

MATLAB EXPO

使用MATLAB进行DevOps: 流数据的预测性维护系统



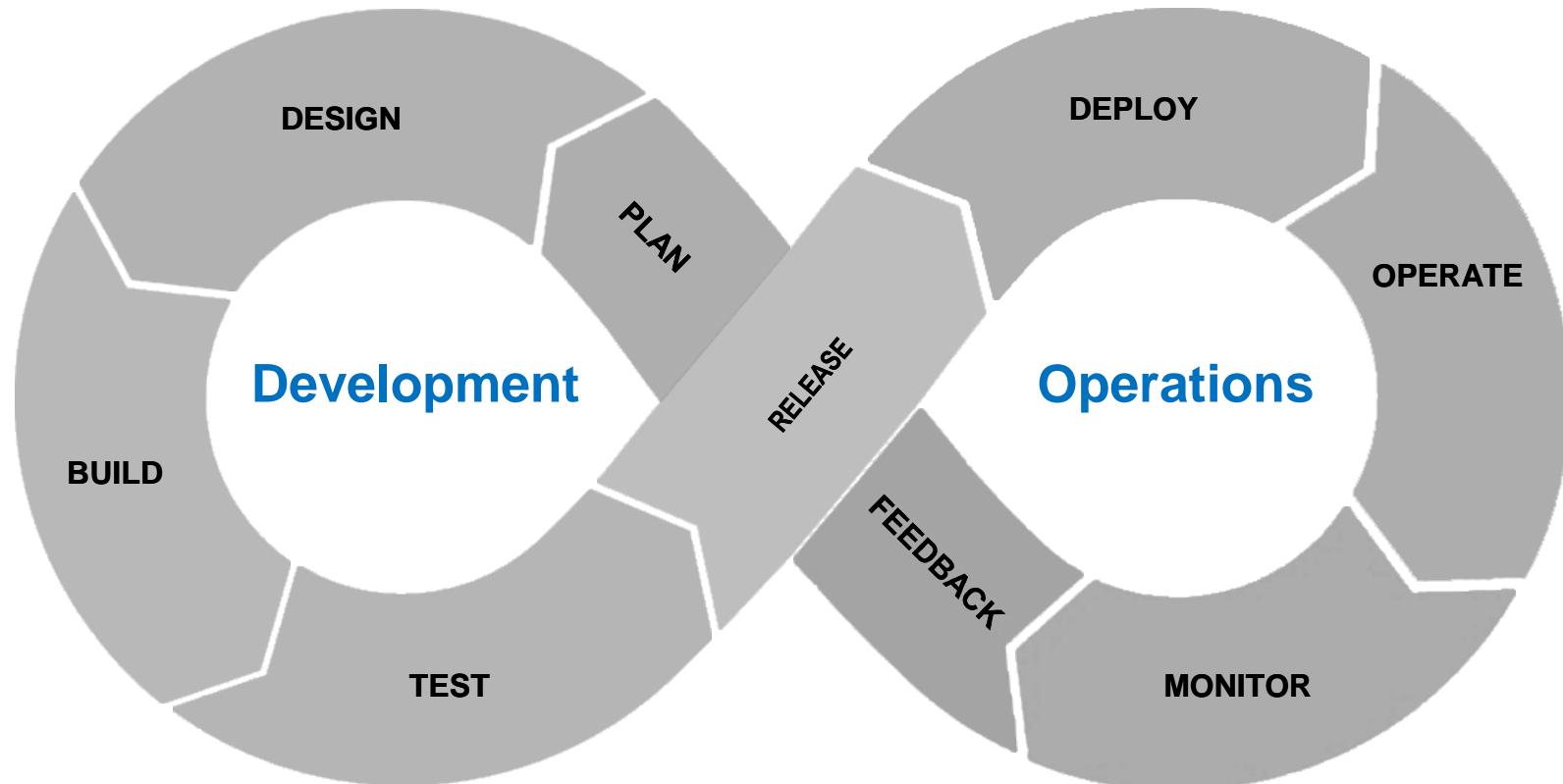
刘海伟
MathWorks中国



主要内容

- 利用**MATLAB**已有的能力 包括预测性维护和漂移检测
- 集成到生产系统 例如数据源和仪表板，并将这些集成从桌面扩展到云端
- 结合CI/CD自动化完成**MATLAB**代码和**Simulink**模型的**build, test, package, deploy**

DevOps: 开发和运营生产软件



Predictive Maintenance

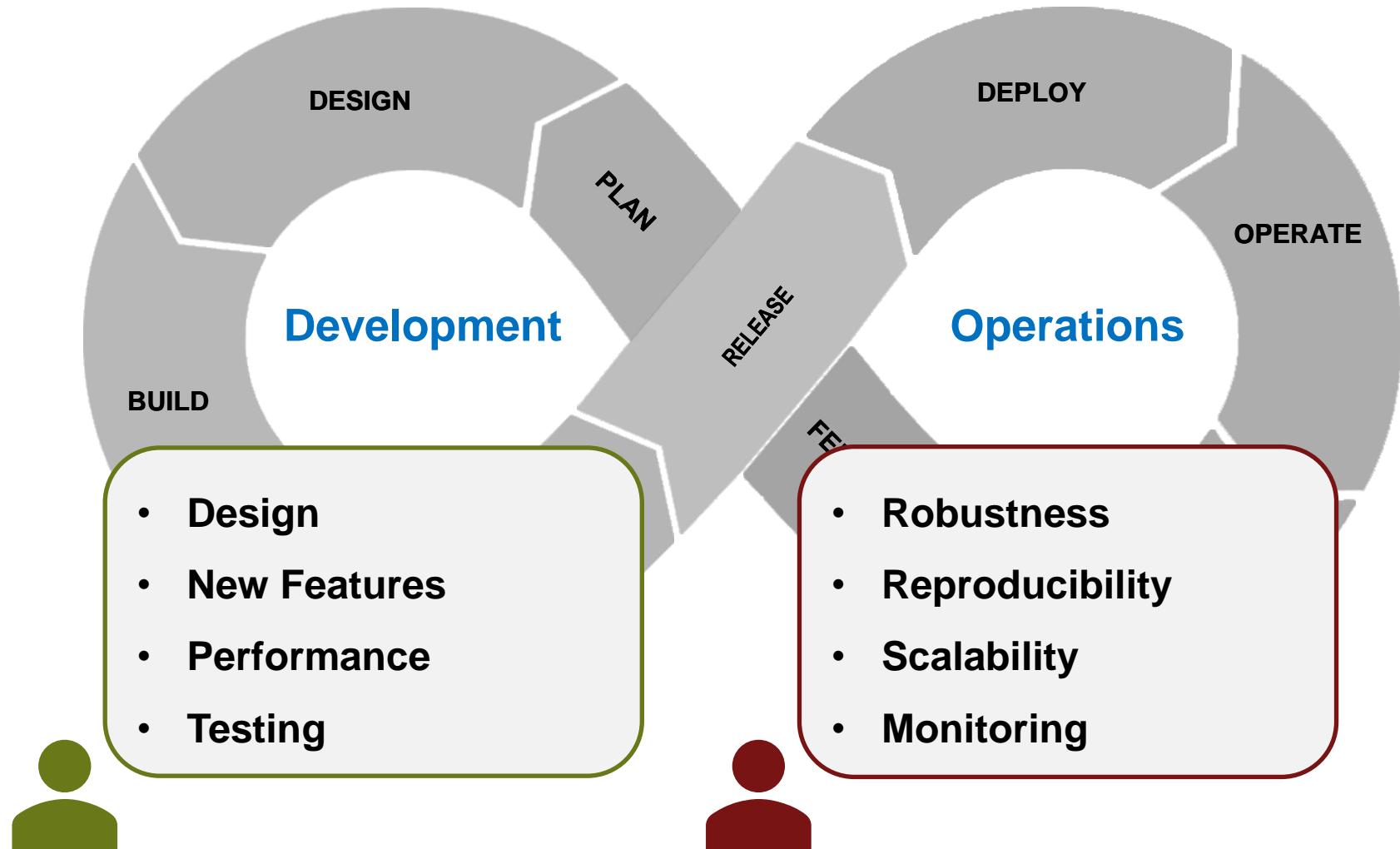


Financial Modeling



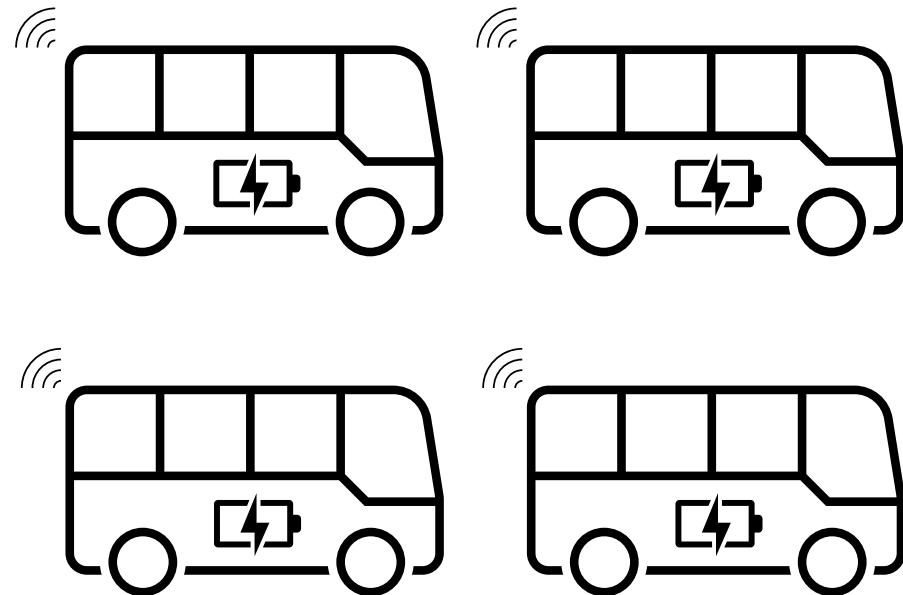
Embedded Controls

开发和运维和而不同：不同的关注点



示例:预测电池 State-of-Health

- 电动巴士车队
- 运维较昂贵: 是否可以预测什么时候电池需要更换了?
- 开始收集电池的远程数据

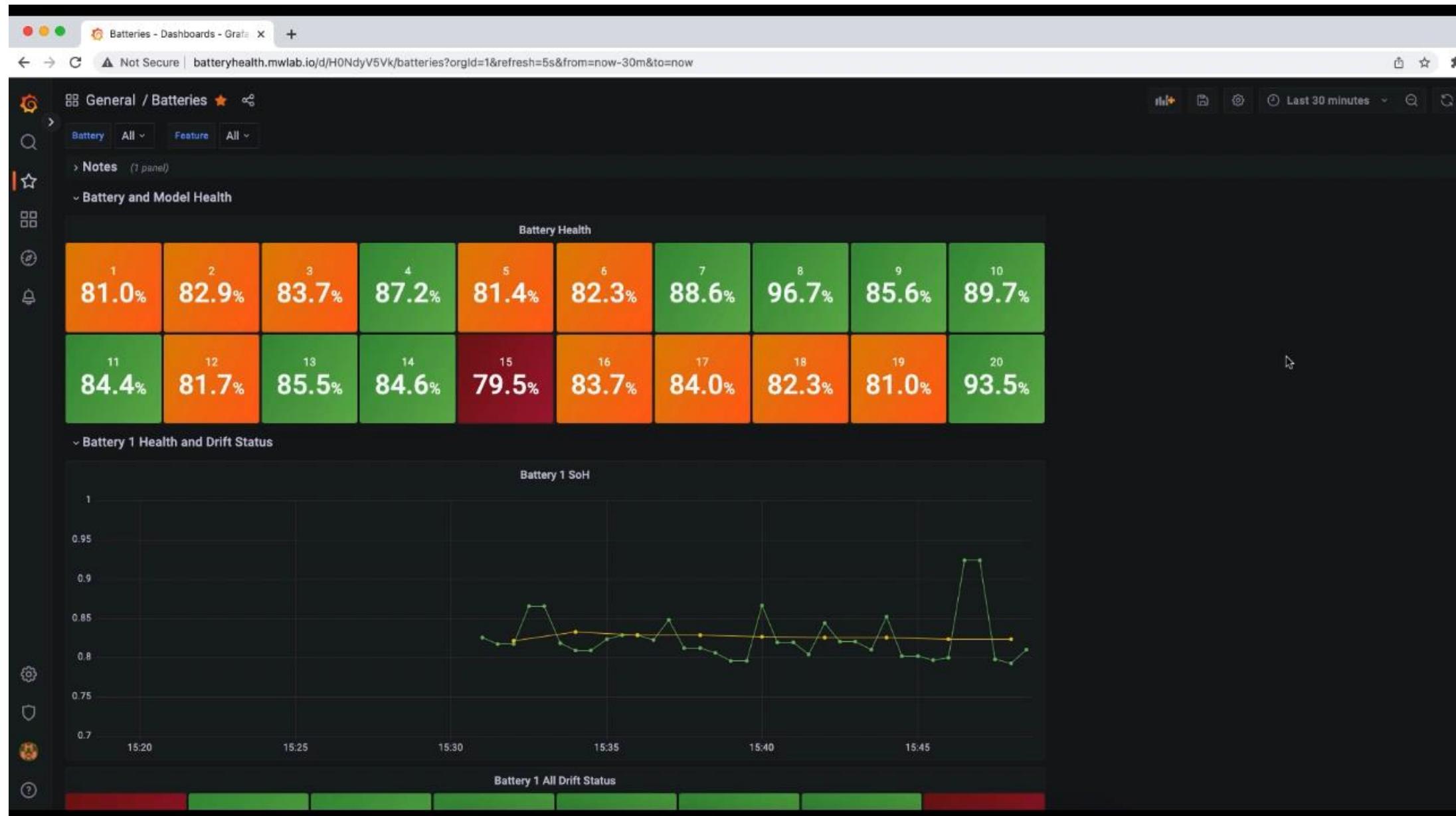


Variables – observations

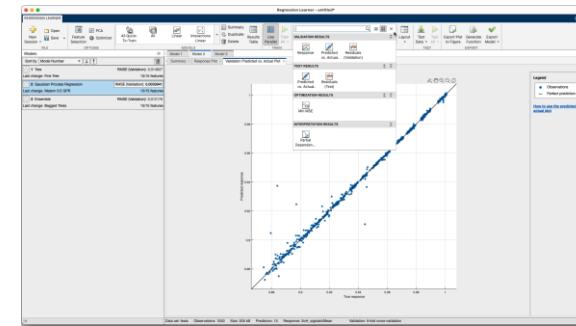
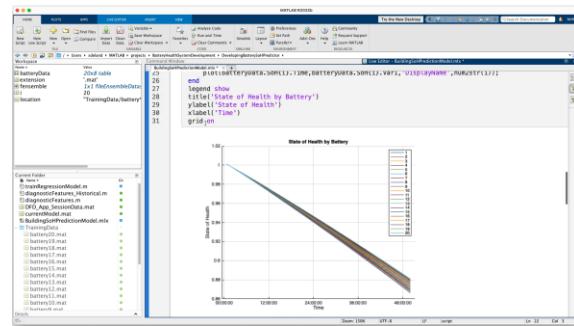
observations

1800x7 timetable

	timestamp	1 Current	2 Voltage	3 Temperature1	4 Temperature2	5 SoC_B1	6 SoC_B2	7 BatteryID
1	01-Nov-2021 00:...	2.6869	7.4436	333.1463	332.7619	0.4995	0.4995	1
2	01-Nov-2021 00:...	2.6872	7.4426	333.1317	332.3924	0.4990	0.4990	1
3	01-Nov-2021 00:...	2.6876	7.4417	333.1073	332.0405	0.4985	0.4985	1
4	01-Nov-2021 00:...	2.6879	7.4408	333.0740	331.7048	0.4980	0.4980	1
5	01-Nov-2021 00:...	2.6882	7.4399	333.0327	331.3844	0.4975	0.4975	1
6	01-Nov-2021 00:...	2.6885	7.4390	332.9843	331.0783	0.4970	0.4970	1
7	01-Nov-2021 00:...	2.6888	7.4381	332.9205	330.7857	0.4965	0.4965	1



使用领域相关的工具创建SoH预测功能，用于工程数据的预测性维护

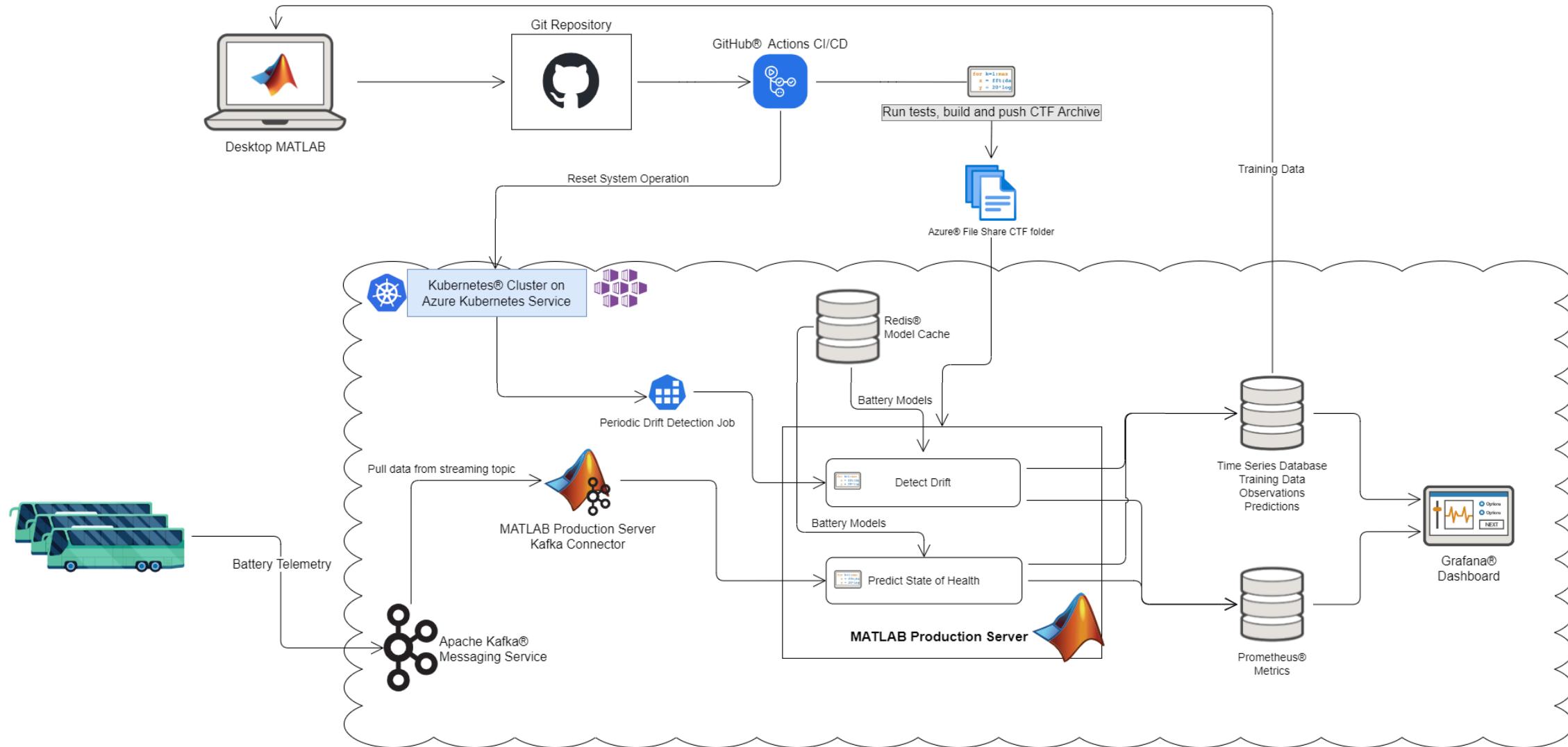


Data Exploration

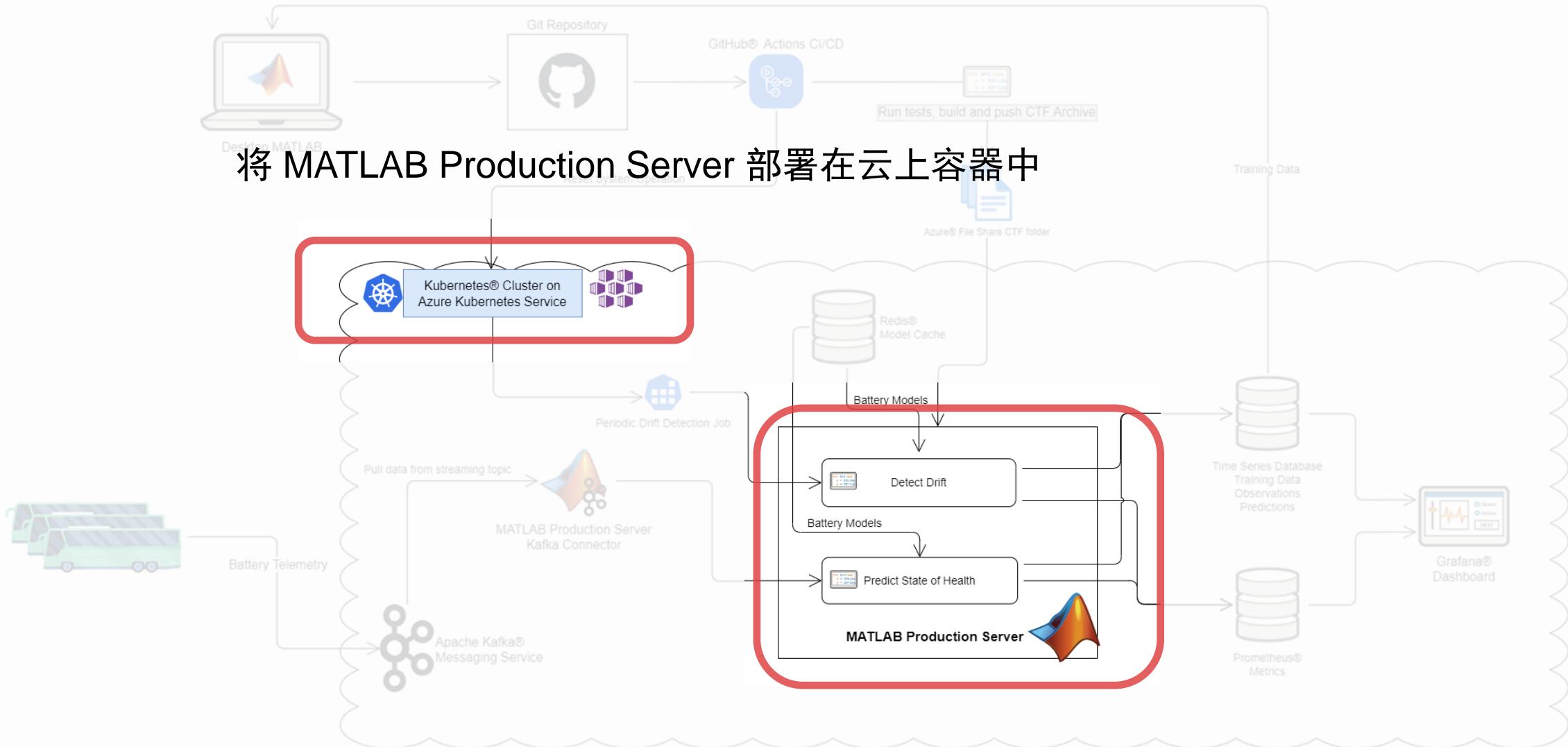
Feature Extraction

Machine Learning

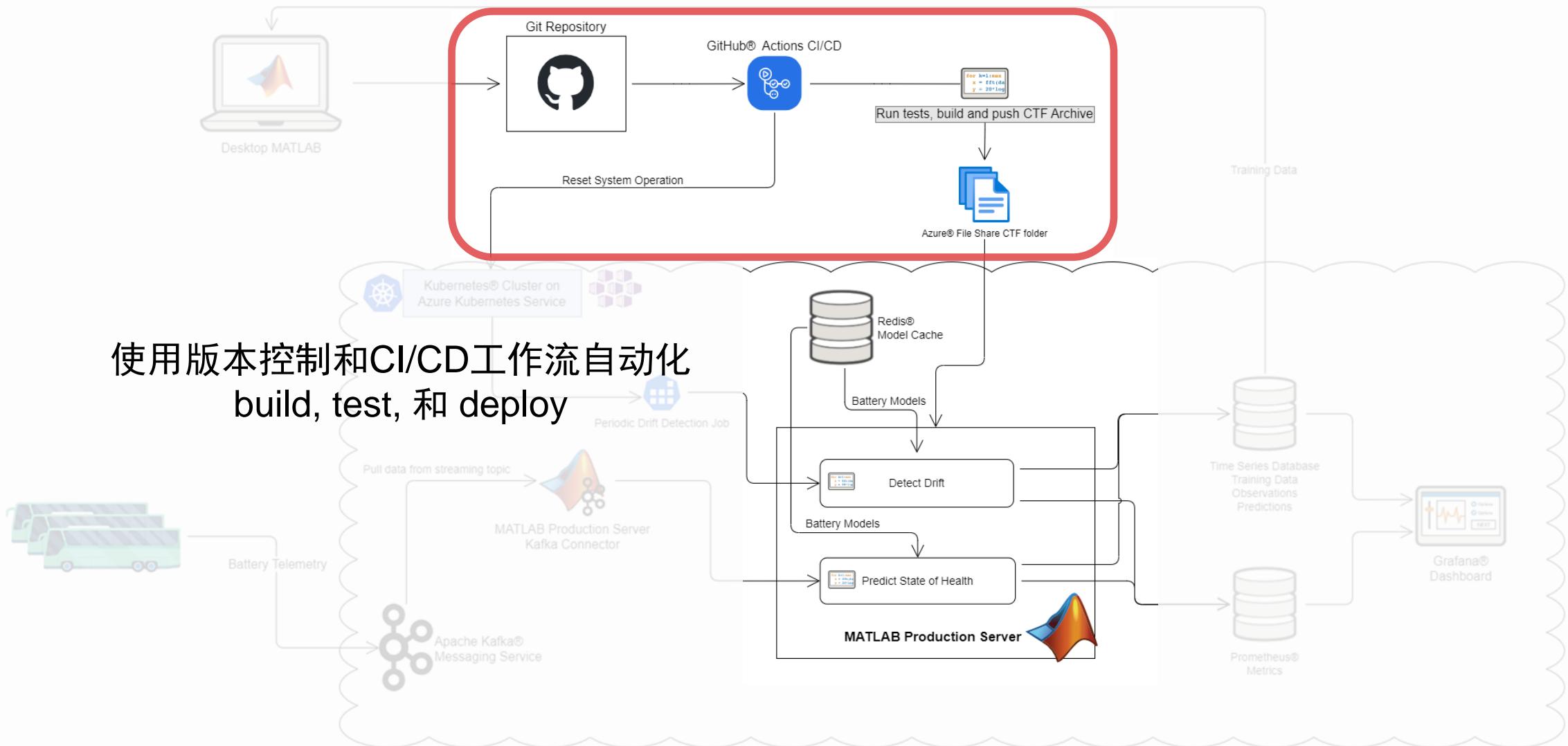
运行在云上的可扩展生产系统，使用行业标准工具



运行在云上的可扩展生产系统，使用行业标准工具



运行在云上的可扩展生产系统，使用行业标准工具



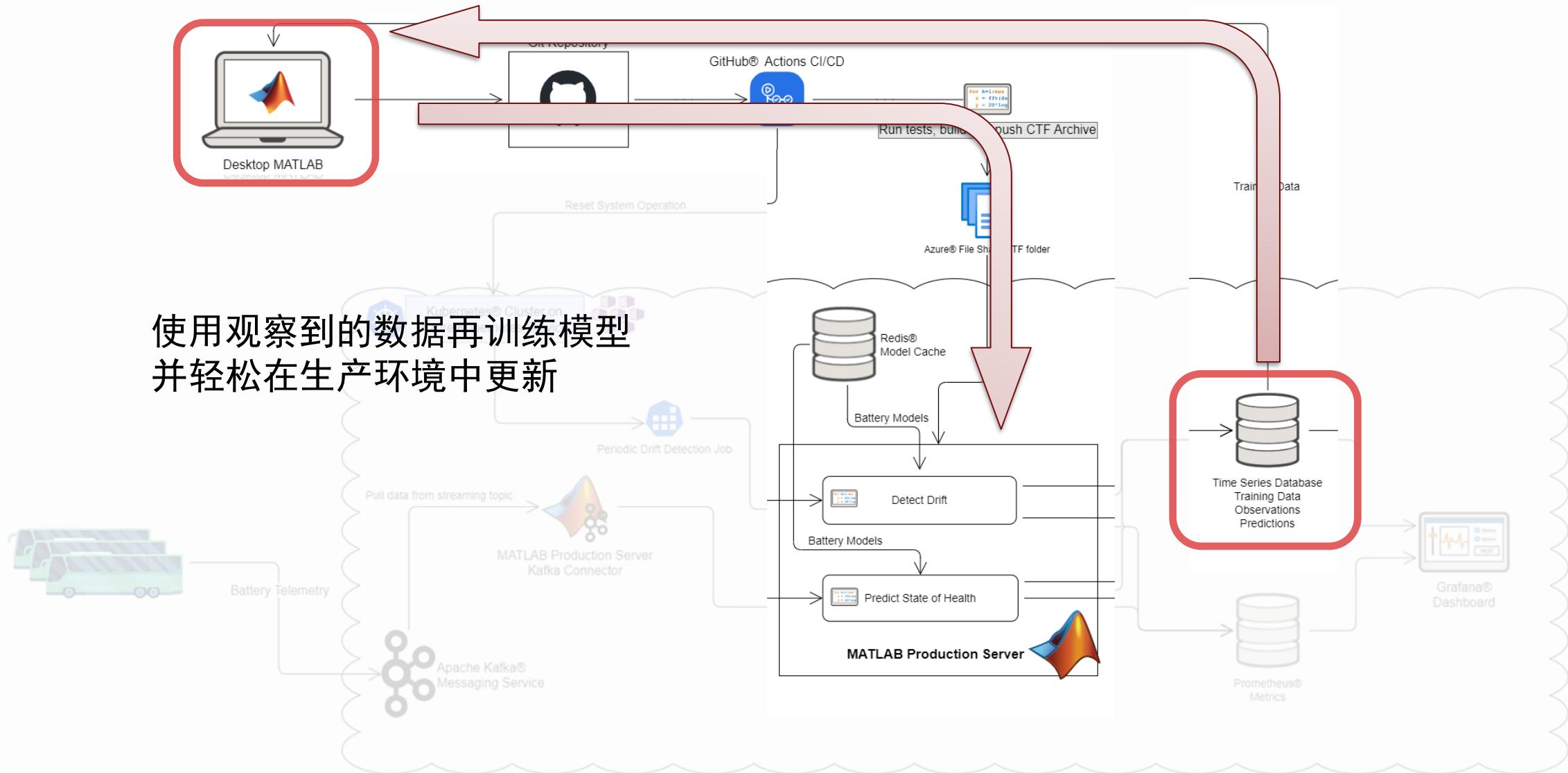
运行在云上的可扩展生产系统，使用行业标准工具



运行在云上的可扩展生产系统，使用行业标准工具



运行在云上的可扩展生产系统，使用行业标准工具



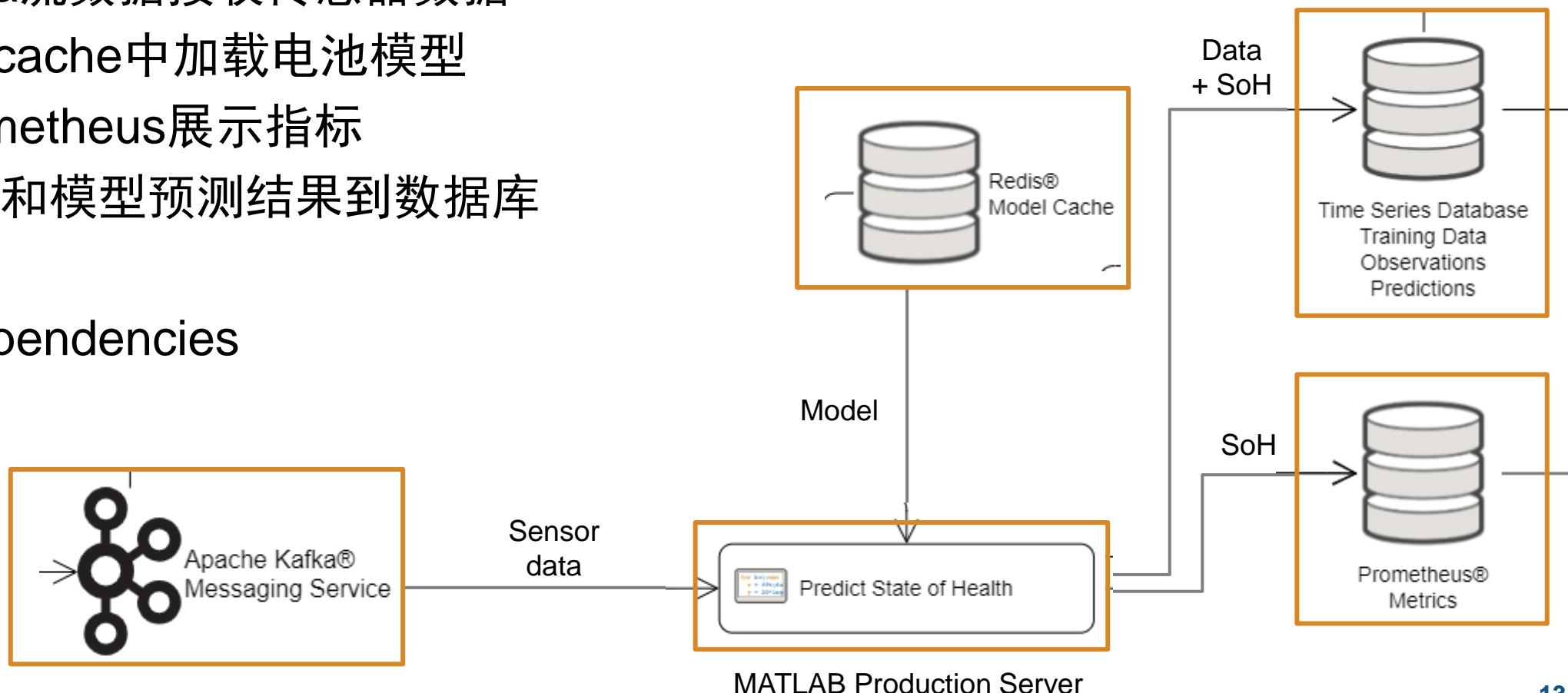
State of health算法运行在生产环境中

生产系统

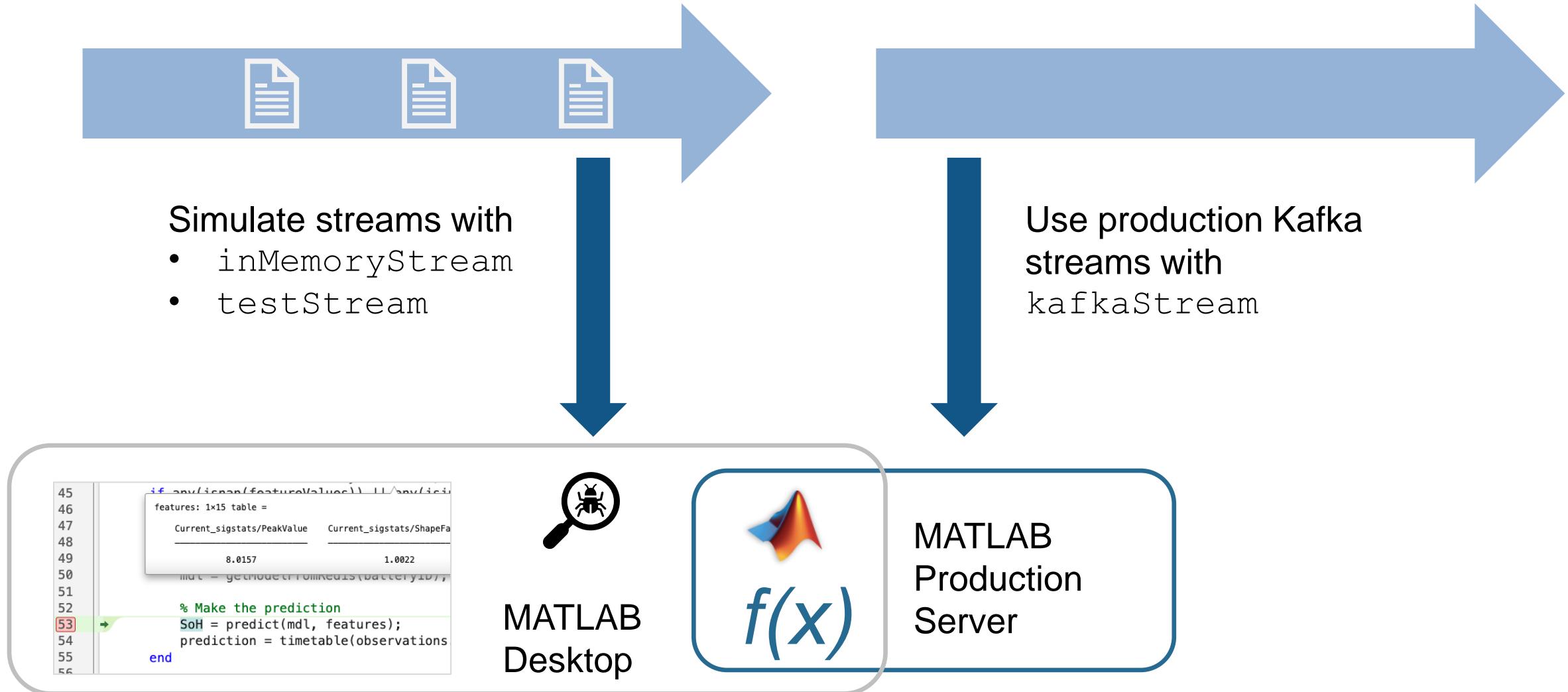
- 通过kafka流数据接收传感器数据
- 从Redis cache中加载电池模型
- 使用Prometheus展示指标
- 保存数据和模型预测结果到数据库

本地测试

- Mock dependencies



编写SoH预测函数来使用kafka数据流



Debug locally, then deploy the same MATLAB code to production.

自动 build, test, package, 和部署 MATLAB 代码

esteinerMW / Battery-Health-Estimation-Streaming-Demo (Private)
forked from mathworks/Battery-Health-Estimation-Streaming-Demo

[Actions](#)

← Build and upload deployable archive (CTF) to MATLAB Production Server
✓ update battery dashboard #19

[Summary](#)

Jobs

- build (succeeded 12 hours ago in 3m)
 - > ✓ Set up job
 - > ✓ Run actions/checkout@v3
 - > ✓ Setup MATLAB Support Packages
 - > ✓ Setup MATLAB
 - > ✓ Run MATLAB buildtool
 - 1 ► Run matlab-actions/run-build@v1
 - 8 ► Generate script
 - 10 ► Run command
 - > ✓ Azure login
 - > ✓ Azure CLI script - upload CTF to az file-share
 - > ✓ Post Run actions/checkout@v3
 - > ✓ Complete job
- ✓ Reset Demo Operations

Run details

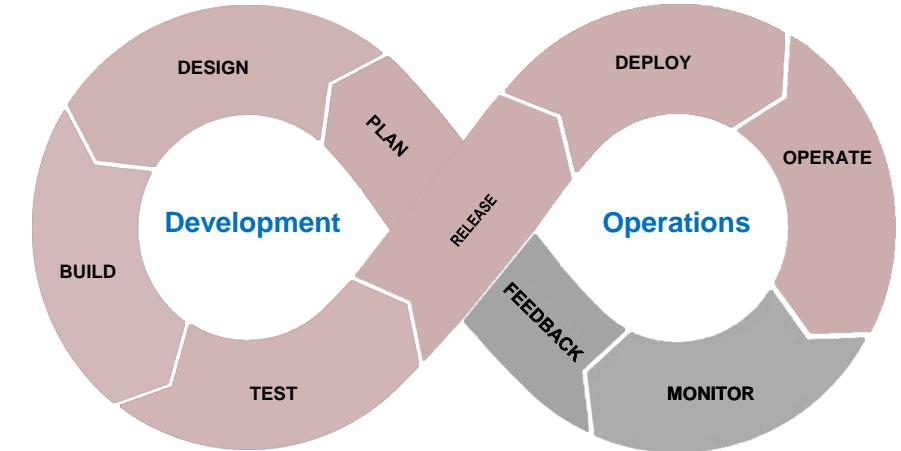
Usage

Workflow file

```

- name: Run MATLAB buildtool
uses: matlab-actions/run-build@v1
with:
tasks: packageDriftDetection
packageSoHPrediction

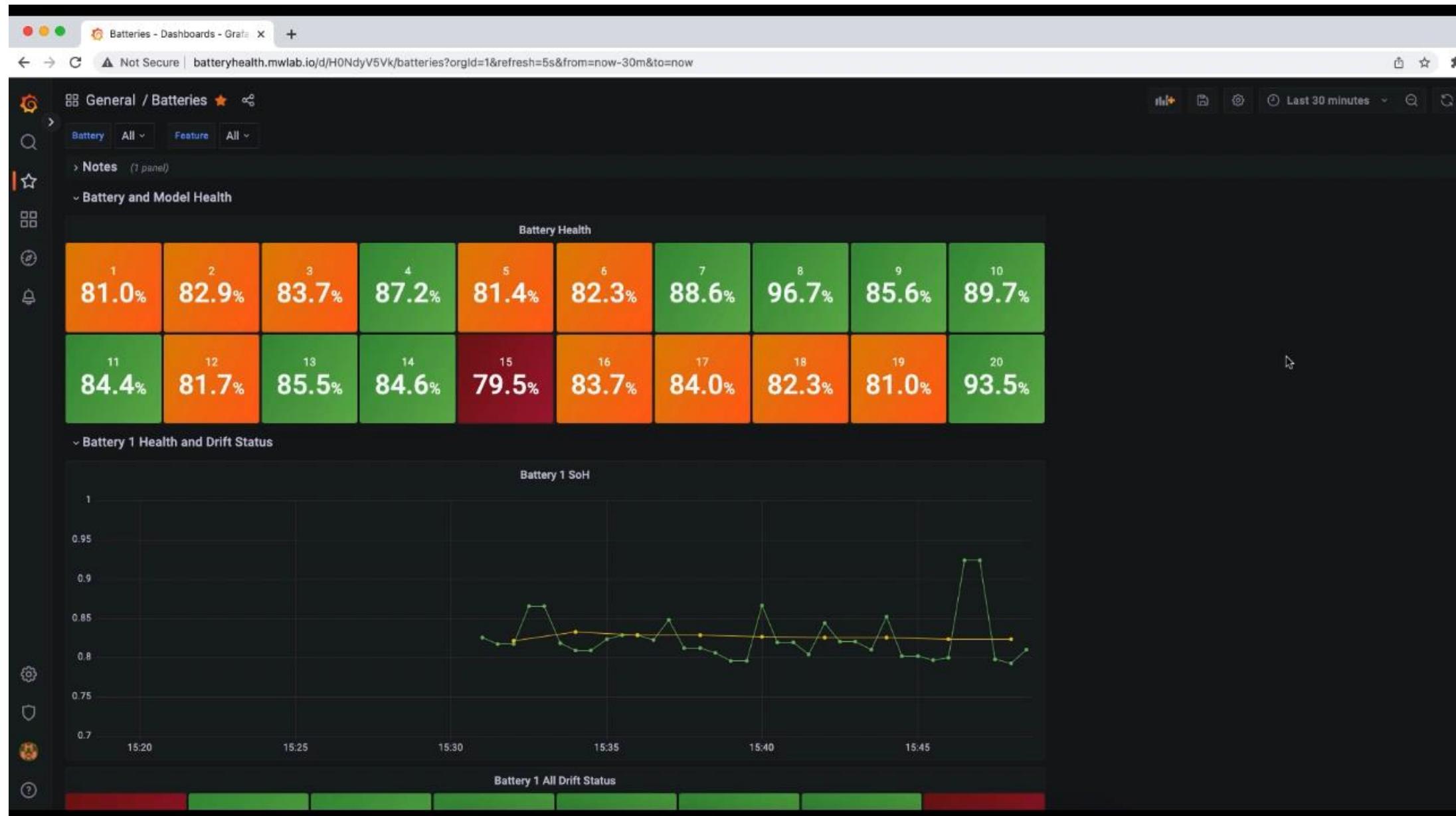
```



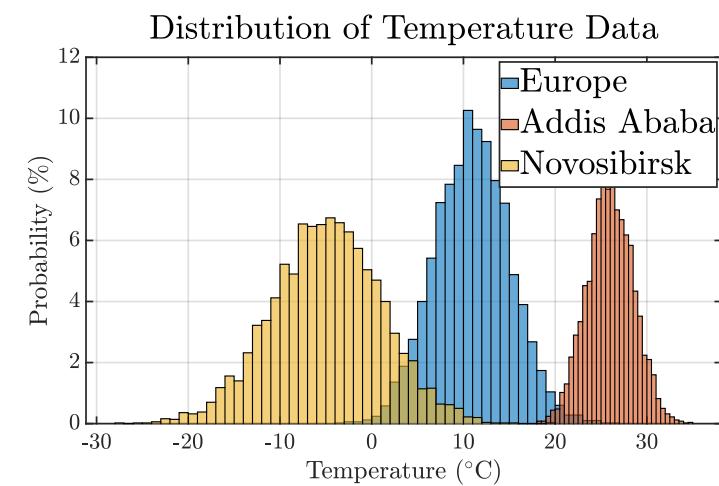
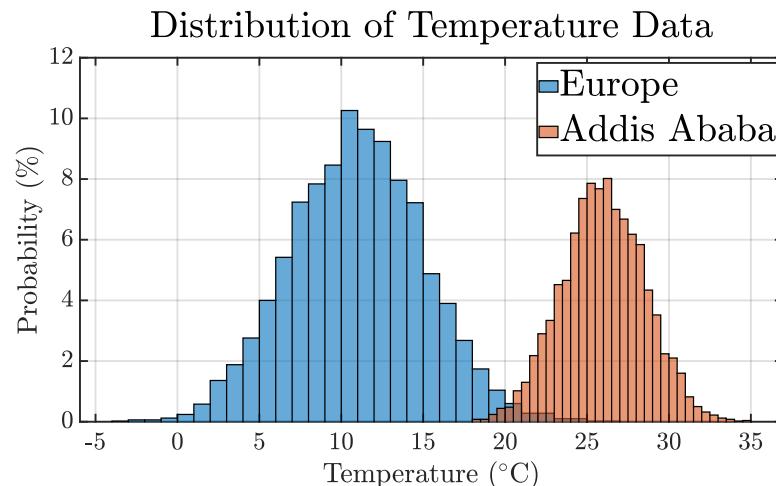
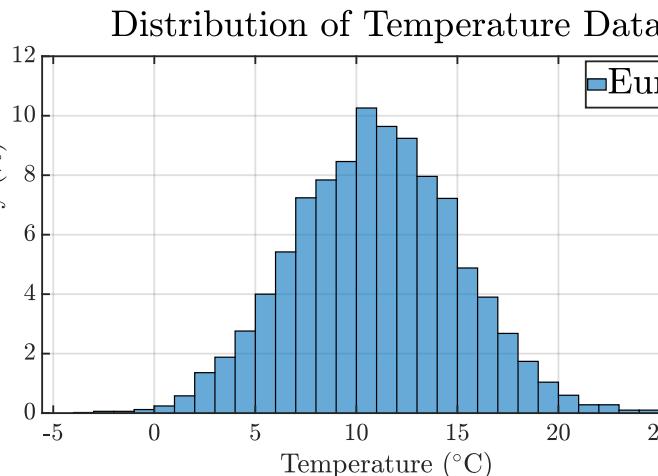
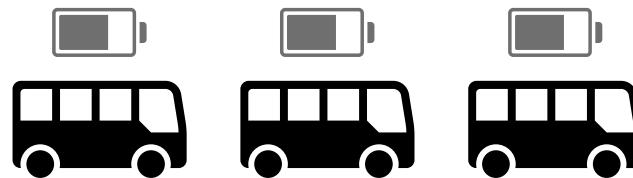
```

function plan = buildfile
plan = buildplan(localfunctions);
plan("packageDriftDetection").Dependencies = "test";
plan("packageSoHPrediction").Dependencies = "test";
plan("test").Dependencies = "validate";
end

```

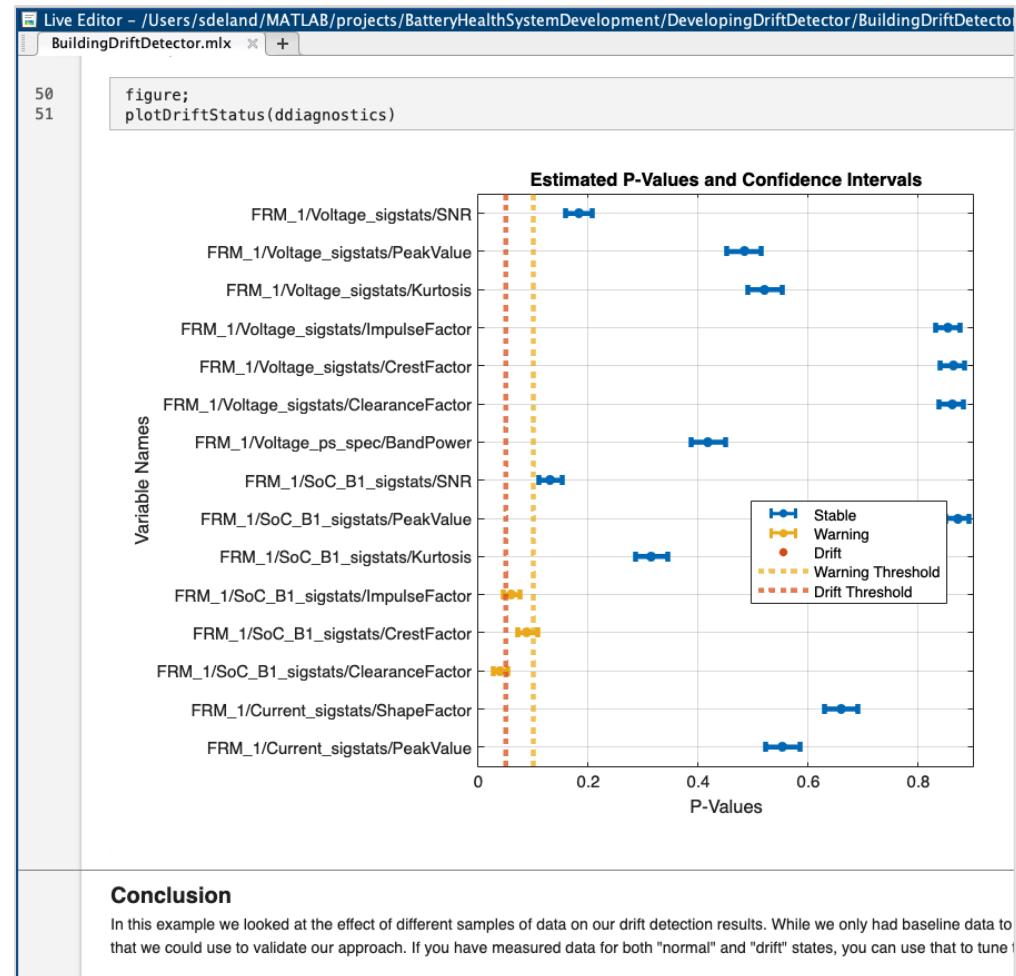


静态数据假设在现实世界中很少成立

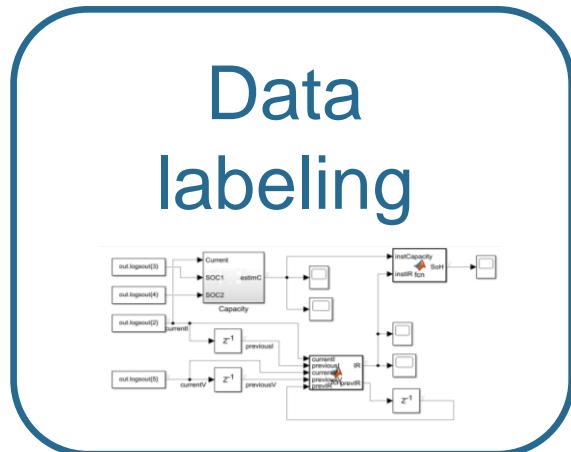


使用 detectdrift 开发漂移检测算法

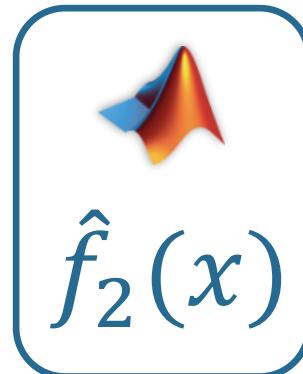
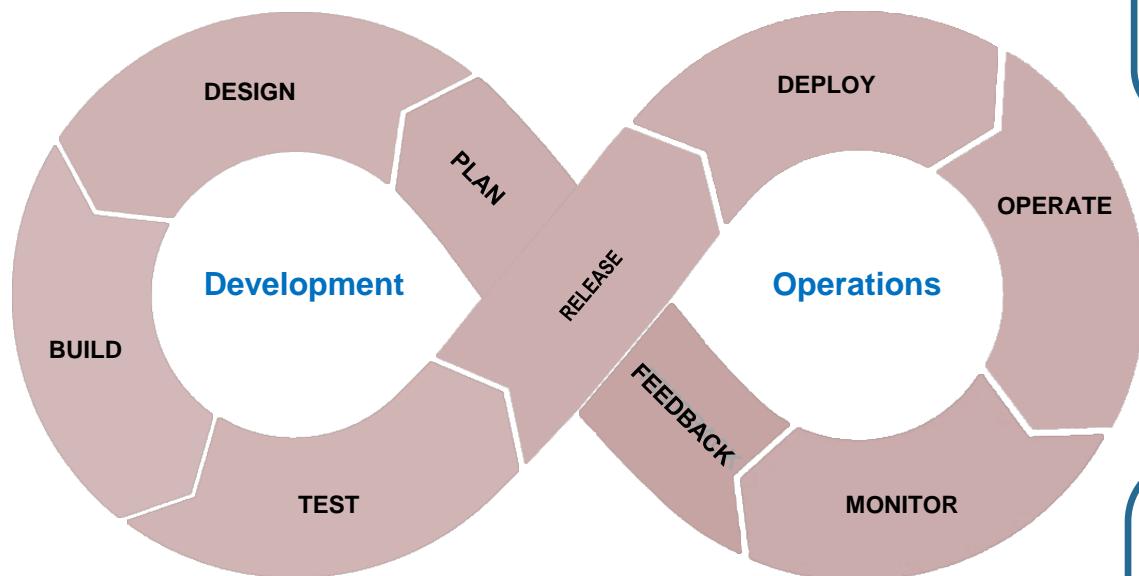
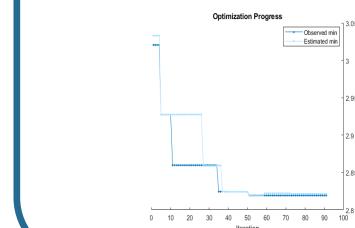
- 使用历史数据 (训练数据) 来创建一个基准分布
- 生成合成数据来测试漂移
 - 生产环境中将使用真实流数据



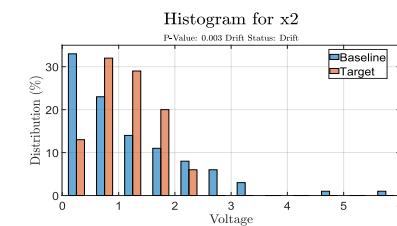
当检测到数据漂移之后就更新模型



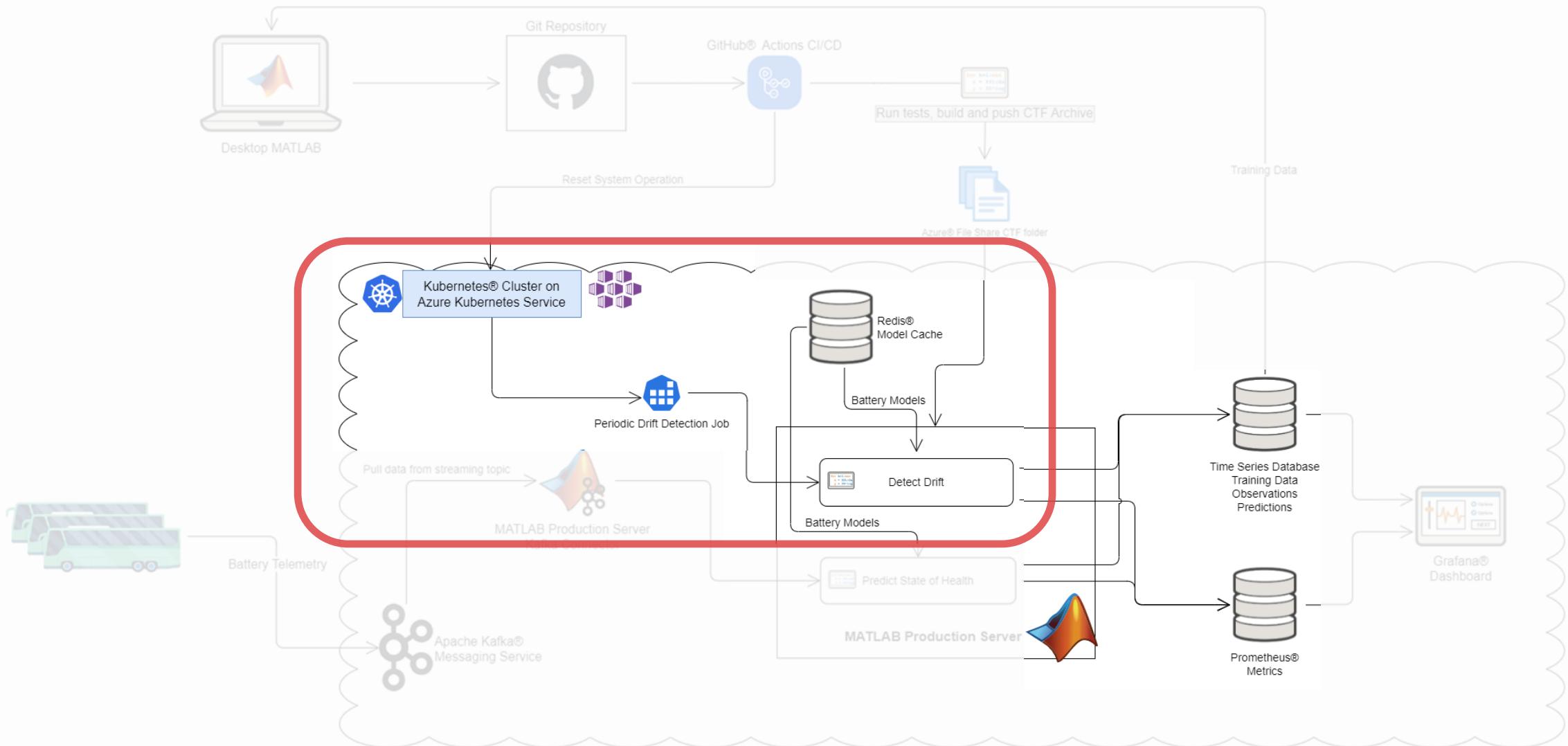
Retrain



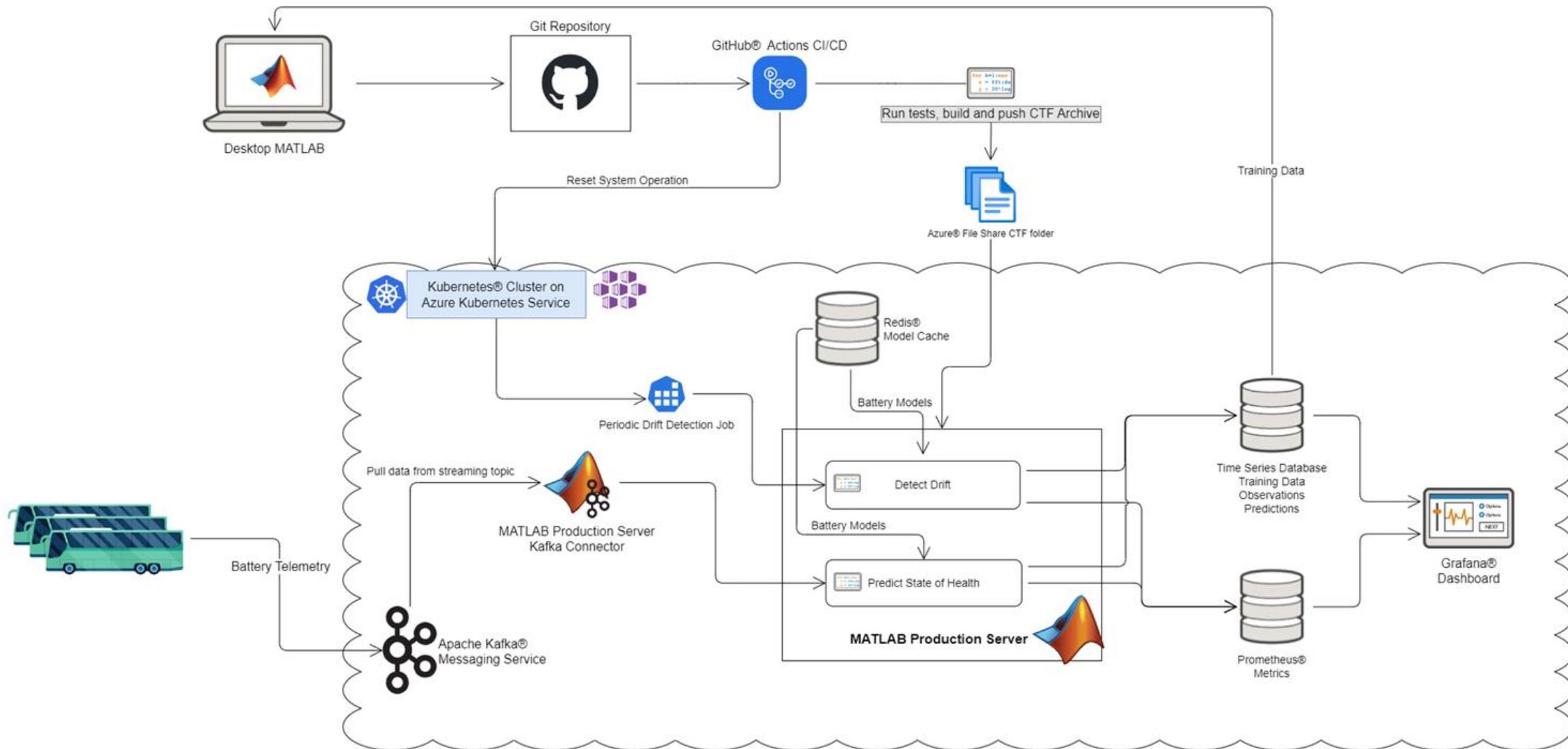
Drift Detection



更新基础架构来定期运行漂移检测功能



完整的系统



主要内容

- 利用**MATLAB**已有的能力 包括预测性维护和漂移检测
- 集成到生产系统 例如数据源和仪表板，并将这些集成从桌面扩展到云端
- 结合CI/CD自动化完成**MATLAB**代码和**Simulink**模型的**build, test, package, deploy**

更多内容

MATLAB and Simulink in Enterprise IT
Deliver operational value with IT and Line of Business collaboration

Your IT organization plays a key role in leading digital transformation, including the creation of new digital products and service helps IT and engineering work together to deliver tangible business results.

Collaborative Development and Operationalization

Develop > Build & Test > Deploy > Operate > ...

Domain experts develop innovative algorithms and models using MATLAB and Simulink with IT providing access to tools. IT assistance is critically required to deploy these innovations into enterprise production systems. The operationalized innovations result in digital products and services providing tangible business results.

How MATLAB and Simulink are used with Enterprise IT

<https://www.mathworks.com/solutions/enterprise-it-systems.html>

CI/CD Resources
Use MathWorks Products in your Continuous Integration Pipelines

Server: Bamboo, Jenkins, GitLab CI/CD, Azure Pipelines, GitHub Actions, CircleCI, Travis

On-Premise from R2013b

Cloud Hosted from R2020a

MathWorks provides (7) documented CI integrations to reduce risk and simplify use and setup. From on-premise integrations to now cloud integrations, and hybrids in between, we have you supported. MathWorks customers can use one of our published integrations or you can create your own integration to any 3rd party platforms.

CI/CD Resources

<https://www.mathworks.com/solutions/enterprise-it-systems/ci-cd.html>

MATLAB and Simulink in the Cloud

Using MATLAB and Simulink in the cloud enables engineers and scientists to speed up their development processes by providing on-demand access to enhanced compute resources, software tools, and reliable data storage. You can:

- Open MATLAB and Simulink in a web browser using [MATLAB Online](#) and [Simulink Online](#)
- Connect to cloud data and other services from Amazon Web Services® (AWS®), Microsoft Azure®, and more
- Scale long-running computations and simulations to CPUs, GPUs, or compute clusters in the cloud
- Integrate MATLAB with cloud-based continuous integration (CI) systems to automate code testing and improve code quality
- Deploy MATLAB and Simulink models and incorporate custom MATLAB and Simulink analytics into cloud-based applications without recoding in other languages

MATLAB and Simulink in the Cloud

<https://www.mathworks.com/solutions/cloud.html>

Automating Machine Learning with DevOps for MATLAB and Simulink

By Peter Webb and Gokhan Atinc, MathWorks

As more organizations rely on machine learning applications for core business functions, many are taking a closer look at the full lifecycle of those applications. The initial focus on development and deployment of machine learning models has expanded to encompass continuous monitoring and updates. Changes in the input data may decrease a model's predictive or classification accuracy. Prompt retraining and model evaluation produces better models and more accurate decisions.

In machine learning operations, or ML Ops, the plan, design, build, and test activities of development are linked with the deploy, operate, and monitor activities of operations in a continuous feedback loop (Figure 1). Many data science teams have started to automate parts of the ML Ops cycle, such as deployment and operations.

Figure 1: The ML Ops cycle.

Automating Machine Learning with DevOps for MATLAB and Simulink

<https://www.mathworks.com/company/newsletters/articles/automating-machine-learning-with-devops-for-matlab-and-simulink.html>

Q&A

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