MATLAB EXPO

UNITED KINGDOM

Developing, Testing and Deploying Models and Algorithms in the Cloud

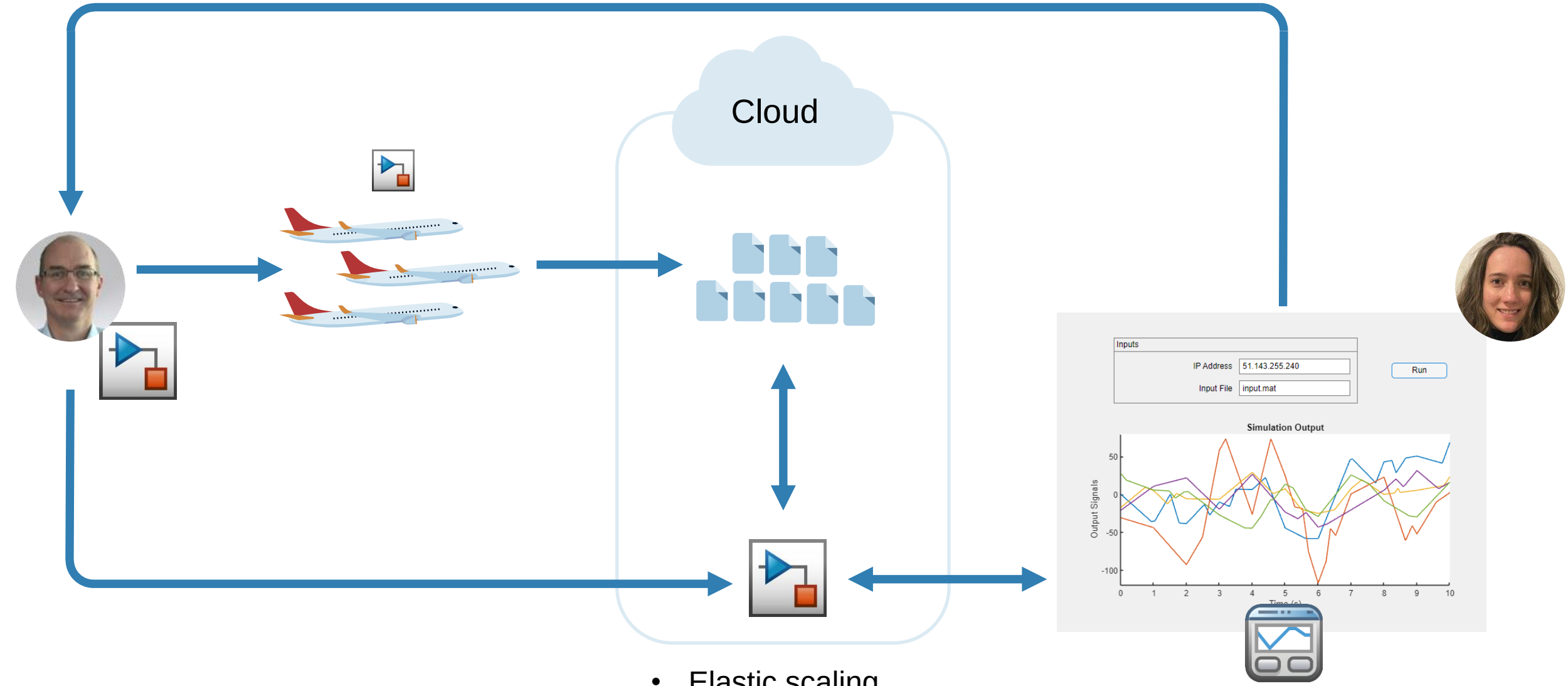
Charles Hawkins, MathWorks

Amélie Lamarquette, MathWorks

MathWorks

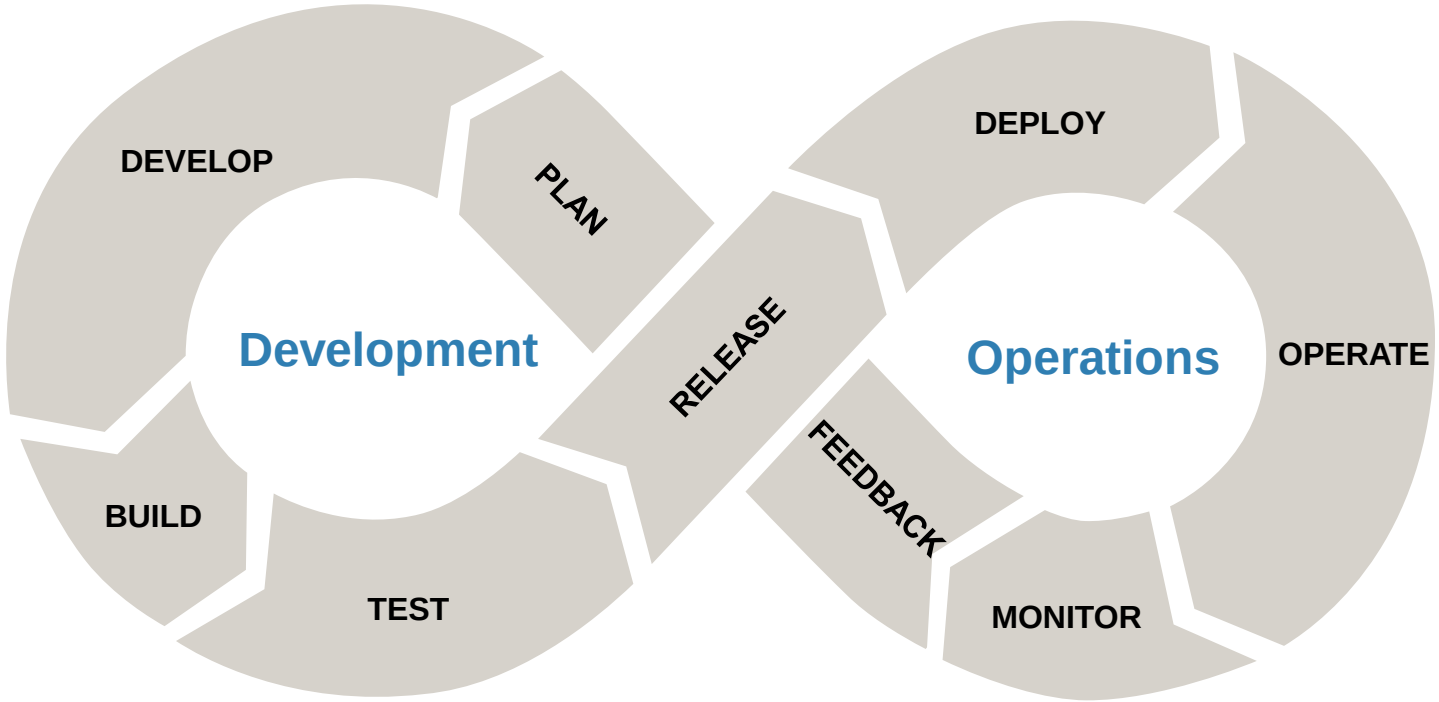
What Will You Learn Today?

- We are making it easier for you to:
  - Implement MBD workflows in CI systems
  - Access cloud data directly from MATLAB
  - Create a microservice with MATLAB Compiler SDK

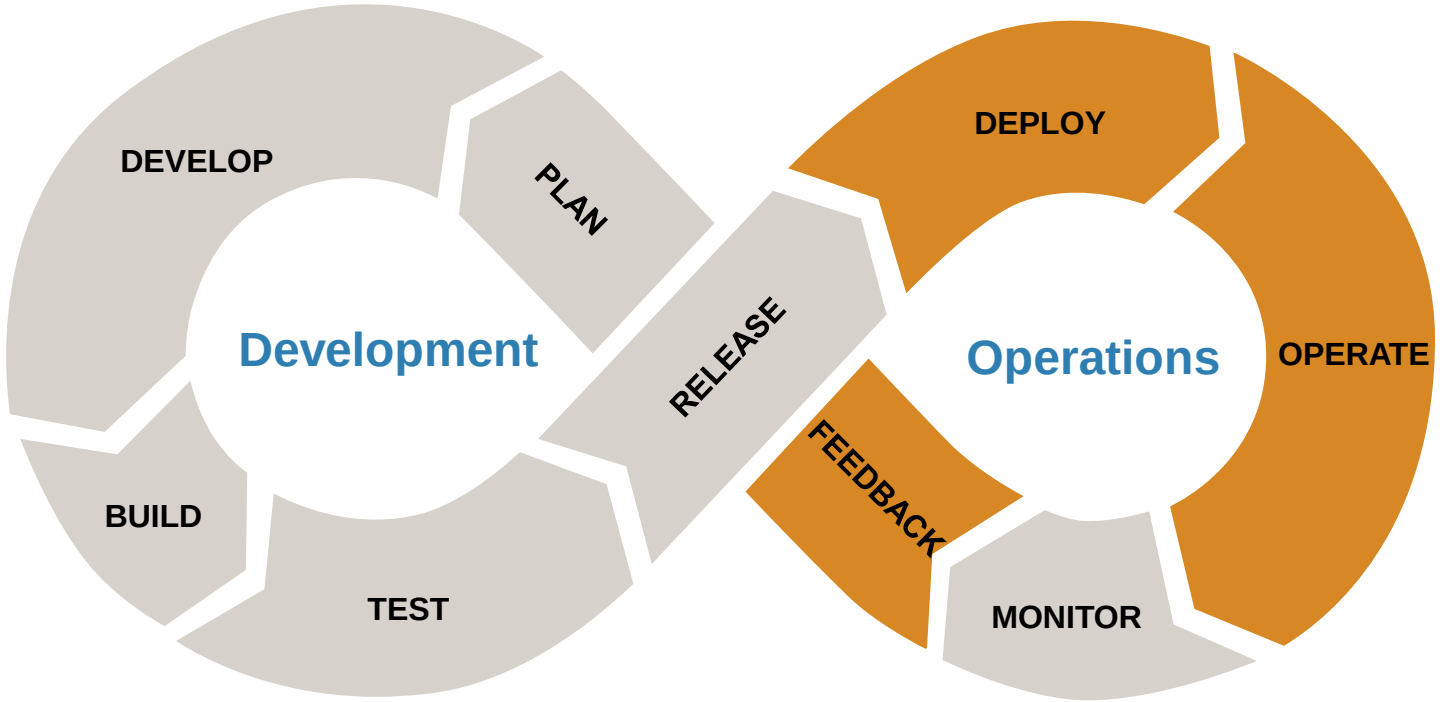


- Elastic scaling
- Data sovereignty
- Automation
- Multiple uses

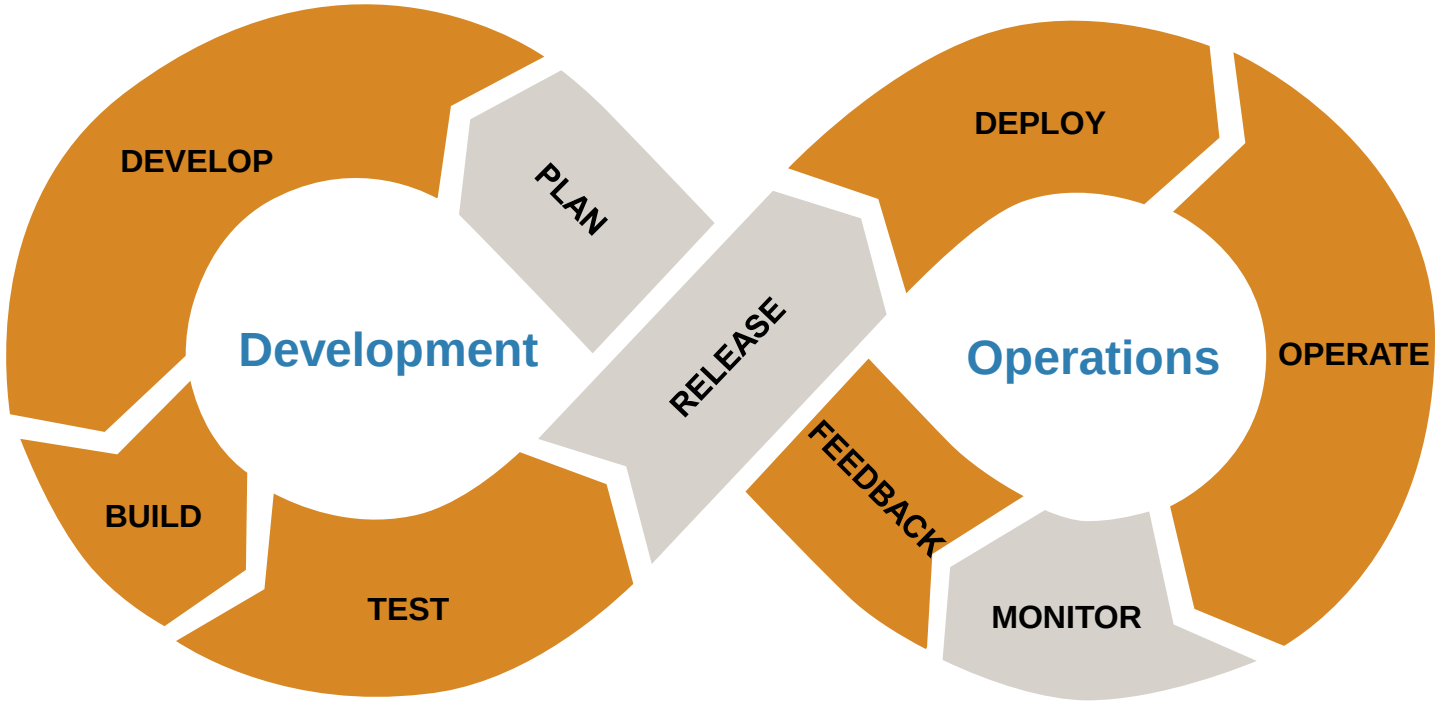
DevOps Lifecycle



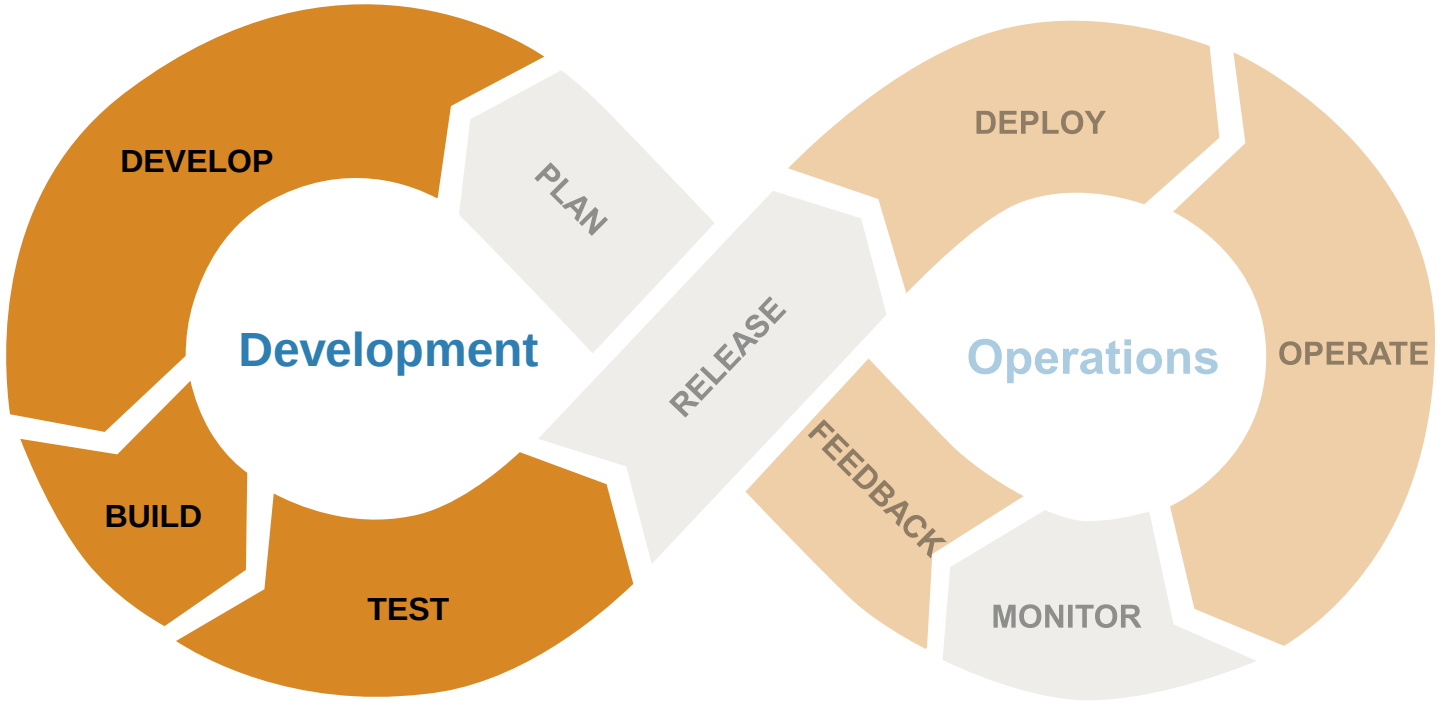
DevOps Lifecycle



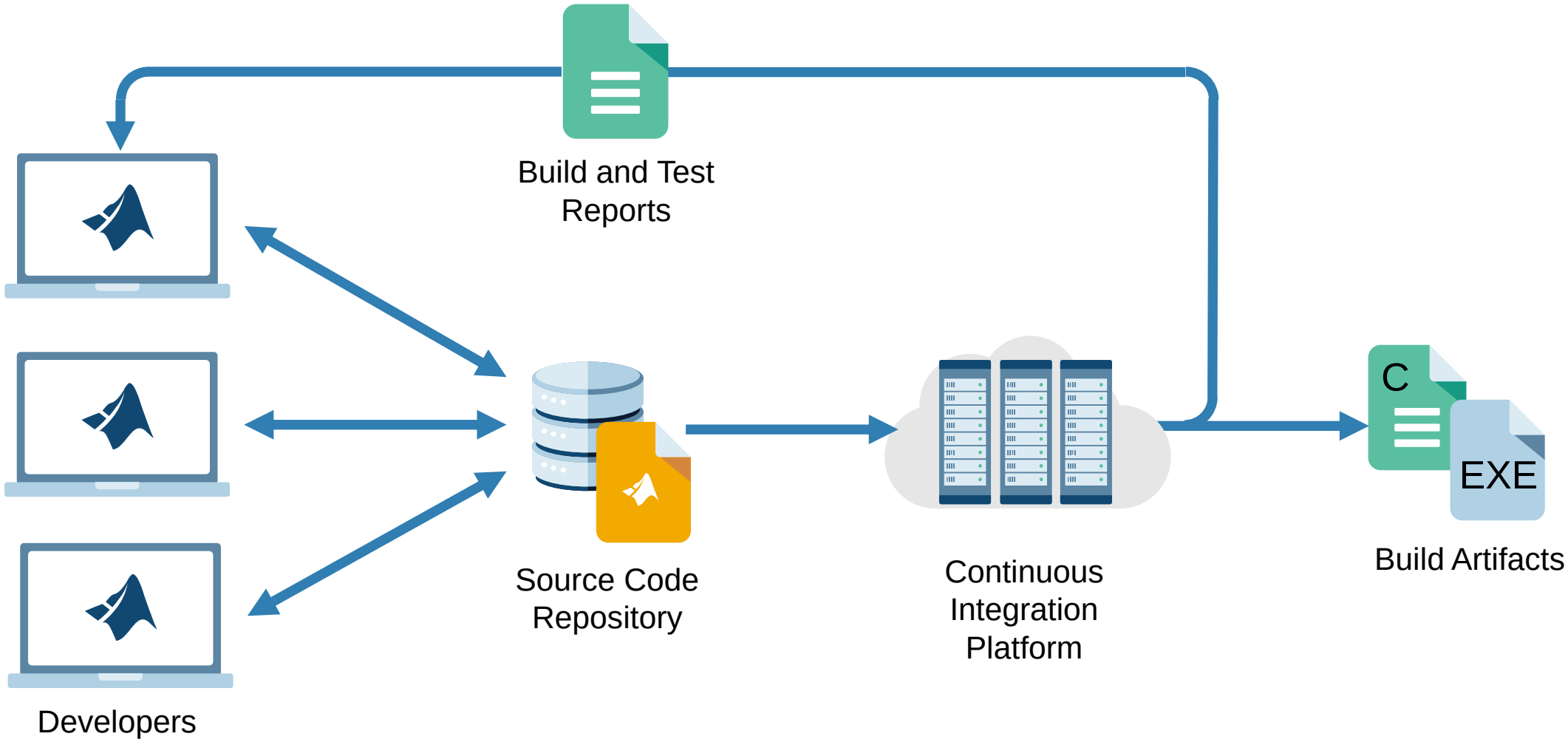
DevOps Lifecycle



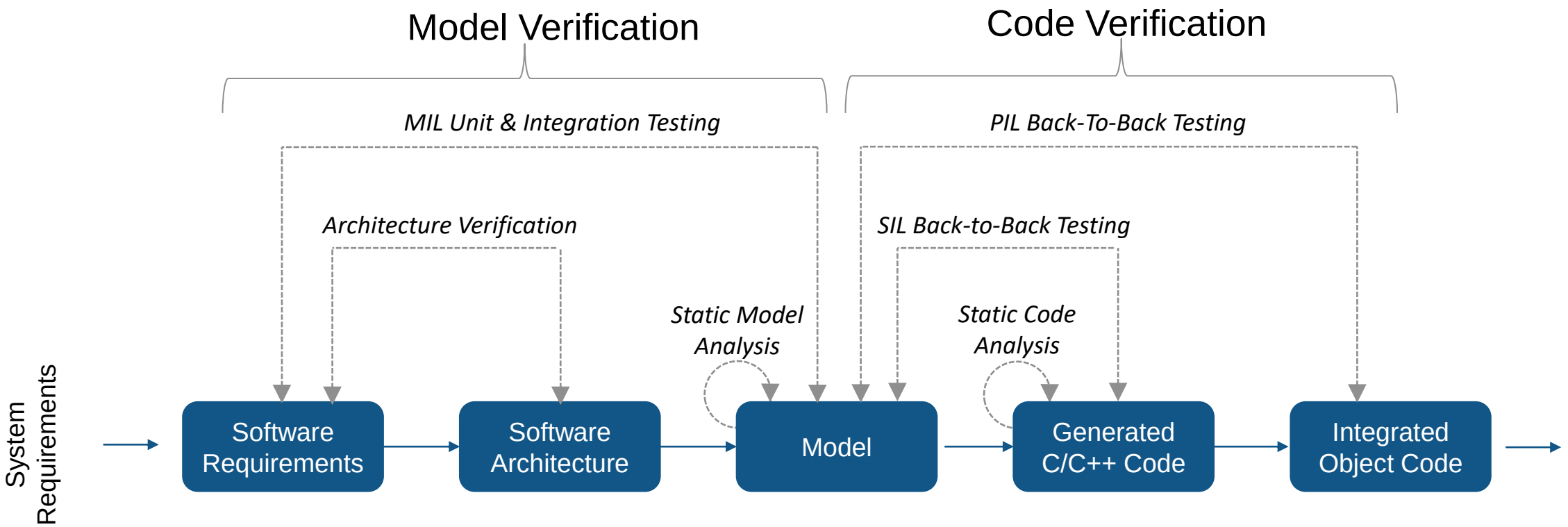
DevOps Lifecycle



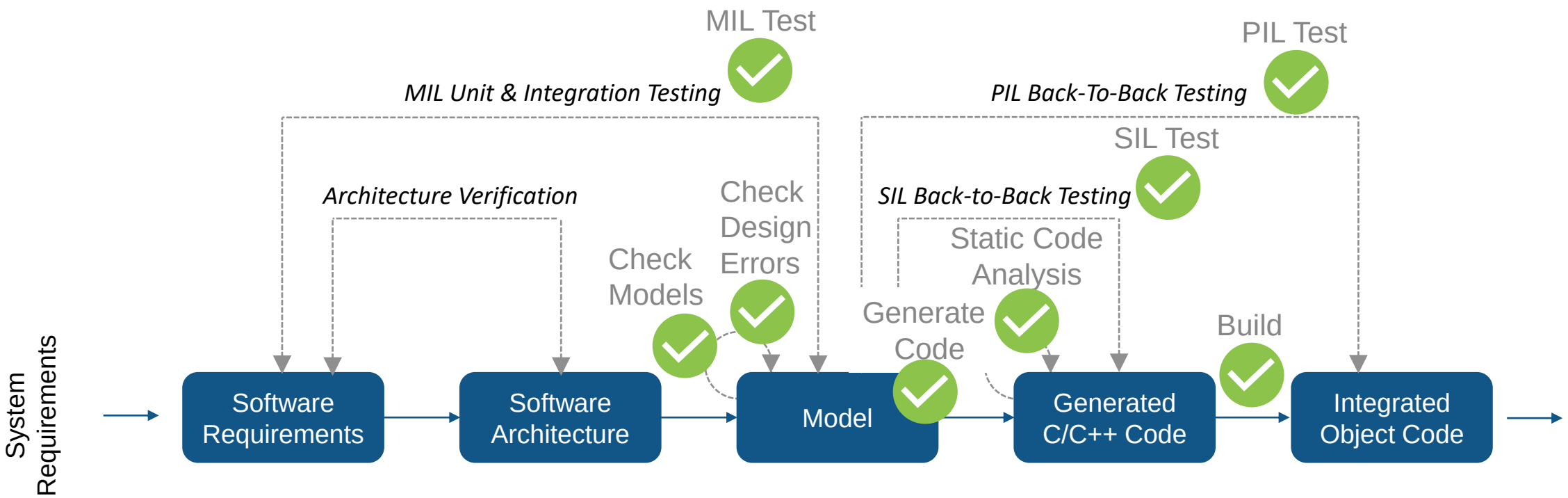
What does a CI-based workflow look like?



Model-Based Design Reference Workflow



Model-Based Design Reference Workflow



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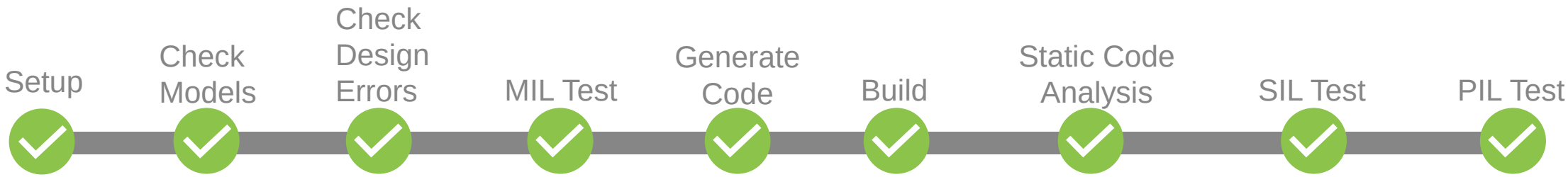
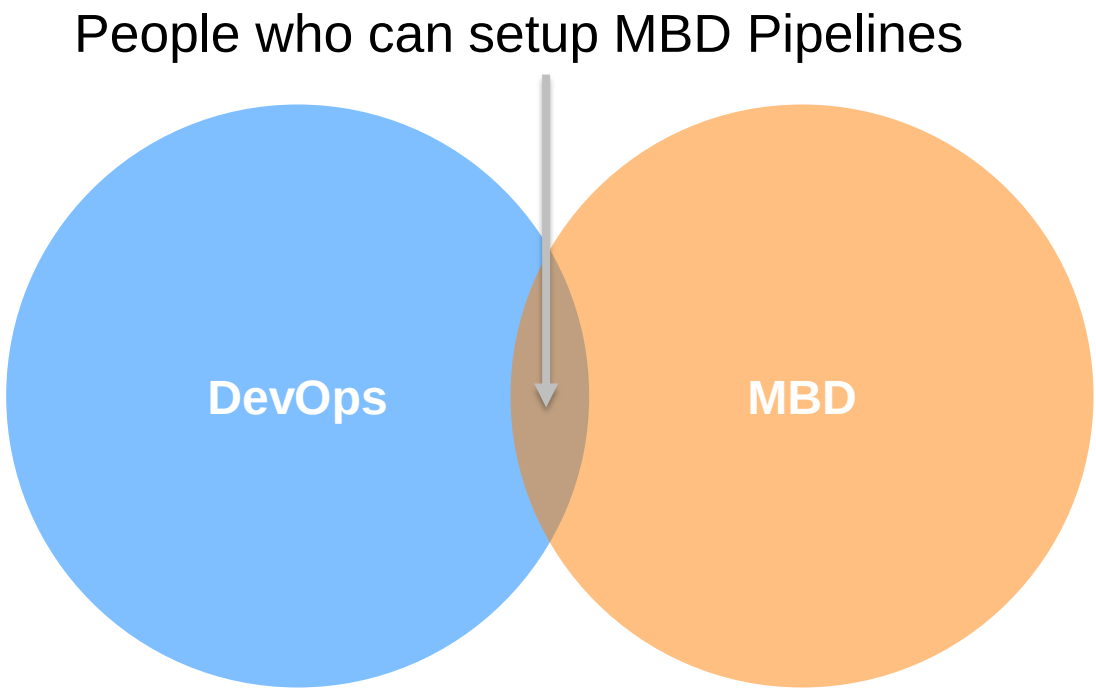


- Define Process and Automate
  - Identify Tasks
  - Define Sequence
  - Define Outputs
  - Script the Tools

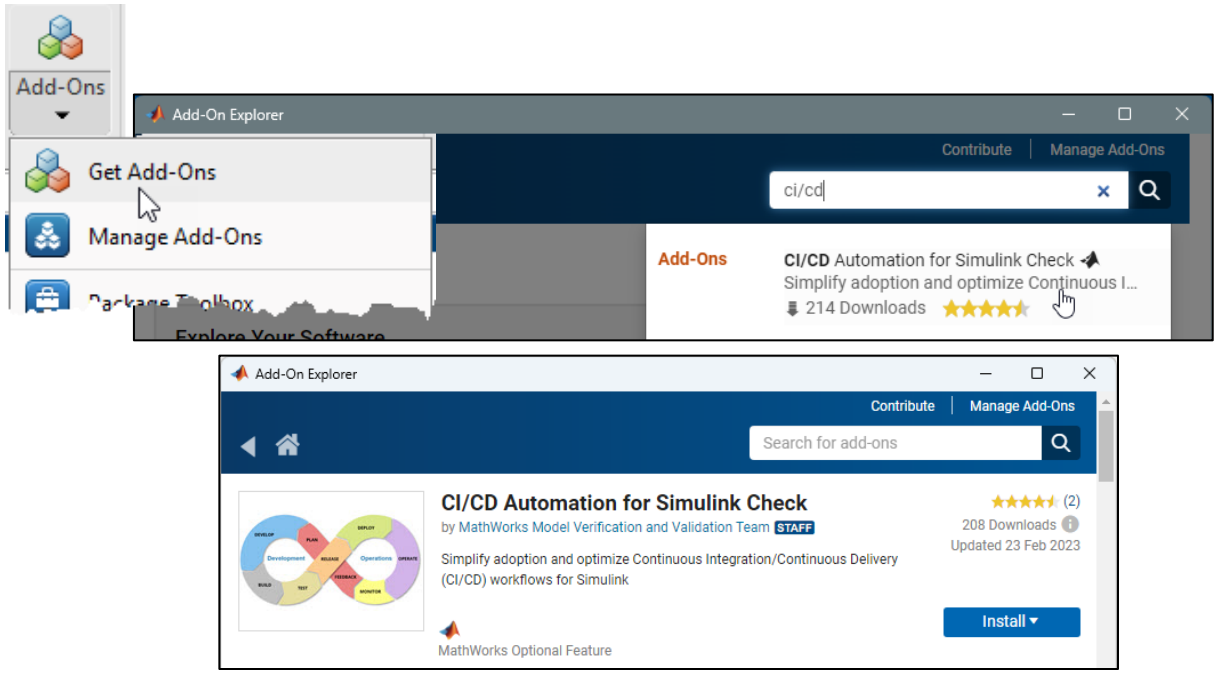
Simplifying Continuous Integration for Model-Based Design



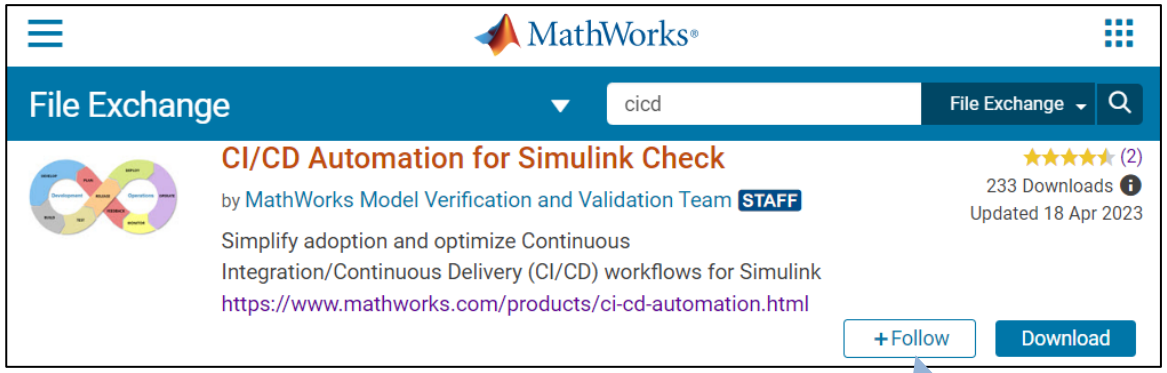
- Enable MBD users to model pipeline inside MATLAB
- Create single integration point for DevOps engineers
- Empower MBD users to maintain and debug pipeline

Get the CI/CD Automation for Simulink Check Support Package

From MATLAB with Add-On Manager



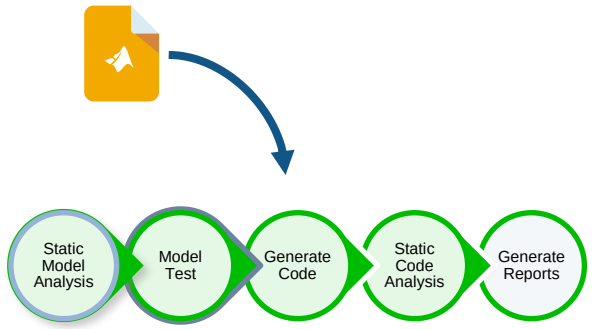
Download from File Exchange



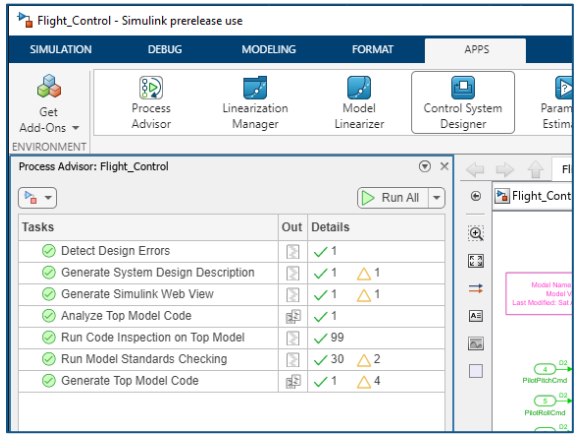
Follow to get notified of updates

Supports MATLAB R2022a and later

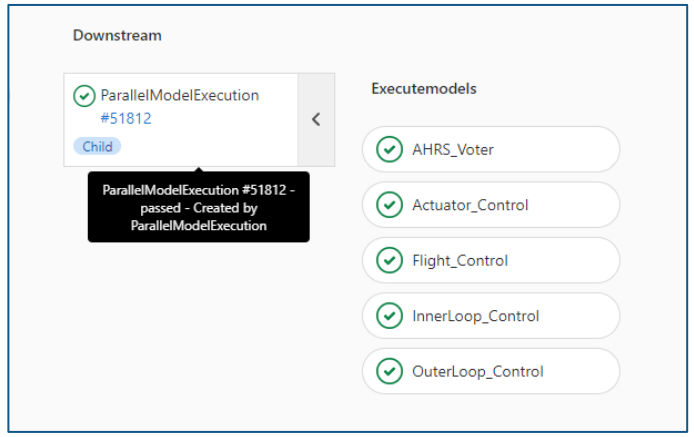
Support Package : CI/CD Automation for Simulink Check



1) <u>Simple Setup</u>
- ✓ Prebuilt MBD pipeline
- ✓ Built-in MBD tool support
- ✓ Tailorable



2) <u>Desktop Integration with Process Advisor app</u>
- ✓ Local Testing
- ✓ Local Debugging
- ✓ Local Execution



3) <u>3rd Party CI Integration</u>
- ✓ e.g. GitLab/GitHub
- ✓ Auto-generate config files

Prebuilt & Tailorable MBD Pipeline

Built-in Library of Tasks

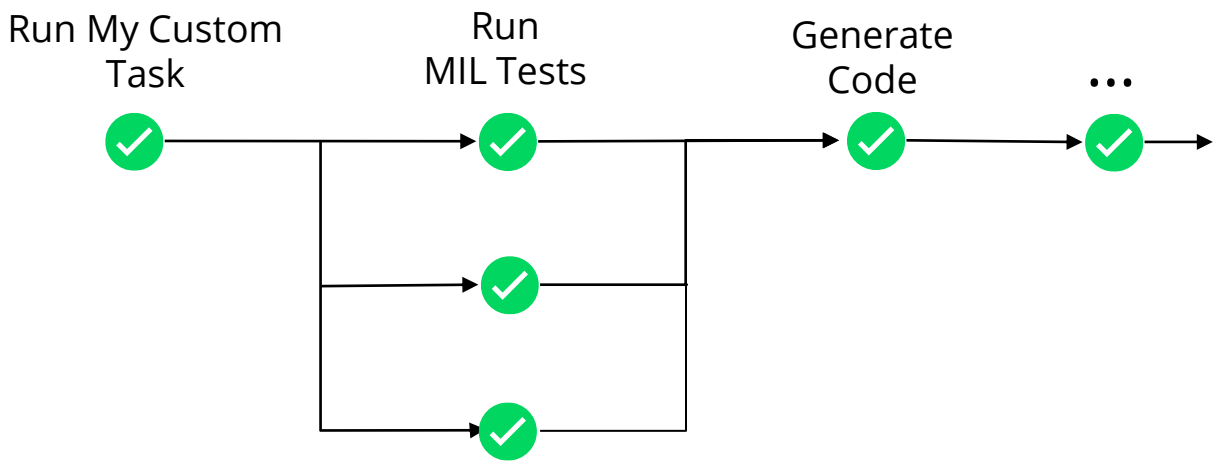
- Static Analysis
- Code Generation
- Testing

Zero Upfront Code

TASKS	TOOLS
Check Model Standards Compliance	Simulink Check
Run Tests	Simulink Test
Generate Source Code	Embedded Coder
Check Code Standards Compliance	Polyspace Bug Finder
Generate Software Design Description	Simulink Report Generator
Design Error Detection	Simulink Design Verifier
Verify Model Update & Simulation	Simulink
Check Model Metrics	Model Advisor

Fully Tailorable

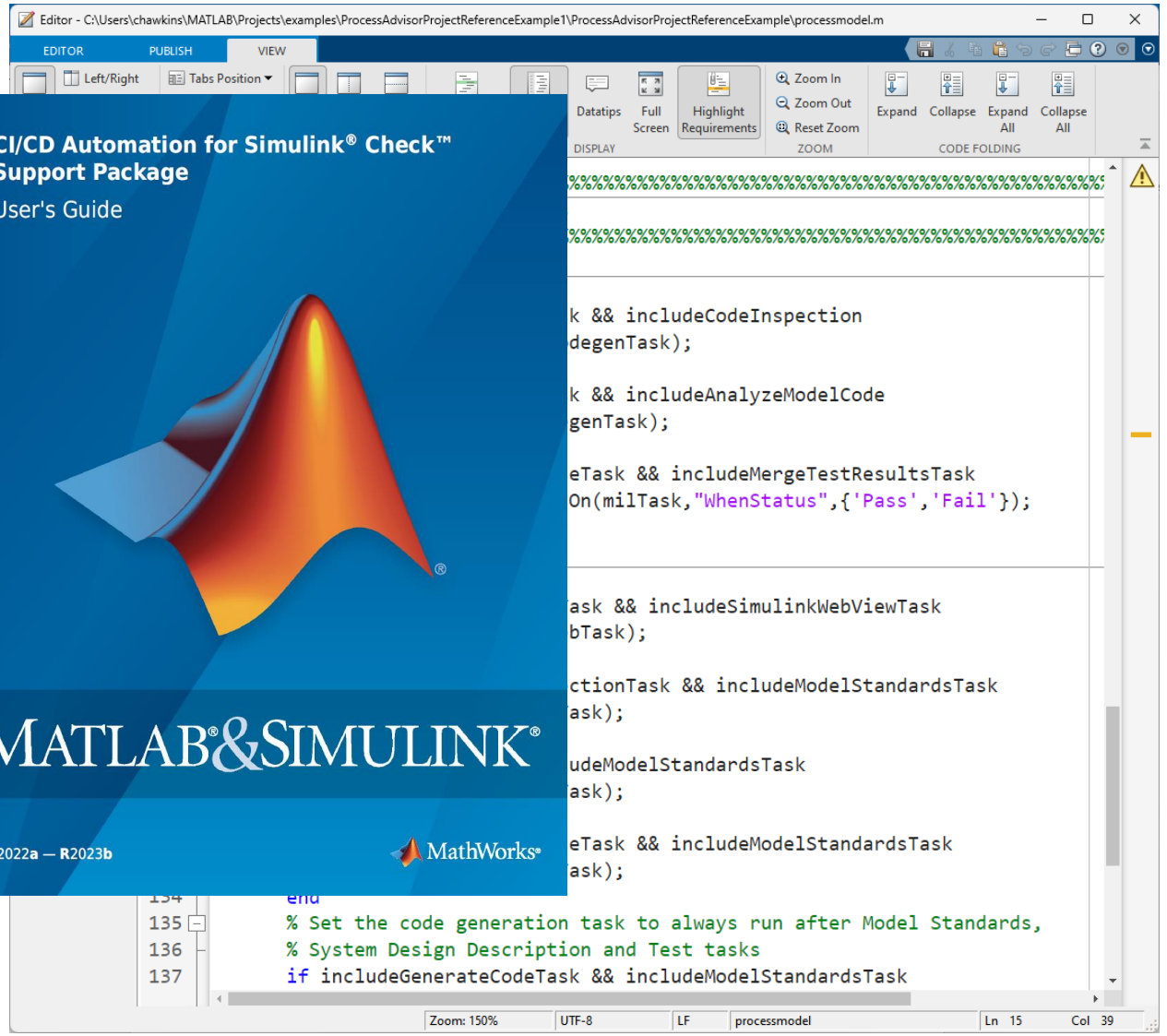
- Create custom tasks
- Modify existing steps
- Add and remove steps



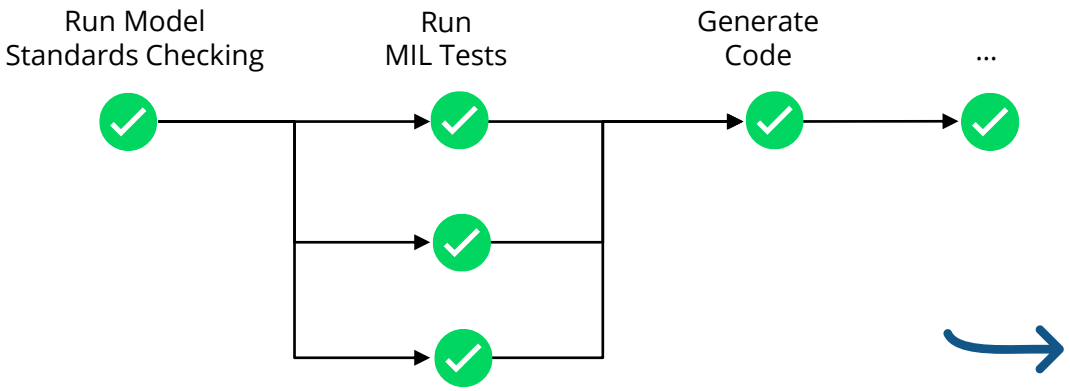
Pipeline Definition – The Process Model

- MATLAB code file
- Automatically generated
- Register tasks
- Set task dependencies
- Set task run order

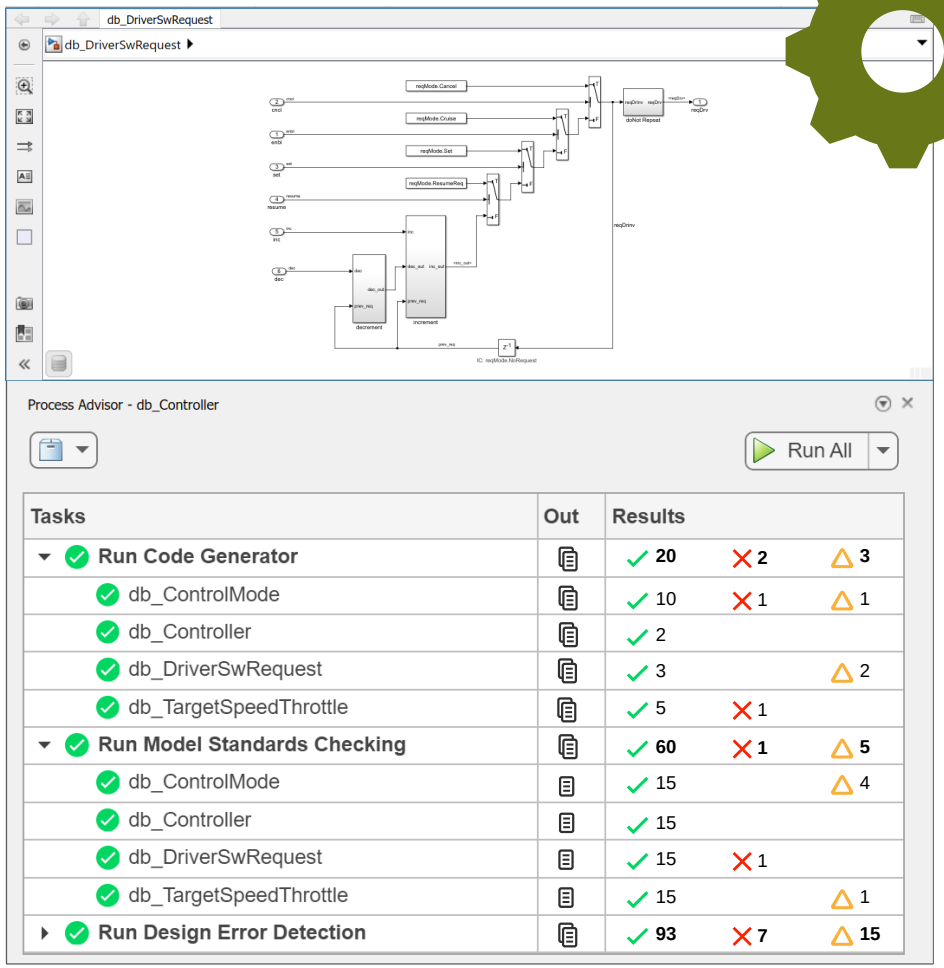
- Full documentation



Pipeline Testing & Pre-qualification - Process Advisor



Process Model



MBD
Build Tool

Process Advisor

Local Desktop Workflow

MATLAB R2023b

HOME PLOTS APPS

Try the New Desktop | Search Documentation | Charles

New Script | New Live Script | New | Open | Find Files | Compare — FILE

Import Data | Clean Data | Variable | Save Workspace | Clear Workspace — VARIABLE

Favorites | Analyze Code | Run and Time | Clear Commands — CODE

Simulink — SIMULINK

Layout | Preferences | Set Path | Parallel | Add-Ons — ENVIRONMENT

Help | Community | Request Support | Learn MATLAB — RESOURCES

C: ▸ Users ▸ chawkins ▸ MATLAB ▸ Projects ▸ examples ▸ ProcessAdvisorExample14 ▸

Current Folder

Name	Git
.git	·
01_Requirements	·
02_Models	■
03_Code	·
04_Results	·
derived	·
resources	·
tools	·
work	·
.gitattributes	●
.gitignore	●
.gitlab-ci.yml	●
Dockerfile	●
ProcessAdvisorExample.prj	●
processmodel.m	■

Details

Command Window

fx >>

Workspace | Command History

Name	Value

Pipeline Configuration Generation Simplified

1) Configure your Options

```
>> opt = padv.pipeline.GitLabOptions

opt =

  GitLabOptions with properties:

                      Tags: ""
    EnableArtifactCollection: 1
        ArtifactZipFileName: "padv_artifacts.zip"
          ArtifactsExpireIn: "30 days"
              ArtifactsWhen: "always"
      GeneratedYMLFileName: "simulink_pipeline"
       PipelineArchitecture: "SingleStage"
           ForceRunAllTasks: 0
            ExitInBatchMode: 1
           RerunFailedTasks: 0
           RerunErroredTasks: 0
            MatlabLaunchCmd: "matlab"
      MatlabStartupOptions: "-nodesktop -logfile output.log"
        AddBatchStartupOption: 1
  GeneratedPipelineDirectory: "derived\pipeline"
      GenerateJUnitForProcess: 1
```

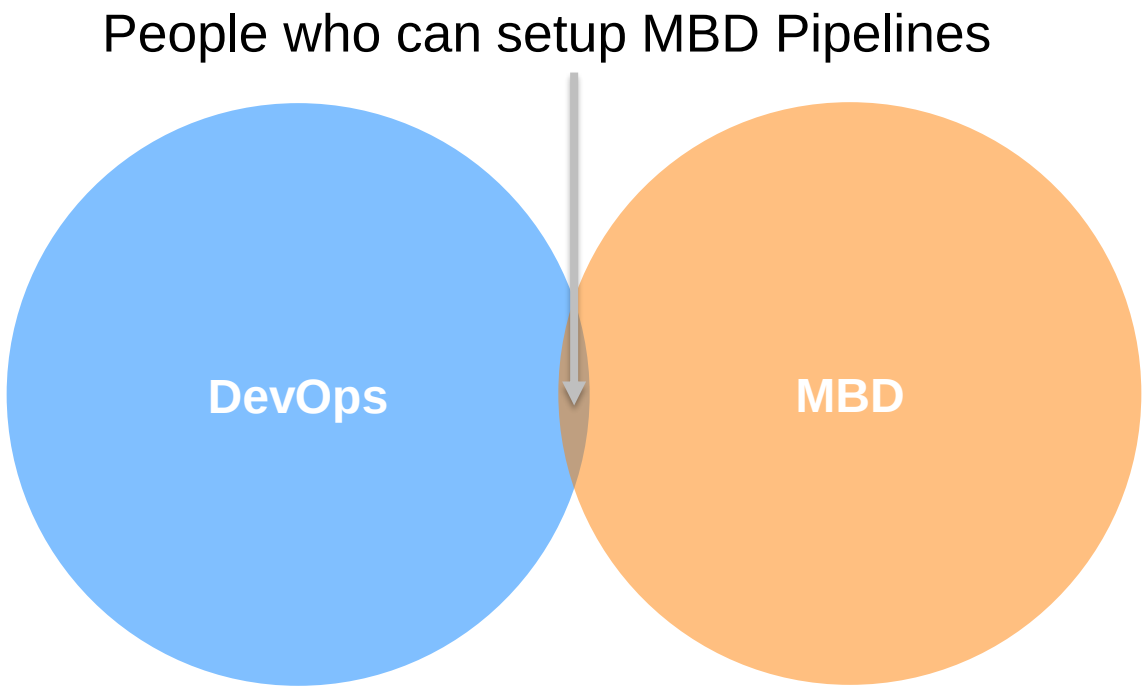
2) Generate your Pipeline

```
>> padv.pipeline.generatePipeline(opt)
####################
## Getting details about the current project
## Resolving pipeline architecture 'SingleStage'
## Generating internal pipeline

## Generating 'GitLab' pipeline
#### Creating pipeline: 'simulink_pipeline.yml'
#### Adding 'stages' information
#### Adding 'jobs':
####       Adding job: 'Runprocess'
#### Adding job to collect artifacts

## Writing pipeline content into 'simulink_pipeline.yml'
####################
```

3) Integrate the Output

```
41  SimulinkPipelineExecution:
42
43      stage: SimulinkPipelineExecution
44
45      trigger:
46
47          include:
48
49              artifact: derived/pipeline/simulink_pipeline.yml
50
51              job: SimulinkPipelineGeneration
52
53          strategy: depend
54
55      # Do not change the name of this variable
56      variables:
57          PADV_ROOT_PIPELINE_ID: $CI_PIPELINE_ID
```

Automatic Pipeline Generation



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

Automatic Pipeline Generation

People who can setup MBD Pipelines

- Enab
- Creat
- Empo

```
11      stage: SimulinkPipelineGeneration
12
13      tags:
14          - padv_demo_ci
15
16      script:
17      # Open the project and generate the pipeline using
18      # appropriate options in project root
19          - >
20              matlab
21              -nodesktop
22              -logfile "$MATLAB_LOG_FILE"
23              -batch "
24              cp = openProject(pwd);
25              padv.pipeline.generatePipeline(
26              padv.pipeline.GitLabOptions(
27              PipelineArchitecture = padv.pipeline.Architecture.SerialStagesGroupPerTask,
28              GeneratedYMLFileName = 'simulink_pipeline.yml',
29              GeneratedPipelineDirectory = fullfile('derived','pipeline')));
30              "
```

Files · master · Charles Hawkins /

insidelabs-git.mathworks.com/chawkins/processadvisorproject23b/-/tree/master

Bookmarks | Personal | MathWorks Inside -... | MathWorks | IEEE-754 Floating-P...

Search GitLab /

P ProcessAdvisorProject23b

- Project information
- Repository
  - Files
  - Commits
  - Branches
  - Tags
  - Contributor statistics
  - Graph
  - Compare revisions
- Issues 0
- Merge requests 0
- CI/CD
- Security and Compliance
- Deployments

Collapse sidebar

Charles Hawkins > ProcessAdvisorProject23b > Repository

Update GitLab options
Charles Hawkins authored 2 hours ago

b3e278f7

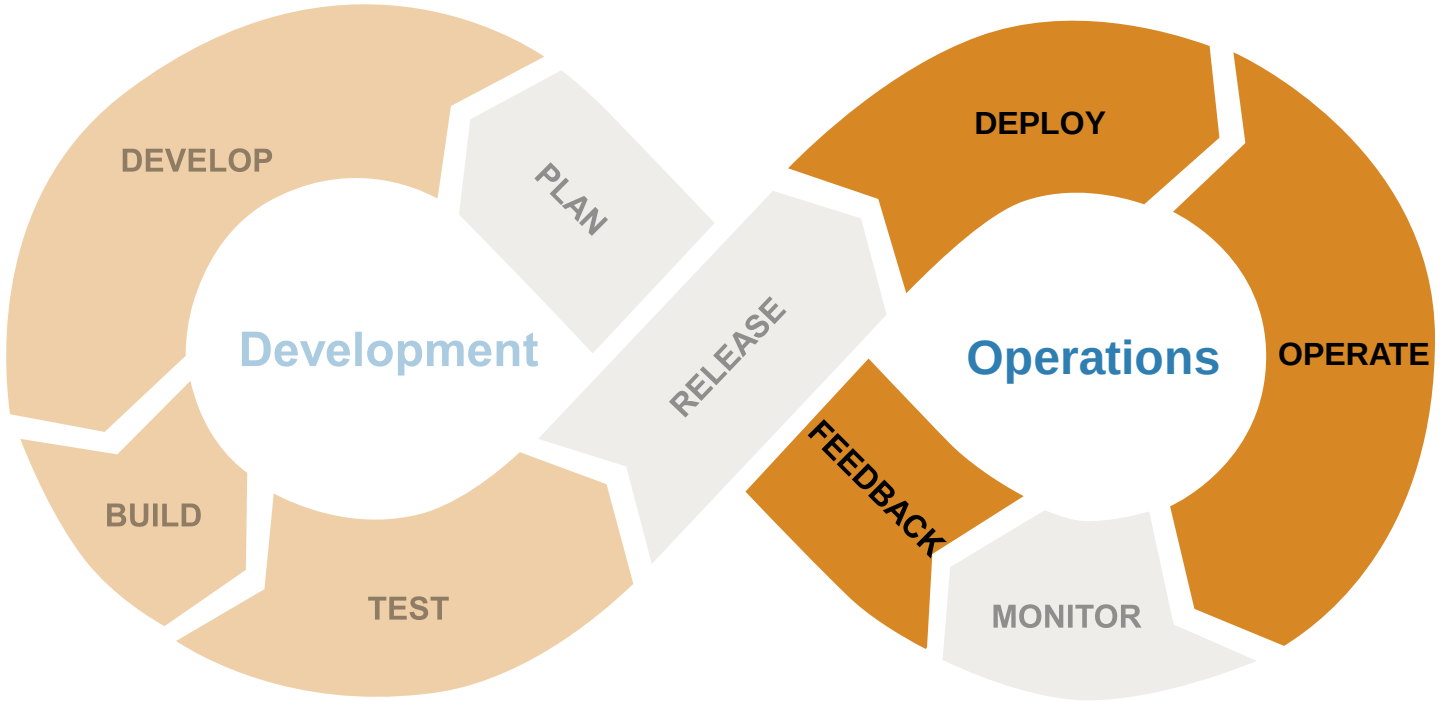
master | processadvisorproject23b / | History | Find file | Web IDE | Clone

Name	Last commit	Last update
01_Requirements		
02_Models		
03_Code		
04_Results		
resources/project		
tools		
work/cache		
.gitattributes		

artifacts.zip

Show all

DevOps Lifecycle



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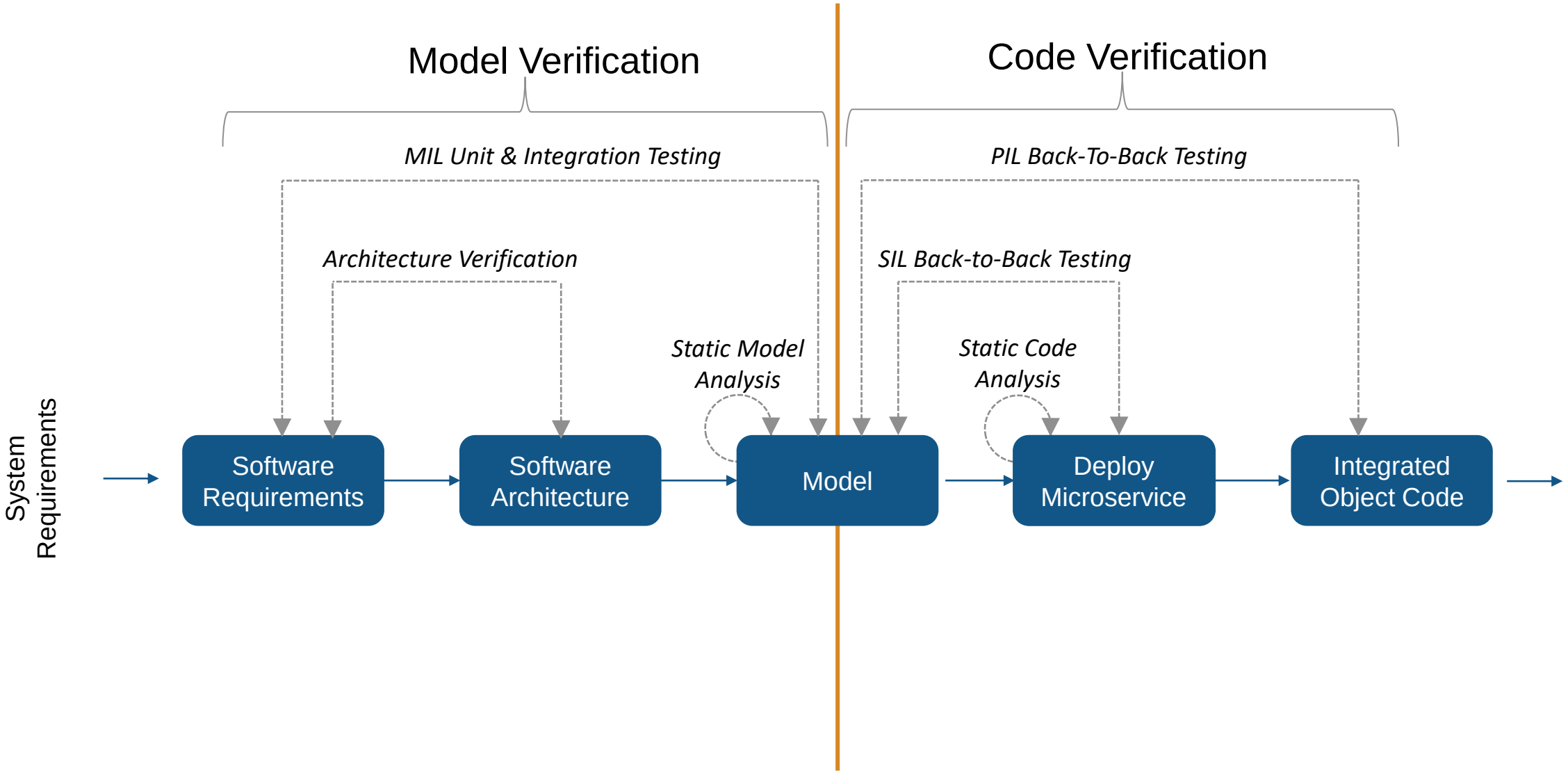
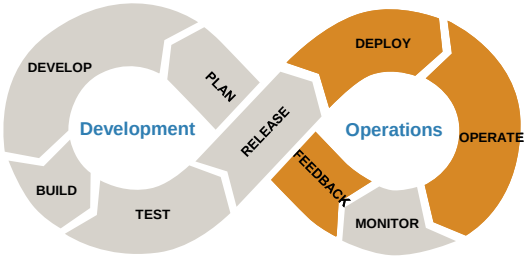


Workflow


DEVELOP
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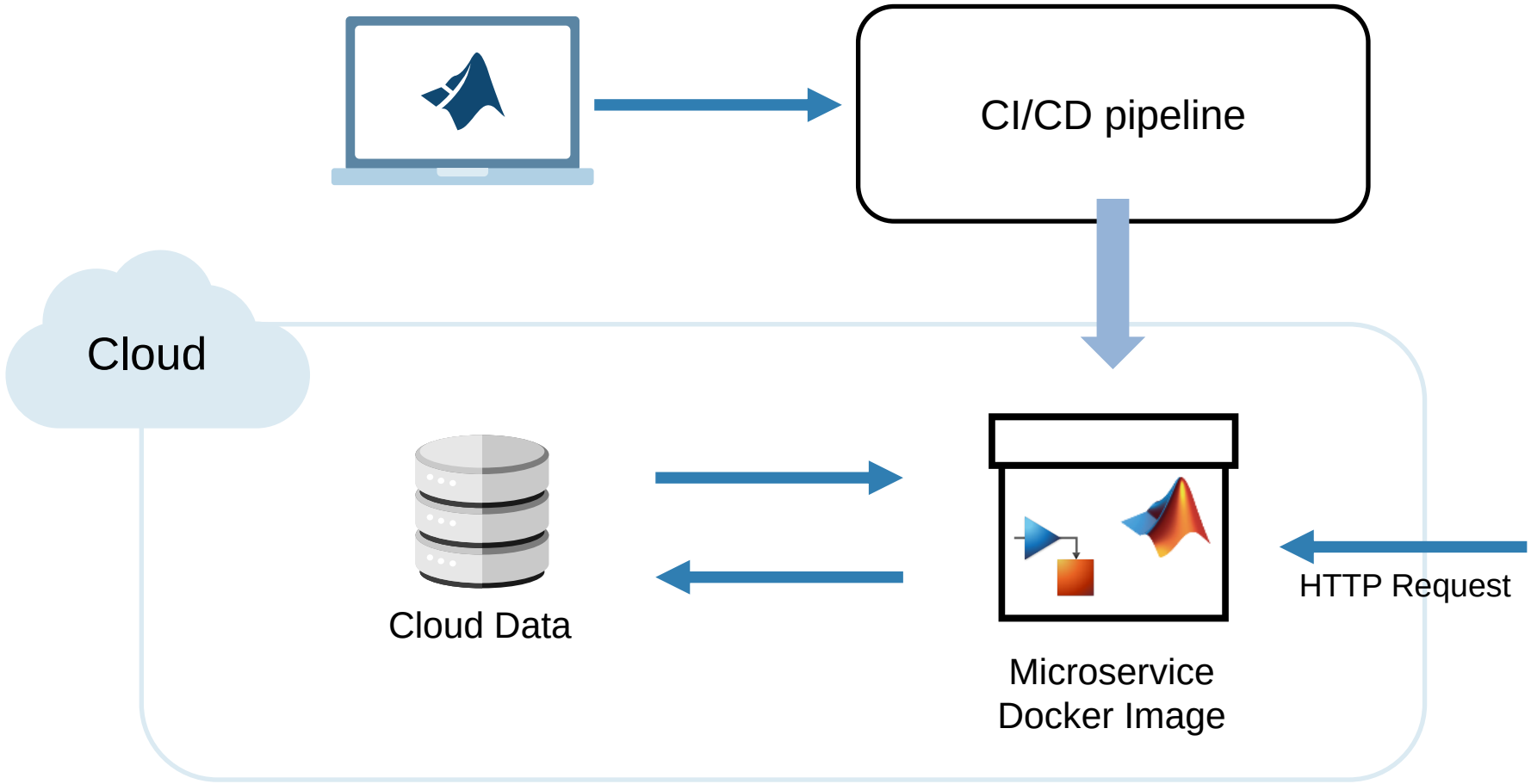
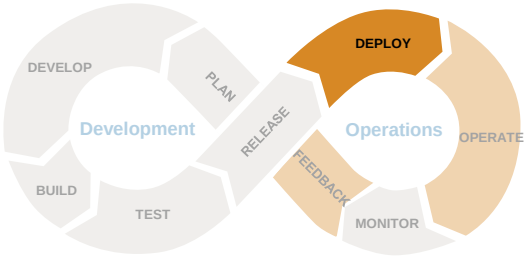
Development
RELEASE
Operations
OPERATE
FEEDBACK
BUILD
TEST
MONITOR


CI/CD pipeline
Cloud
Cloud Data
HTTP Request
Microservice
Docker Image

Workflow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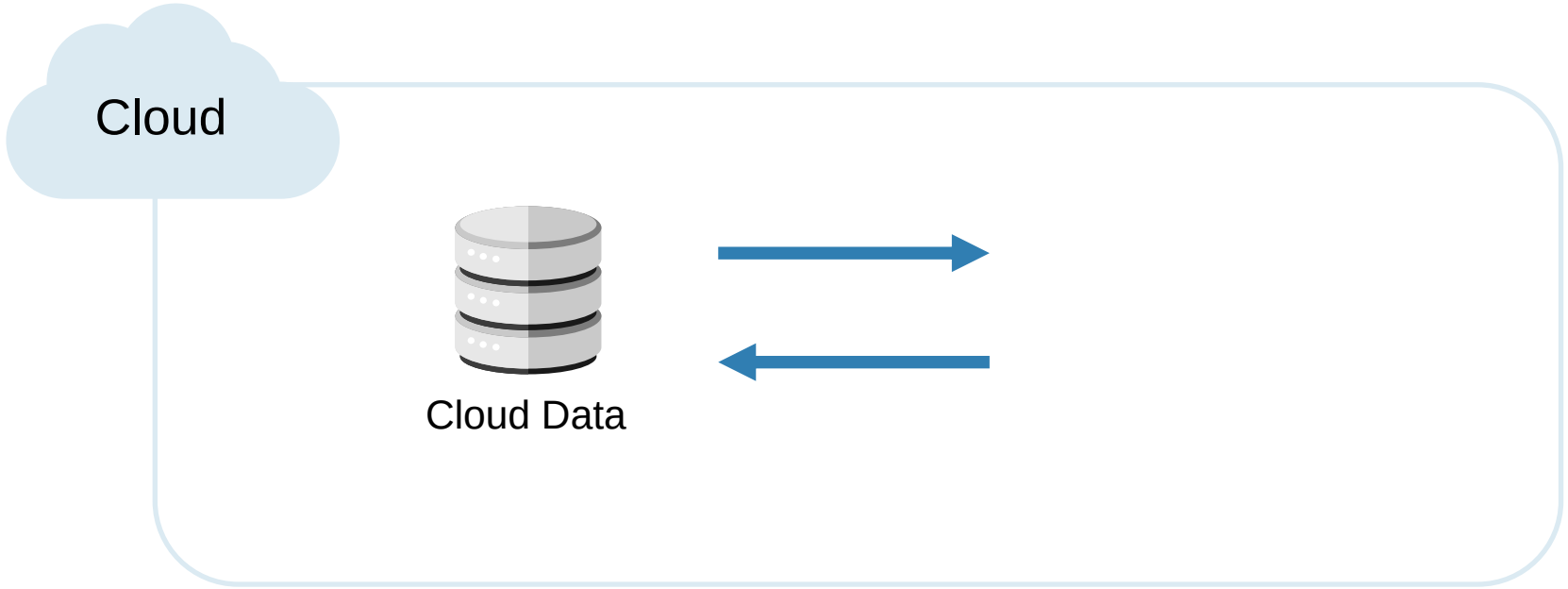
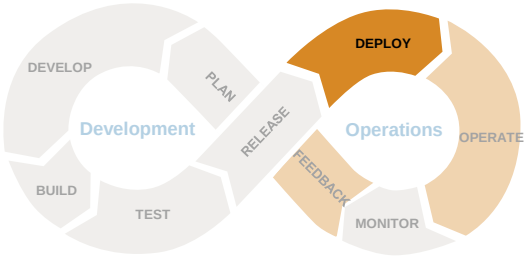

Cloud
Cloud Data

Deploy – Read/Write Cloud Data from MATLAB



Local Data

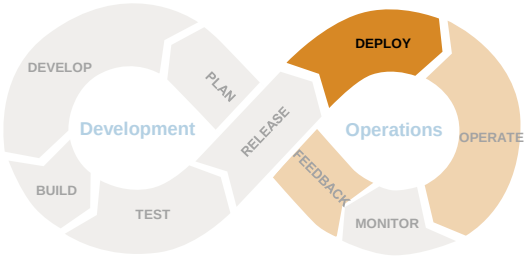
```
fileName = "path/to/file.mat";
load(filename,"var");
save("path/to/newfile.mat","var","-v7.3")
```

Remote Data

```
loadenv("secrets.env")
```

```
fileName = "wasbs://container@account/path/to/file.mat";
load(filename,"var");
save("wasbs://container@account/path/to/newfile.mat","var","-v7.3")
```

Workflow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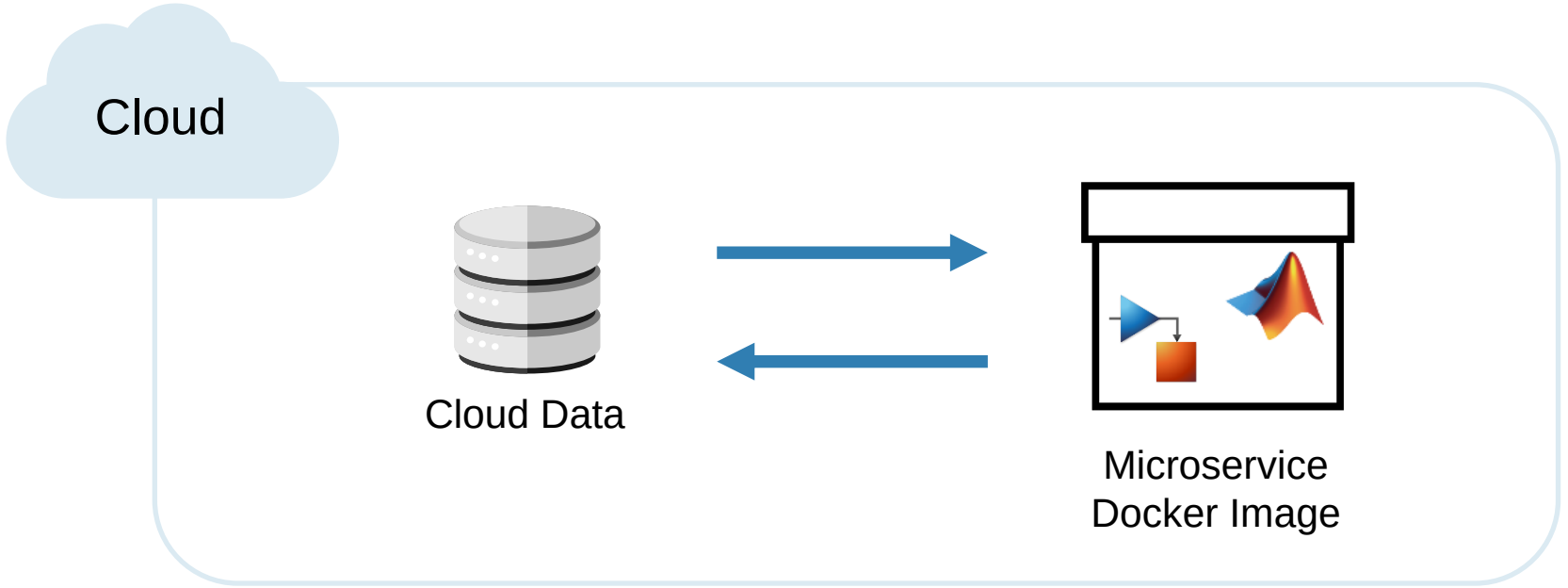
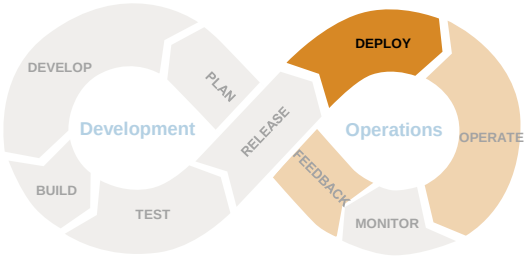

Cloud
Cloud Data
Microservice
Docker Image

Deploy – Microservice Docker Image




```
function playSimulation(inputFile, outDir)
    % Load input file
    load(inputFile, 'AHRS1', 'AHRS2', 'AHRS3');

    % Define the input data
    inputData = Simulink.SimulationData.Dataset;
    inputData = addElement(inputData, AHRS1, 'AHRS1');
    inputData = addElement(inputData, AHRS2, 'AHRS2');
    inputData = addElement(inputData, AHRS3, 'AHRS3');

    % Set input data as external data
    in = Simulink.SimulationInput('AHRS_Voter');
    in = setExternalInput(in,inputData);
    % Configure for deployed simulation
    in = simulink.compiler.configureForDeployment(in);

    % Run the simulation
    simOut = sim(in);

    % Write results in the output folder
    out = simOut.yout{1}.Values;
    save(outDir+"output.mat", "out", '-v7.3')
end
```

Read Data

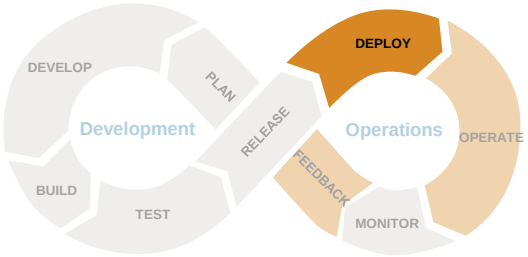
Define Input

Prepare Simulation

Simulate

Save Data

Deploy – Create a Microservice in MATLAB

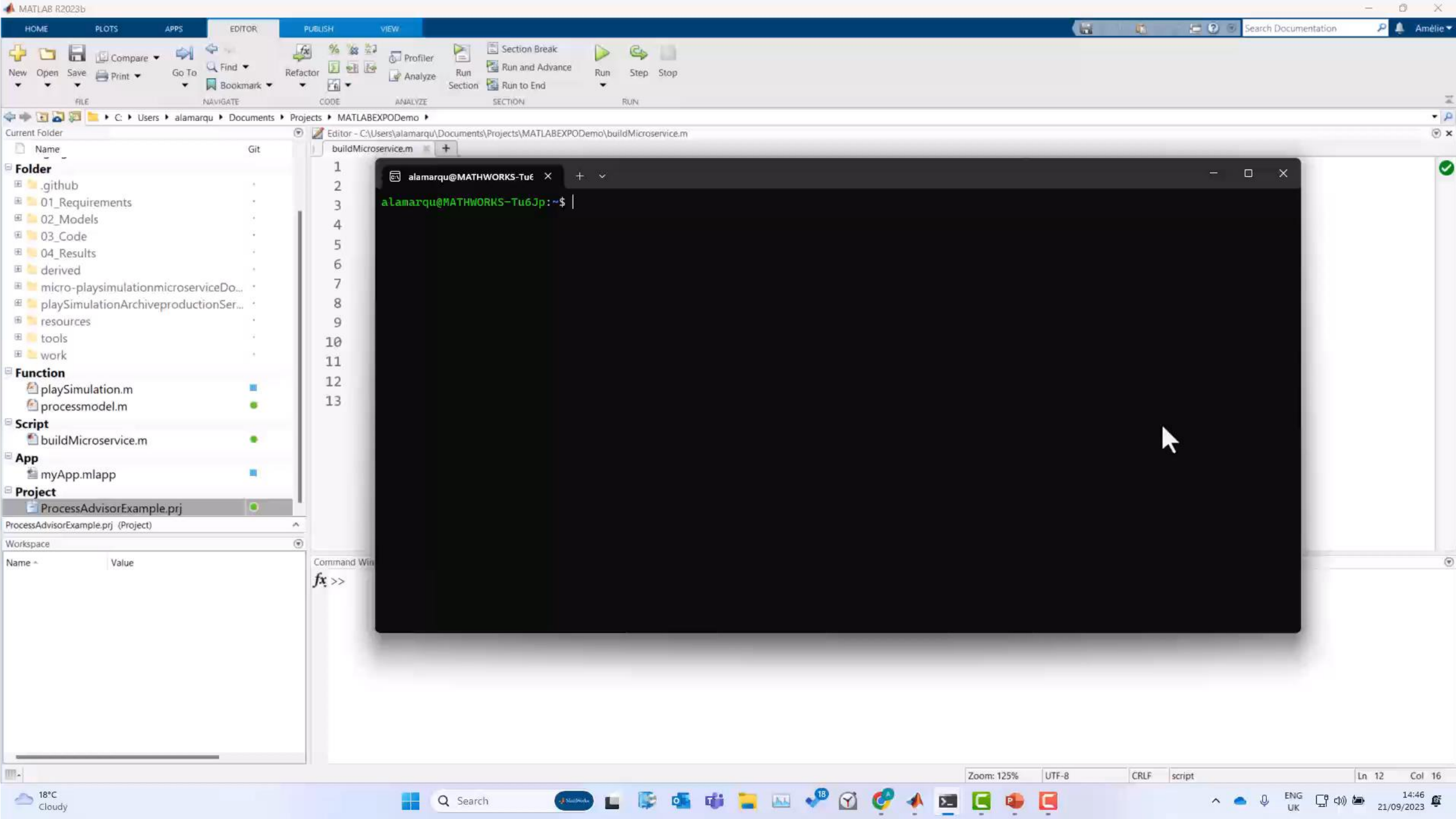


- Requirements:
  - Docker
  - MATLAB Compiler
  - MATLAB Compiler SDK
  - Simulink Compiler

- Code:

```
mpsResults =
compiler.build.productionServerArchive(“myFunction.m","ArchiveName",“myarchive");

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


MATLAB R2023b
HOME
PLOTS
APPS
EDITOR
PUBLISH
VIEW
Search Documentation
Amélie
New
Open
Save
Compare
Print
Go To
Find
Bookmark
Refactor
Profiler
Analyze
Run Section
Section Break
Run and Advance
Run to End
Run
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Stop
FILE
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CODE
ANALYZE
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.github
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02_Models
03_Code
04_Results
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resources
tools
work
Function
playSimulation.m
processmodel.m
Script
buildMicroservice.m
App
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Project
ProcessAdvisorExample.prj
ProcessAdvisorExample.prj (Project)
Workspace
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Value
Editor - C:\Users\alamarqu\Documents\Projects\MATLABEXPODemo\buildMicroservice.m
buildMicroservice.m
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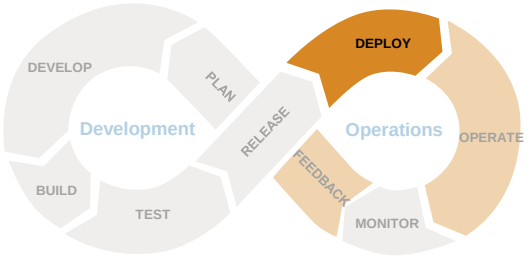
21/09/2023

Workflow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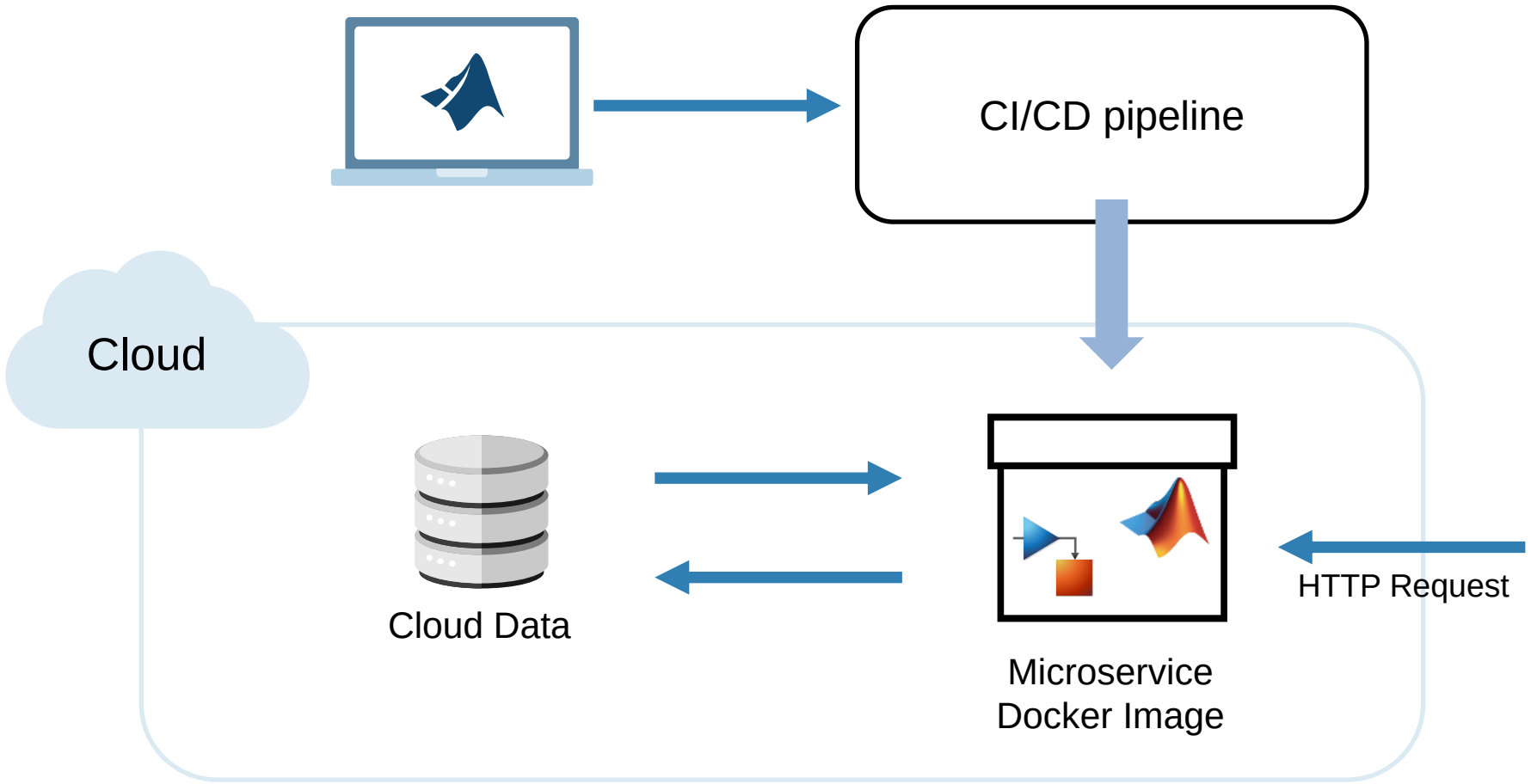
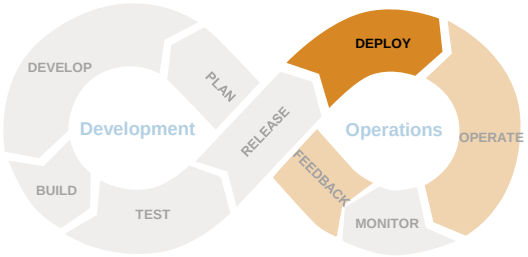
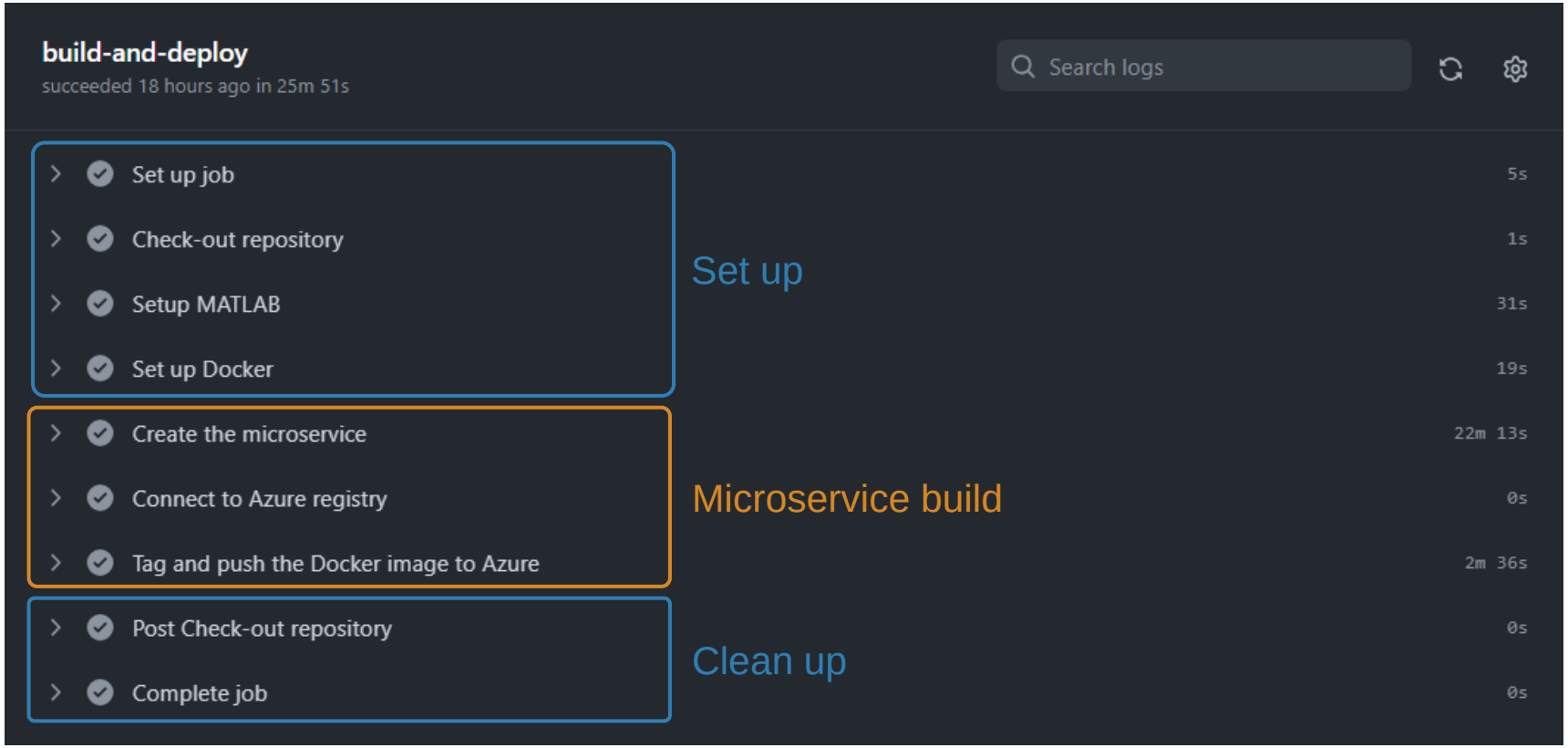

CI/CD pipeline
Cloud
Cloud Data
HTTP Request
Microservice
Docker Image

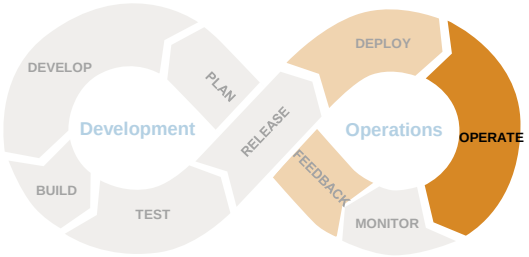
Deploy – Integration with the DevOps Pipeline

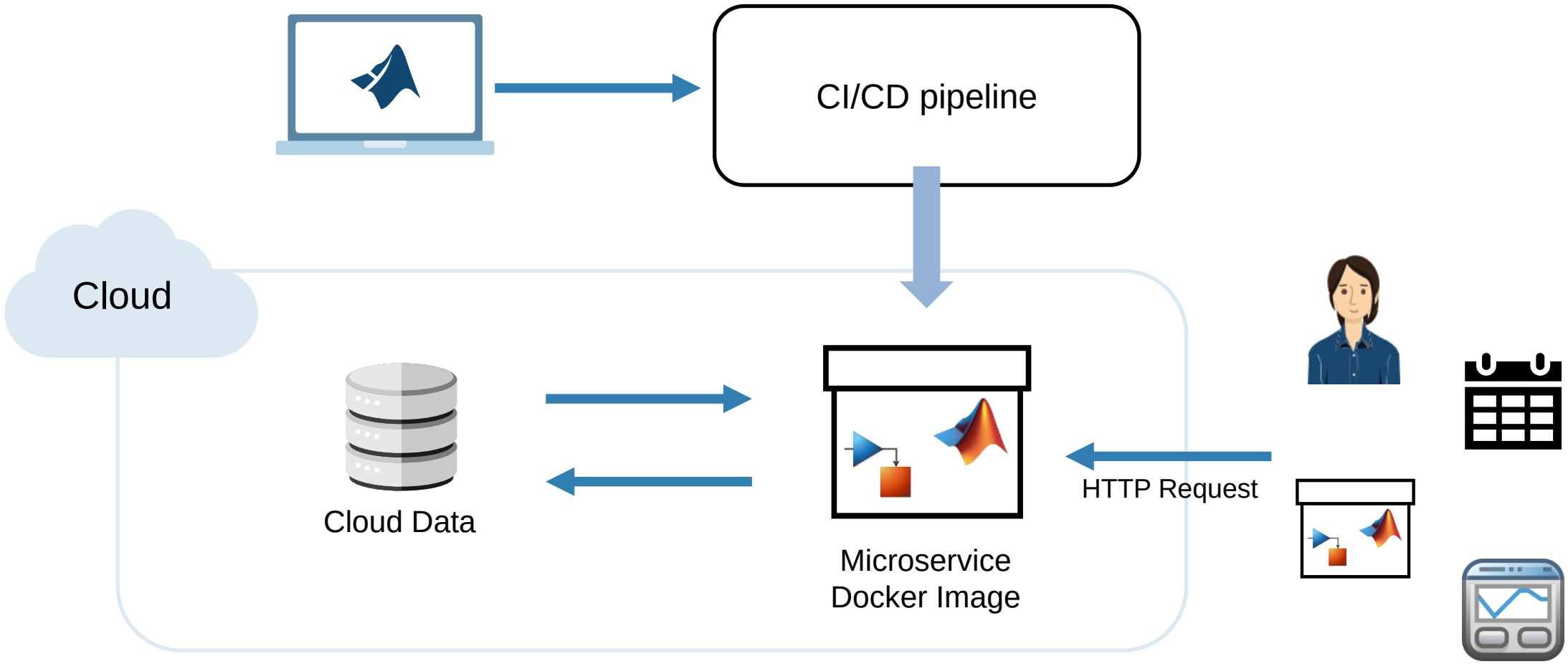


- How to use it in pipeline

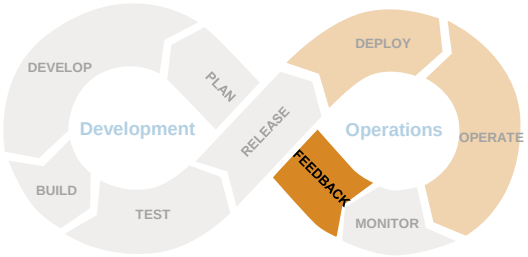


Operate – Sending Requests

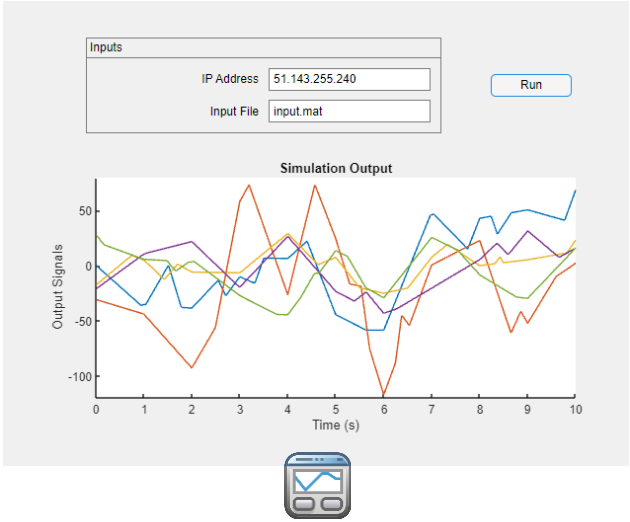




Feedback – Visualise Data



- Application e.g. using microservices



- Dashboards

MATLAB R2023b

HOME PLOTS APPS

Search Documentation

Amélie

New Script | New Live Script | New | Open | Find Files | Compare | Import Data | Clean Data | Variable | Save Workspace | Clear Workspace | Favorites | Analyze Code | Run and Time | Clear Commands | Simulink | Layout | Preferences | Set Path | Parallel | Add-Ons | Help | Community | Request Support | Learn MATLAB

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

C: ▸ Users ▸ alamarqu ▸ Documents ▸ Projects ▸ MATLABEXPODemo ▸

Current Folder

Name Git

- **Folder**
  - .github
  - 01_Requirements
  - 02_Models
  - 03_Code
  - 04_Results
  - derived
  - micro-playsimulationmicroserviceDock...
  - playSimulationArchiveproductionServe...
  - resources
  - tools
  - work
- **Function**
  - playSimulation.m
  - processmodel.m
- **Script**
  - buildMicroservice.m
- **App**
  - myApp.mlapp
- **Project**
  - ProcessAdvisorExample.prj

Details

Workspace

Name Value

Command Window

fx >>

18°C Cloudy

Search

ENG UK

17:17 21/09/2023

The Cloud and MathWorks Products

MathWorks Cloud

Private Cloud

Public Clouds

aws Microsoft Azure

MATLAB Online
Simulink Online
MATLAB Drive

Reference Architectures

Cloud Data Services

Cloud Center

MathWorks Server Products

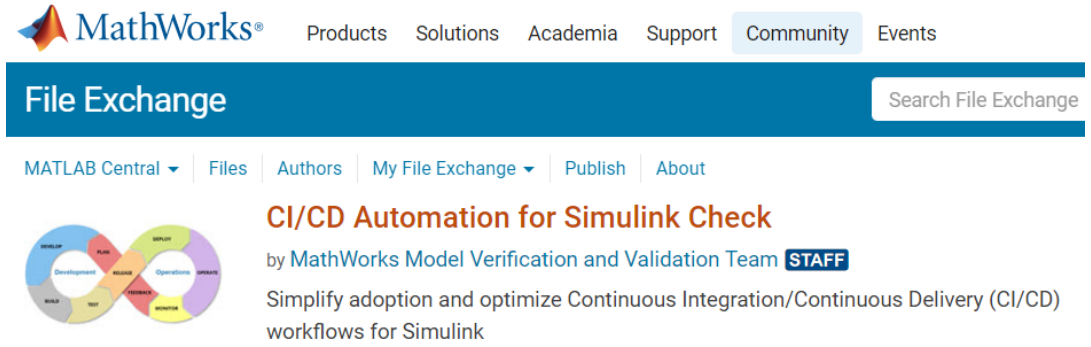
Microservices

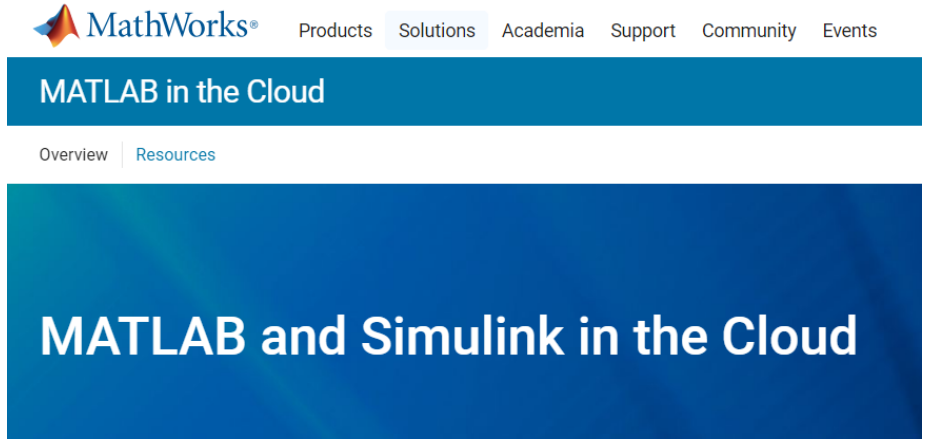
What Will Did You Learn Today?

- We are making it easier for you to:
  - Implement MBD workflows in CI systems
    - Go try the CI/CD Support Package for Simulink Check
  - Access cloud data directly from MATLAB
    - It's just like accessing files on your PC
  - Create a microservice with MATLAB Compiler SDK
    - Two MATLAB commands is all it takes

Additional Resources

- Email
  - continuous-integration@mathworks.com
  - cloud@mathworks.com
- Web
  - File Exchange
  - https://mathworks.com/cloud
  - https://www.mathworks.com/help/compiler_sdk/microservice.html
- Come and talk to us at the demo stations!





MATLAB EXPO

UNITED KINGDOM

Thank you