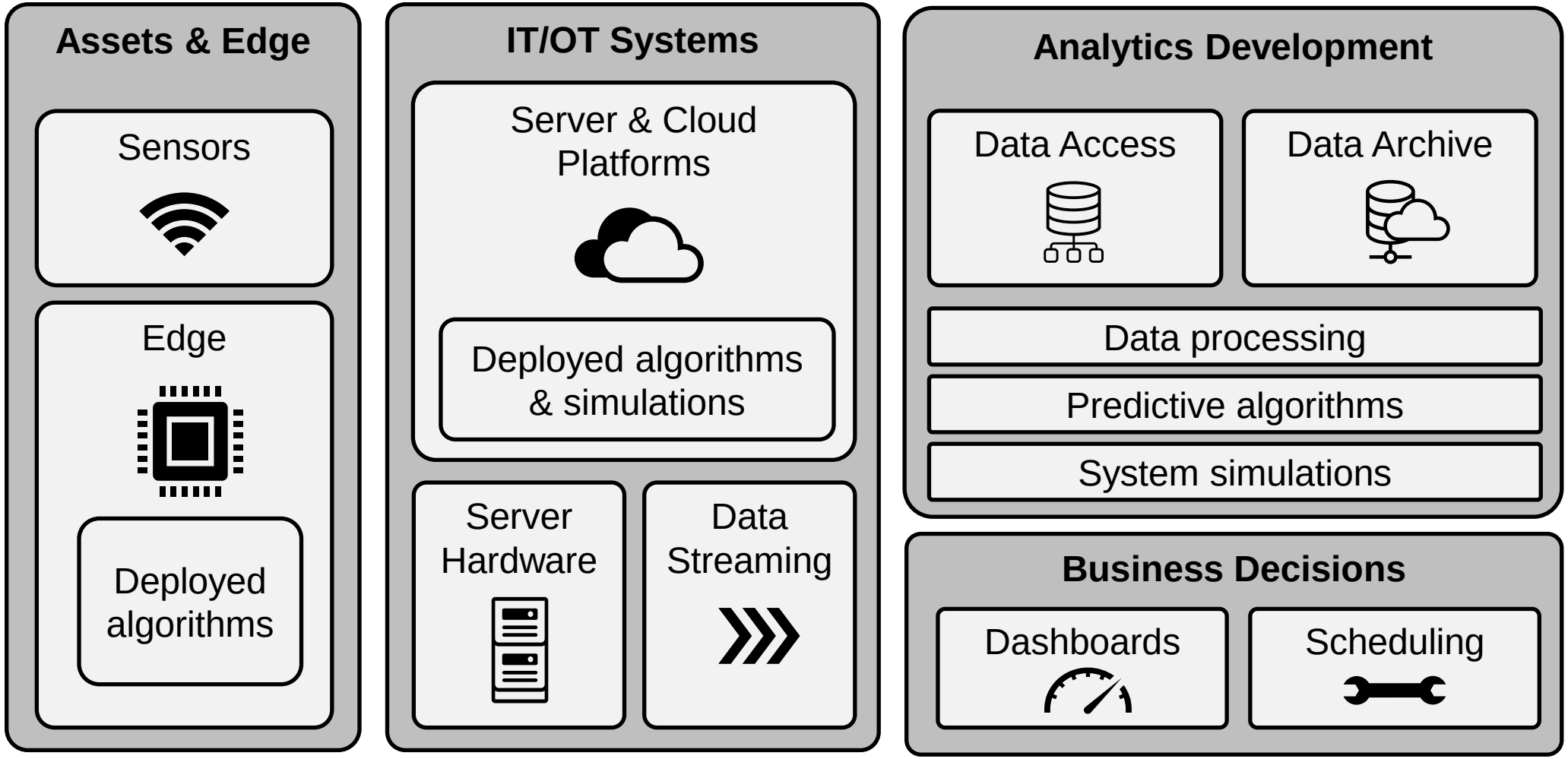
Predictive Maintenance and data drifting

How to use MATLAB® for predictive maintenance applications

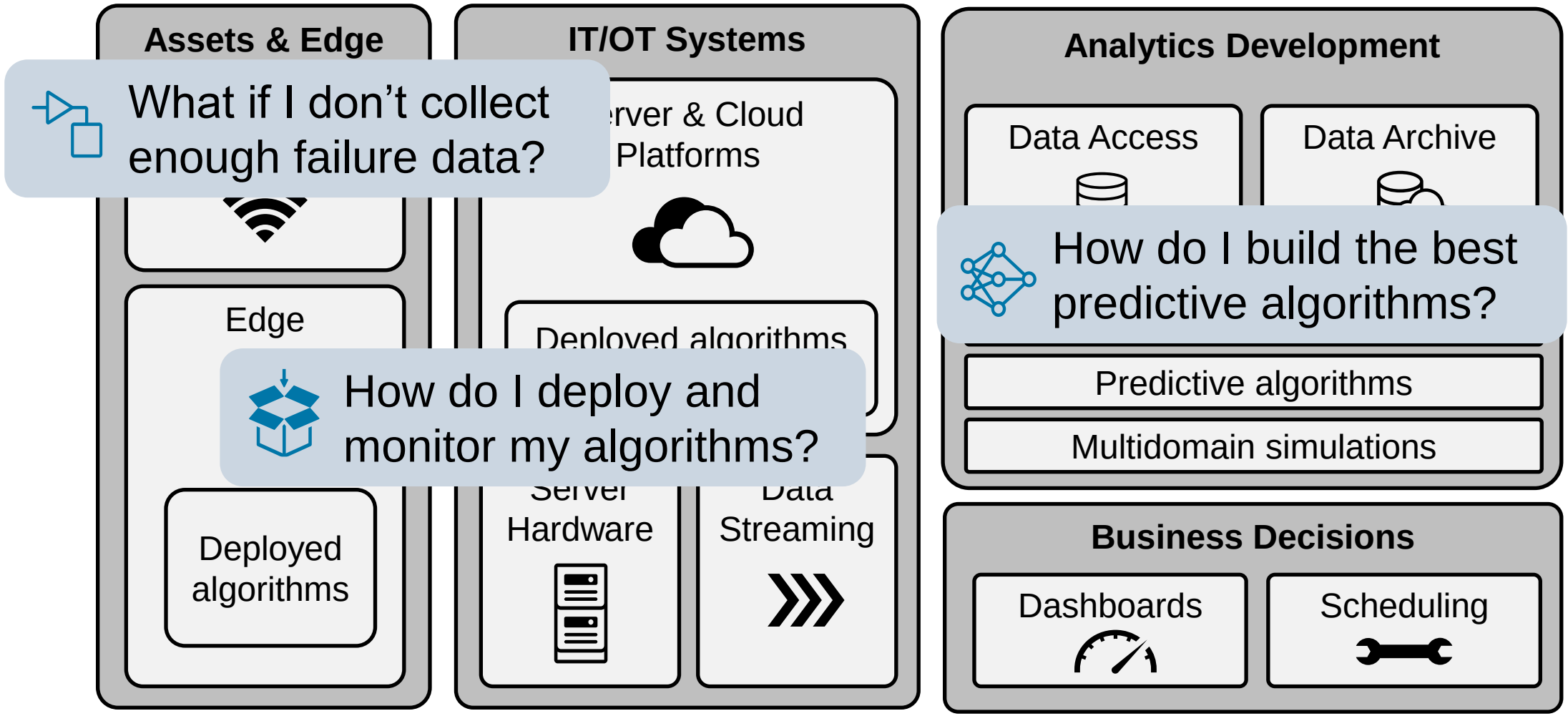
From development to production

Testing and CI/CD deployment

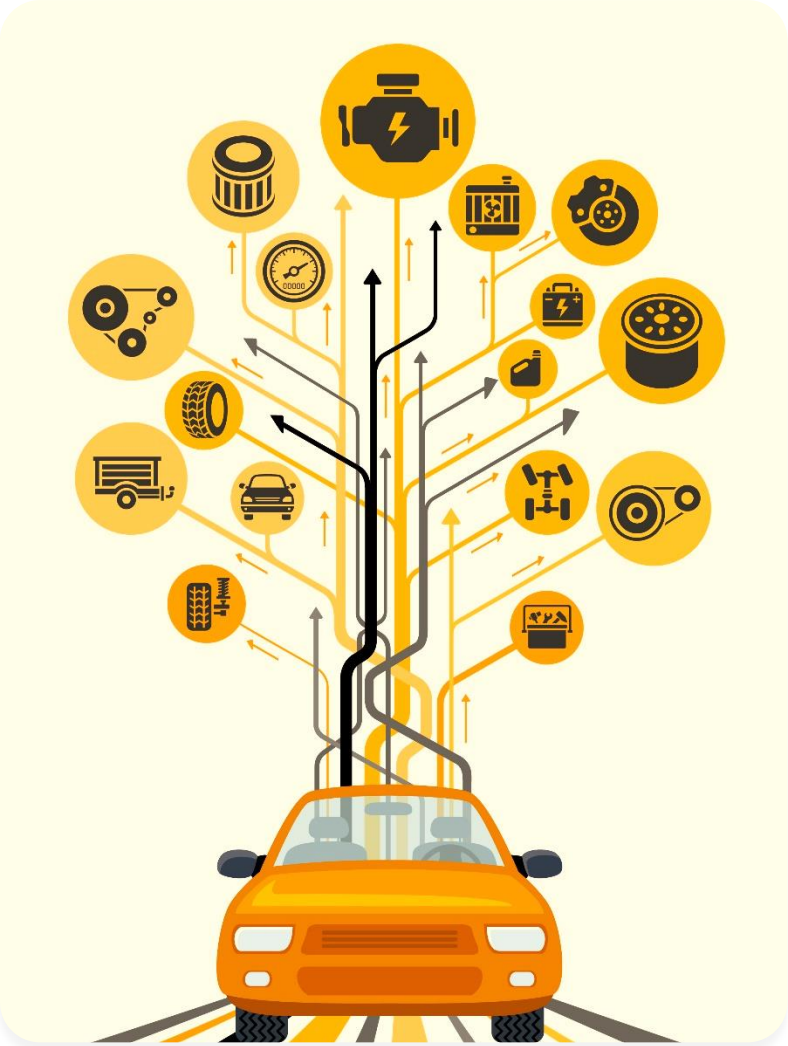
A predictive maintenance solution is more than an algorithm



Many challenges



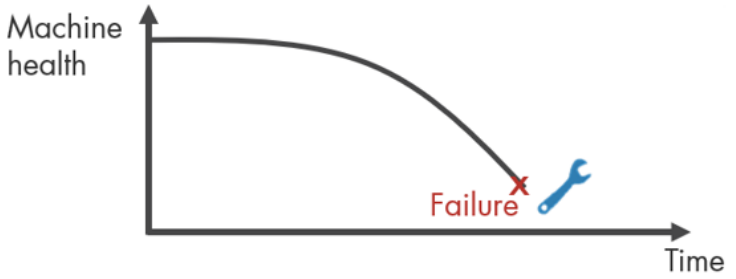
MATLAB for Predictive Maintenance



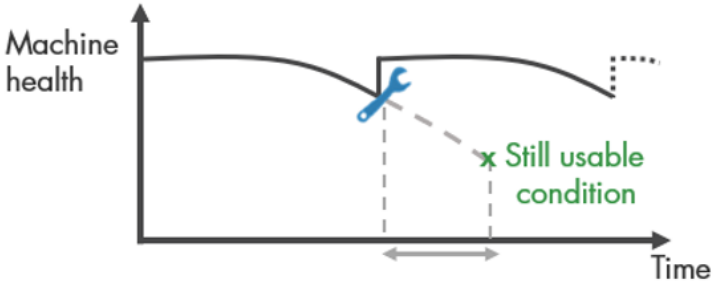
- Use interactive apps to analyze time series
- Import, visualize, extract new features, and generate MATLAB code
- Detect data and concept drifting

Types of Maintenance

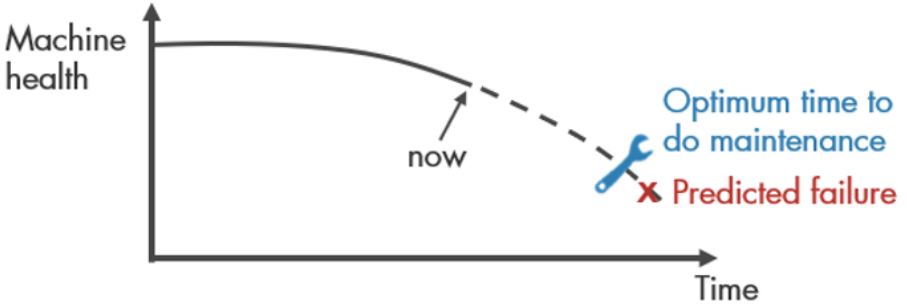
- **Reactive** – Do maintenance once there's a problem
  - Problem: unexpected failures can be expensive and potentially dangerous



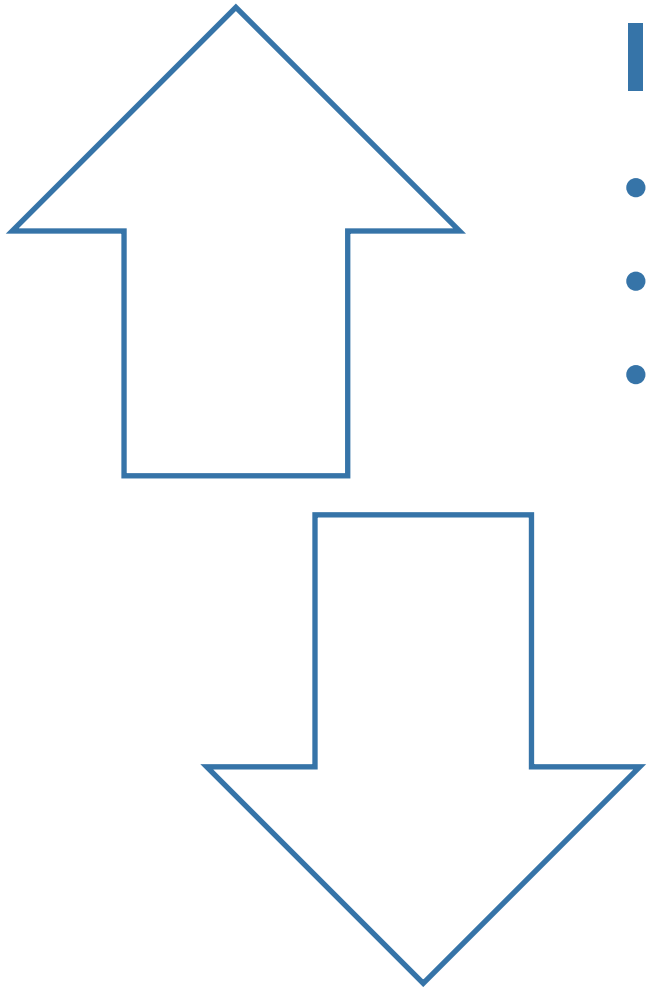
- **Scheduled** – Do maintenance at a regular rate
  - Problem: unnecessary maintenance can be wasteful; may not eliminate all failures



- **Predictive** – Forecast when problems will arise
  - Problem: difficult to make accurate forecasts for complex equipment



Why perform predictive maintenance?



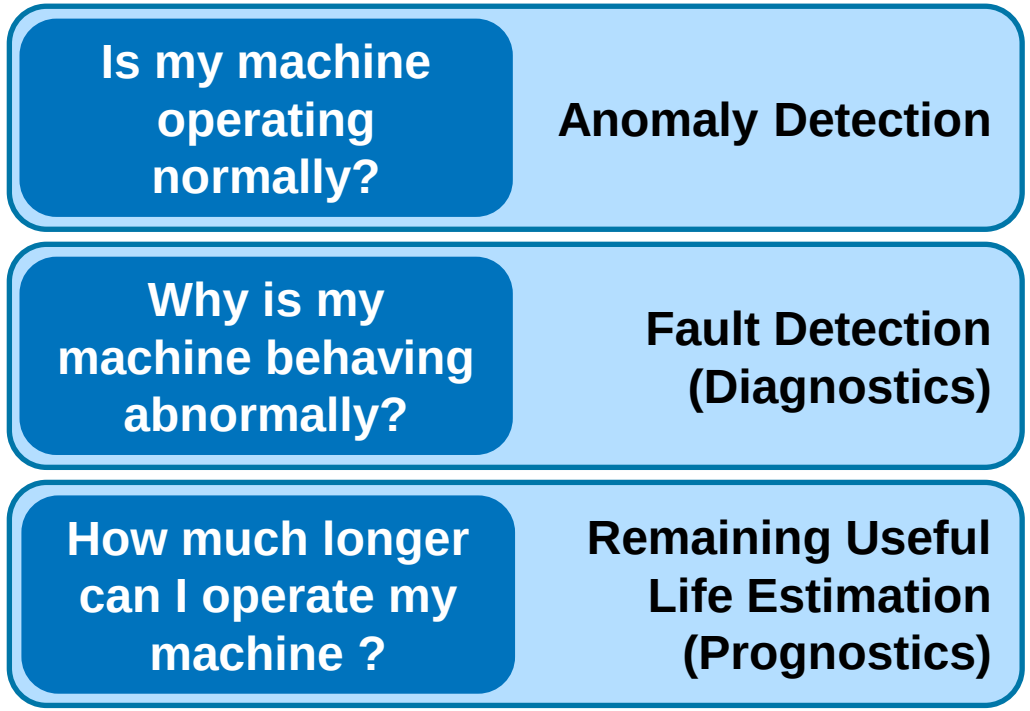
Increase

- Service life of parts
- Equipment safety
- Overall profitability

Reduce

- Downtime
- Maintenance costs
- Equipment failures

What does a predictive maintenance algorithm do?

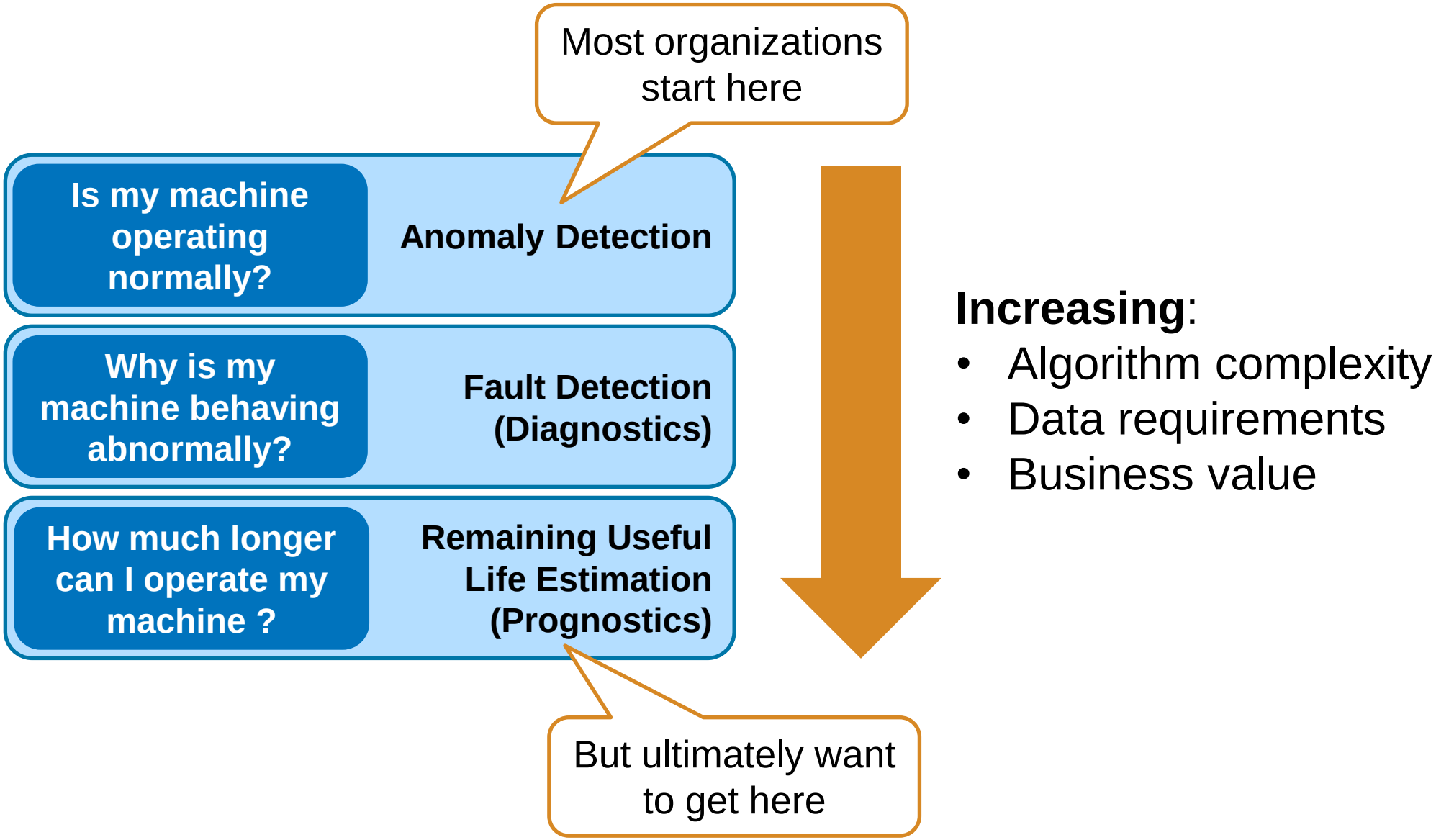


I need help.

One of my cylinders is blocked.

I will shut down your line in 15 hours.

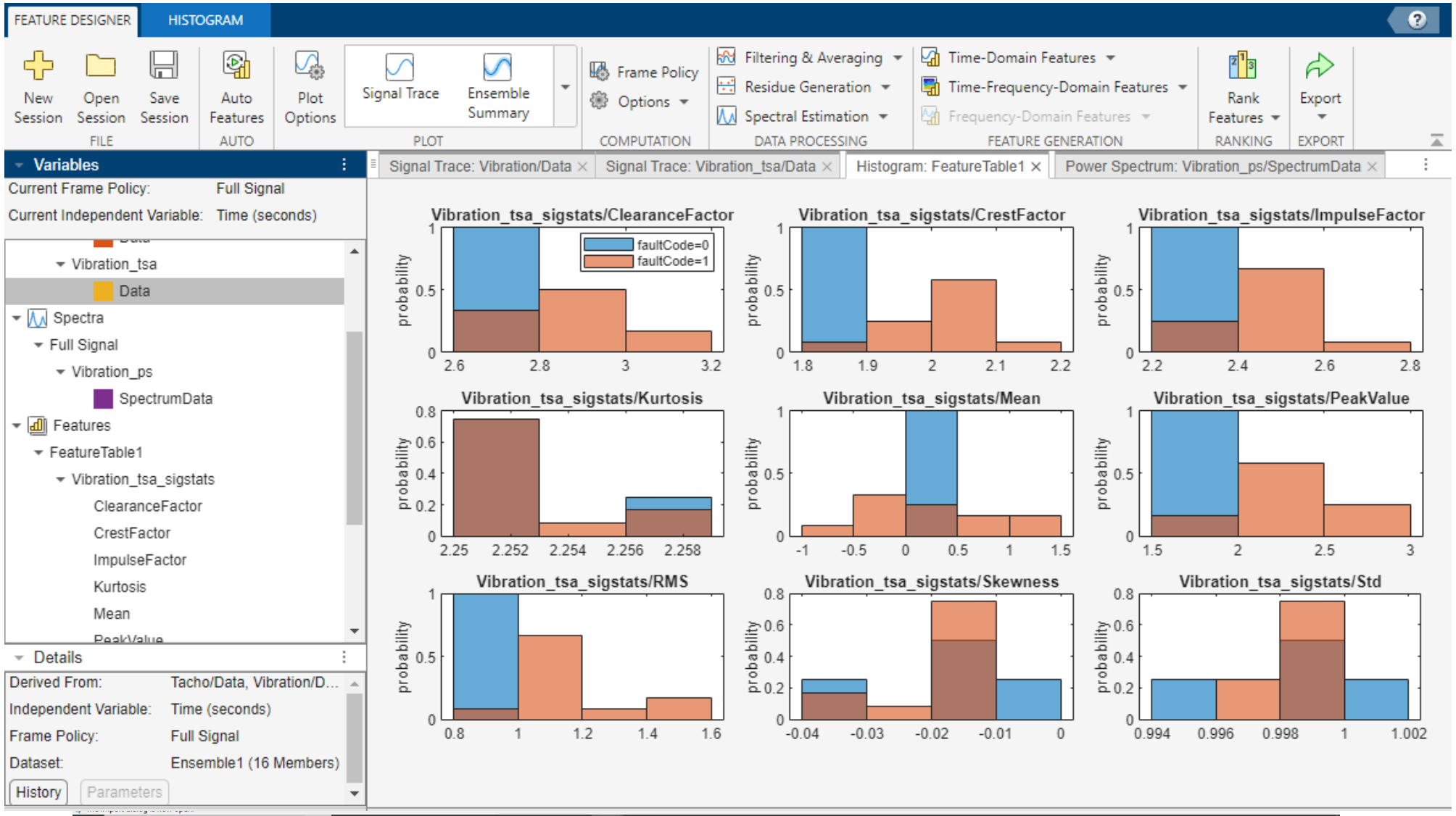
What does a predictive maintenance algorithm do?



Increasing:

- Algorithm complexity
- Data requirements
- Business value

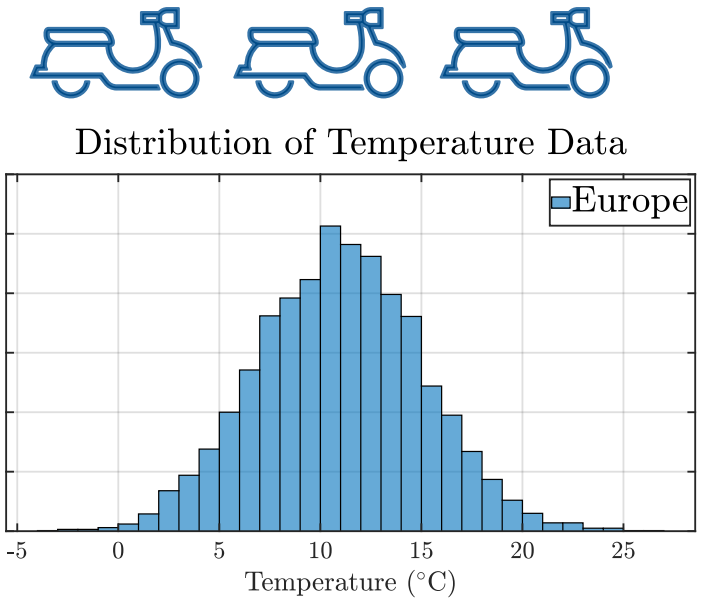
MATLAB apps to extract and generate new features

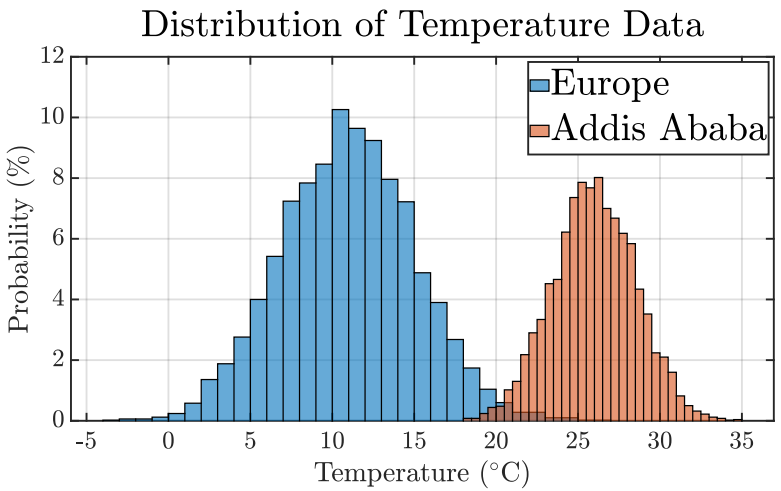


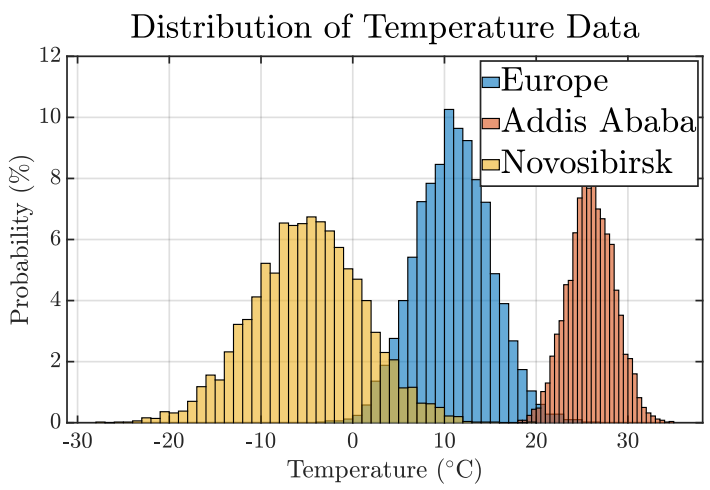
MATLAB for Predictive Maintenance

Data and concept drifting

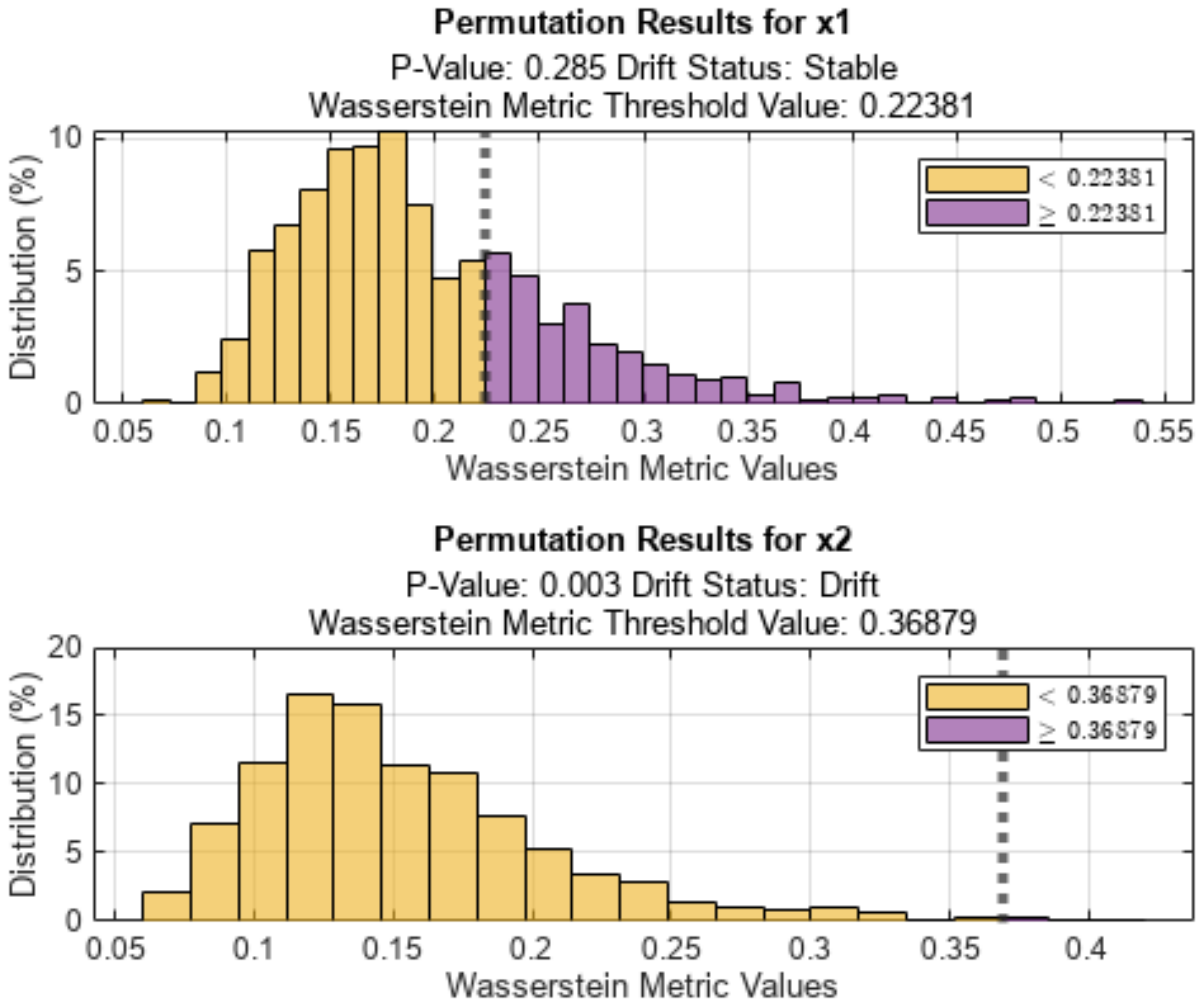
Why data/concept drift? Because static data/model assumption rarely holds in the real world







Data drifting: detect drift from baseline



*"More than **half** of AI Models Never Make It To Production"*

Source: Gartner 2021

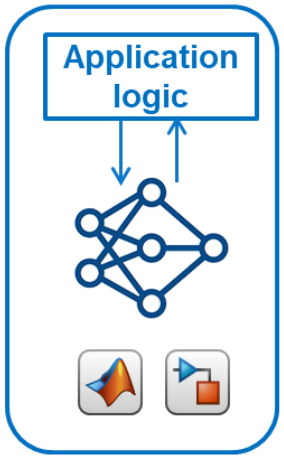
Predictive Maintenance and data drifting

From development to production

How to deploy applications and integrate them in an IT ecosystem

Testing and CI/CD deployment

Other deployment - Code generation for Machine/Deep Learning



Coders

Optimization library

Optimization library

Optimization library

Library free source code

intel

OneDNN Library

arm

ARM Compute Library

NVIDIA

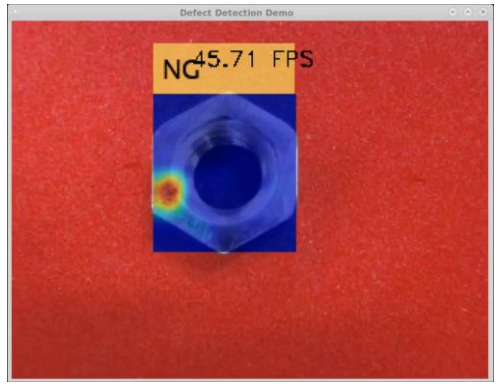
TensorRT and cuDNN Libraries

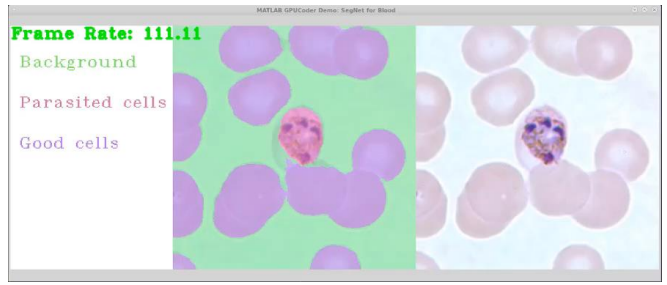
Any CPU

Plain C Code
No Library Needed

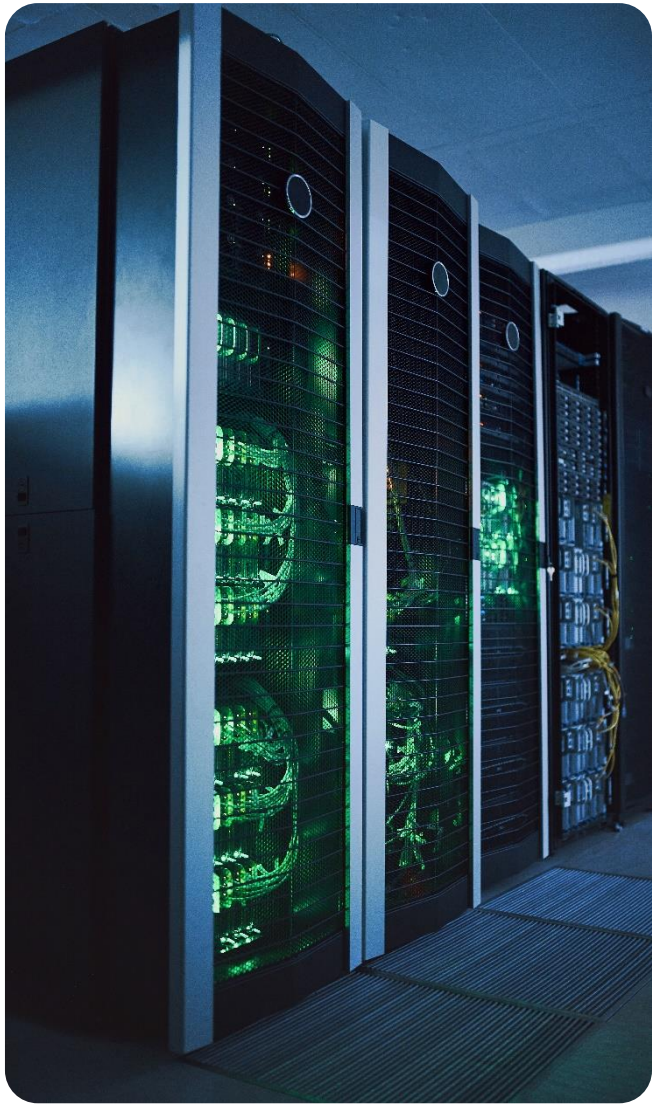
TensorFlow Lite

Support for TFLite	R2022a



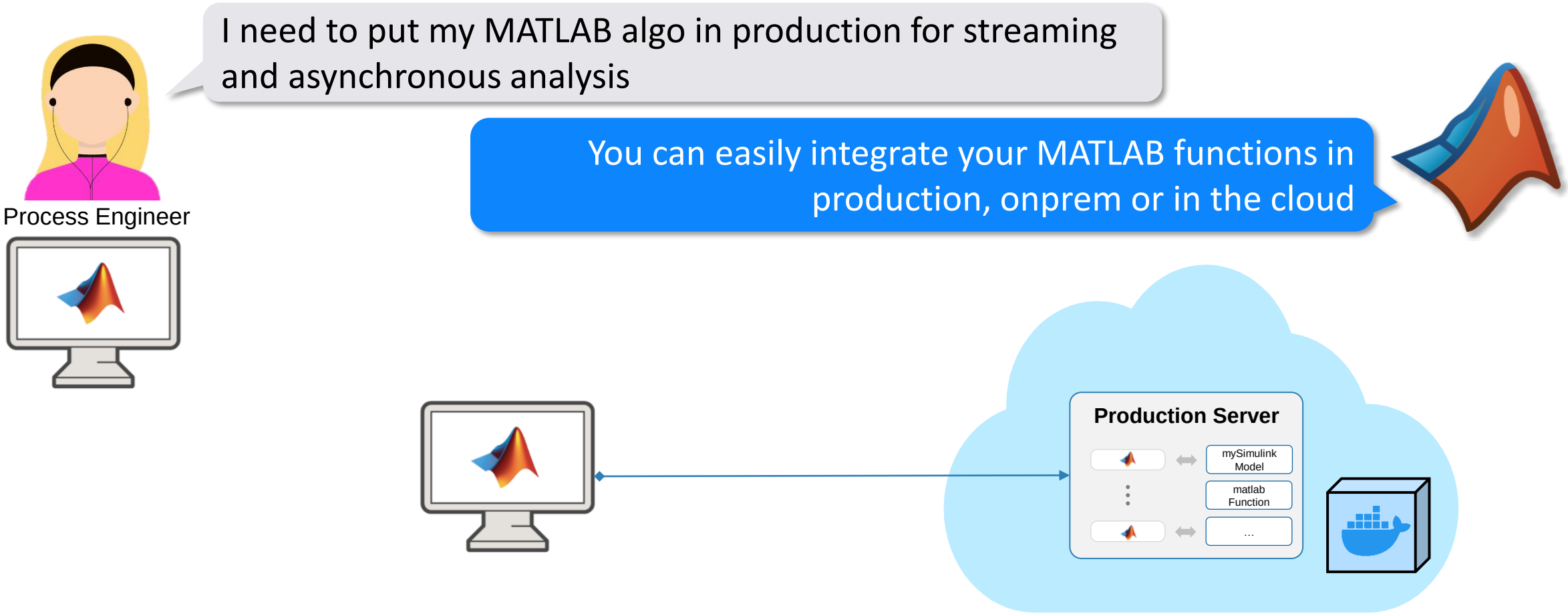


Integrate functions and applications in an IT ecosystem

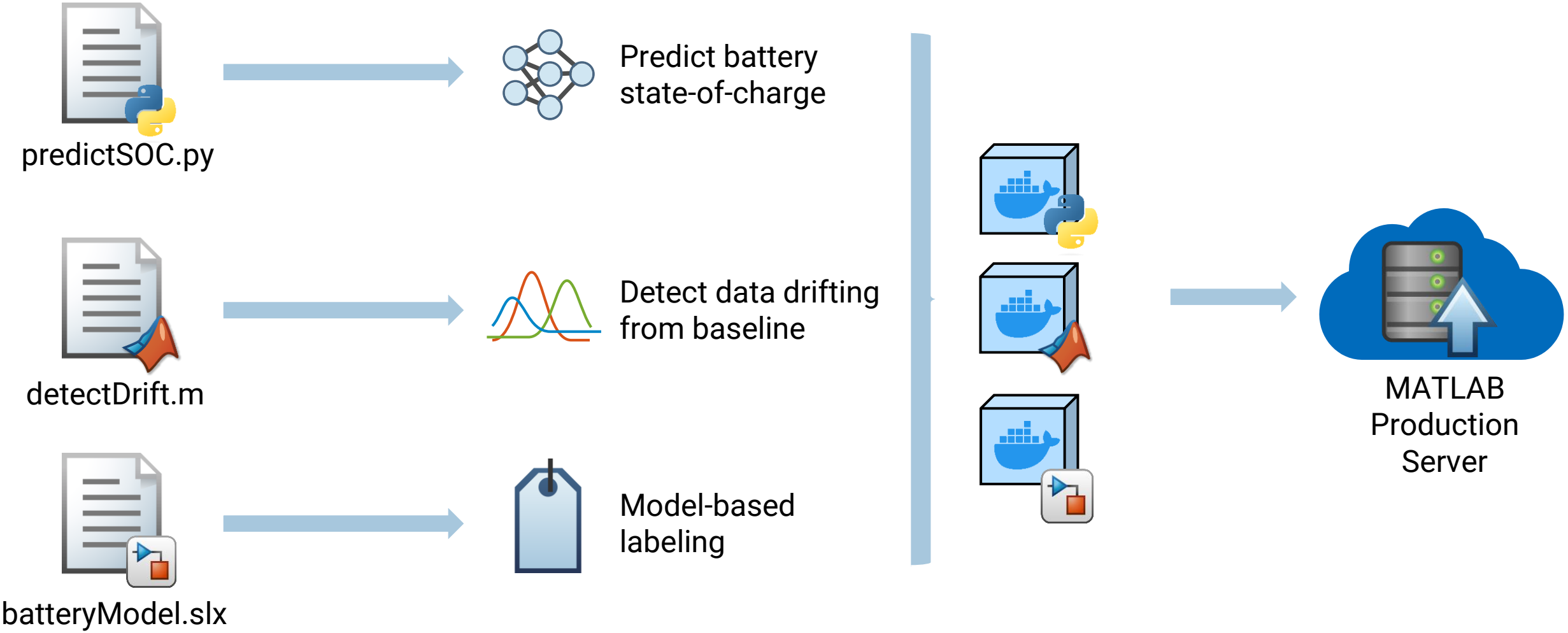


- Ease-to-use functions and apps allow you to deploy applications without any IT skills
- Integrate MATLAB & Simulink into your entreprise applications with an endpoint HTTPS and REST API
- Many different ways to deploy your algorithms

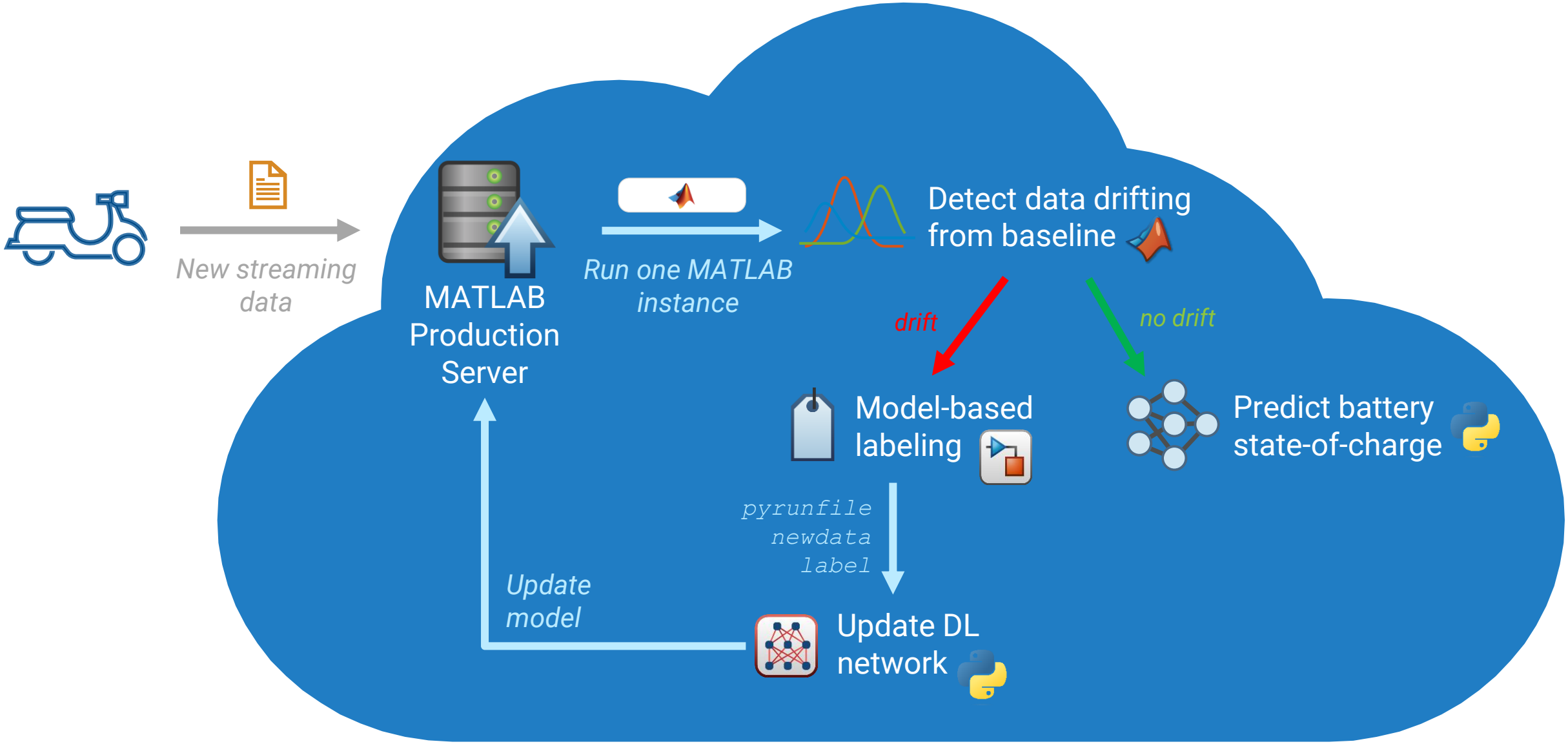
Generate web services and microservices



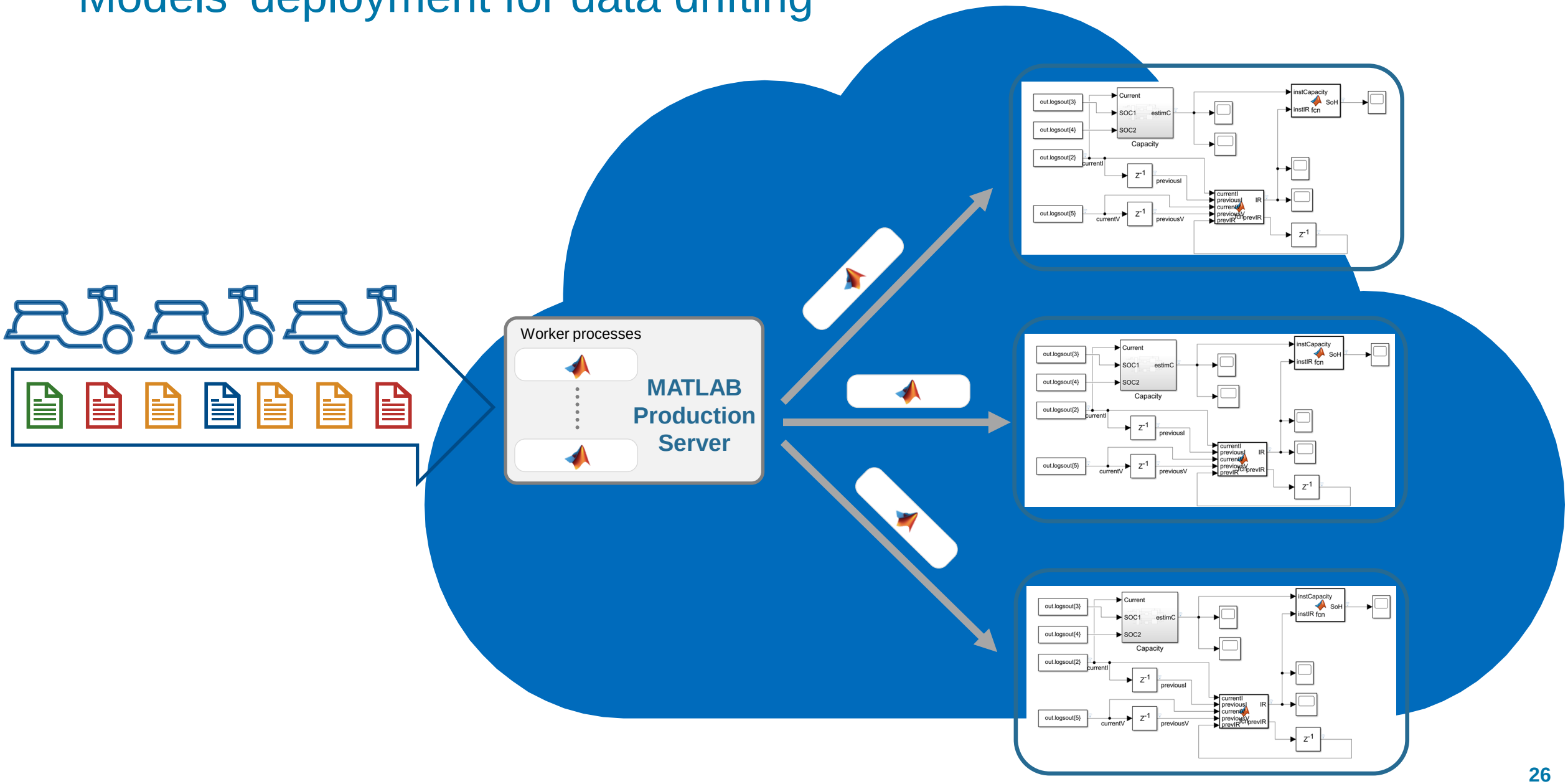
Models' deployment for data drifting



Models' deployment for data drifting



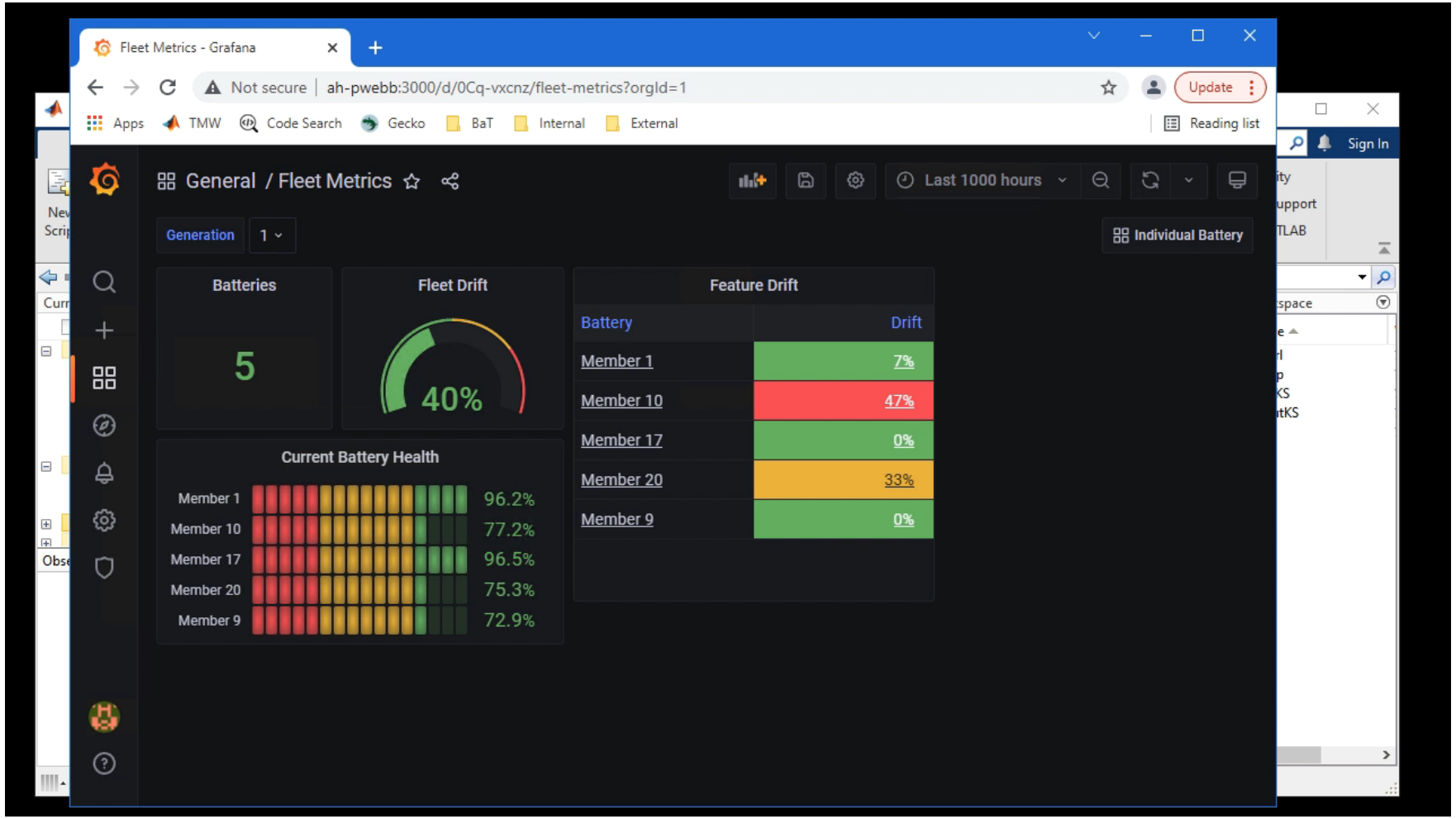
Models' deployment for data drifting



Deployment for streaming analysis

Models' deployment for data drifting

Case study: Step 6 – Integrate algorithms in Grafana



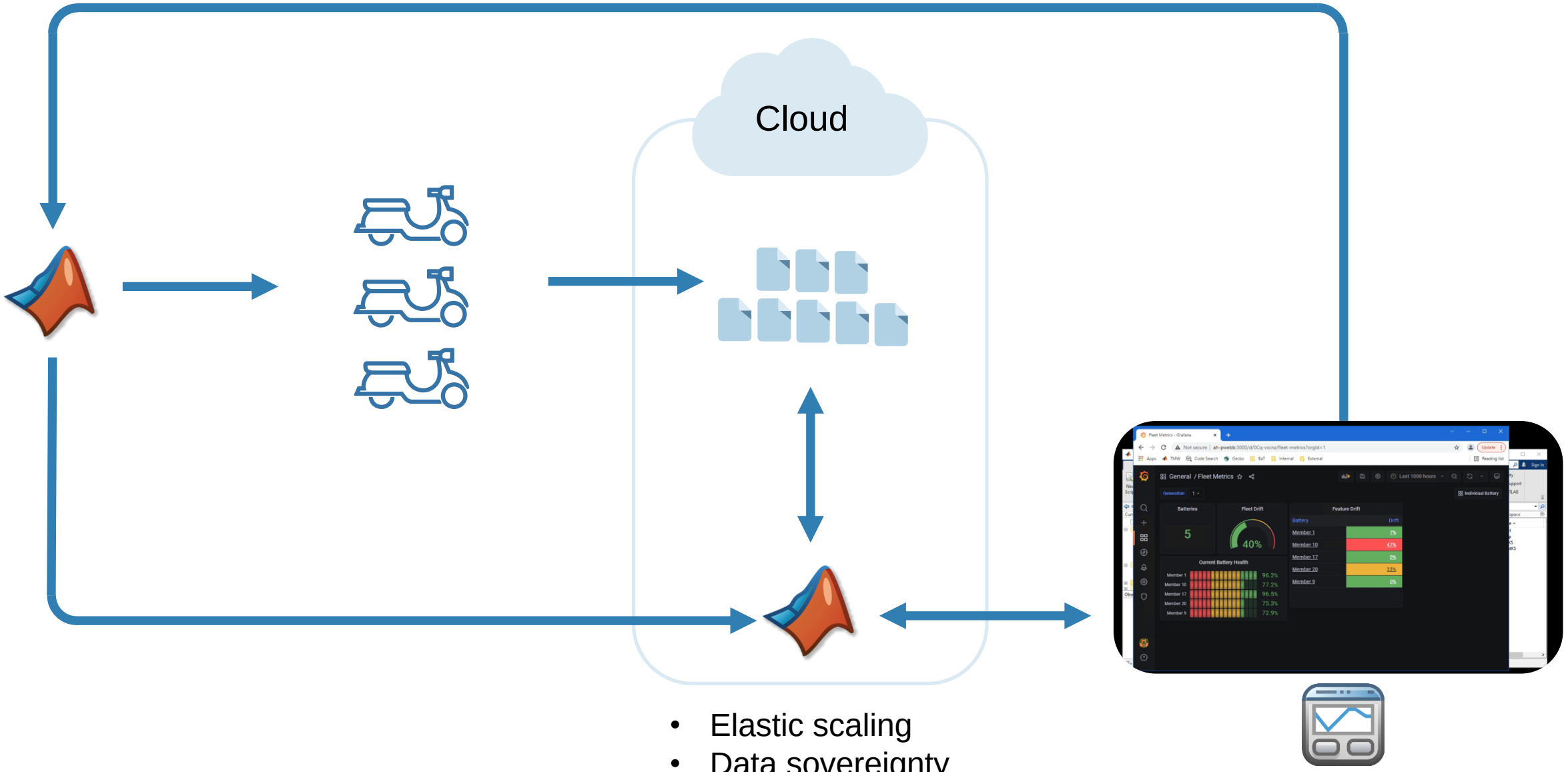
MBD meets AI

Predictive Maintenance and data drifting

From development to production

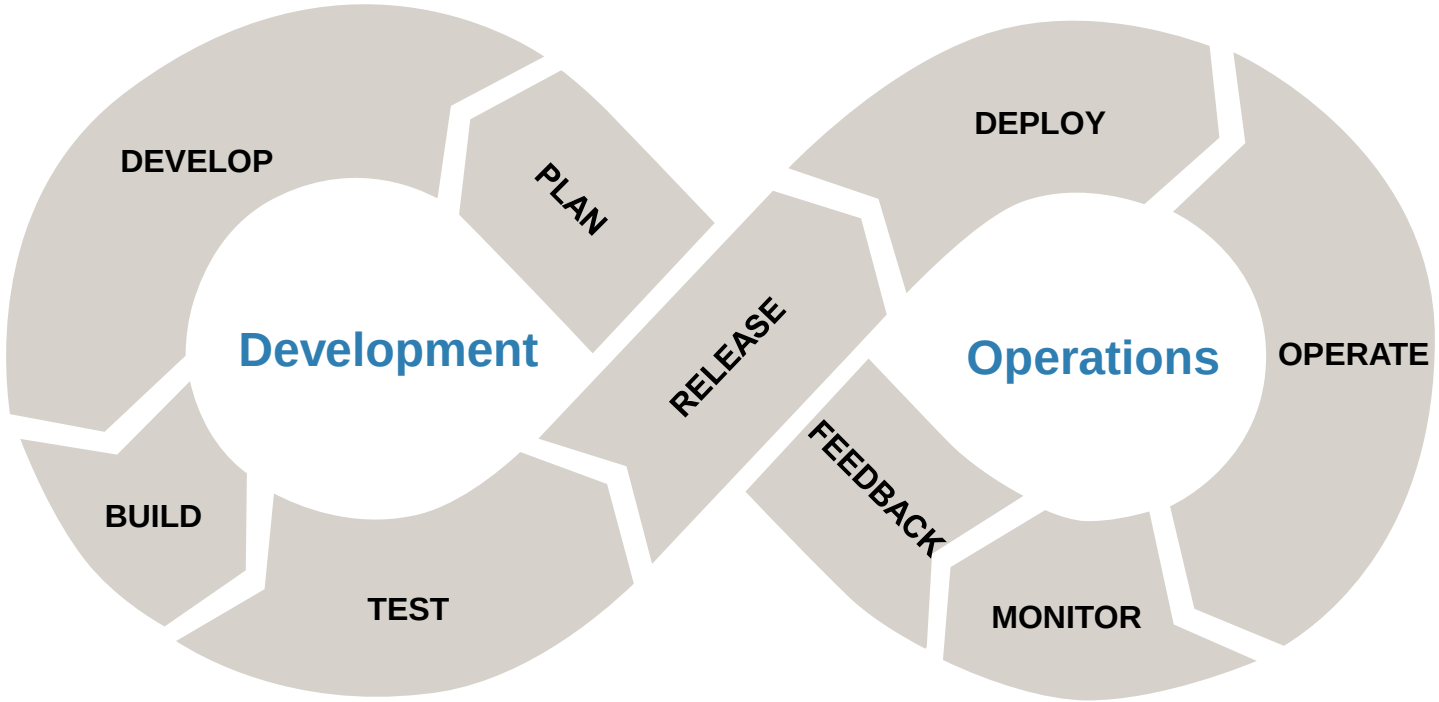
Testing and CI/CD deployment

How to integrate your whole workflow in a local testing and a CI/CD pipeline

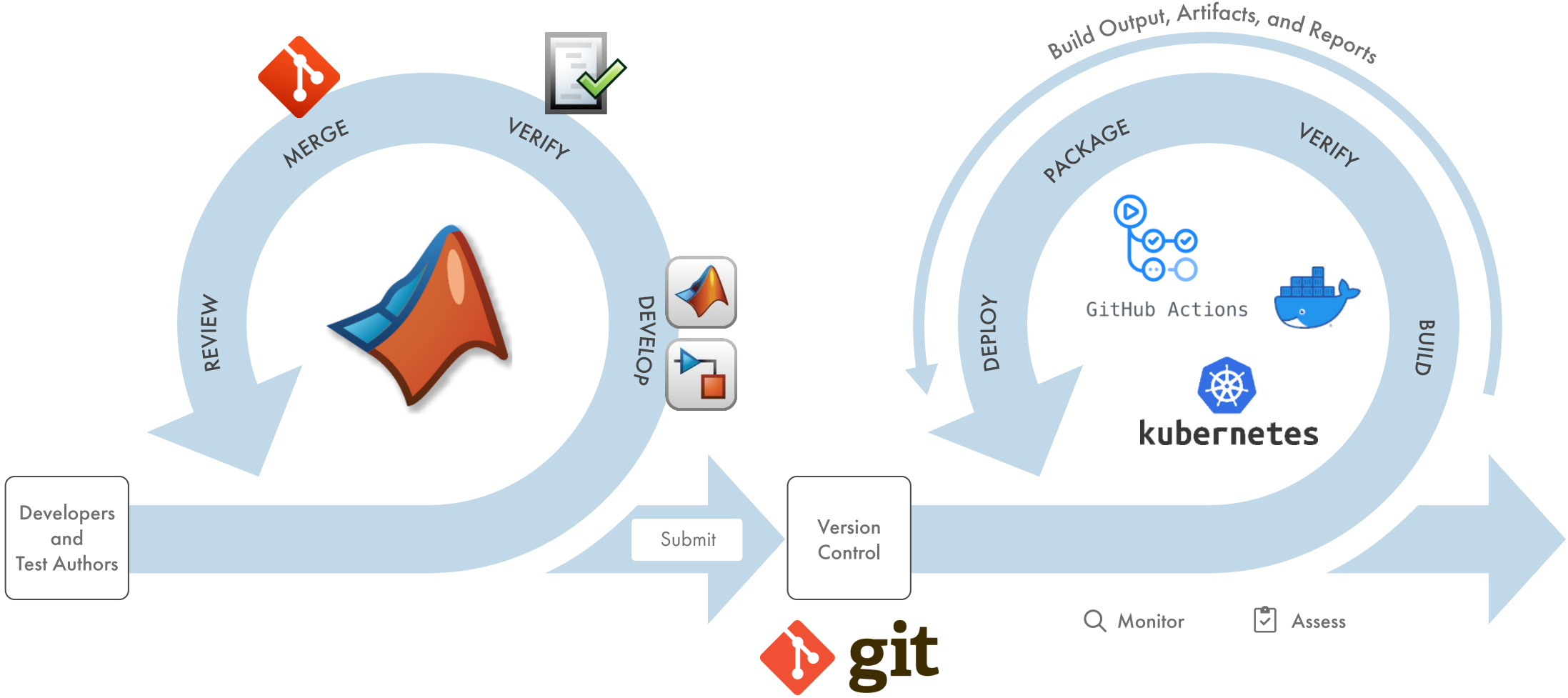


- Elastic scaling
- Data sovereignty
- Automation
- Multiple uses

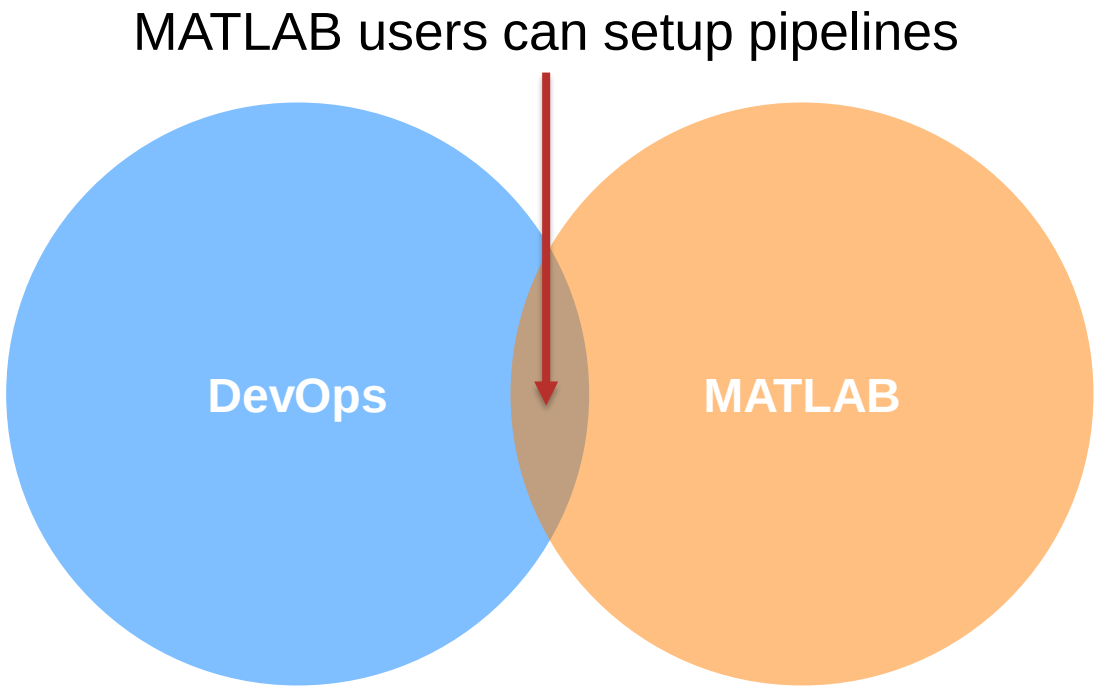
DevOps Lifecycle



DevOps Lifecycle

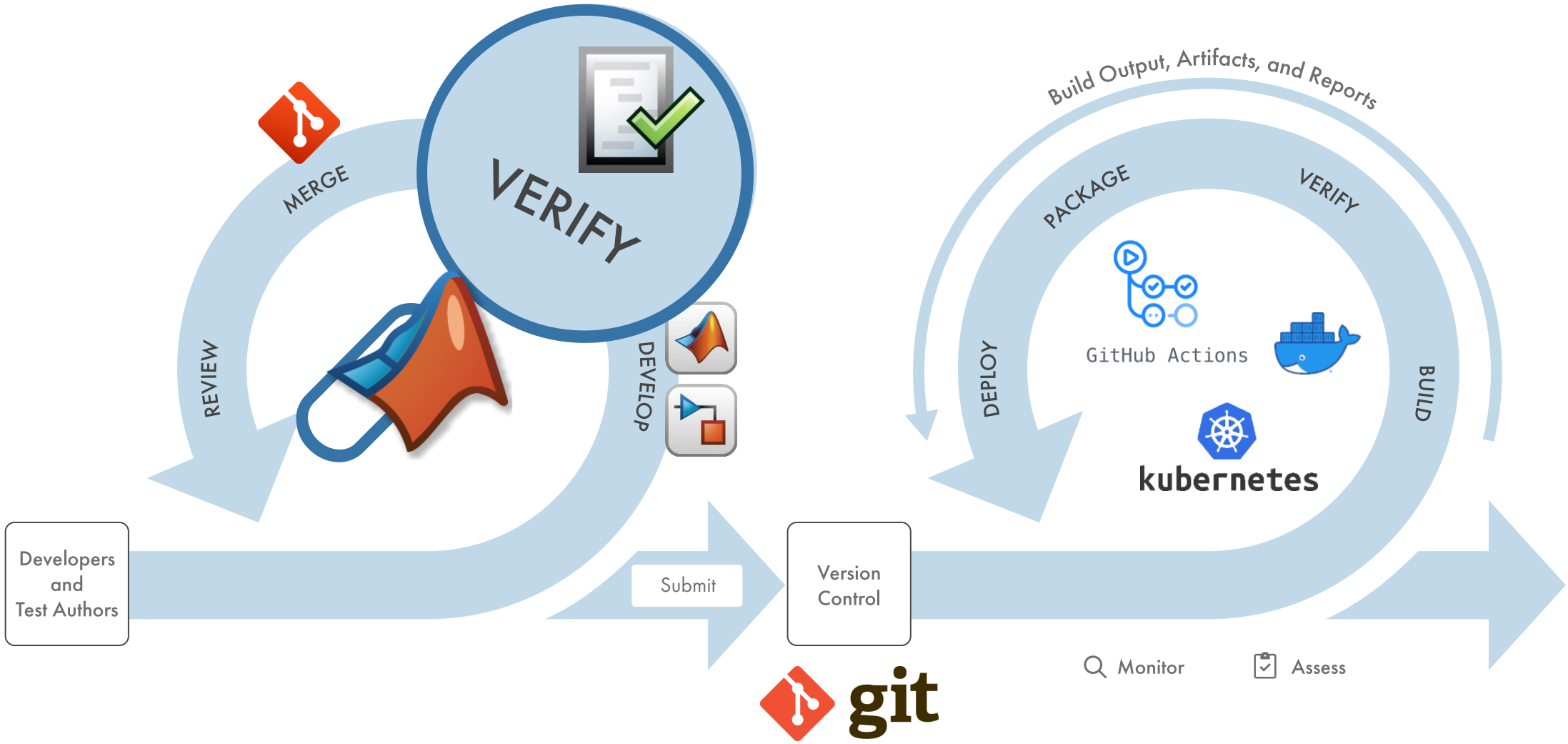


Simplifying Continuous Integration for MATLAB & Simulink users

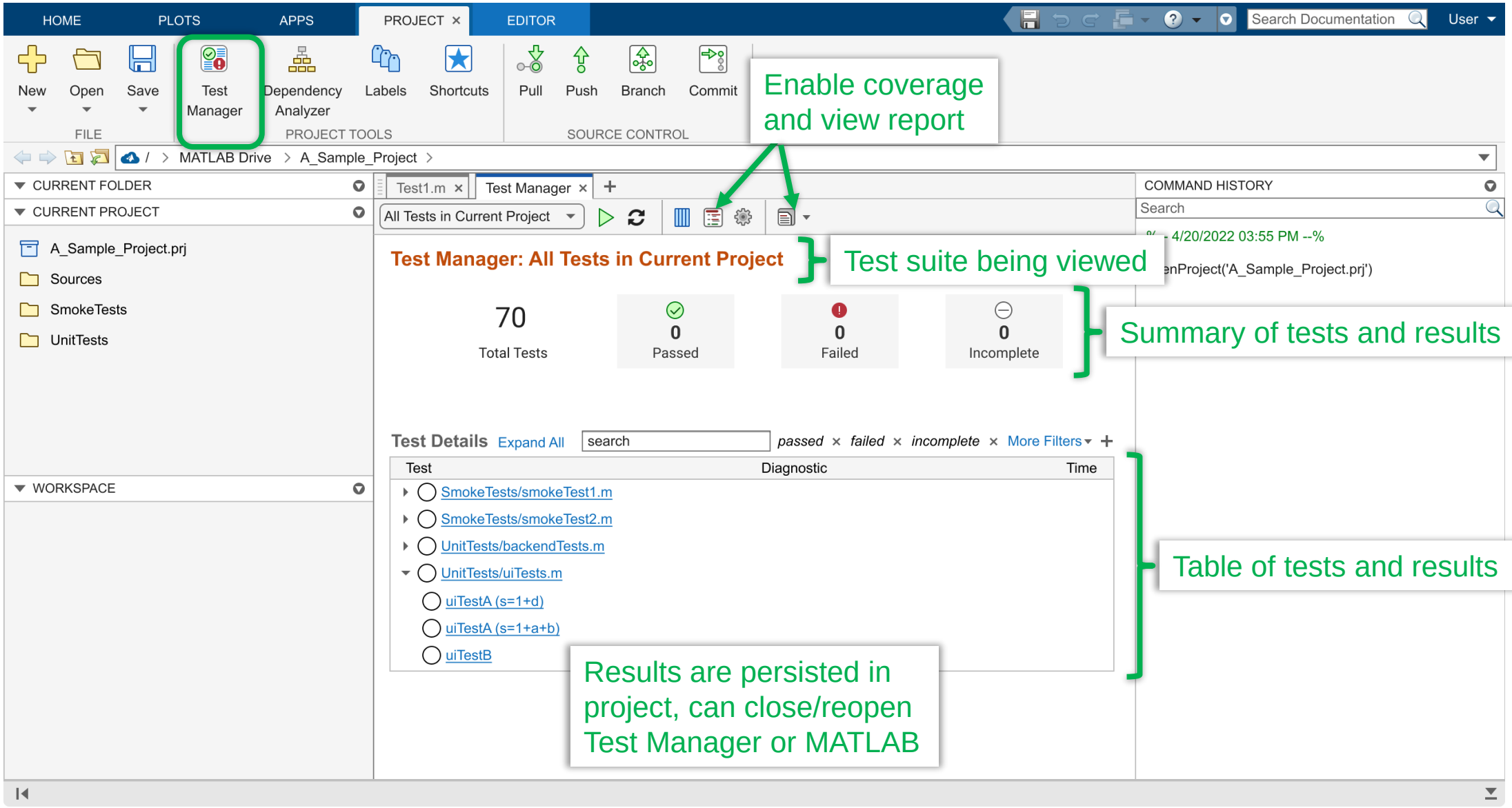


- Enable users to model pipeline inside MATLAB
- Create single integration point for DevOps engineers
- Empower users to maintain and debug pipeline

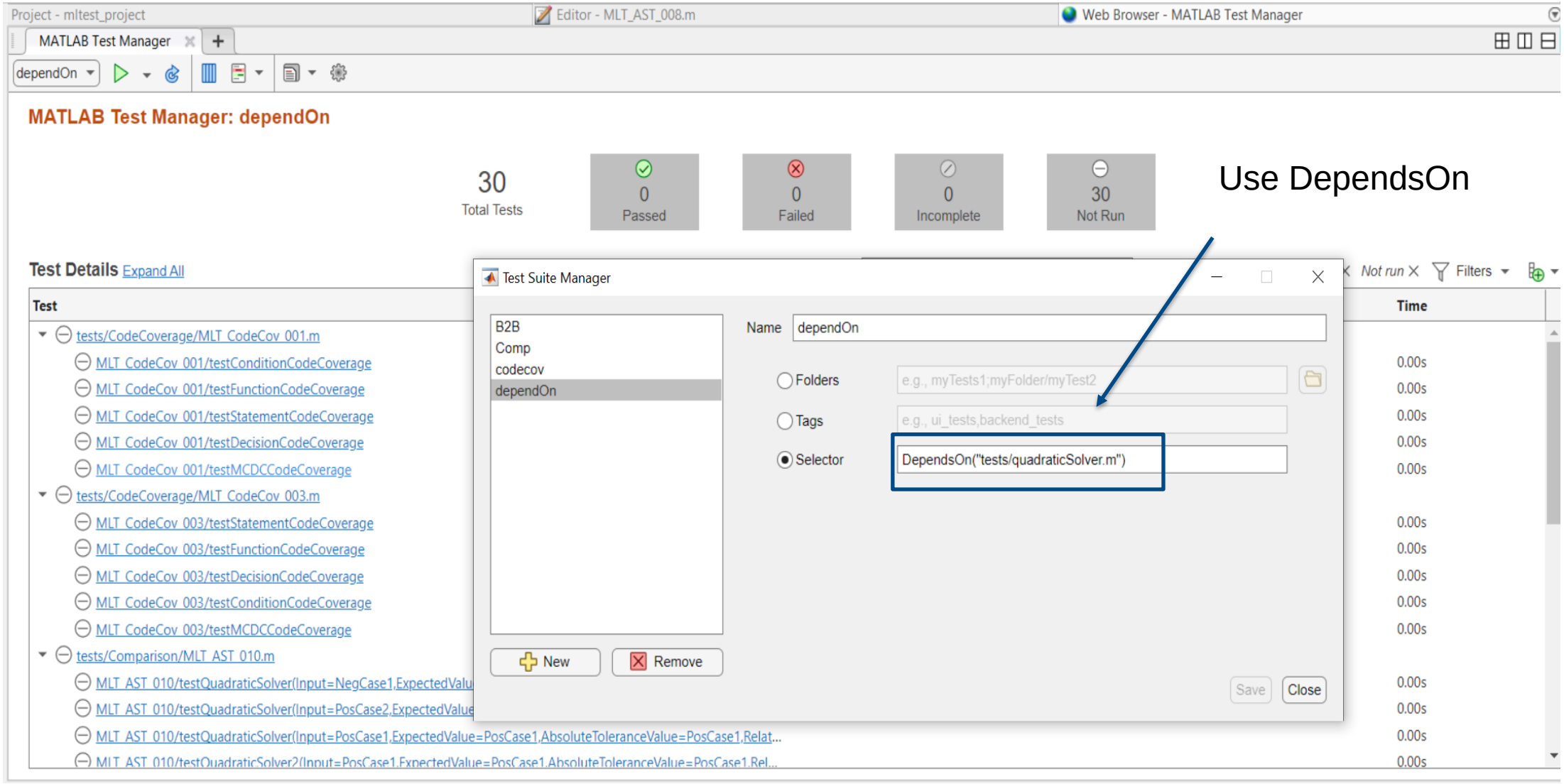
Write and run your tests locally



1 – Write and manage test locally

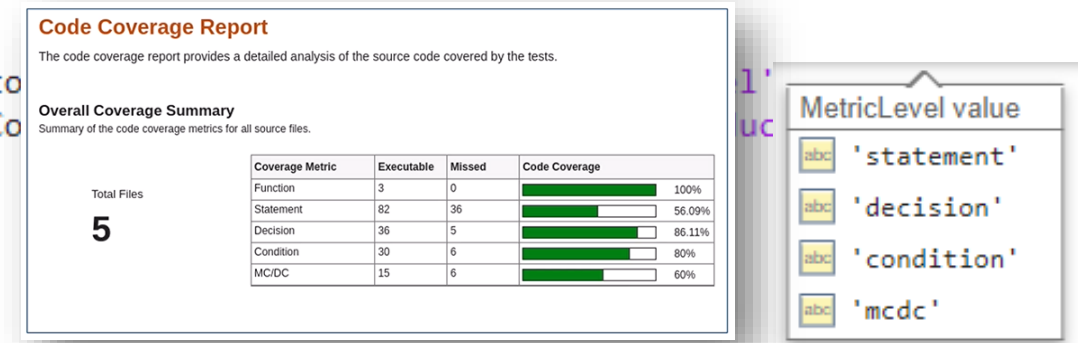


Test selector with *DependsOn*!



Coverage metrics: tells you what you have tested

```
% Advanced Metrics
format = matlab.unittest.plugins.co
plugin = matlab.unittest.plugins.Co
```



MATLAB

Statement & Function Coverage

R2022a

MATLAB Test

Decision Coverage

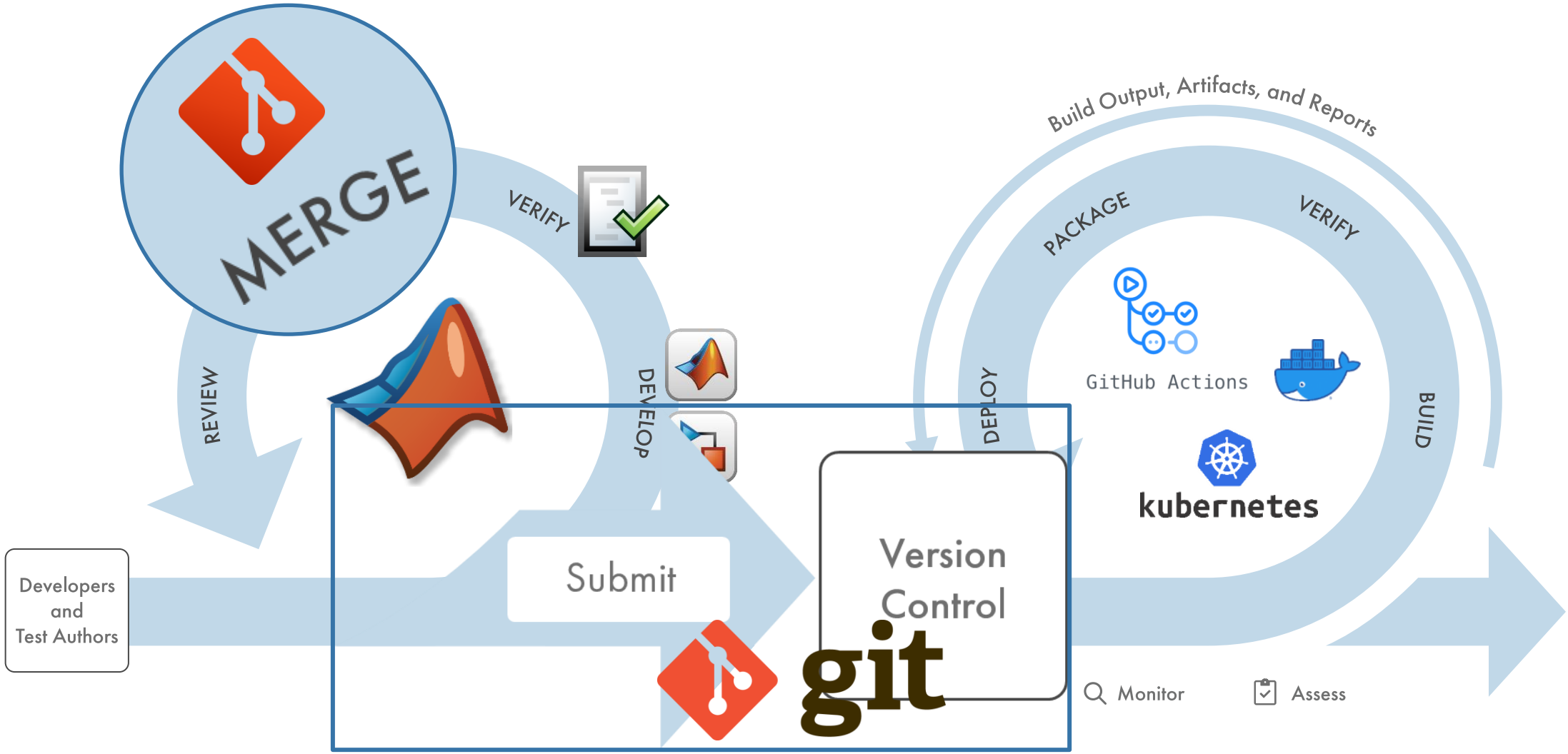
Condition Coverage

Modified Condition/ Decision Coverage

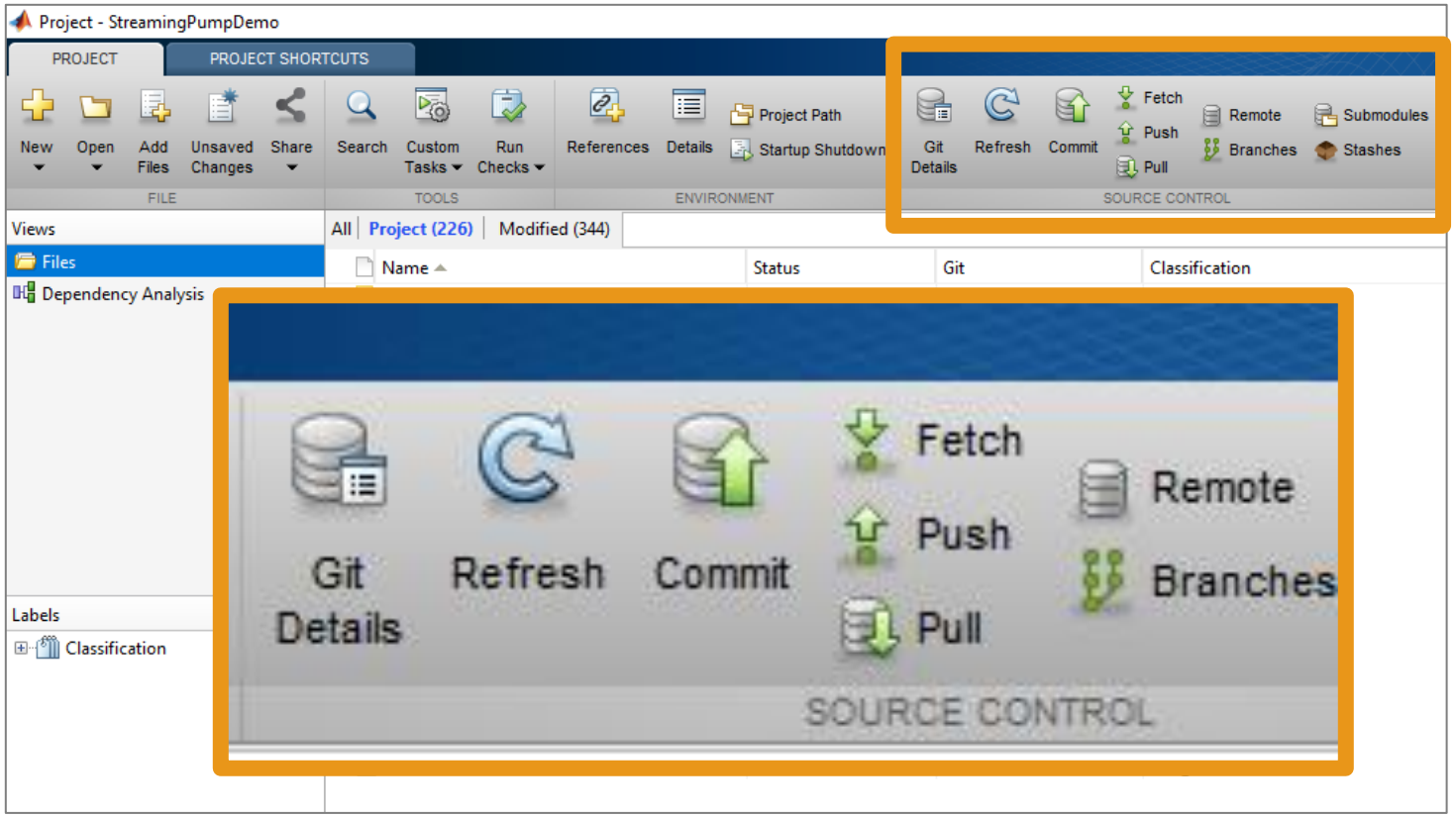
R2023a

Equivalence testing feature: Catch issues before leaving MATLAB

Version control



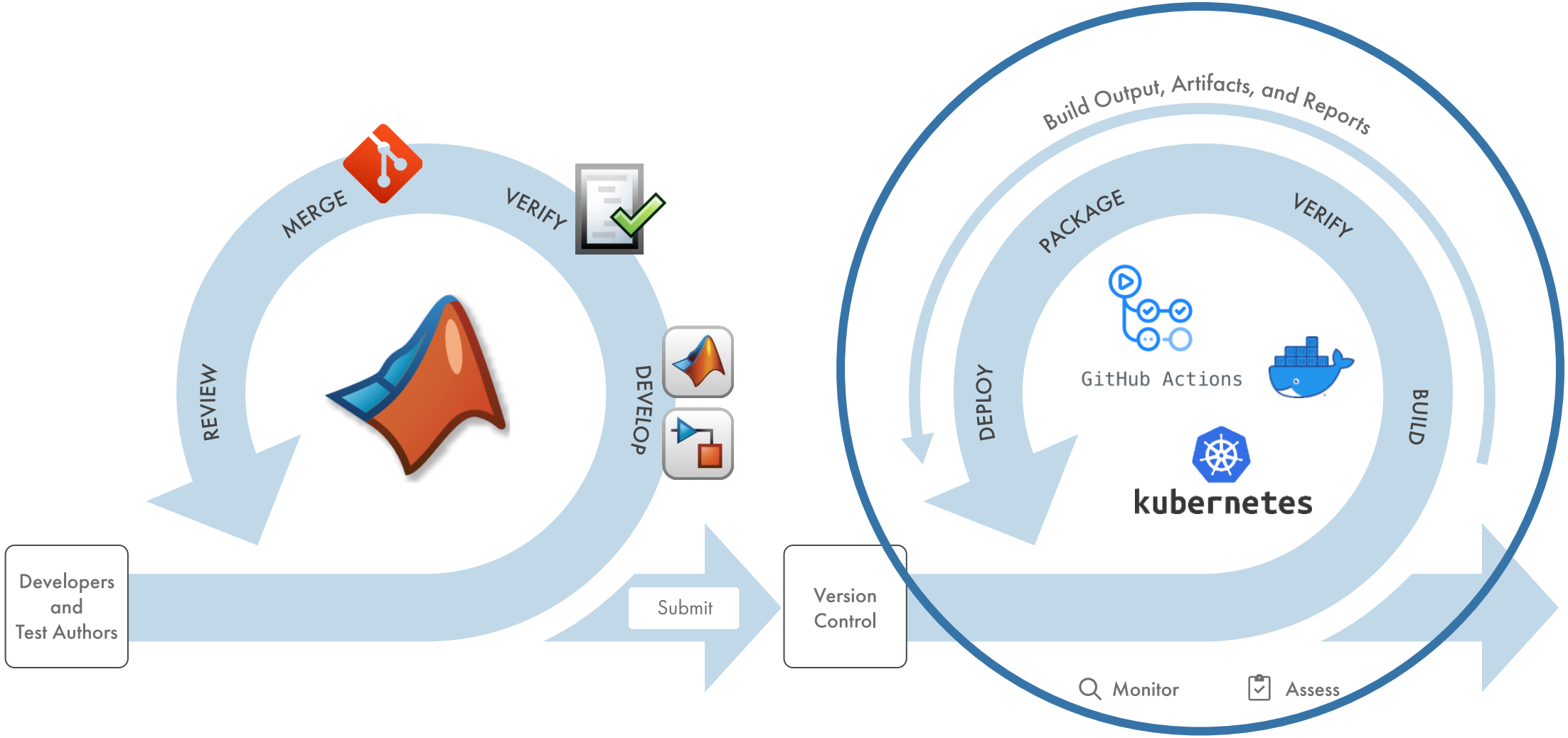
2 – Version your code locally and directly from MATLAB



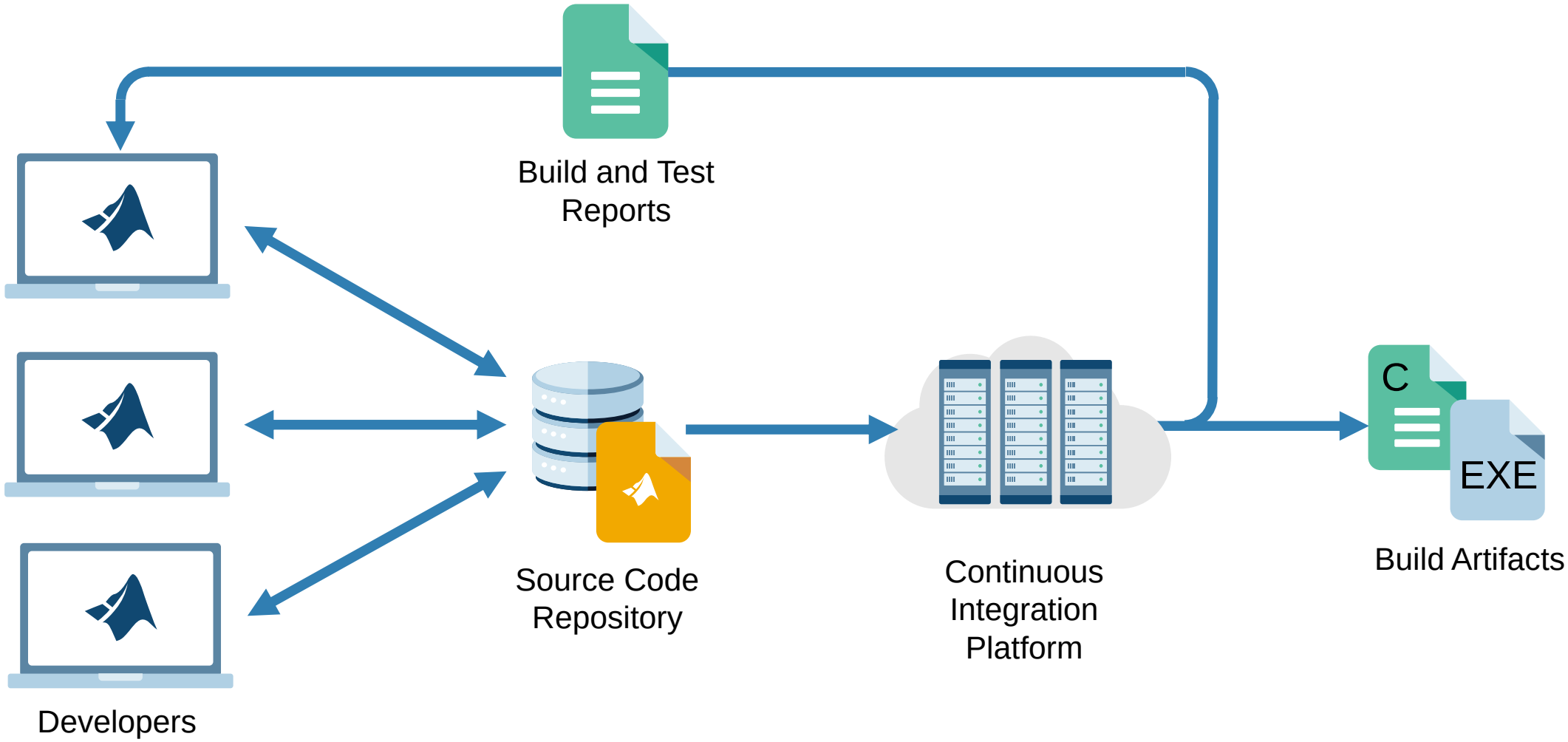
TortoiseSVN

git

Version control



What does a CI-based workflow look like?



Deploy – Create a Microservice in MATLAB

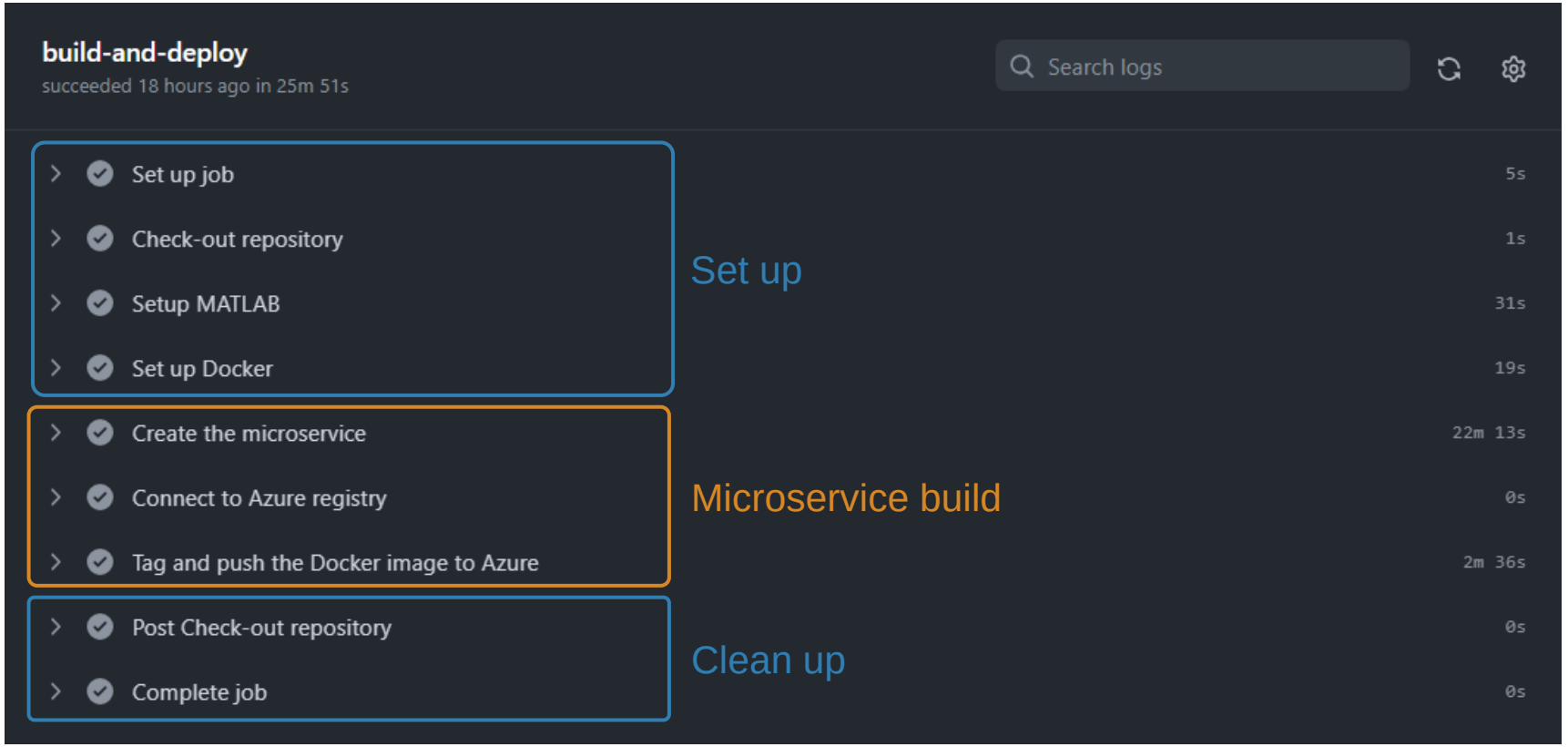
- Requirements:
  - Docker
  - MATLAB Compiler
  - MATLAB Compiler SDK
  - Simulink Compiler

- Code:

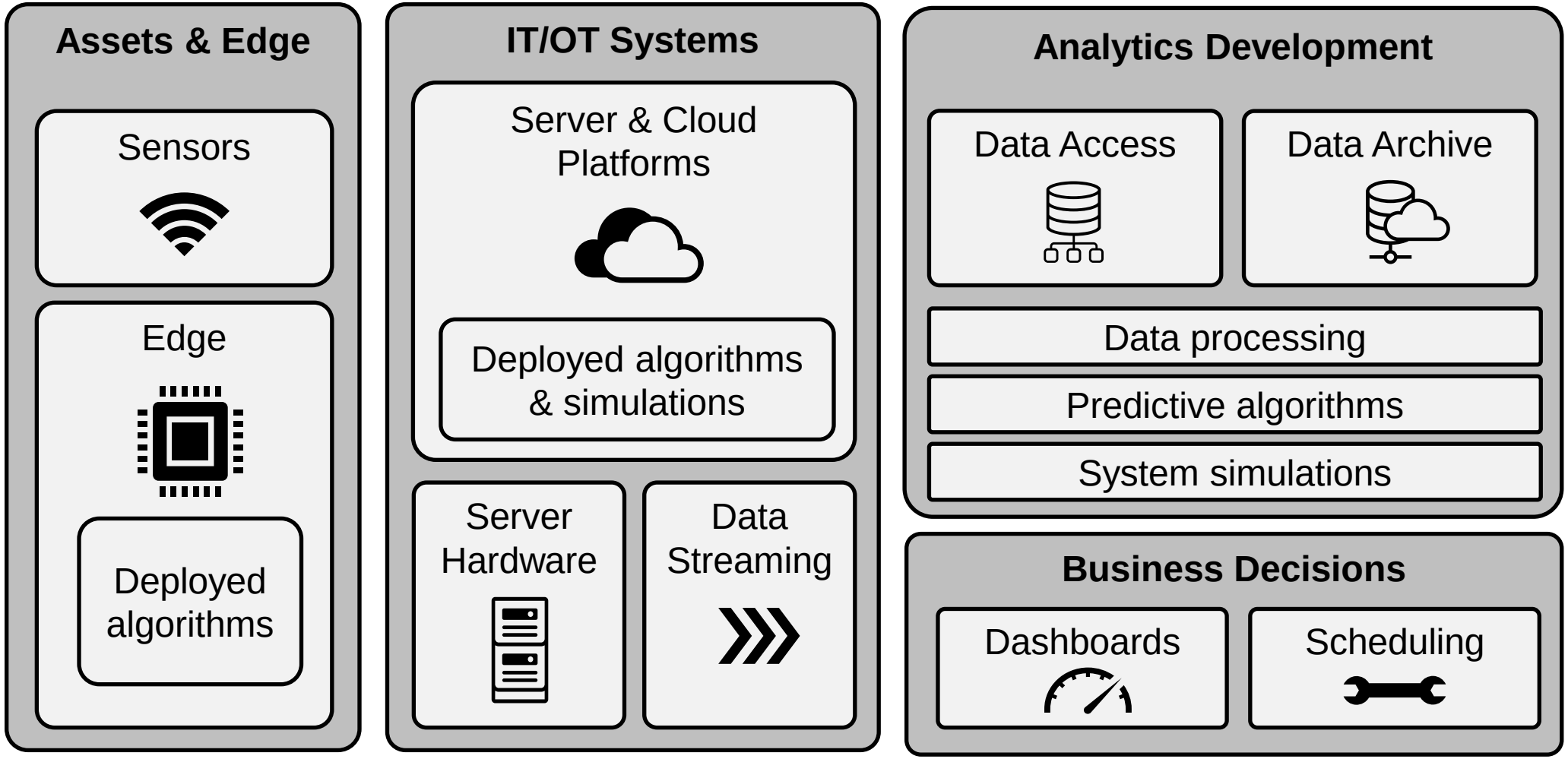
```
mpsResults = compiler.build.productionServerArchive("myFunction.m");

compiler.package.microserviceDockerImage(mpsResults,…
                                         "ImageName","micro-myfunction");
```

Deploy – Integration with the DevOps Pipeline

- How to use it in pipeline



A predictive maintenance solution is more than an algorithm



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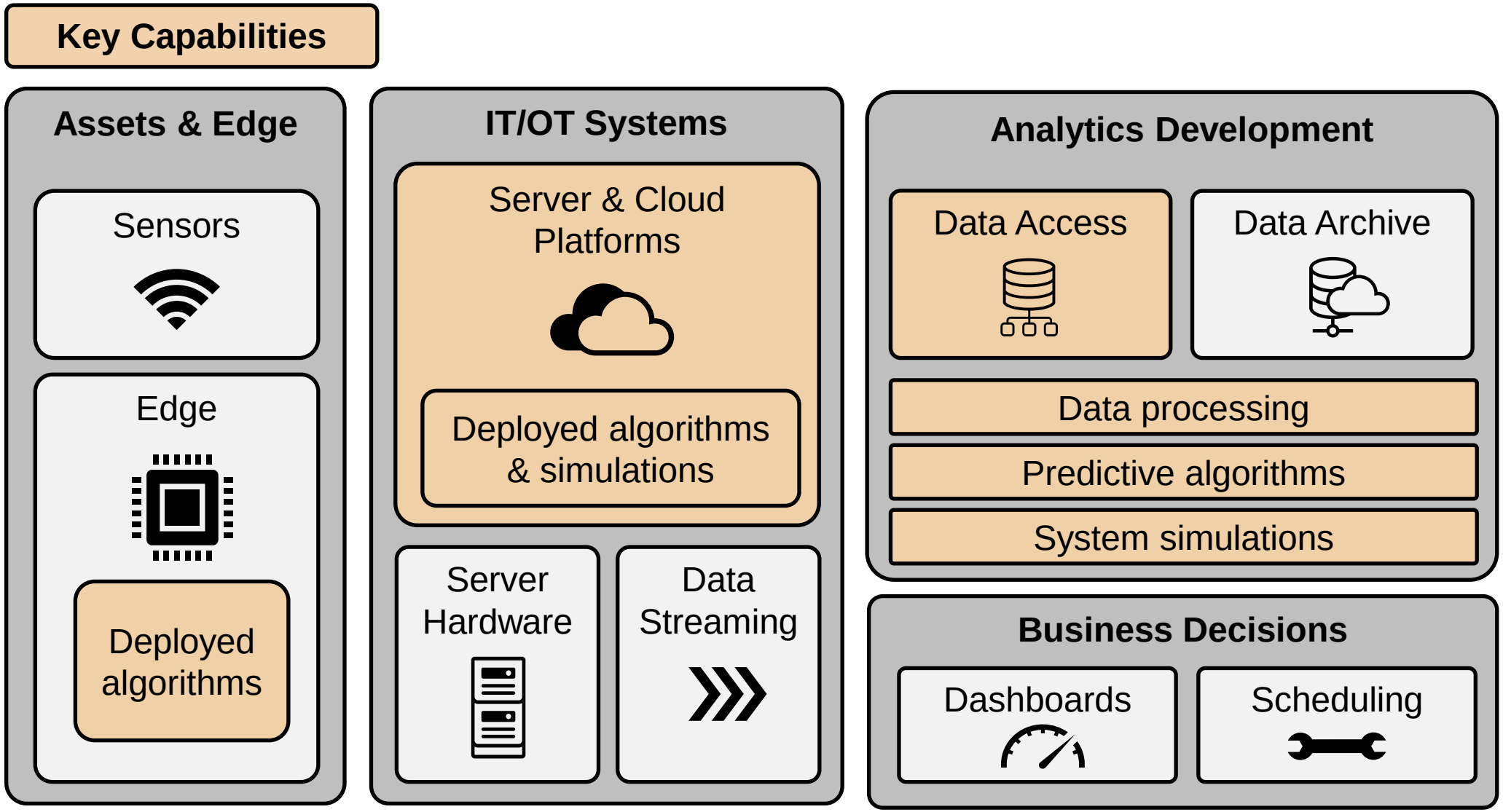

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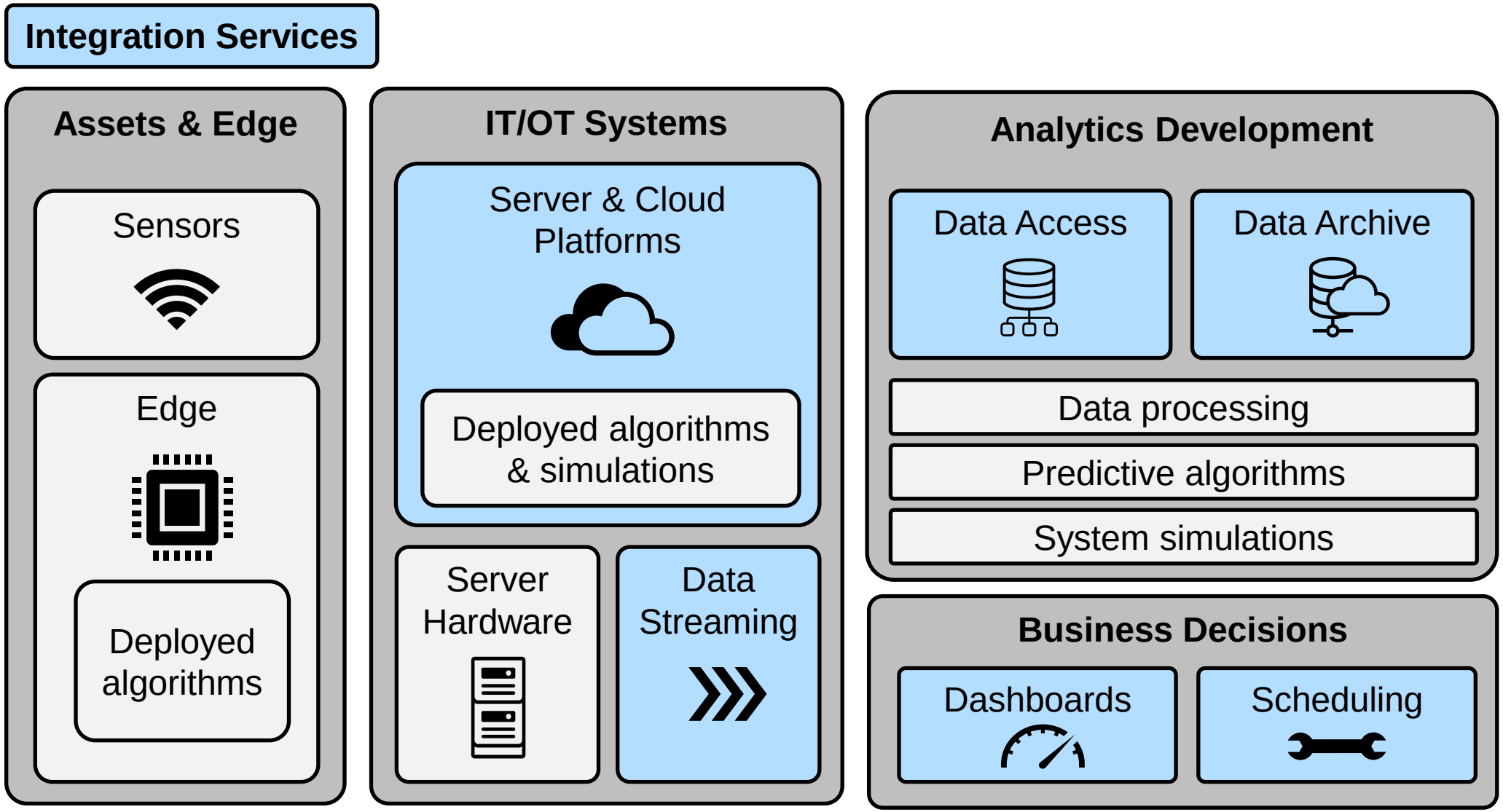

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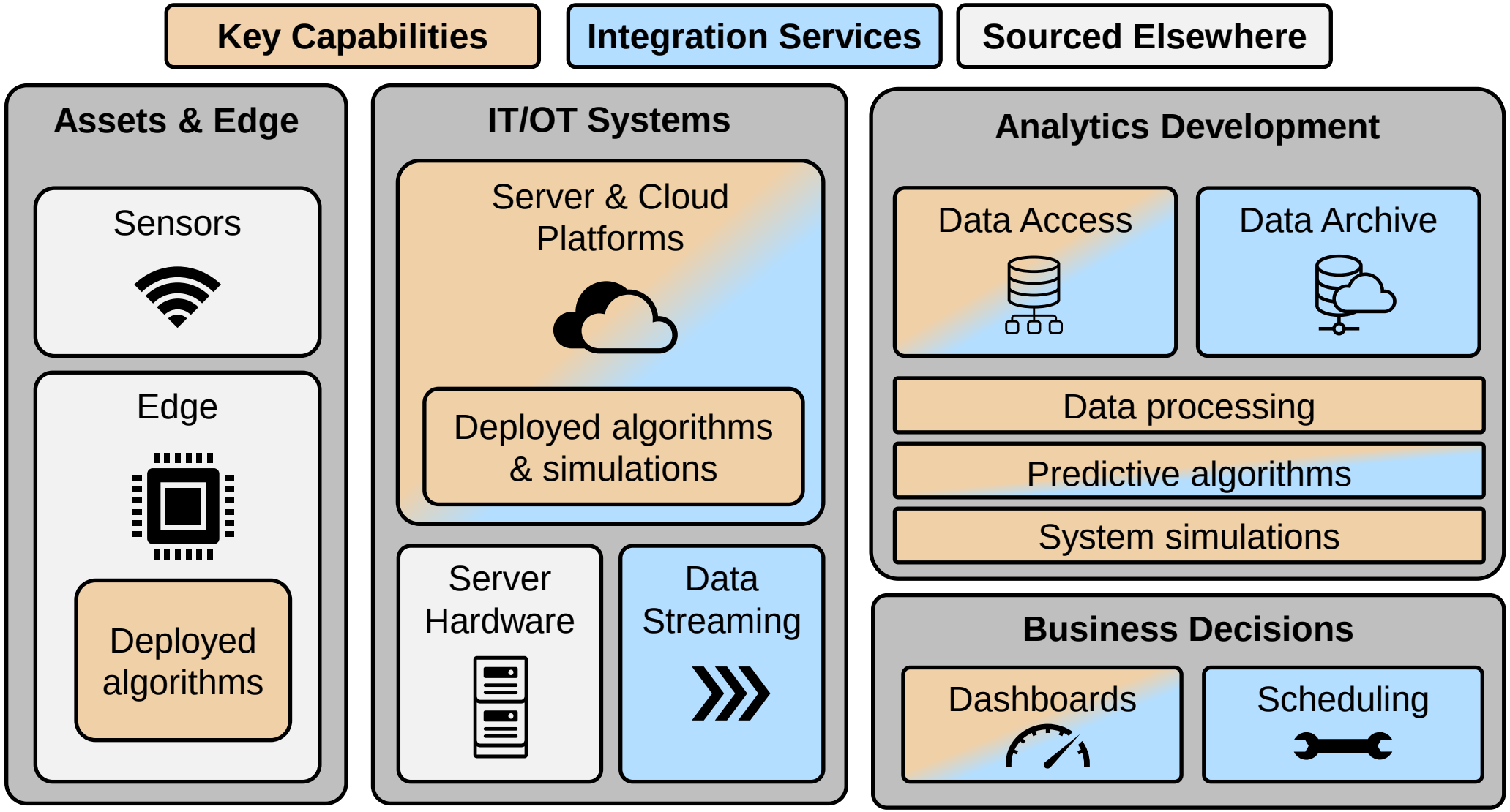

Not Me

MATLAB EXPO

FRANCE

Thank you!
Questions?