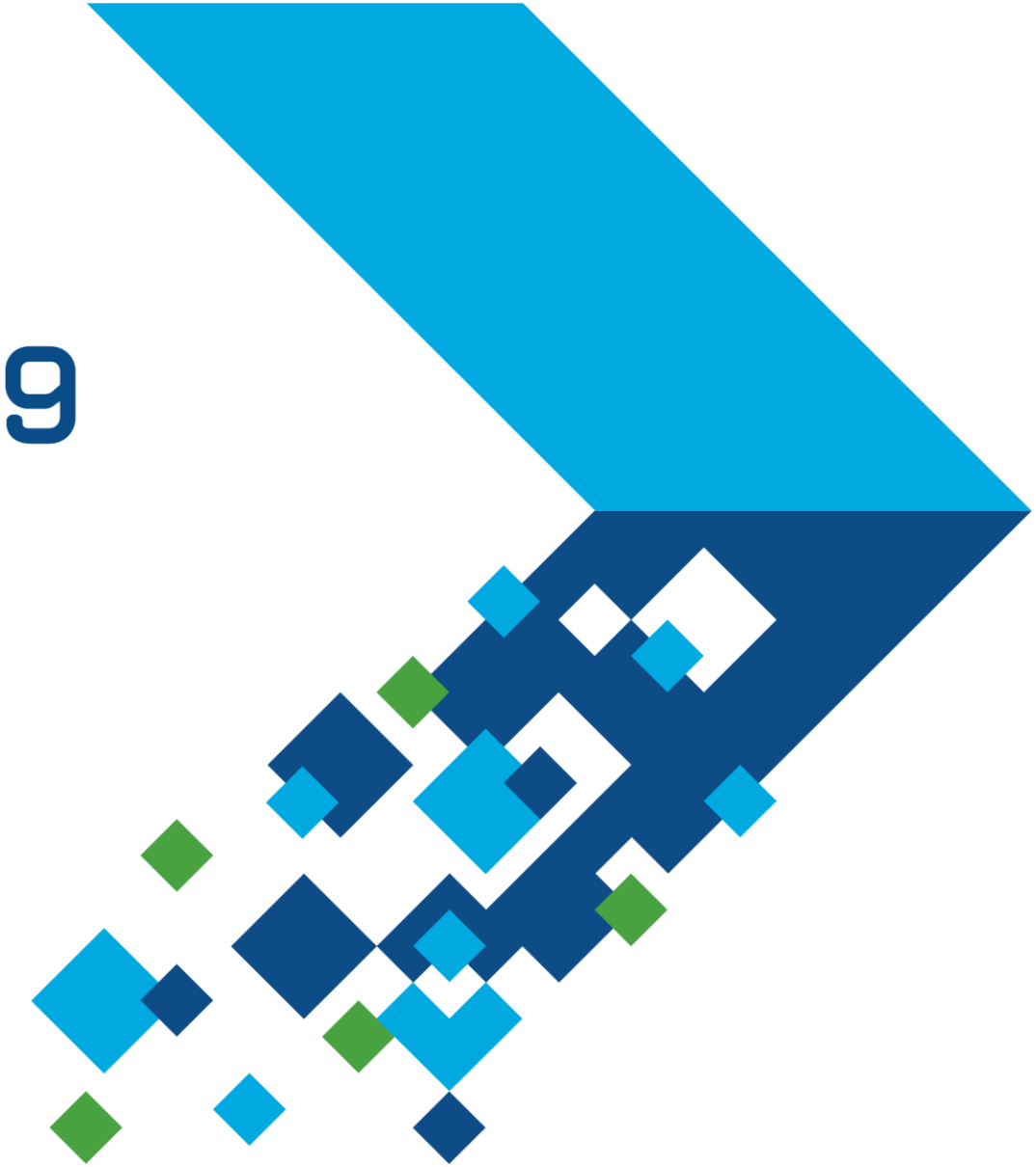
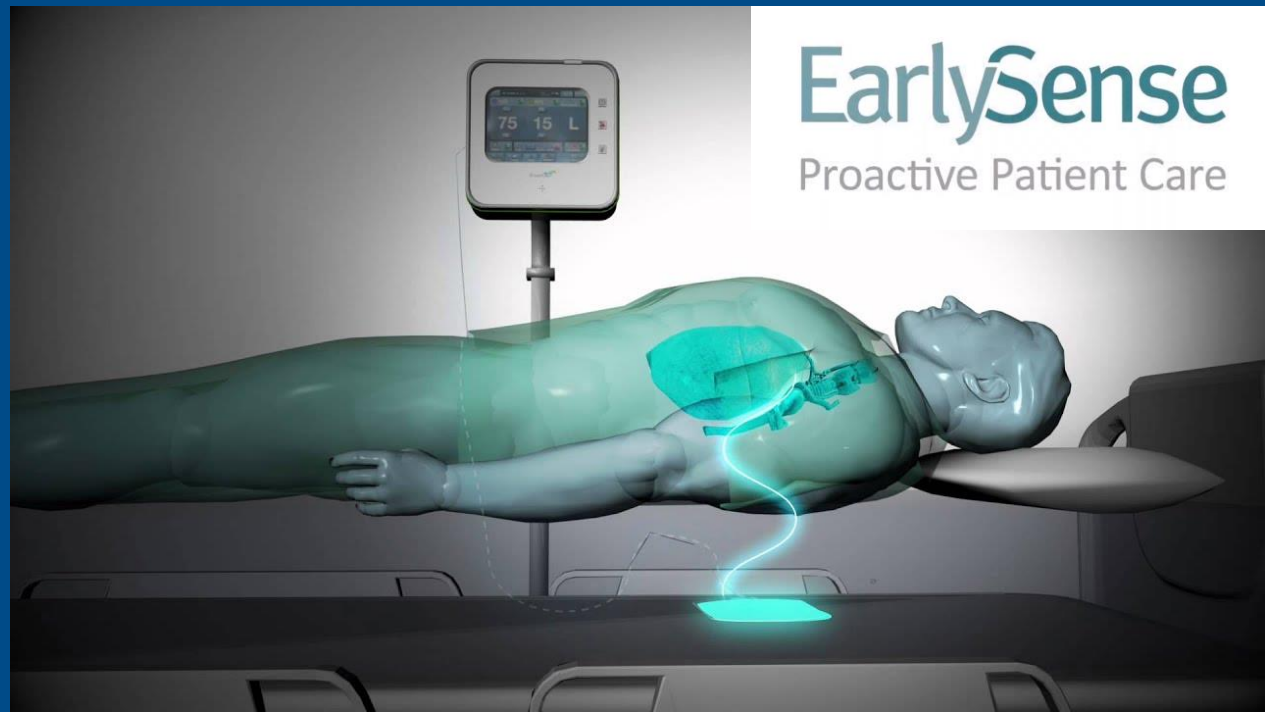
MATLAB EXPO 2019

Novedades de las últimas versiones de MATLAB y Simulink

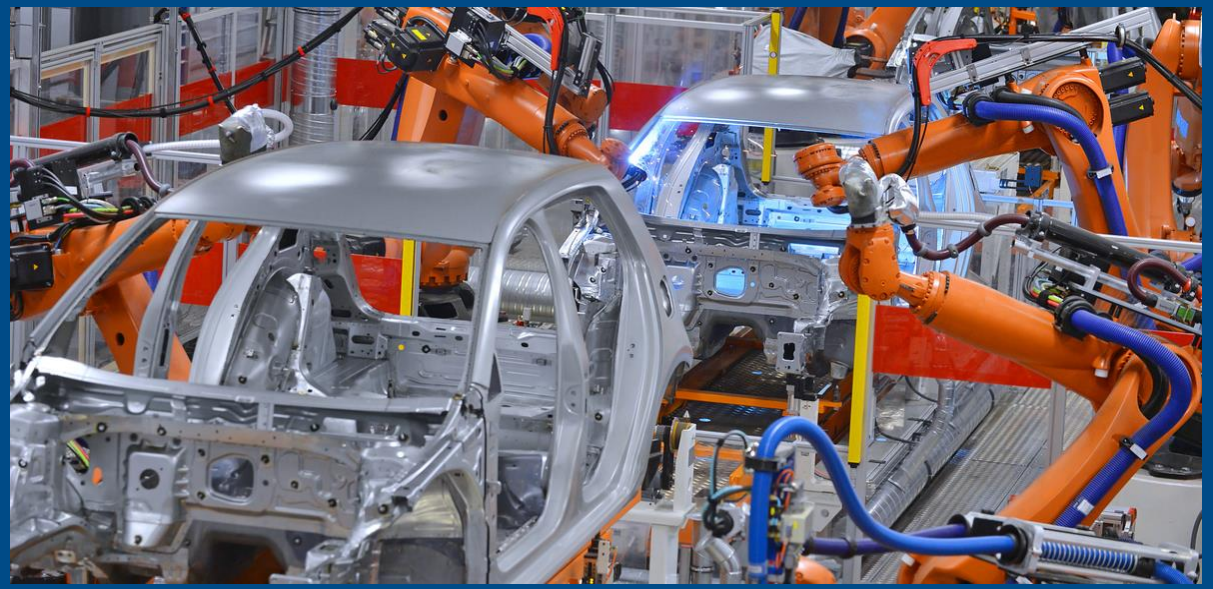
Paz Tárrega y David Pérez

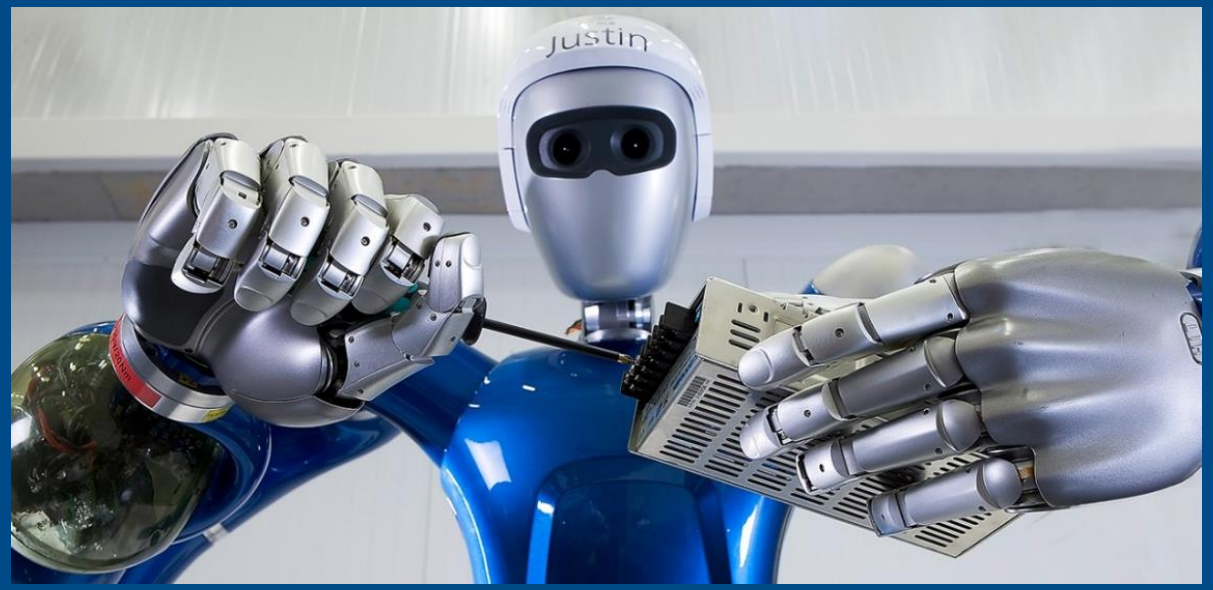


VOYAGE


75 15 L
EarlySense
Proactive Patient Care

Algorithms in Everything





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Using MATLAB & Simulink to Build Algorithms in Everything

Simplifying your work…

…often at higher levels of abstraction.

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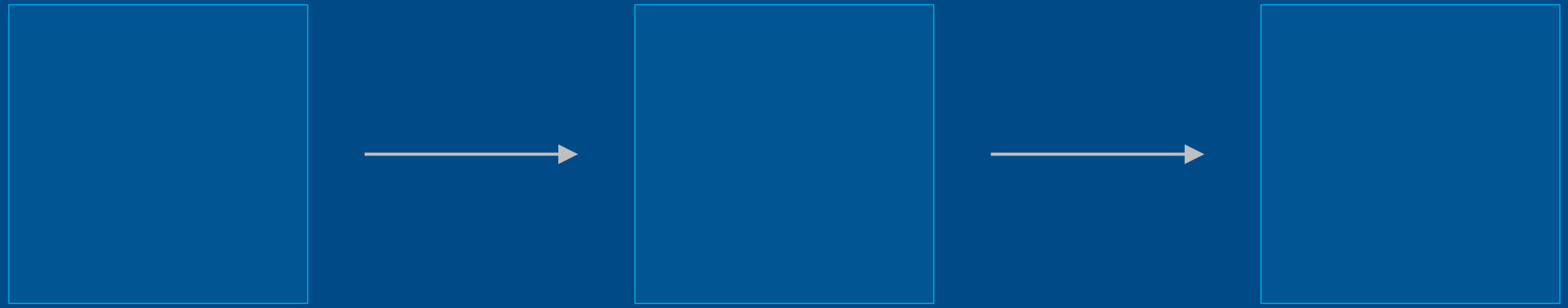
Using MATLAB & Simulink to Build Algorithms in Everything



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Artificial Intelligence

The capability of a machine to
match or exceed intelligent human behavior by
training a machine
to learn the desired behavior

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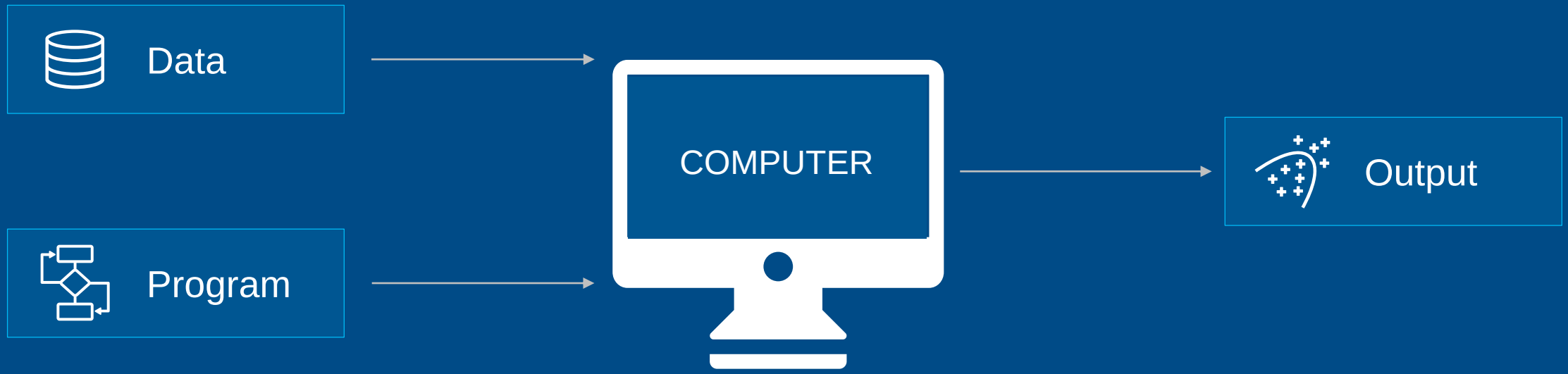
There are two ways to get a computer to do what you want

Traditional Programming



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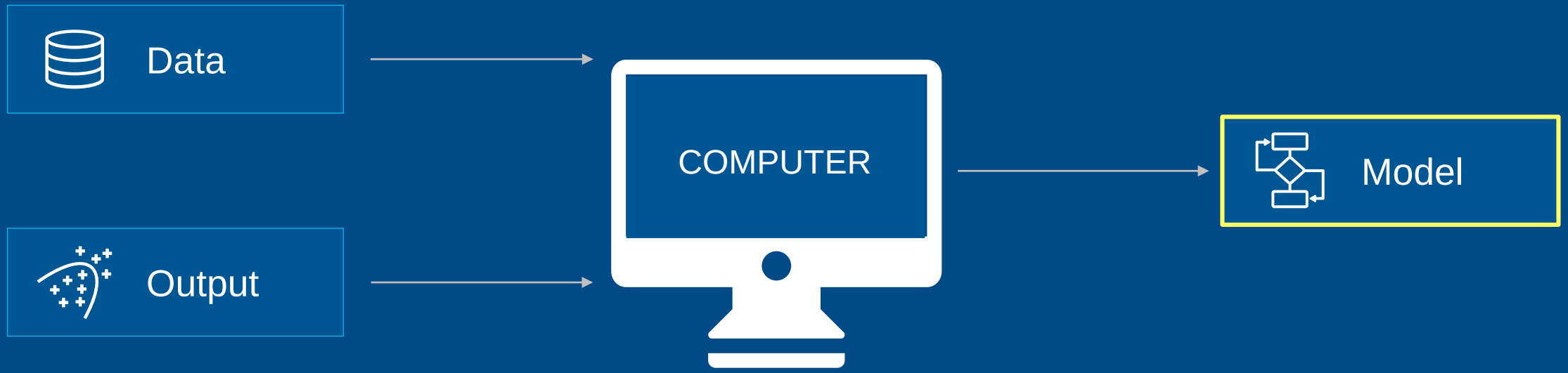
There are two ways to get a computer to do what you want

Machine Learning



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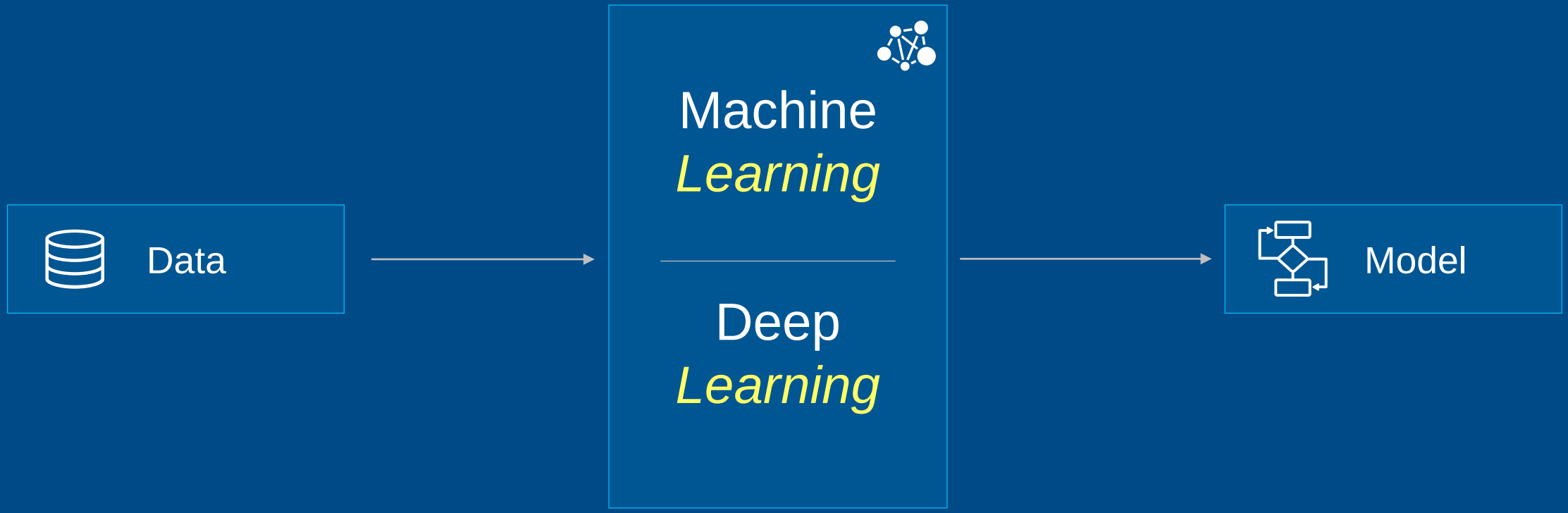
Artificial Intelligence



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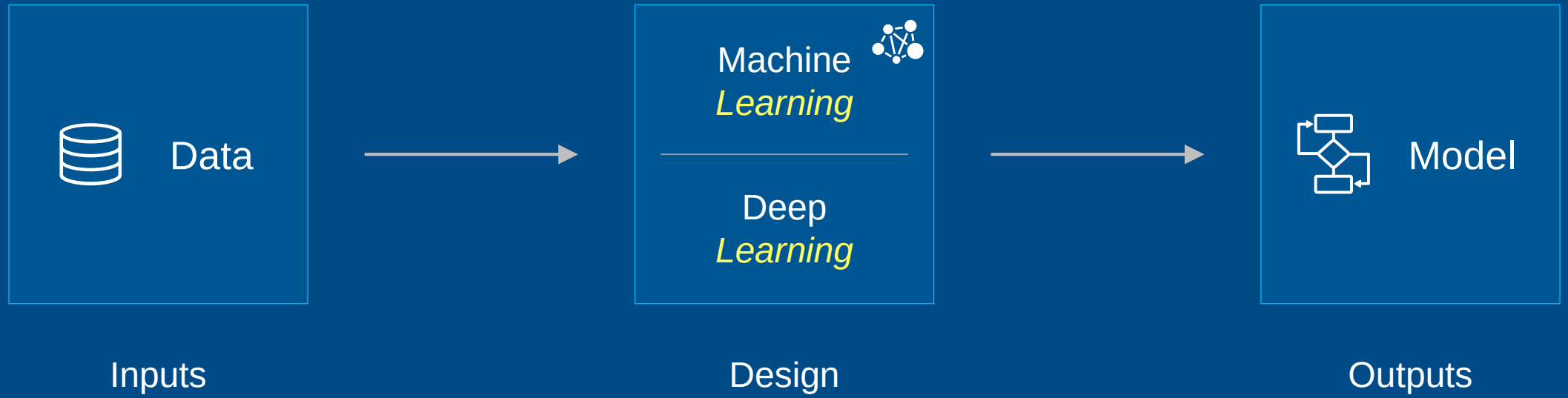
Using MATLAB and Simulink to Build Deep Learning Models



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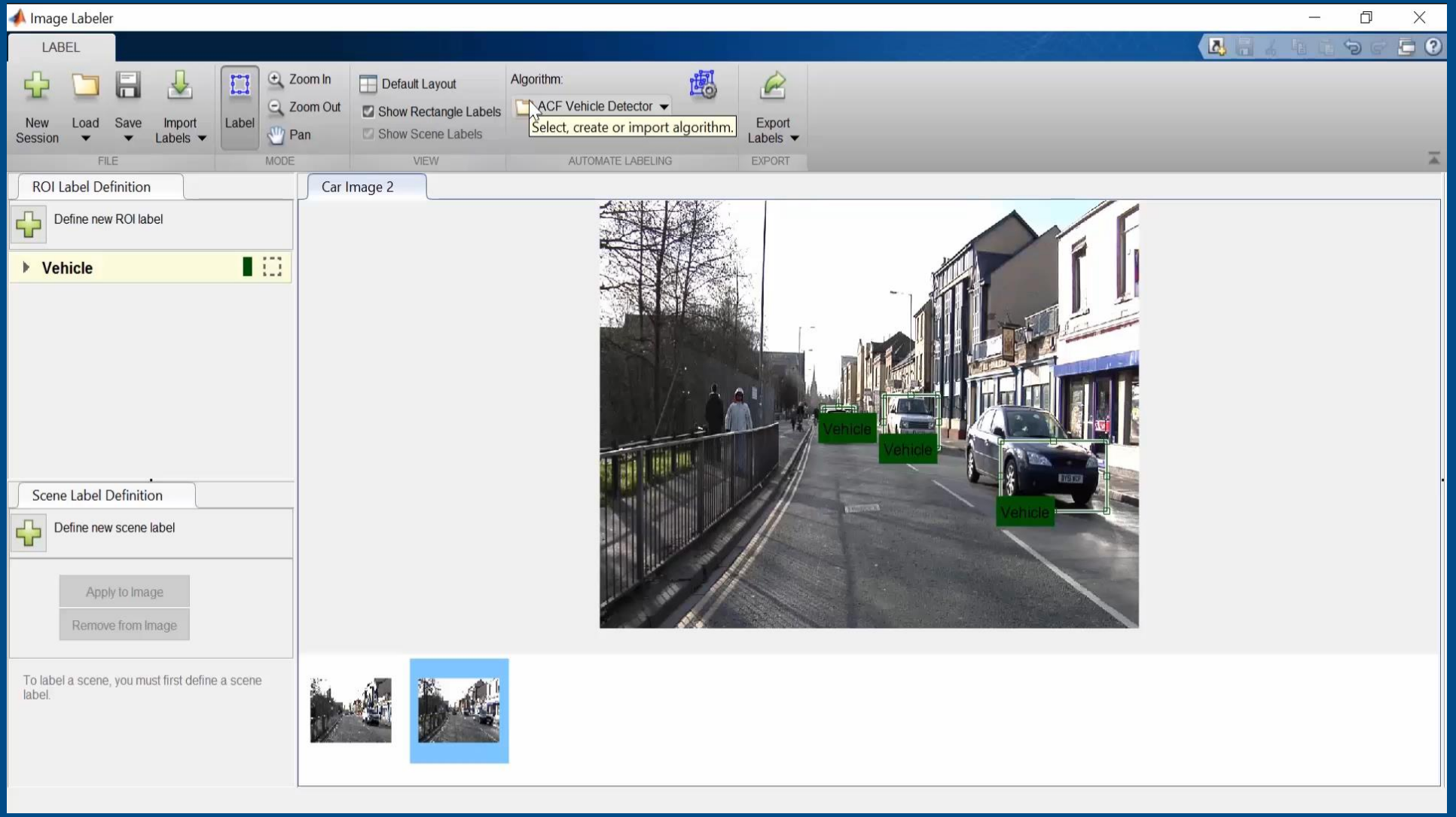
Using Apps for Ground Truth Labeling

Image and Video Data



Computer Vision Toolbox

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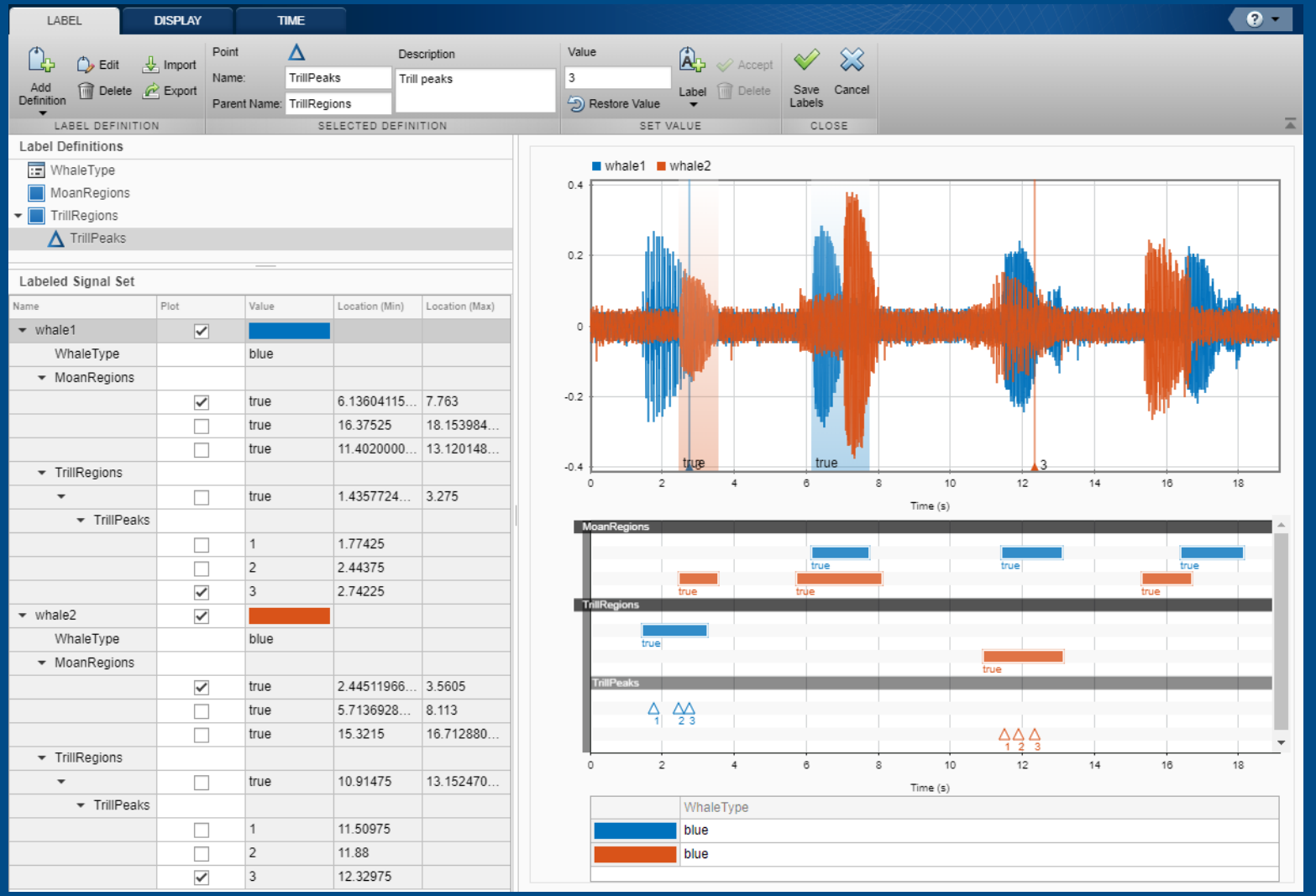
Using Apps for Ground Truth Labeling

Signal Data



Signal Processing Toolbox

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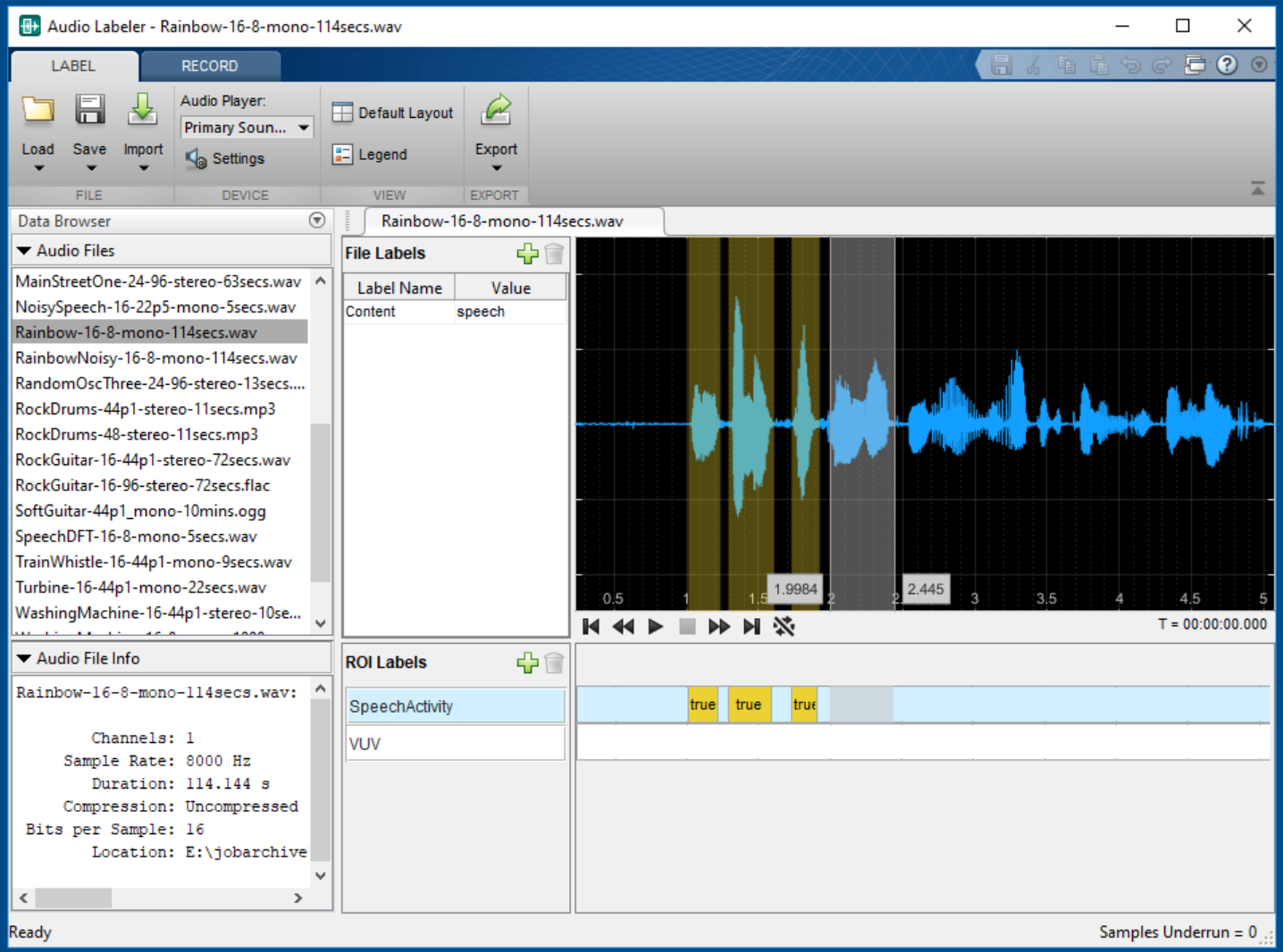
Using Apps for Ground Truth Labeling

Audio Data



Audio Toolbox

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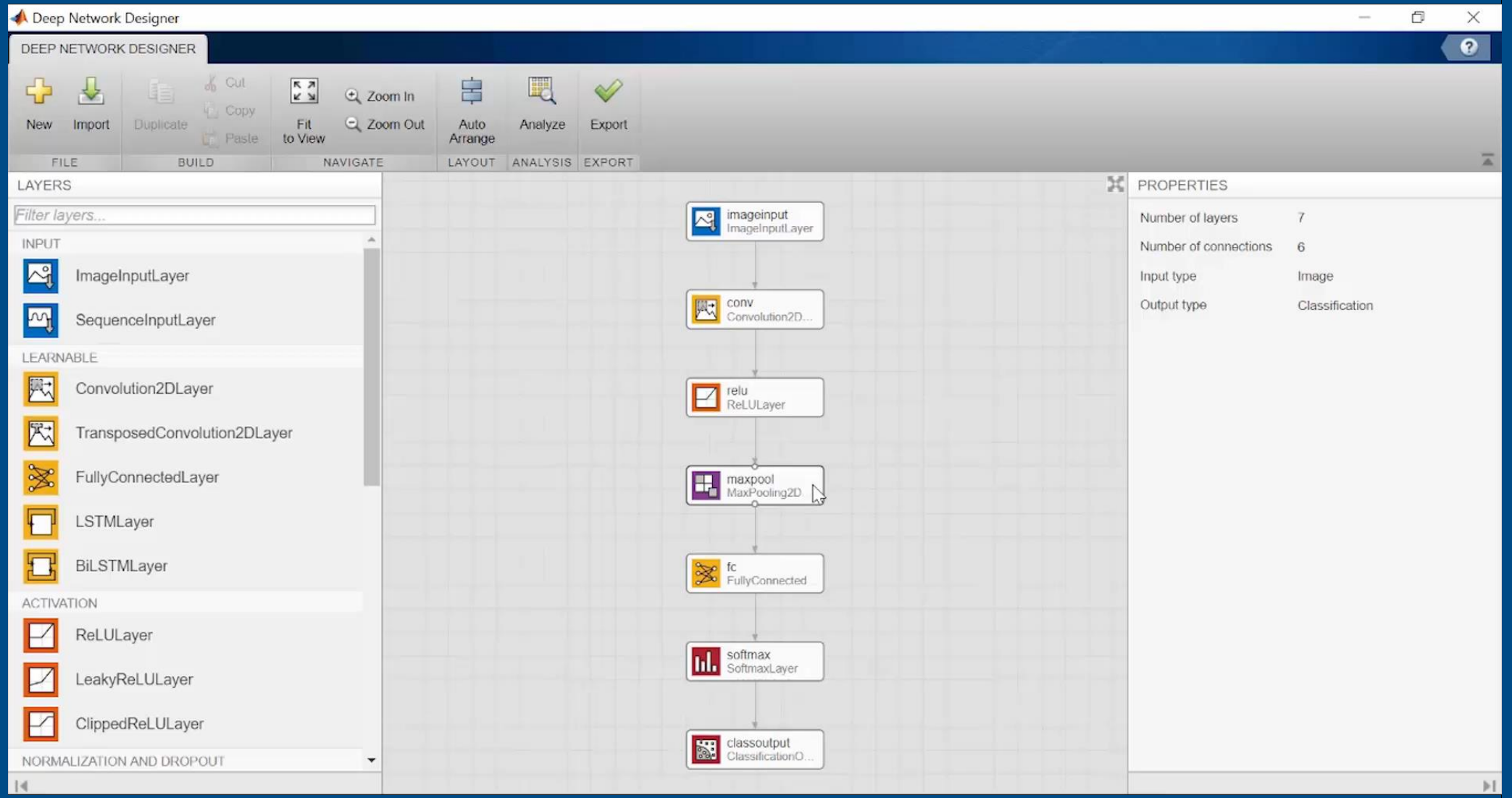
Using Apps for Designing Deep Learning Networks



Deep Learning Toolbox

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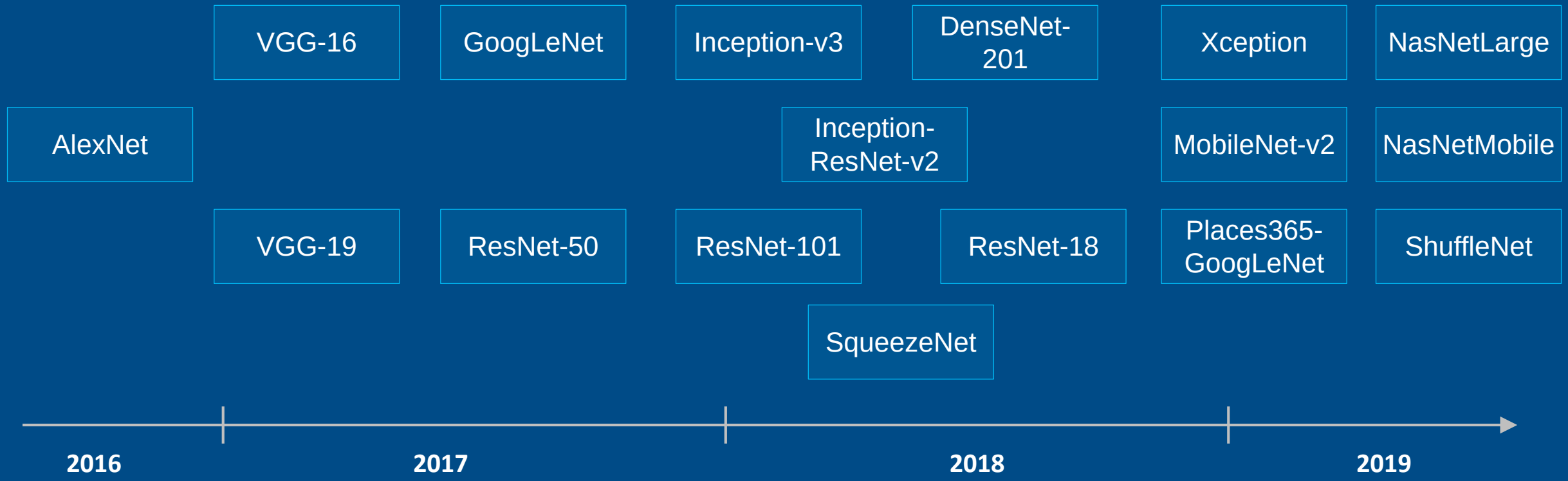
Using Transfer Learning with Pre-trained Models



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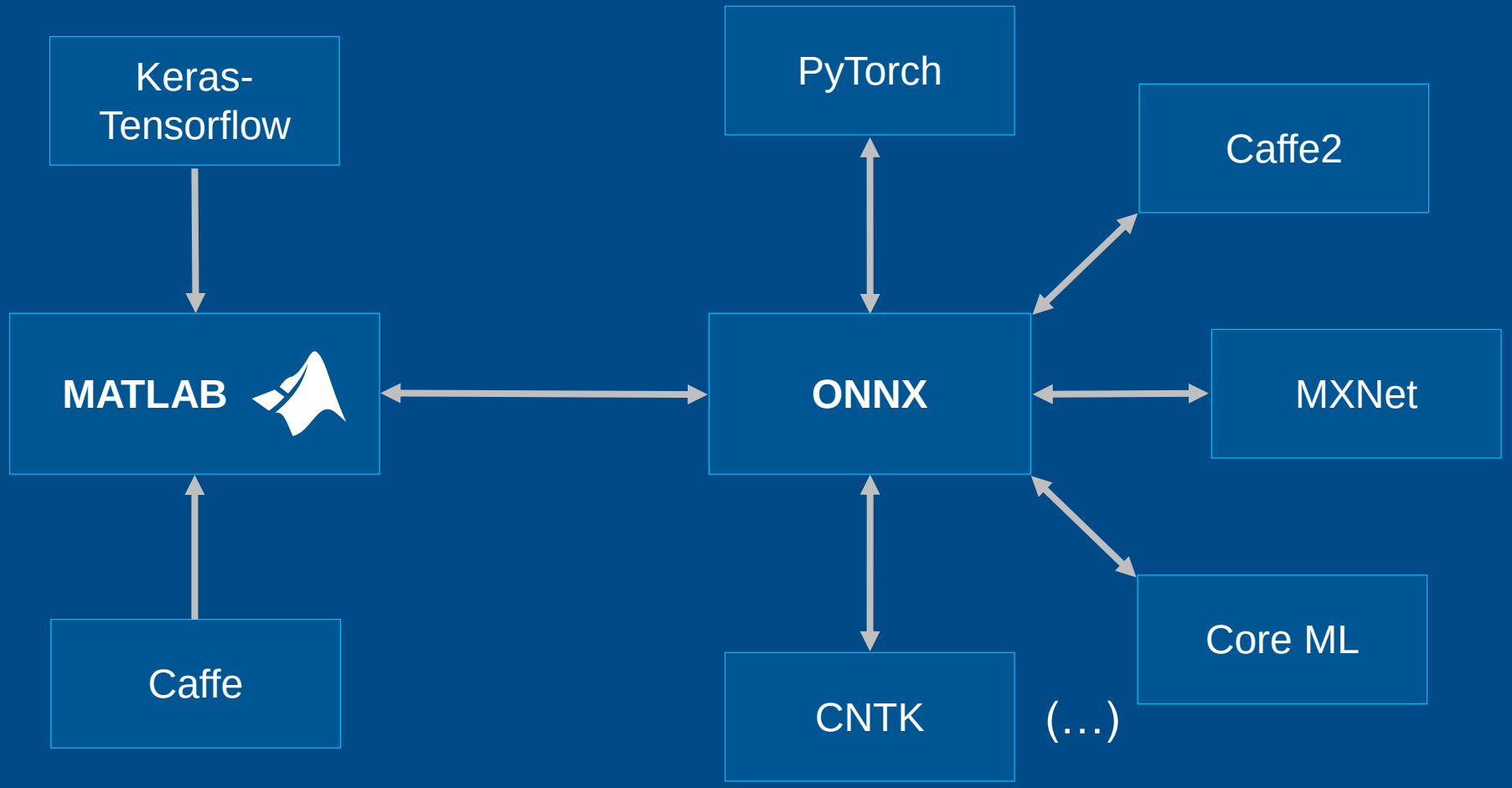
Using Models from Other Frameworks



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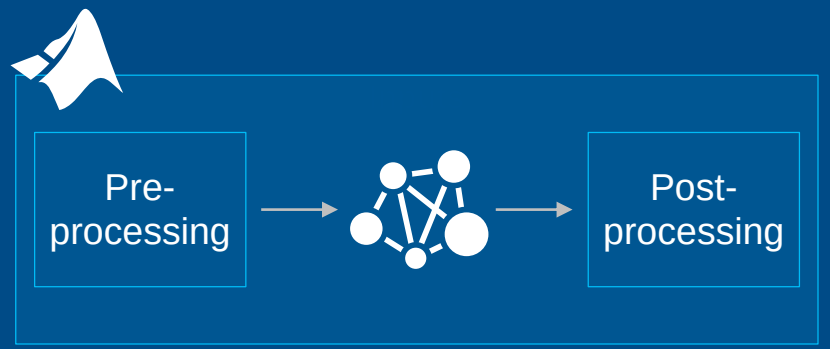
Deploying Deep Learning Applications



Deep Learning Application

Coder Products

Intel MKL-DNN Library

NVIDIA TensorRT & cuDNN Libraries

ARM Compute Library

MATLAB Coder
GPU Coder

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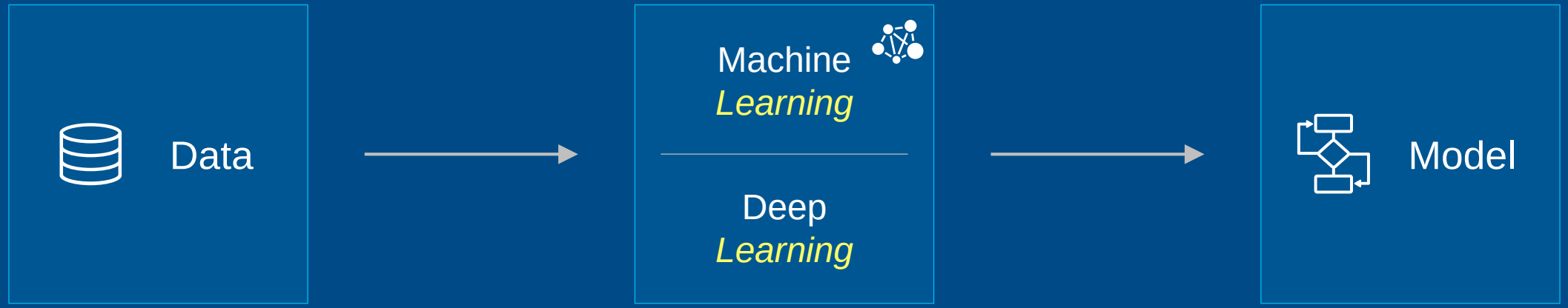
Using MATLAB and Simulink for Reinforcement Learning



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Reinforcement Learning Toolbox

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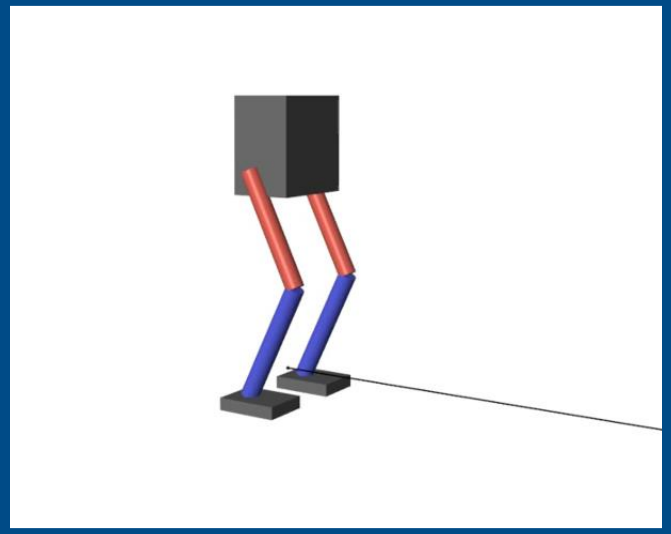
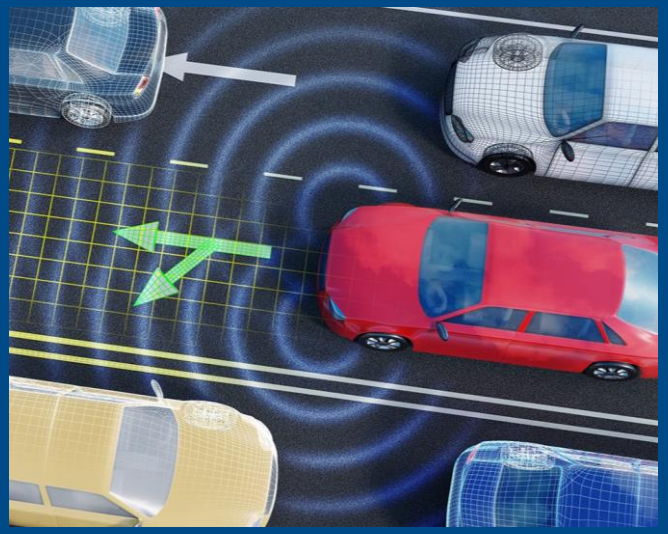
Using MATLAB and Simulink for Reinforcement Learning





Reinforcement Learning Toolbox

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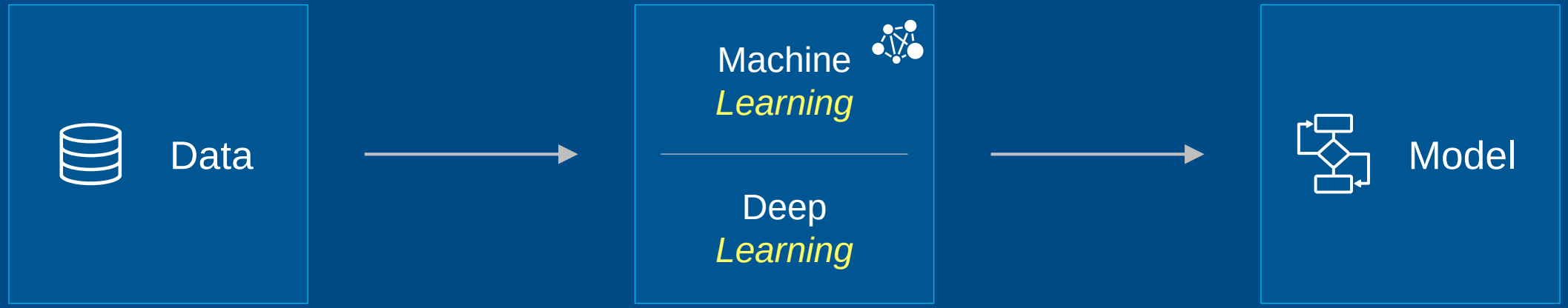
Using MATLAB and Simulink for Reinforcement Learning



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Reinforcement Learning Toolbox

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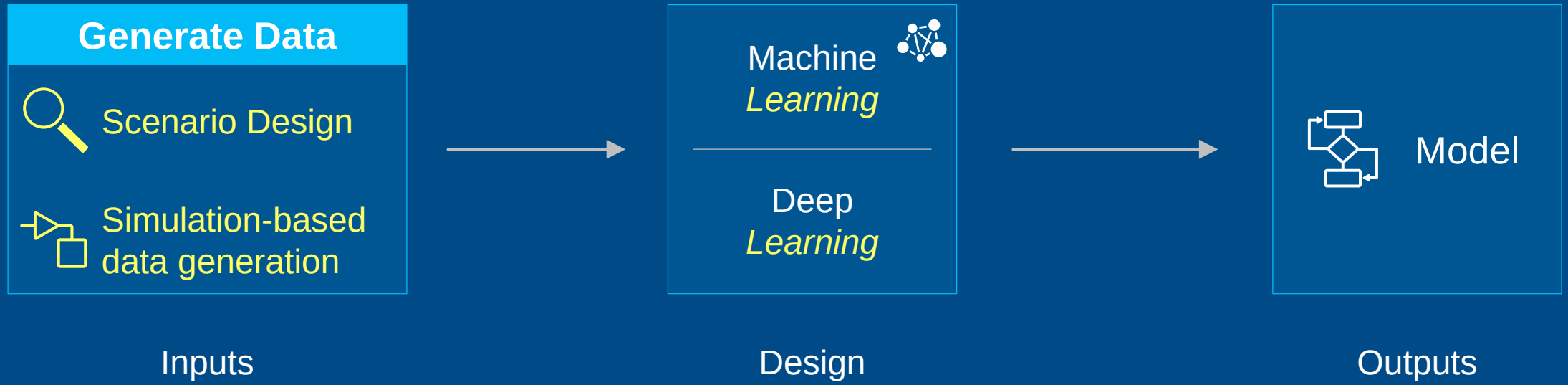
Using MATLAB and Simulink for Reinforcement Learning



MATLAB&SIMULINK

Simulink
Reinforcement Learning Toolbox

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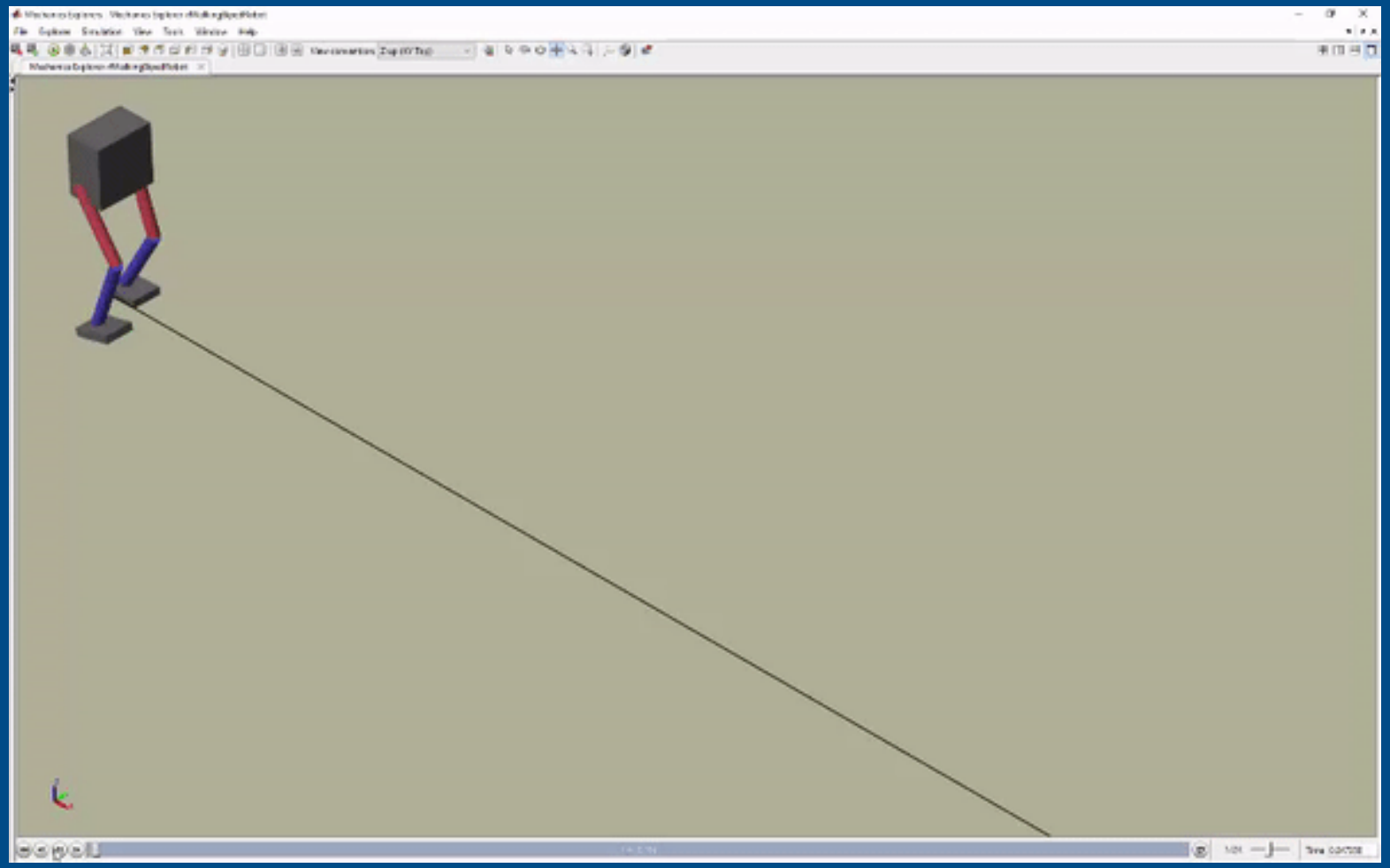
Using MATLAB and Simulink for Reinforcement Learning



Reinforcement Learning Toolbox

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Using MATLAB & Simulink to Build Algorithms in Everything

Inputs

Design

Outputs

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Working with Text Data

Vehicle_Repairs.csv

```
Dept,JobDate,jobno,Vehicleid,UnitNo,Reason,Notes,CostParts,CostLabor,CostTotal
1020,01/06/2015 12:00:00 AM,14073,118743,14,04    DRIVER'S REPORT,"PM SERVICE, CHECK TURN SIGNAL, CLUNKING NOISE WHEN DRIVING",493.85,0,493.85
1020,01/14/2015 12:00:00 AM,14232,230973,13,08    PM SERVICE              ***,"SERVICEROB,EXT,5604",38.869999999999997,0,38.869999999999997
2111,01/02/2015 12:00:00 AM,14006,1243,116,04    DRIVER'S REPORT,NEED 4 PLOW PINS,45,0,45
2111,01/02/2015 12:00:00 AM,14140,B39109      ,178,04    DRIVER'S REPORT,INSTALL SPINNER ASSY,0,0,0
2111,01/03/2015 12:00:00 AM,14163,574950,215,13    SNOW BREAKDOWN,DONT START,0,0,0
2111,01/05/2015 12:00:00 AM,14169,A00413      ,283,04    DRIVER'S REPORT,DOG BONE PIN BROKEN,20,0,20
2111,01/06/2015 12:00:00 AM,14000,766153,248,08    PM SERVICE              ***,"NEED SERVICE, CHECK BRAKES",387.17,0,387.17
2111,01/06/2015 12:00:00 AM,14155,525670,232,04    DRIVER'S REPORT,HYD CAP CHECK ENGINE LIGHT ON,12.95,0,12.95
2111,01/06/2015 12:00:00 AM,14157,621909,213,40    NEGLIGENCE,TARP VALVE STICKINGRIGHT SIDE MIRROR BRACKET BROKEN,50.02,0,50.02
2111,01/06/2015 12:00:00 AM,14164,1226,117,13    SNOW BREAKDOWN,HANDLES IN CAB LOOSE,0,0,0
2111,01/06/2015 12:00:00 AM,14165,525999,114,04    DRIVER'S REPORT,NO PLOW LIGHTS,0,0,0
2111,01/06/2015 12:00:00 AM,14172,B34632      ,276,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14174,1469,122,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14175,68932,147,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14176,68933,148,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14177,621907,208,10    ROADCALL,WILL NOT START,0,0,0
2111,01/06/2015 12:00:00 AM,14181,337657,218,04    DRIVER'S REPORT,CONVEORY NOT WORKING,0,0,0
2111,01/06/2015 12:00:00 AM,14182,D-1920      ,164,10    ROADCALL,DONT START,0,0,0
2111,01/06/2015 12:00:00 AM,14183,525998,217,10    ROADCALL,DONT START,0,0,0
2111,01/06/2015 12:00:00 AM,14184,526000,225,10    ROADCALL,DONT START,0,0,0
2111,01/06/2015 12:00:00 AM,14185,621921,214,04    DRIVER'S REPORT,CONVORY NOT WORKING,0,0,0
2111,01/07/2015 12:00:00 AM,14188,O01469      ,201,04    DRIVER'S REPORT,needs def/jim f,0,0,0
2111,01/07/2015 12:00:00 AM,14190,337656,219,04    DRIVER'S REPORT,NEEDS FLOOR MATTS,65.069999999999993,0,65.069999999999993
2111,01/07/2015 12:00:00 AM,14191,B34632      ,276,10    ROADCALL,DONT START,0,0,0
2111,01/07/2015 12:00:00 AM,14196,1222,118,04    DRIVER'S REPORT,HARDWARE FOR REAR SPRINGS,14.32,0,14.32
2111,01/07/2015 12:00:00 AM,14199,52565,626,04    DRIVER'S REPORT,WASHER FLUIDDEF,28.88,0,28.88
2111,01/09/2015 12:00:00 AM,14107,1467,121,08    PM SERVICE              ***,"REMOVE & REPLACE REAR SPRINGS, CHECK COOLANT TUBESPM SERVIVE",4697.55,0,
```

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Working with Text Data

```
t = readtable(filename,'TextType','string');
disp(t(1:20,6:7))
```

Reason	Notes
"04 DRIVER'S REPORT"	"PM SERVICE, CHECK TURN SIGNAL, CLUNKING NOISE WHEN DRIVING"
"08 PM SERVICE ***"	"SERVICEROB,EXT,5604"
"04 DRIVER'S REPORT"	"NEED 4 PLOW PINS"
"04 DRIVER'S REPORT"	"INSTALL SPINNER ASSY"
"13 SNOW BREAKDOWN"	"DONT START"
"04 DRIVER'S REPORT"	"DOG BONE PIN BROKEN"
"08 PM SERVICE ***"	"NEED SERVICE, CHECK BRAKES"
"04 DRIVER'S REPORT"	"HYD CAP CHECK ENGINE LIGHT ON"
"40 NEGLIGENCE"	"TARP VALVE STICKINGRIGHT SIDE MIRROR BRACKET BROKEN"
"13 SNOW BREAKDOWN"	"HANDLES IN CAB LOOSE"
"04 DRIVER'S REPORT"	"NO PLOW LIGHTS"
"10 ROADCALL"	"WILL NOT START"
"10 ROADCALL"	"WILL NOT START"
"10 ROADCALL"	"WILL NOT START"
"10 ROADCALL"	"WILL NOT START"
"10 ROADCALL"	"WILL NOT START"
"04 DRIVER'S REPORT"	"CONVEORY NOT WORKING"
"10 ROADCALL"	"DONT START"
"10 ROADCALL"	"DONT START"
"10 ROADCALL"	"DONT START"

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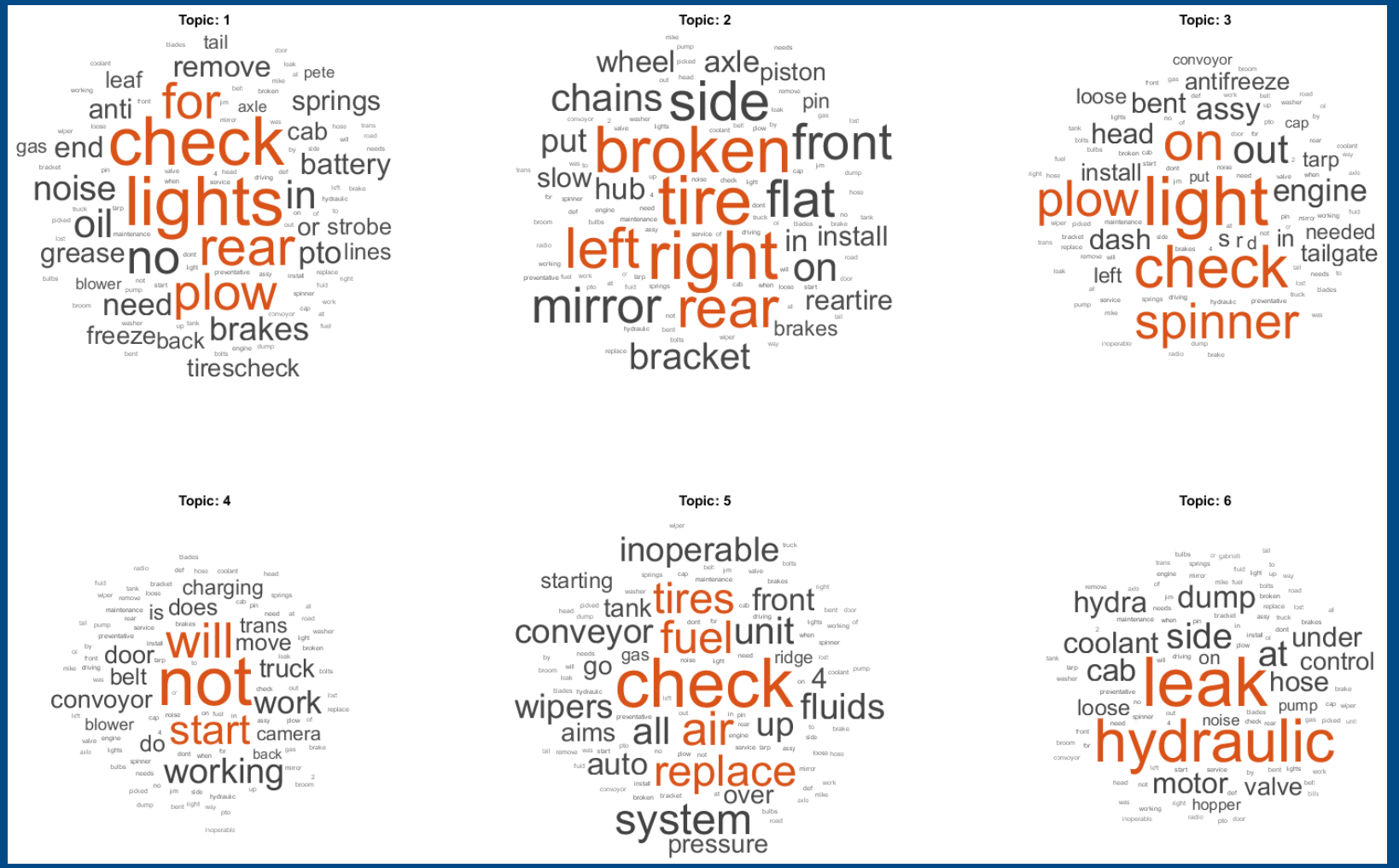
Working with Text Data



Deep Learning Toolbox
Statistics and Machine Learning Toolbox
Text Analytics Toolbox
MATLAB

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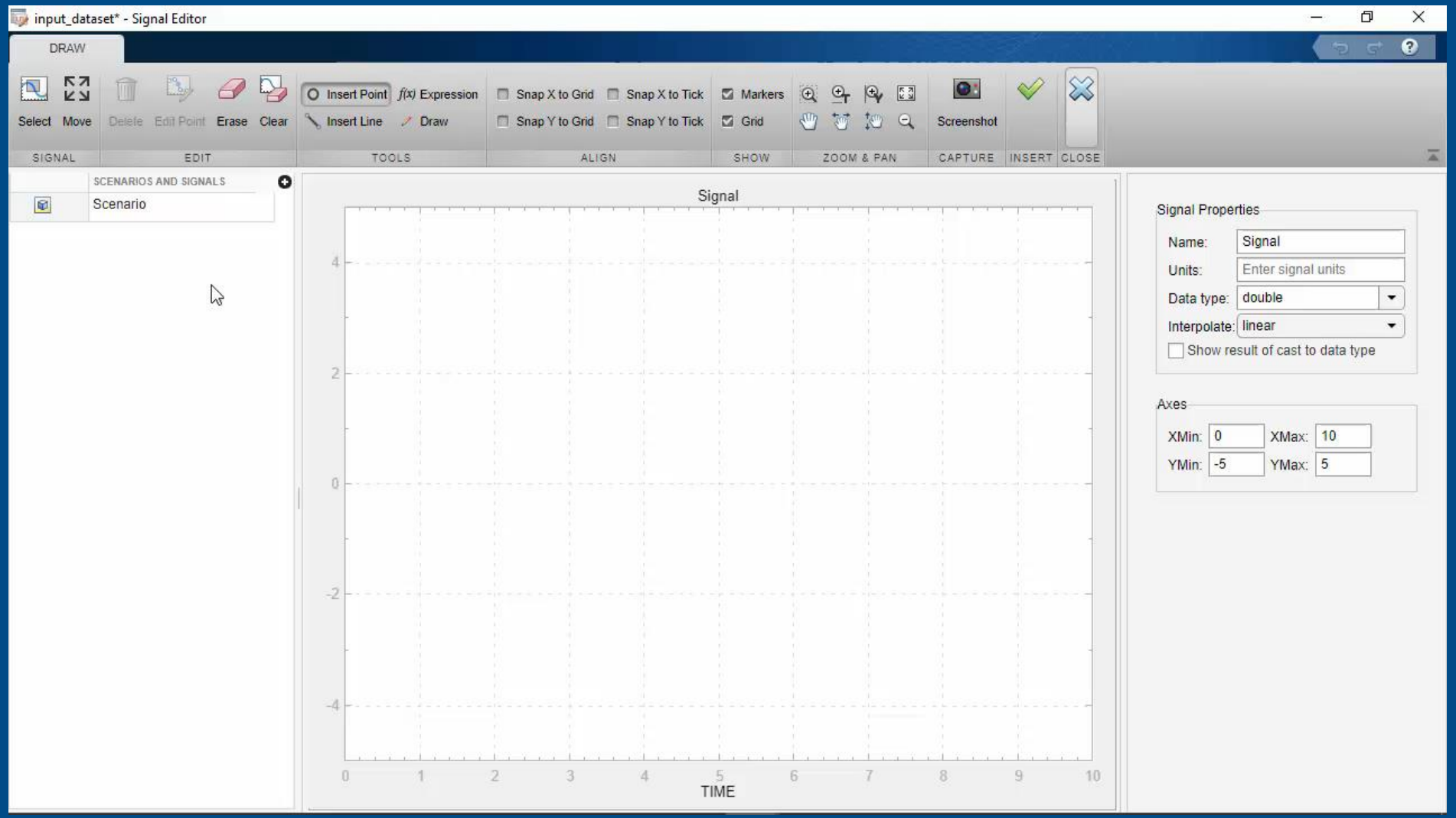
Creating Your Own Data



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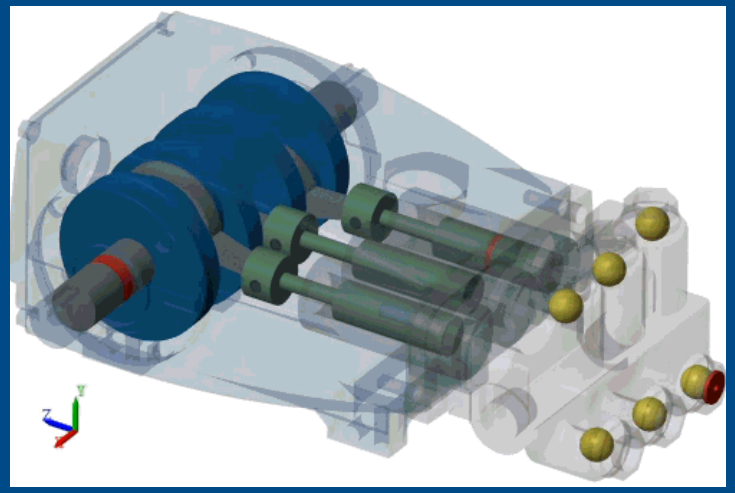
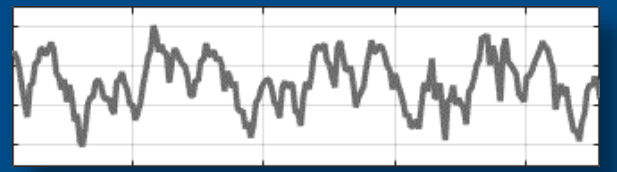
Input





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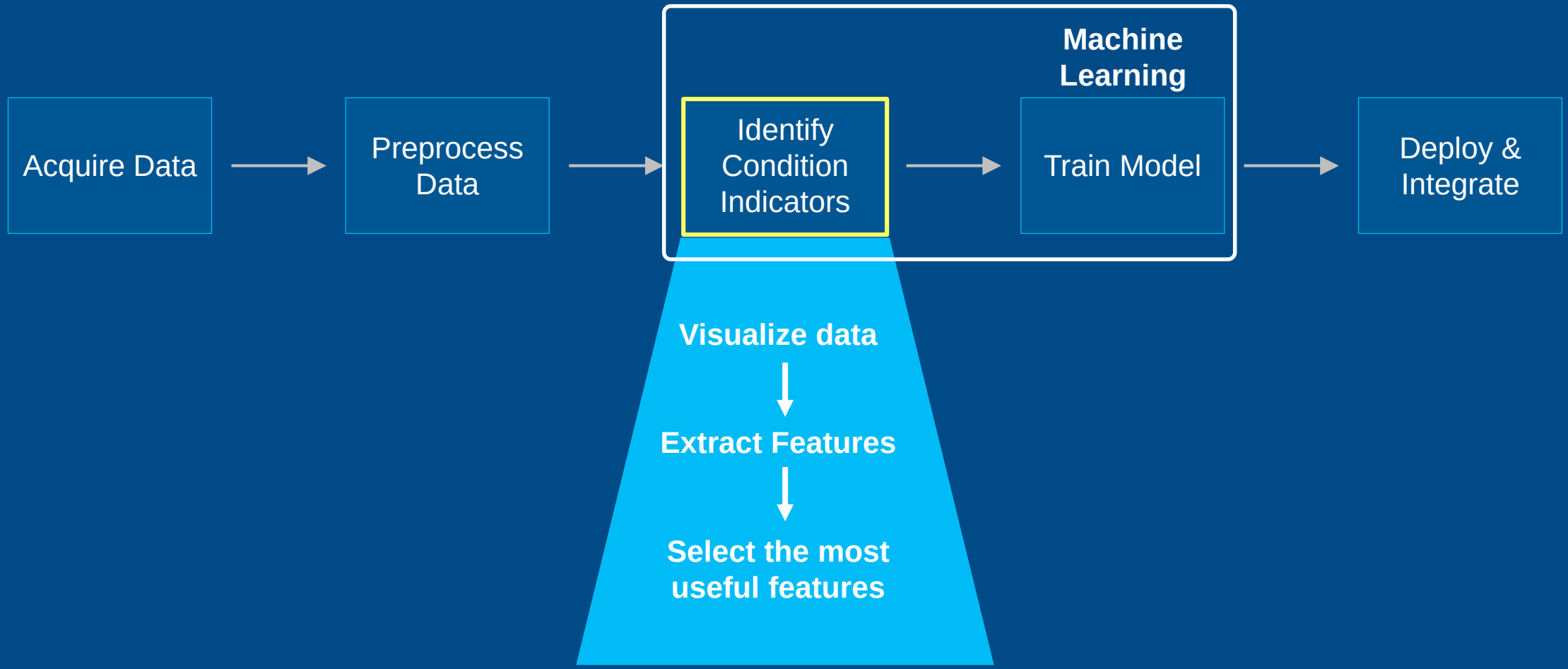
Identifying the Useful Data



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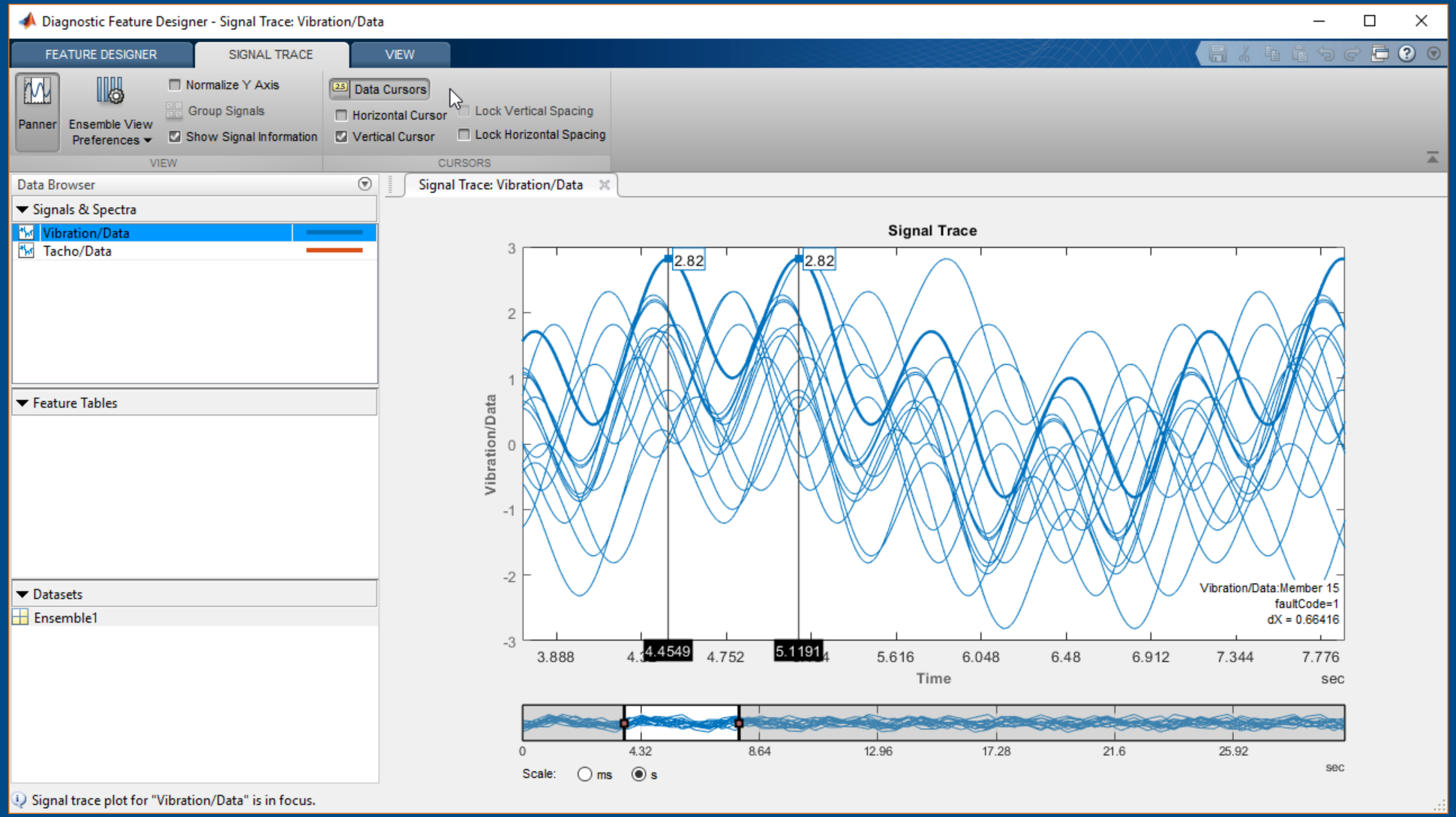
Identifying the Useful Data



Predictive Maintenance Toolbox

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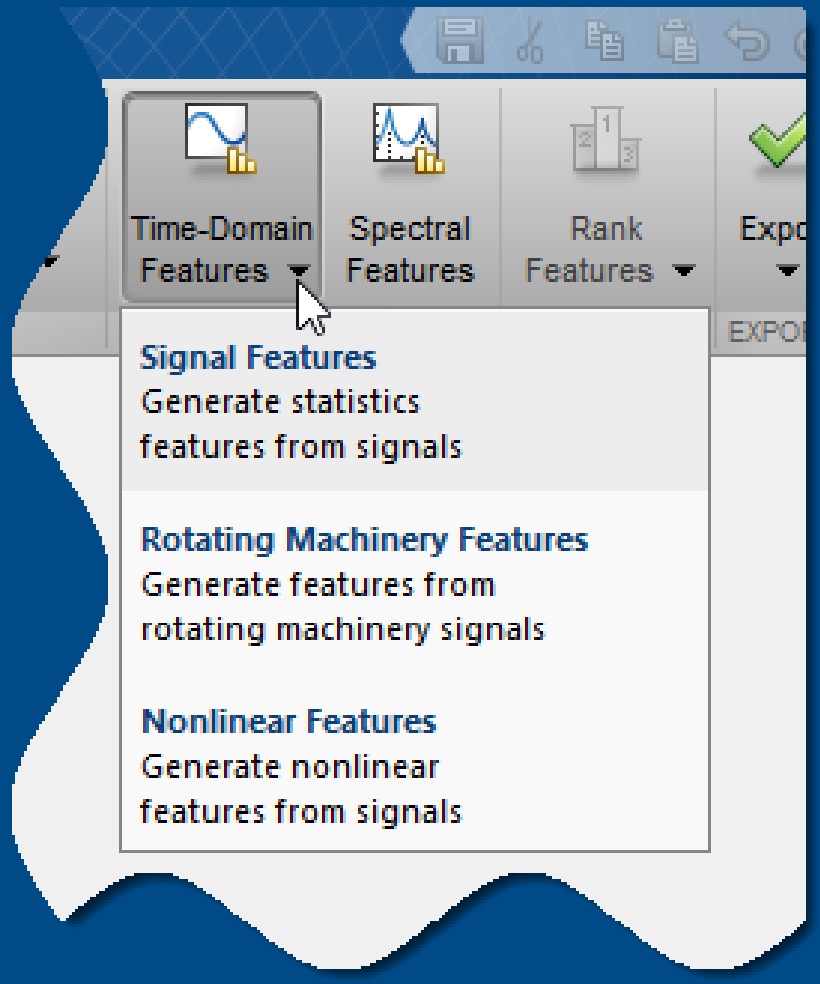
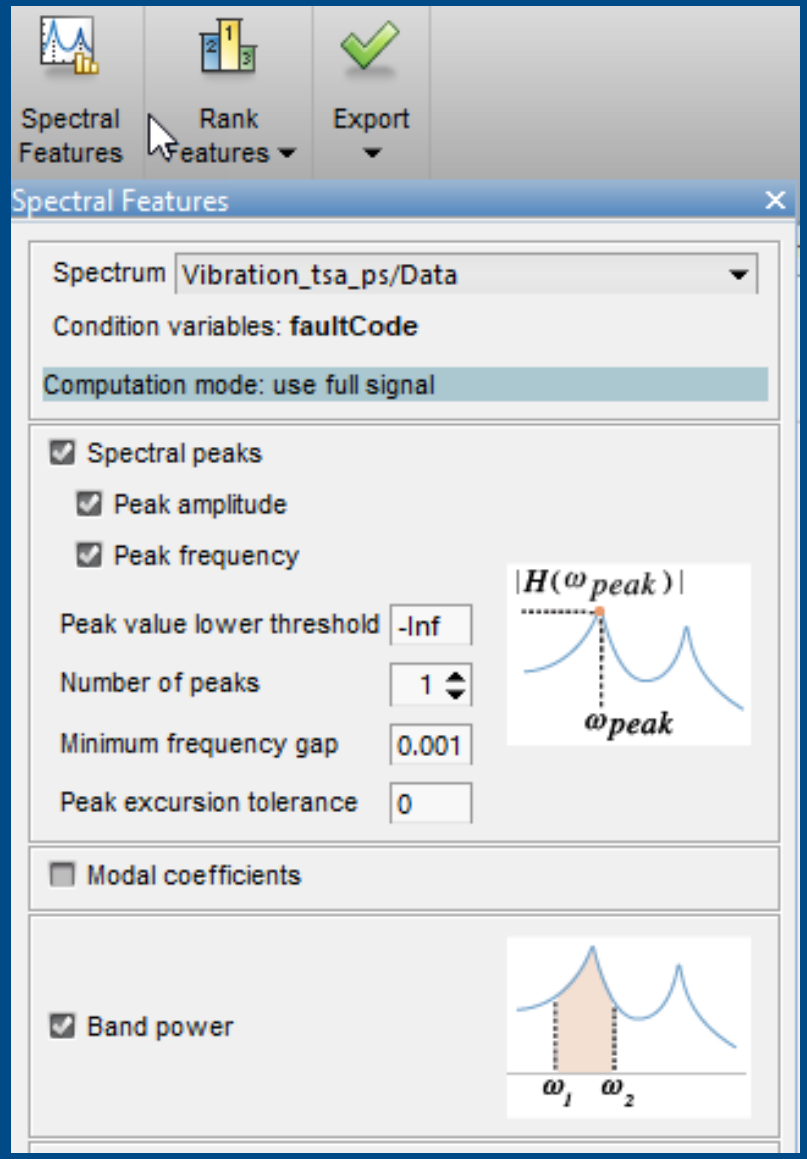
Identifying the Useful Data





Predictive Maintenance Toolbox

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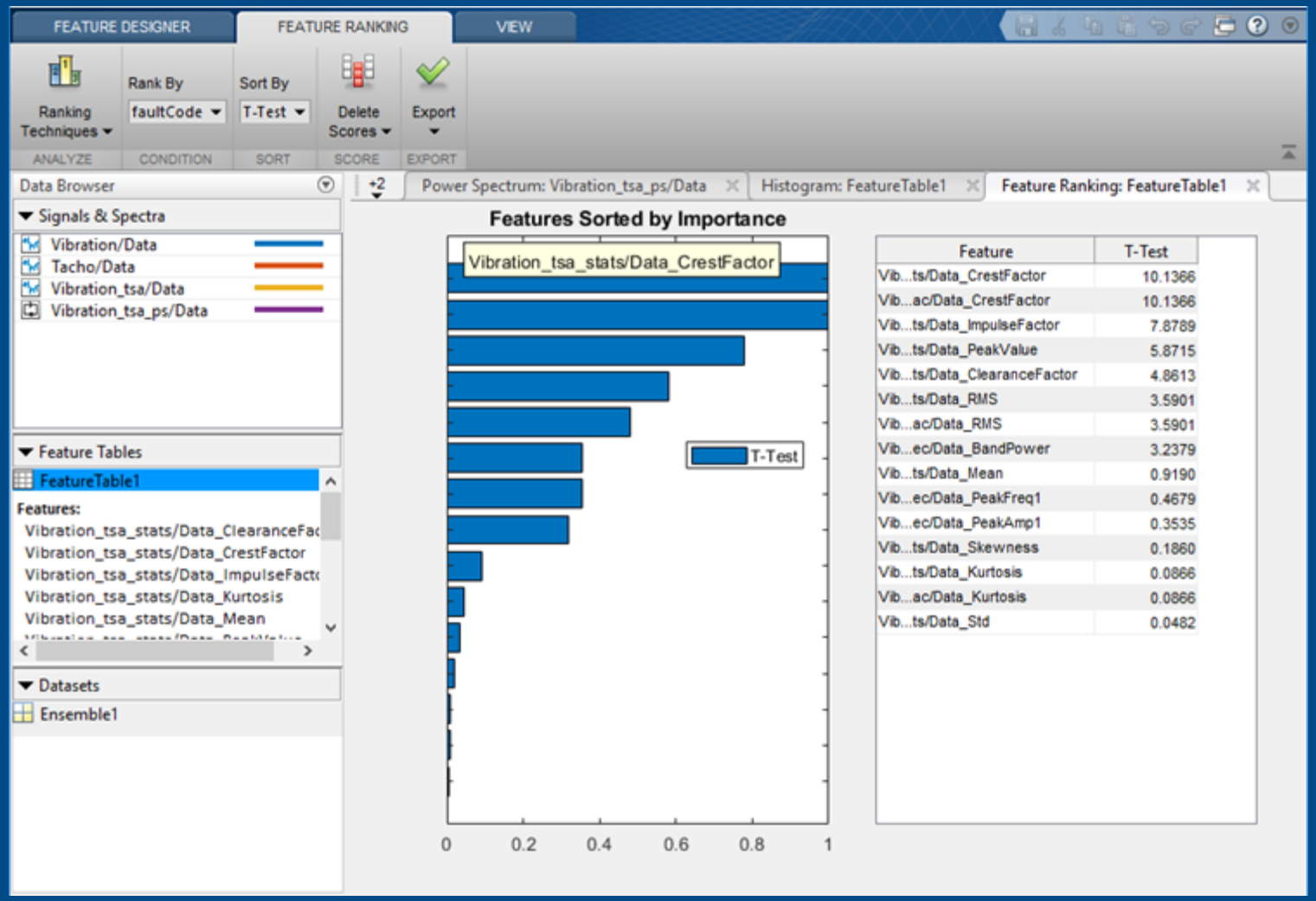
Identifying the Useful Data



Predictive Maintenance Toolbox

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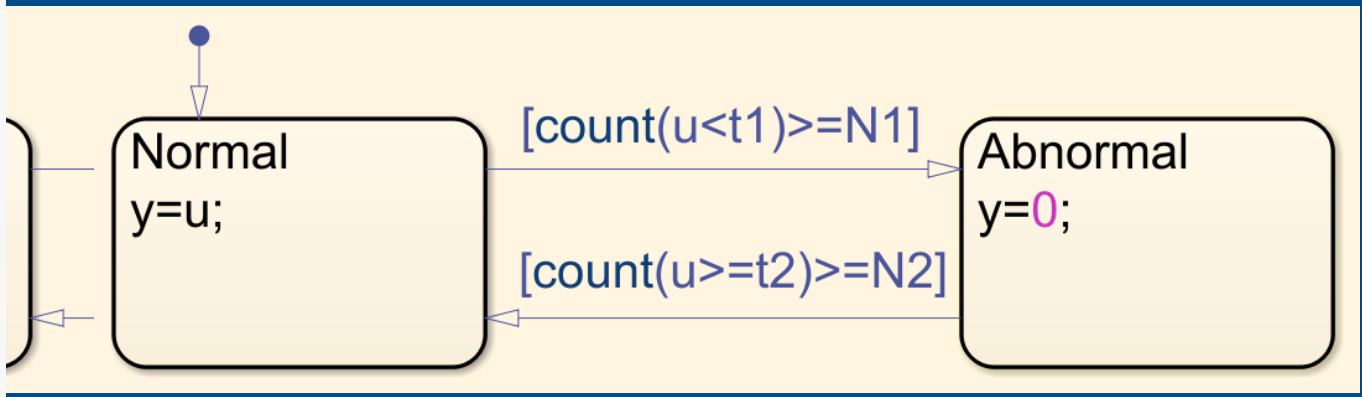
Designing Decision Logic with Stateflow

```
inNormalRegion = true;
counter = 0;
for i=1:length(inData)
    if(inNormalRegion)
        if(inData(i)<t1)
            counter = counter+1;
            if(counter>=N1)
                inNormalRegion = false;
            end
        else
            counter = 0;
        end
     else
        if(inData(i)>=t2)
            counter = counter+1;
            if(counter>=N2)
                inNormalRegion = true;
            end
        else
            counter = 0;
        end
     end
     if(inNormalRegion)
        outData(i) = inData(i);
    else
        outData(i) = 0;
    end
end
```



Stateflow
MATLAB

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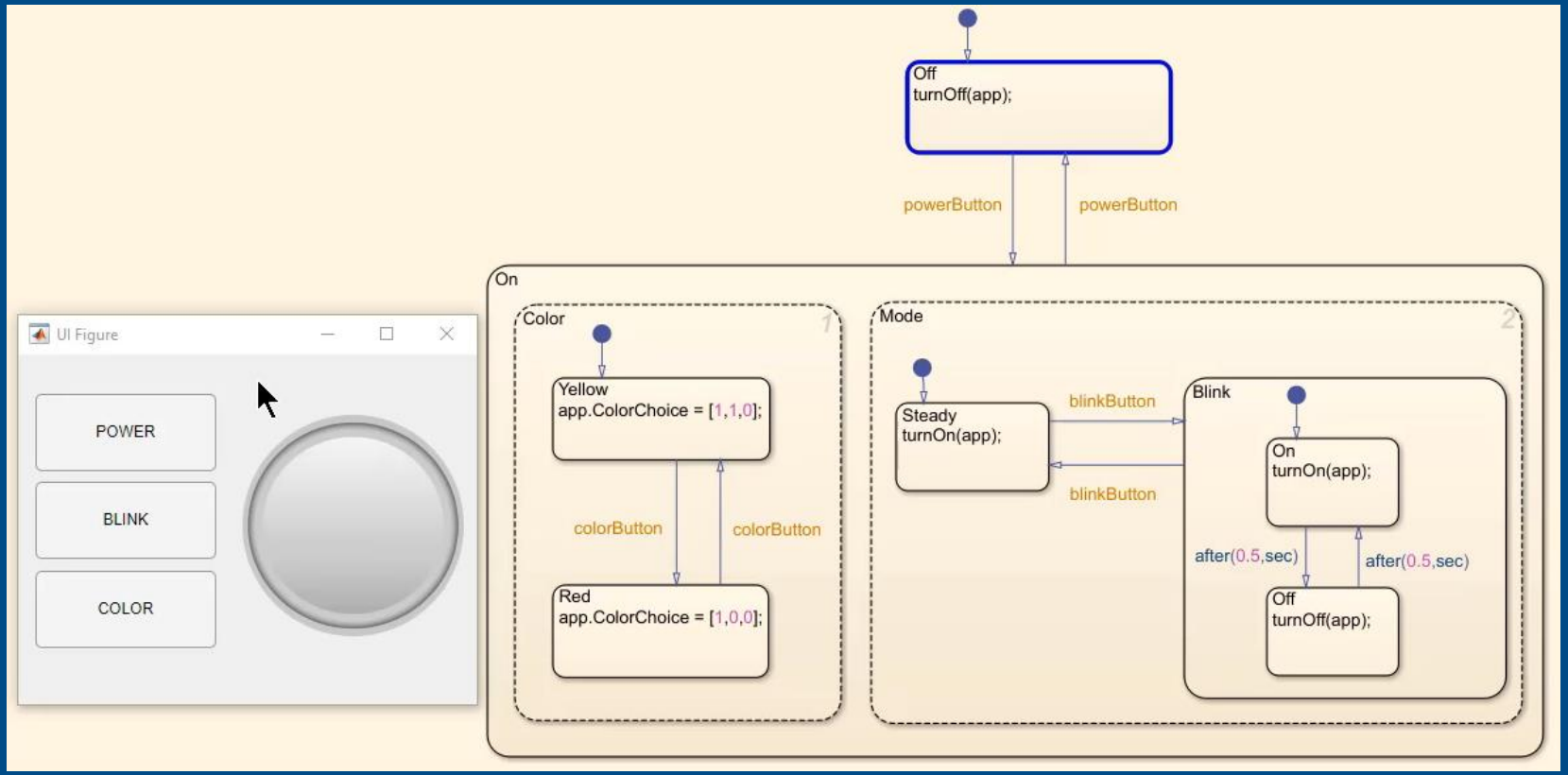
Using Stateflow in MATLAB




```
% Callbacks that handle component events
methods (Access = private)

    % Code that executes after component creation
    function startupFcn(app)
        app.LanternLogic = BlinkLanternLogic('app',app);
    end

    % Button pushed function: POWERButton
    function POWERButtonPushed(app, event)
        app.LanternLogic.powerButton();
    end

    % Button pushed function: COLORButton
    function COLORButtonPushed(app, event)
        app.LanternLogic.colorButton();
    end

    % Close request function: UIFigure
    function UIFigureCloseRequest(app, event)
        delete(app.LanternLogic);
        delete(app);
    end

    % Button pushed function: BLINKButton
    function BLINKButtonPushed(app, event)
        app.LanternLogic.blinkButton();
    end
end
```

Stateflow
MATLAB

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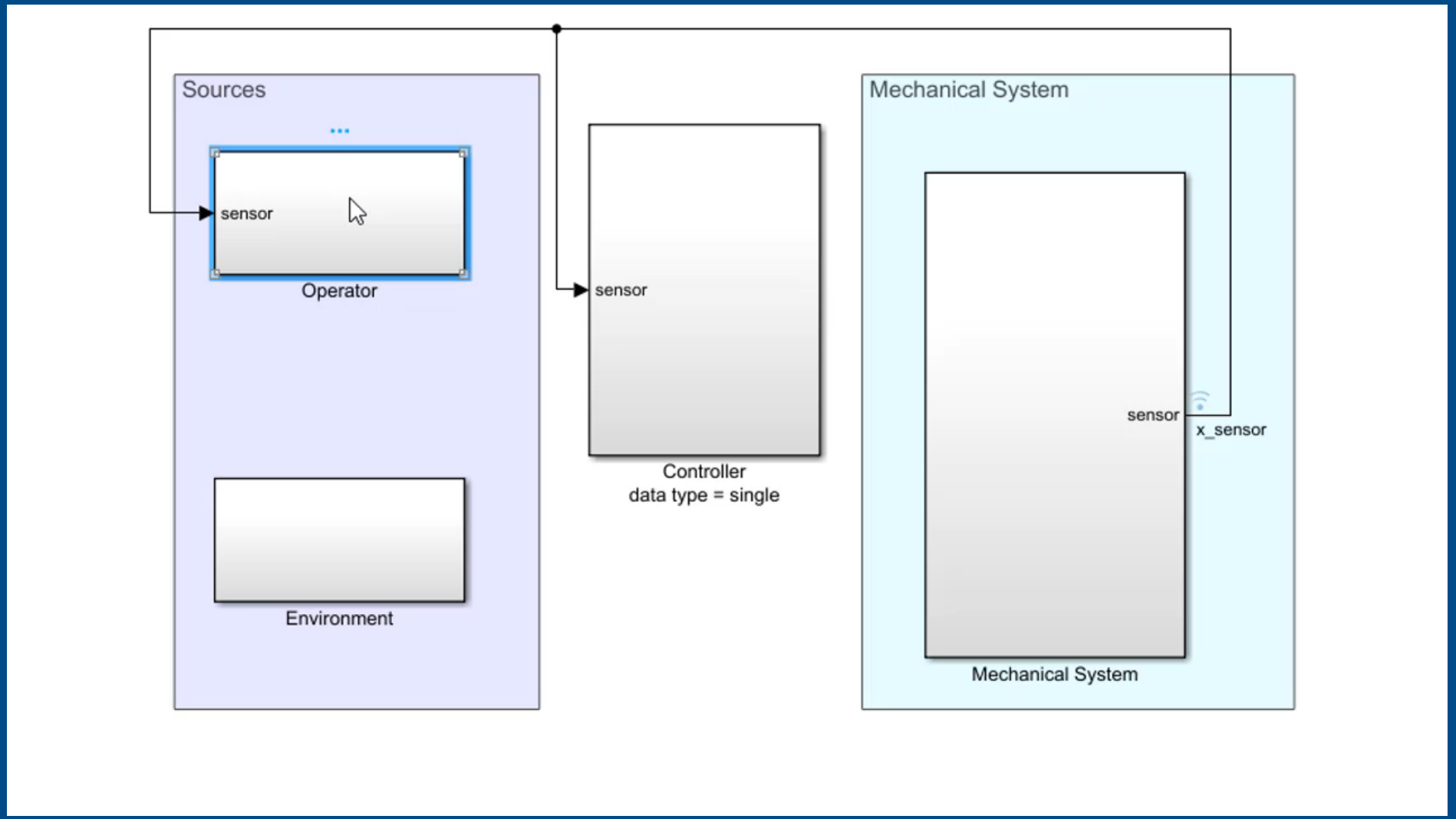
Editing at the Speed of Thought



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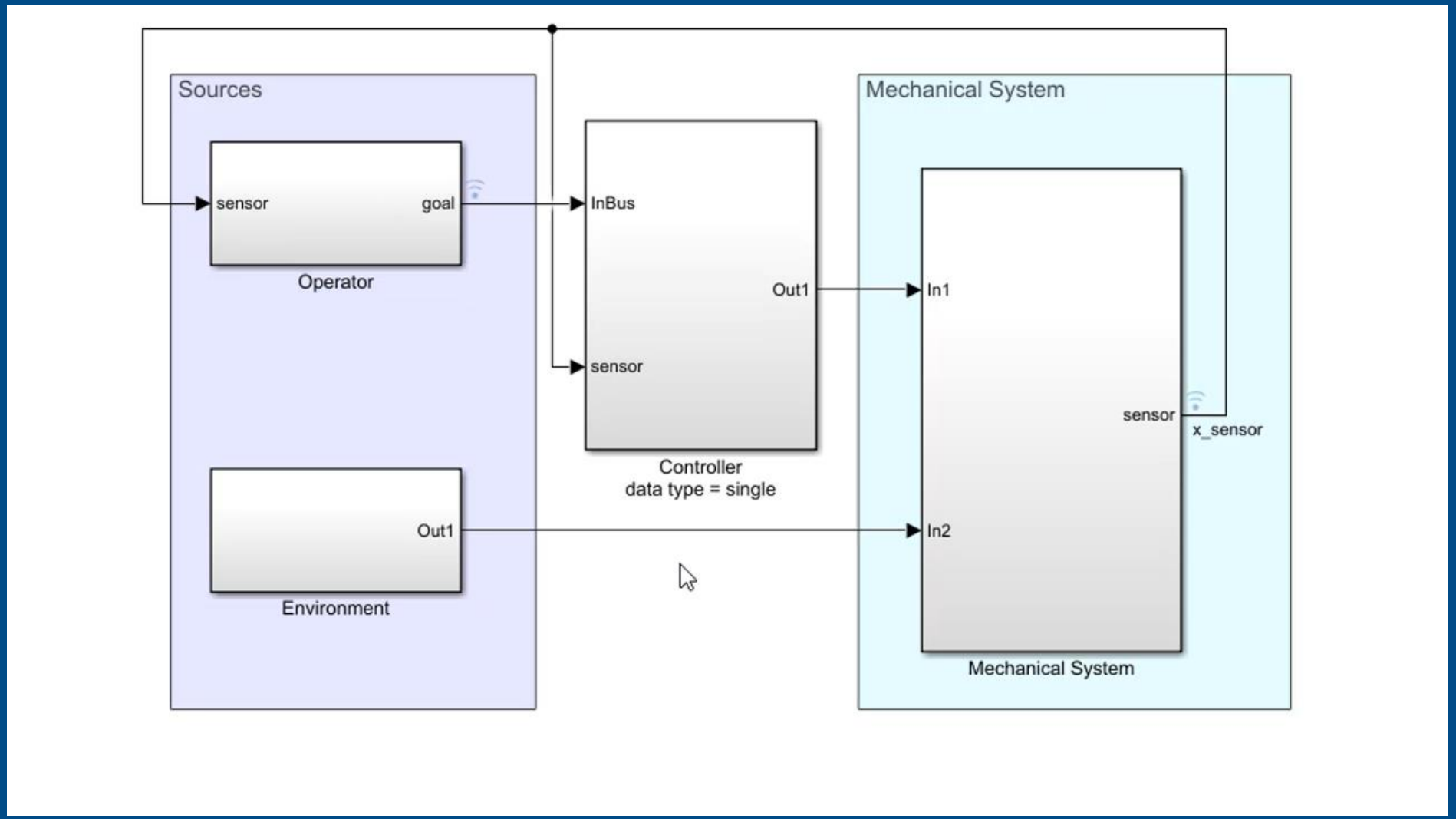
Editing at the Speed of Thought



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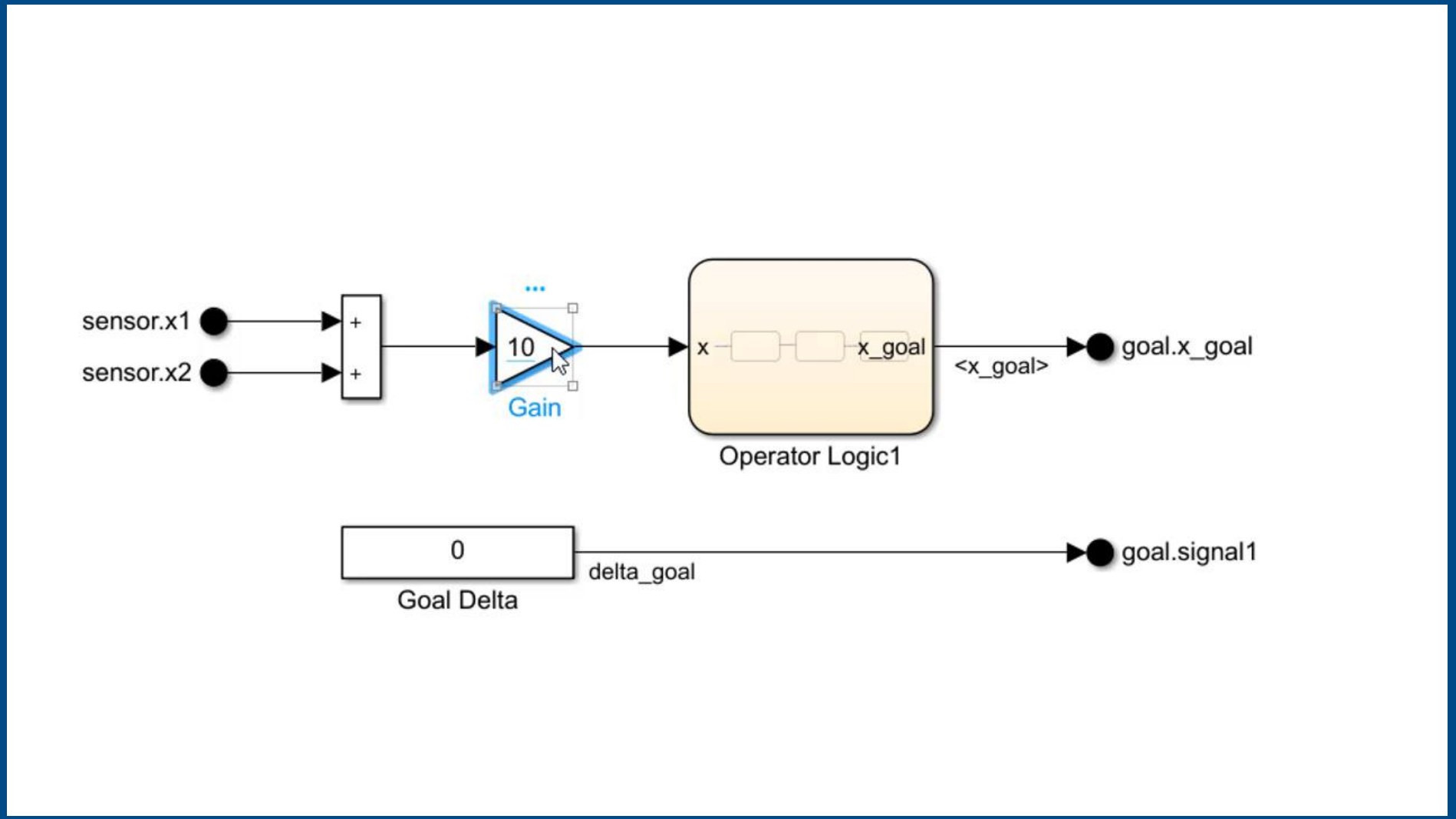
Editing at the Speed of Thought



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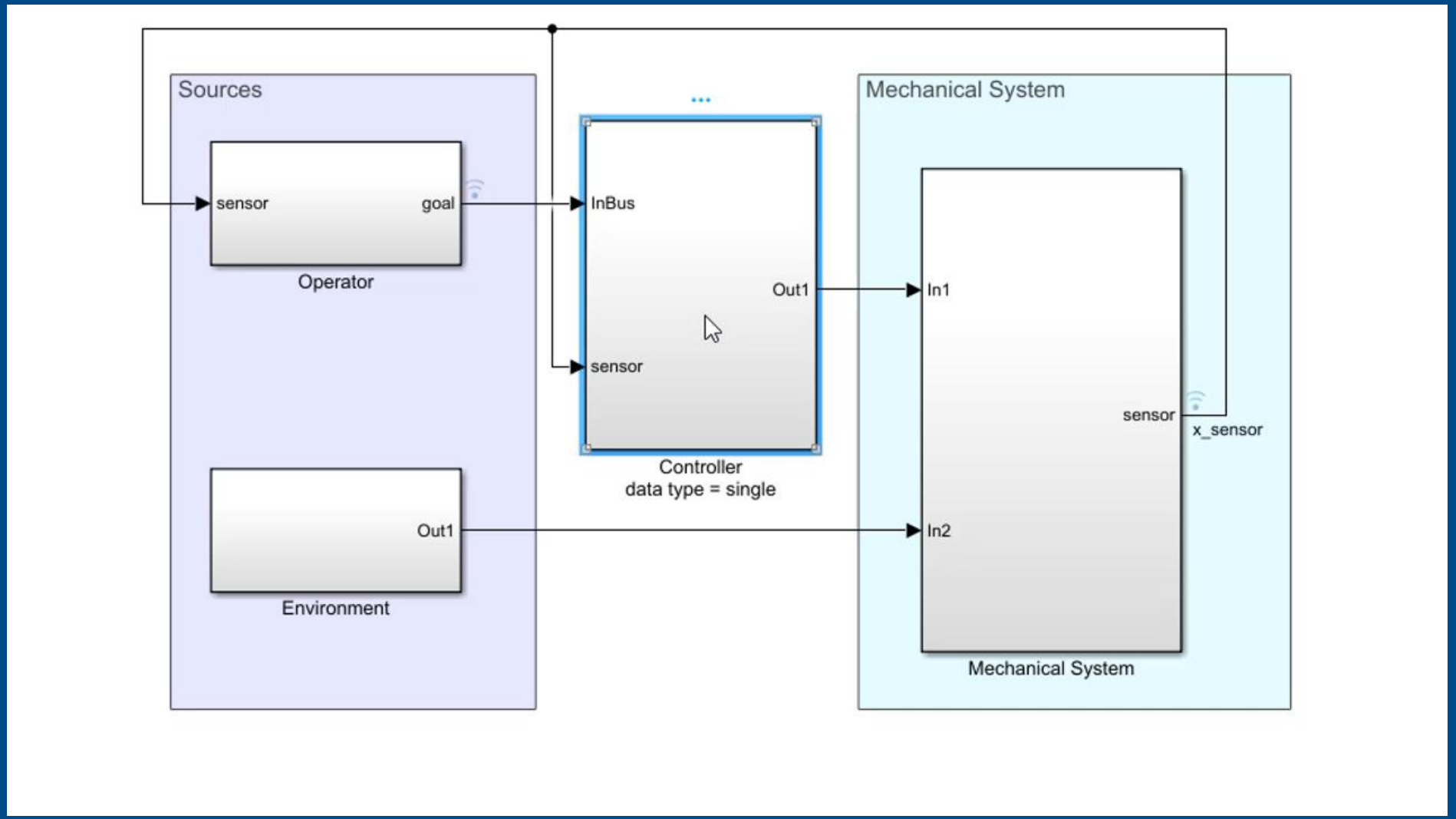
Editing at the Speed of Thought



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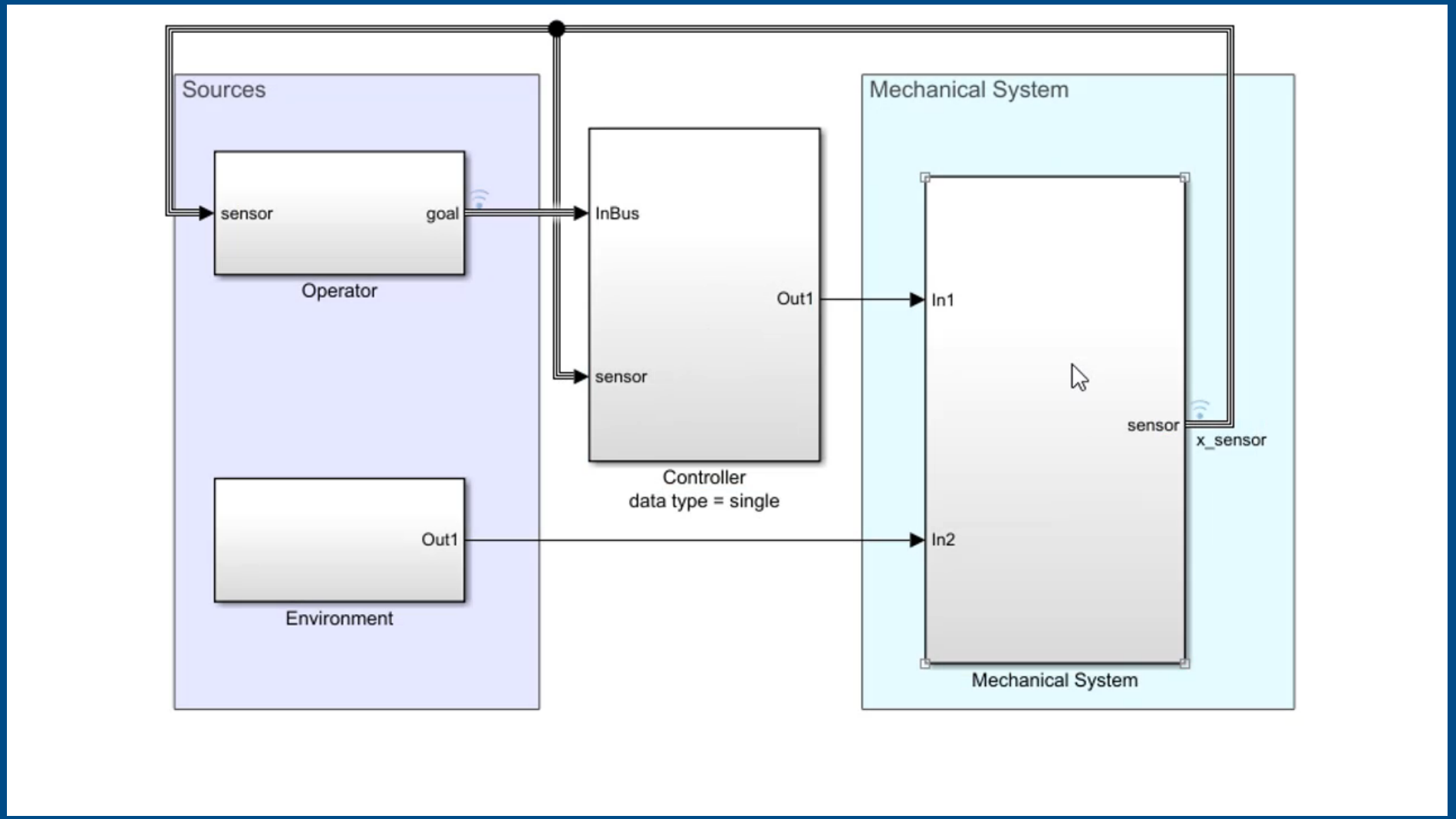
Editing at the Speed of Thought



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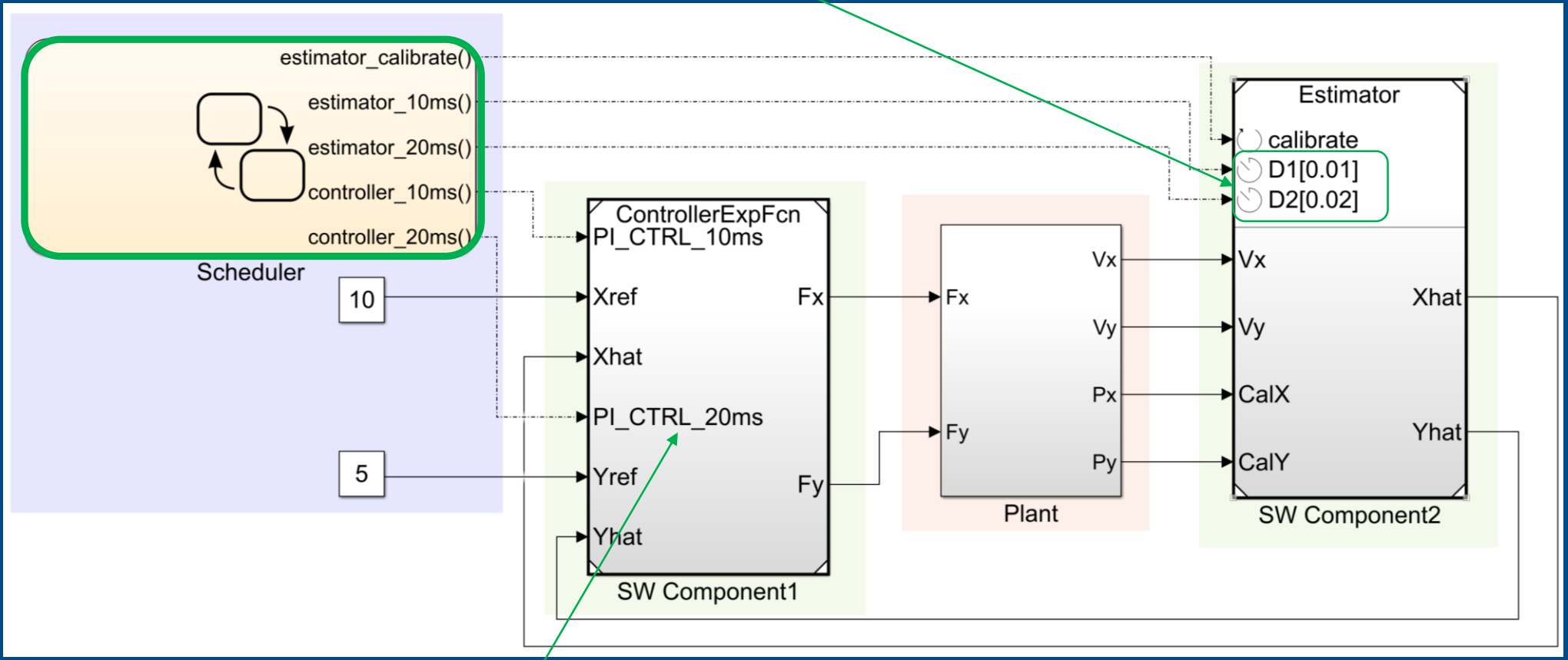
Controlling the Execution of Model Components

Schedulable Rate-Based Model



Export Function Model

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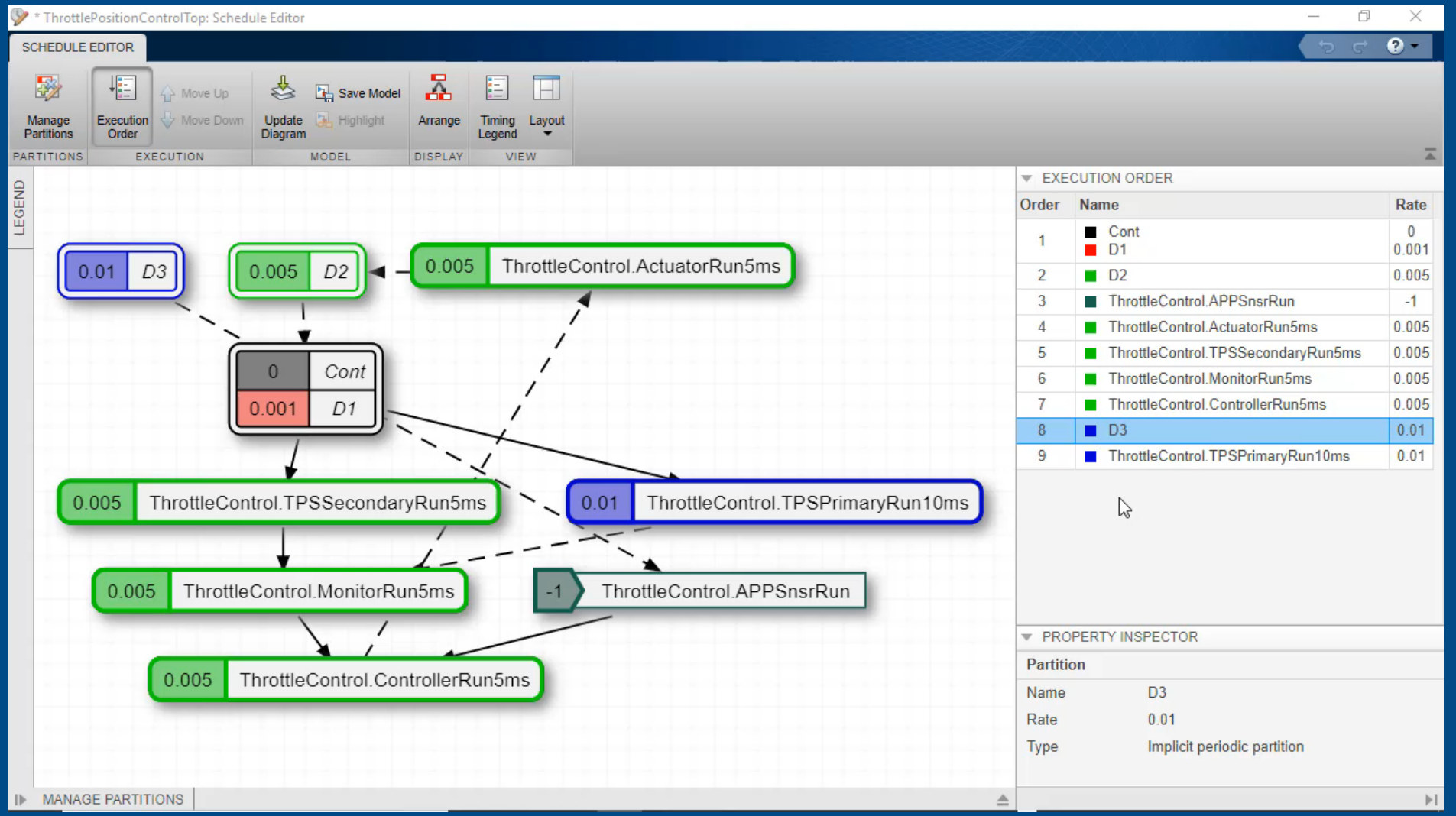
Controlling the Execution of Model Components



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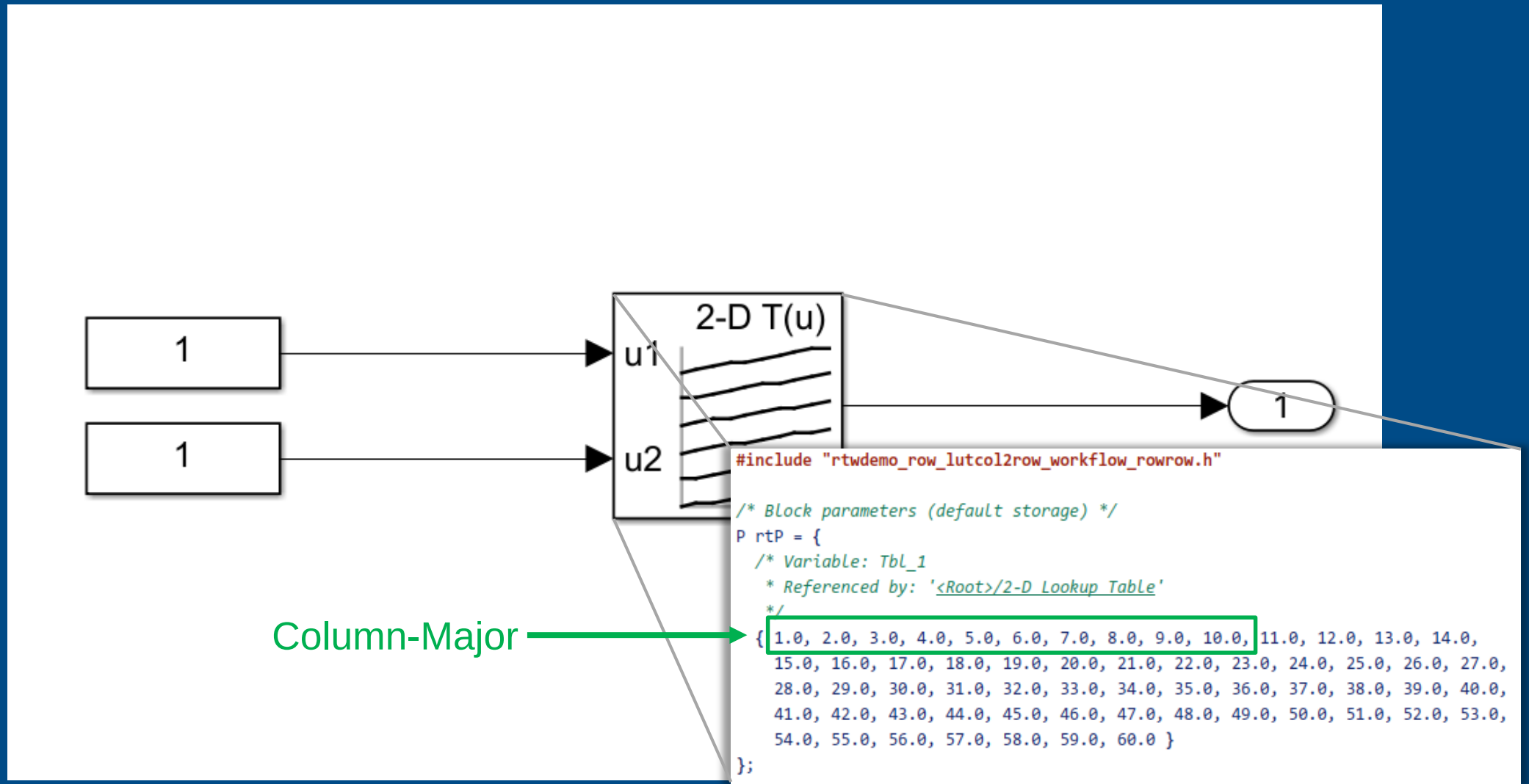
Simplifying Integration with External C/C++ Code



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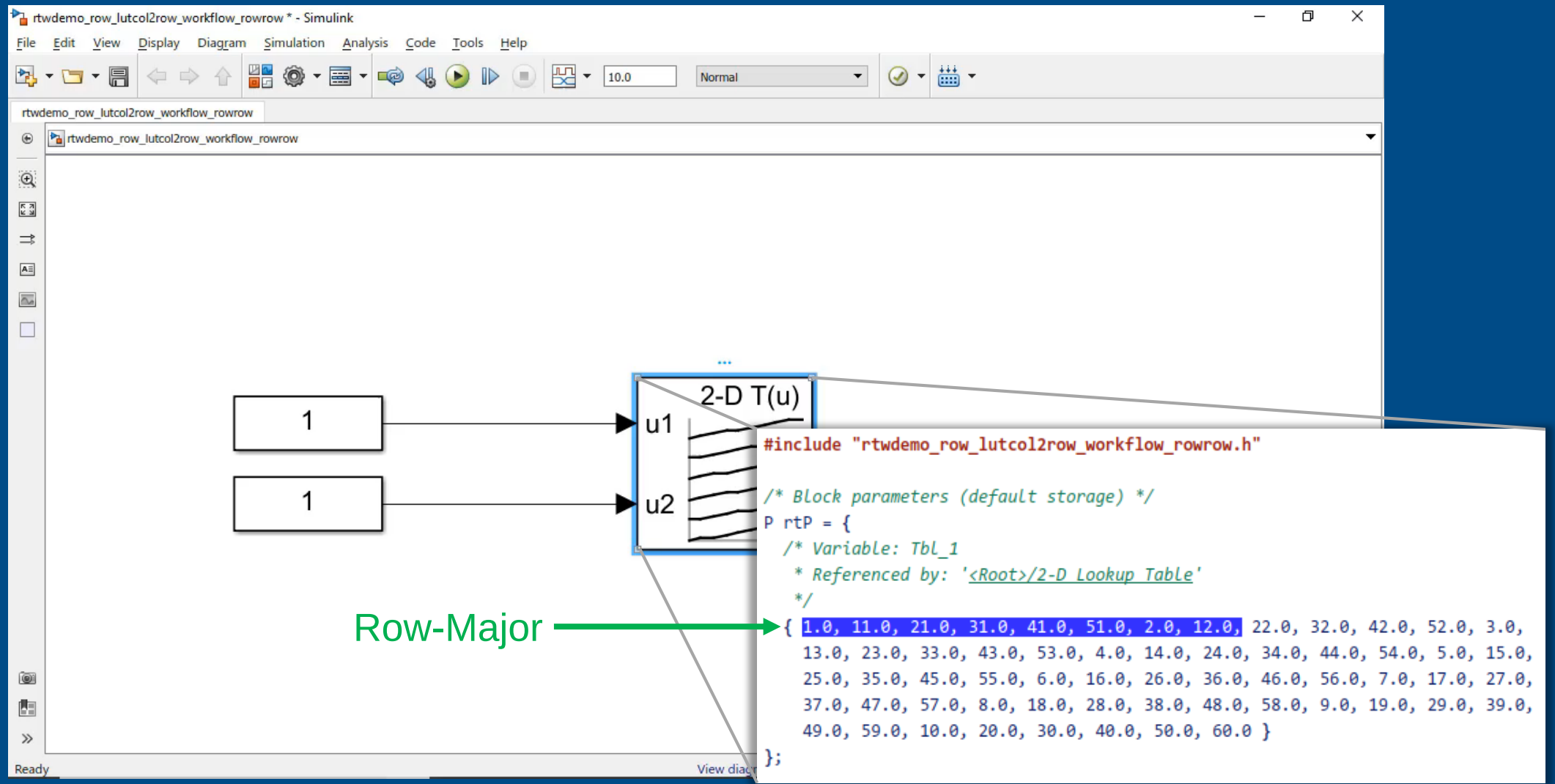
Simplifying Integration with External C/C++ Code



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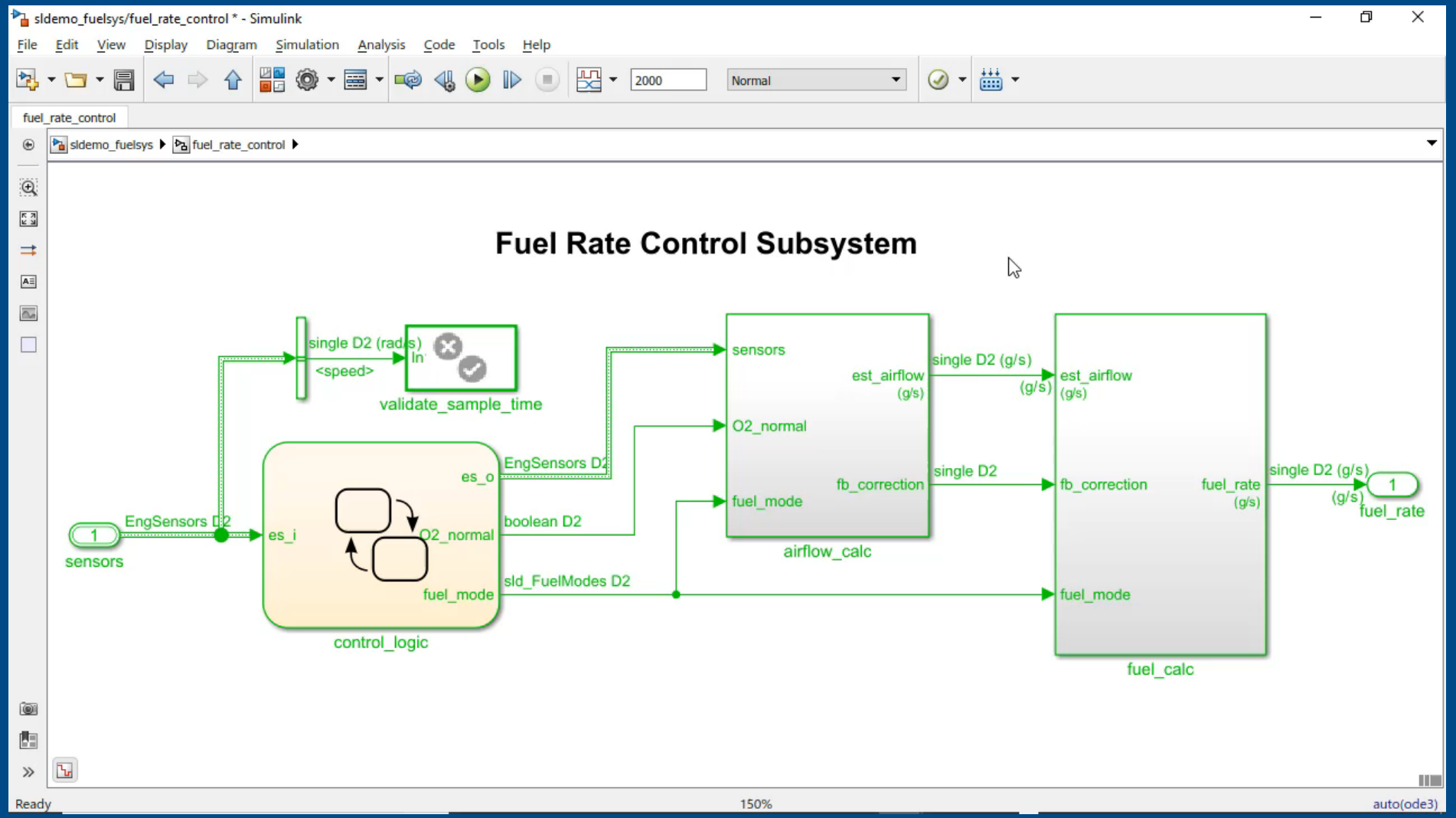
Viewing Generated Code Alongside the Model



Embedded Coder

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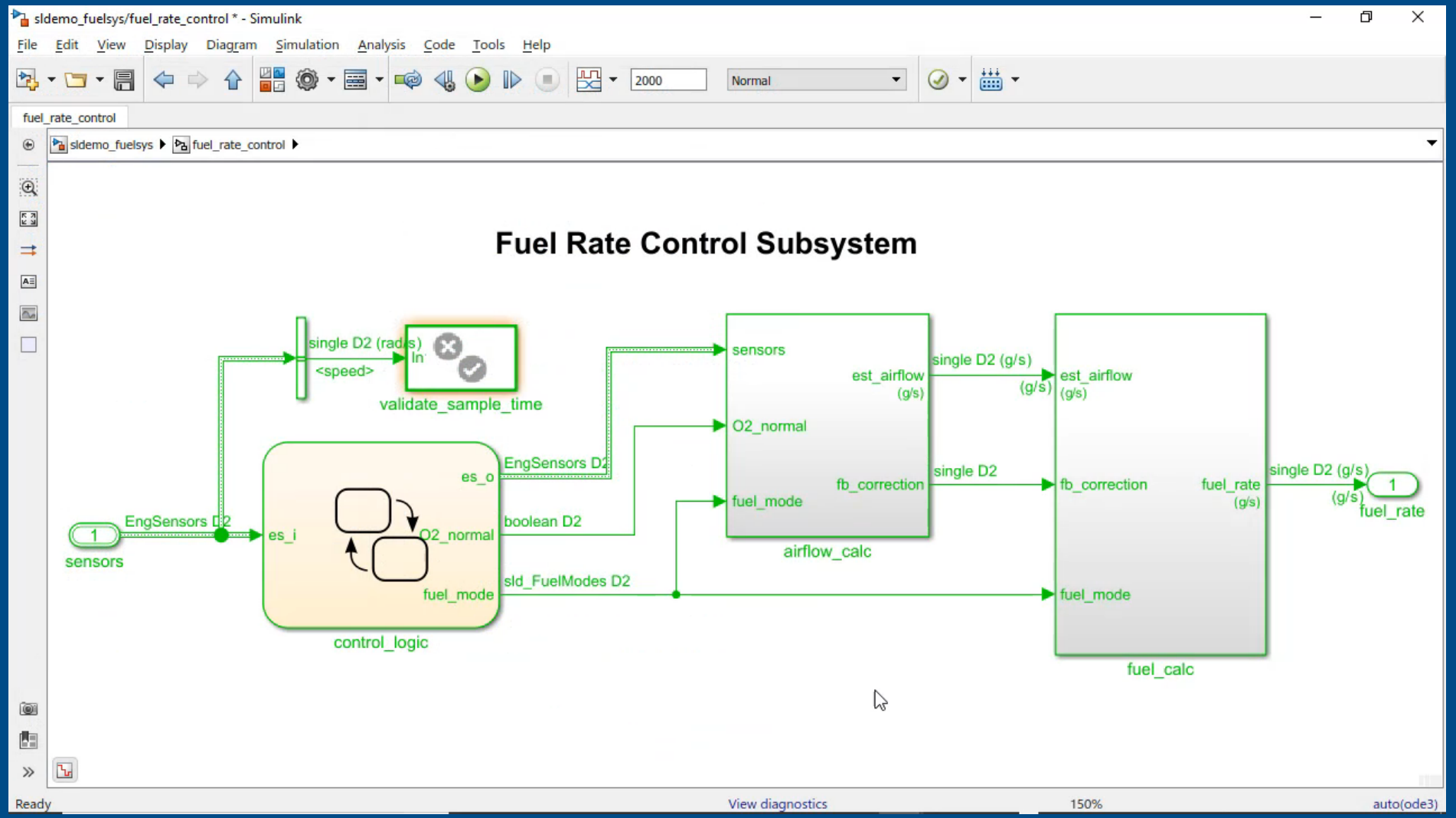
Viewing Generated Code Alongside the Model



Embedded Coder

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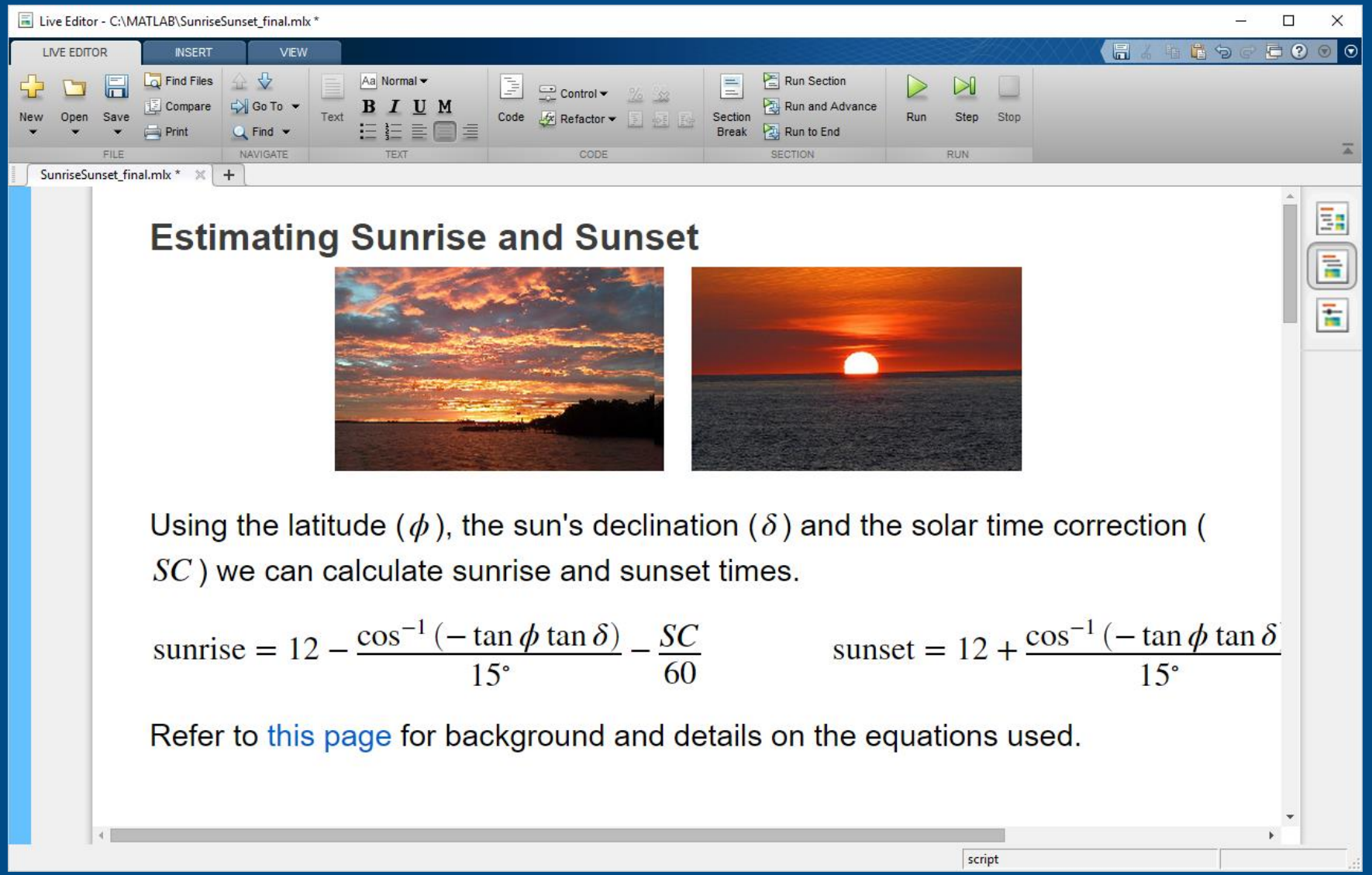
Sharing Live Scripts



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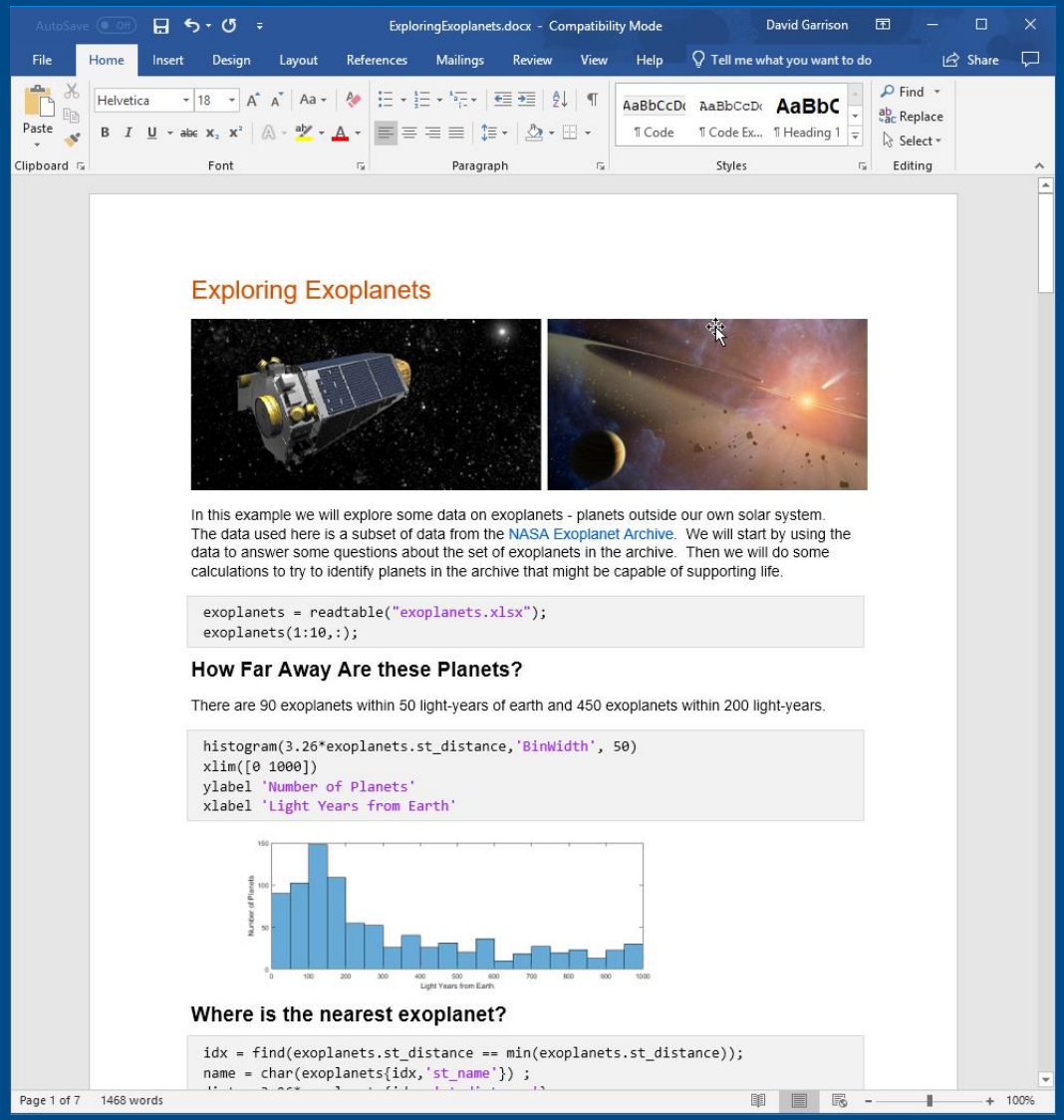
Sharing Live Scripts



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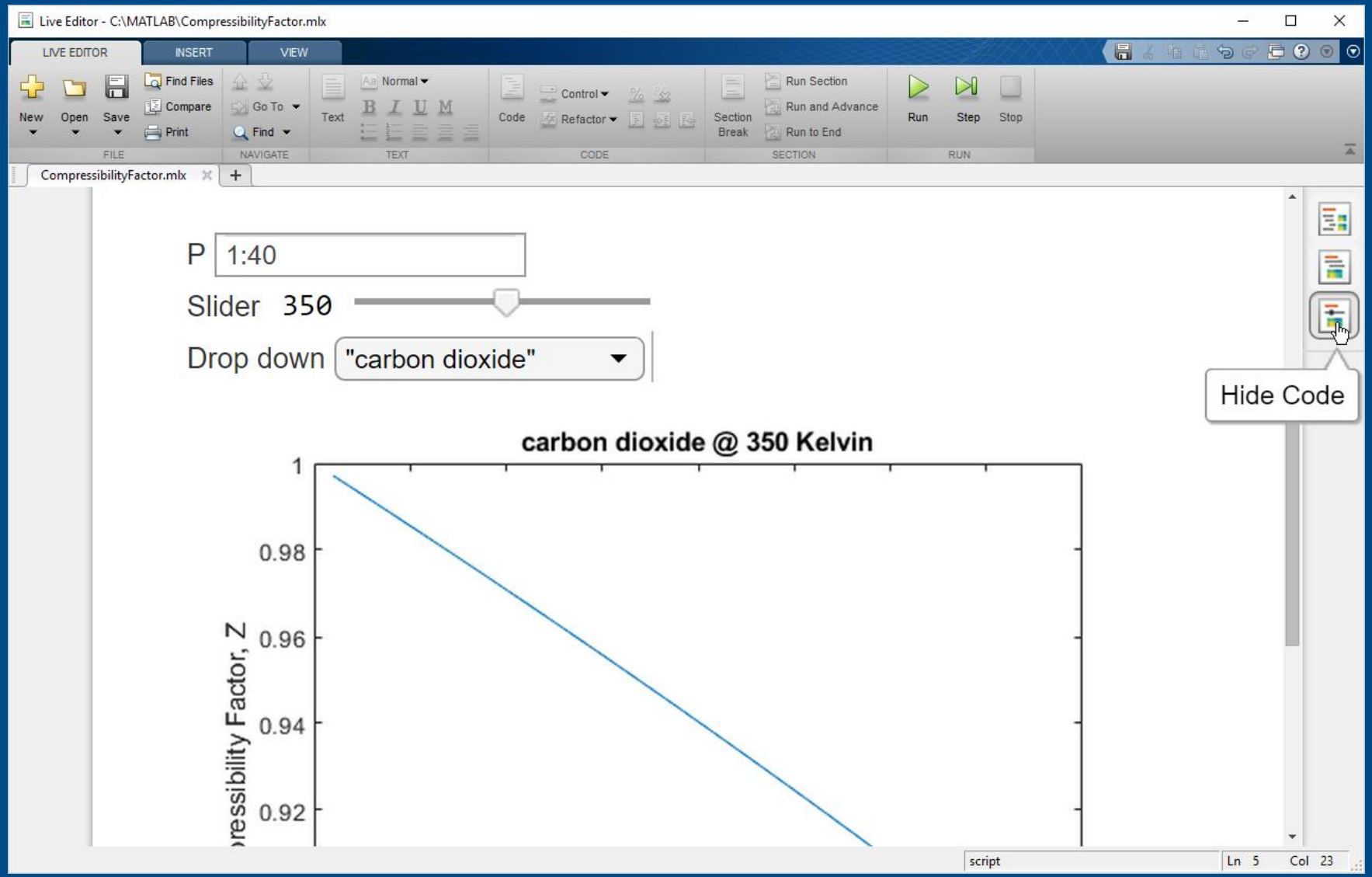
Sharing Live Scripts



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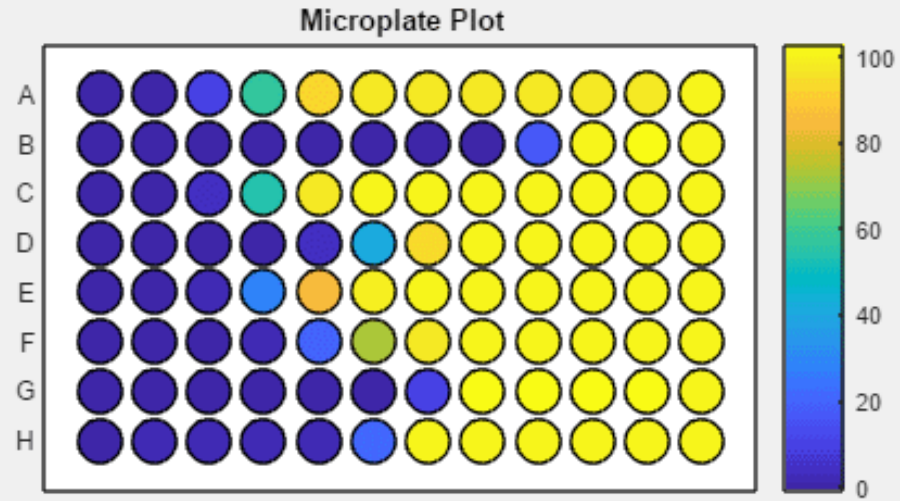
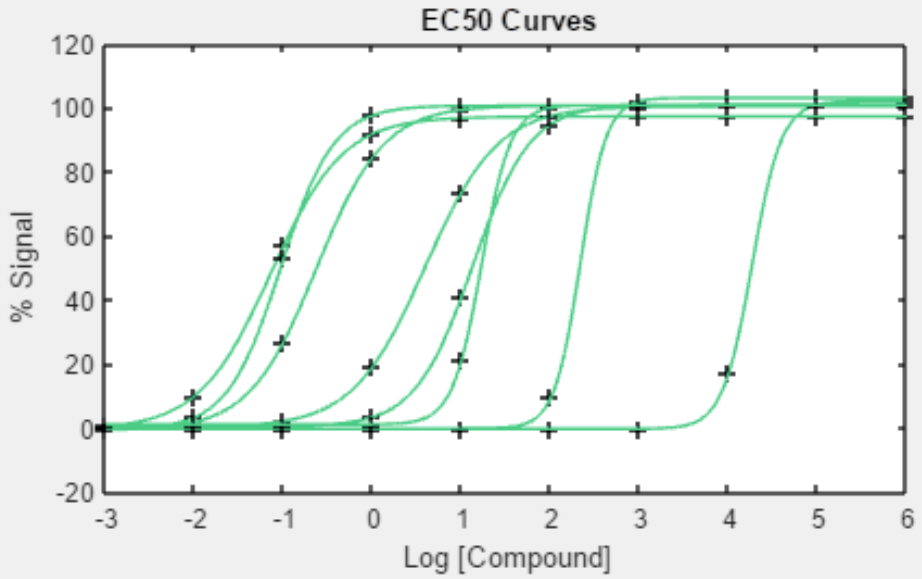
Creating Apps

Output

Plate Browser | Summary Tables

Select Files | Current File: microtiter_data0001.csv





Previous File | Next File | Clear selection

File	Compound Nr	NegControl	Conc1	Conc2	Conc3	Conc4	Conc5	Conc6	Conc7	Conc8
microtiter_d...	1	-0.0741	0.3564	9.8759	56.8743	91.7323	96.7084	97.1532	97.1910	97.1940
microtiter_d...	2	-0.0143	-0.5044	-0.5044	-0.5044	-0.5044	-0.5044	-0.5043	-0.4544	17.0436
microtiter_d...	3	0.0054	-0.4702	3.1998	52.9698	97.5746	100.5006	100.6086	100.6086	100.6086
microtiter_d...	4	0.1096	0.2325	0.2385	0.3712	3.2339	41.1060	94.7343	100.6591	100.9487
microtiter_d...	5	-0.0572	-0.7461	1.7104	26.8872	84.5134	99.2335	100.4717	100.5601	100.5700

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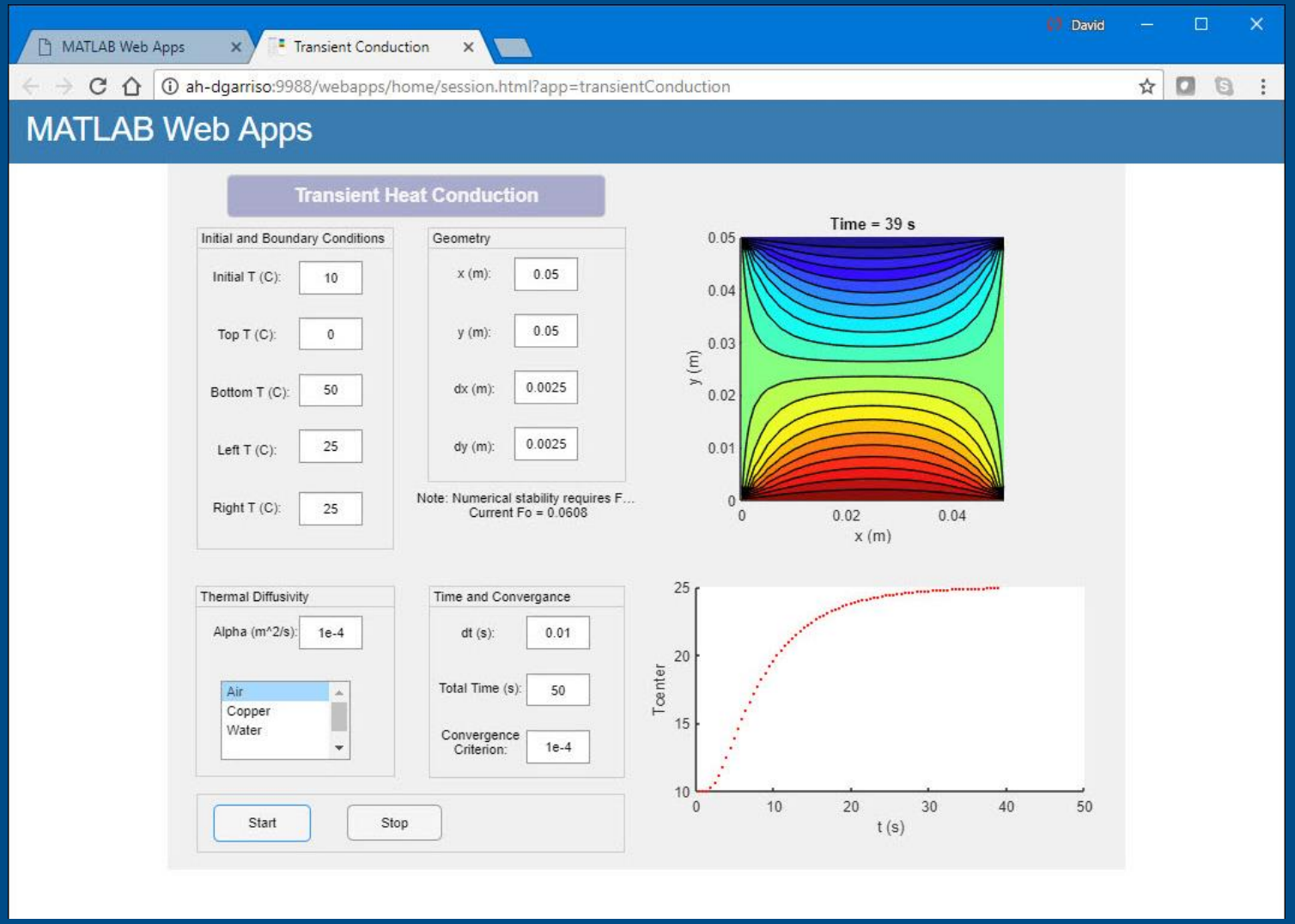
Deploying Web Apps



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Using MATLAB & Simulink to Build Algorithms in Everything

Inputs

Design

Outputs

MATLAB&SIMULINK®

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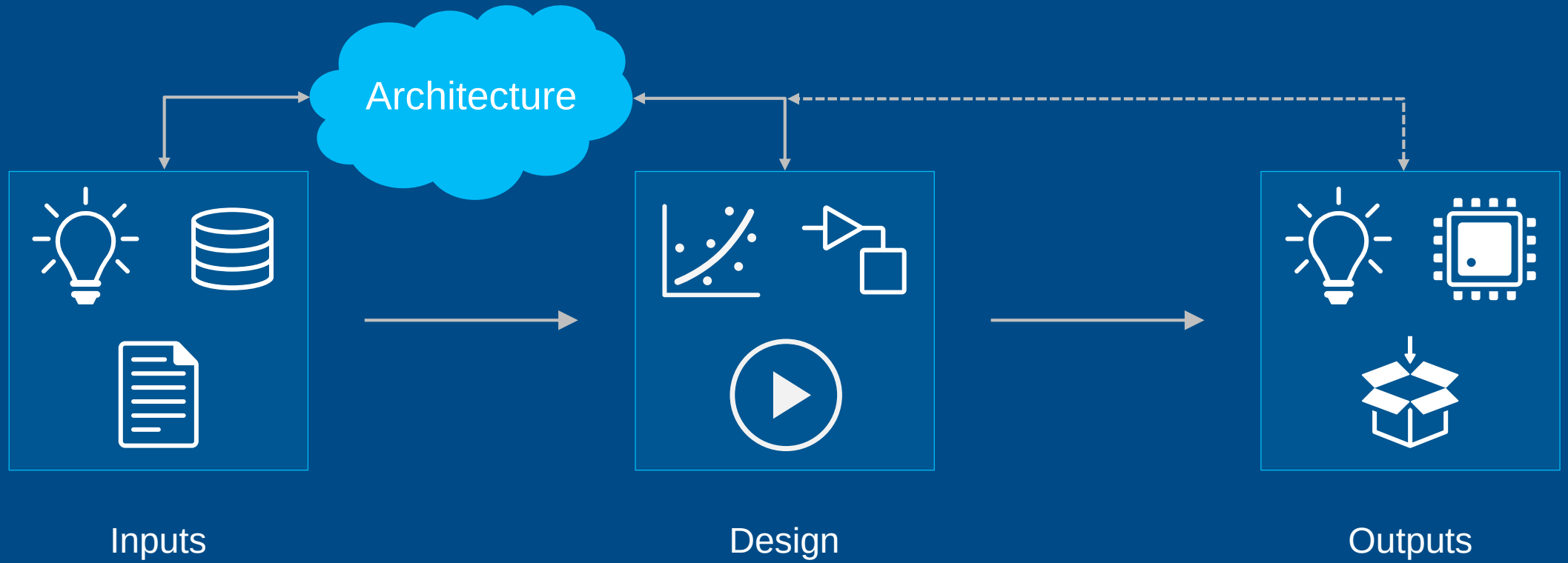
Evaluating Architectures



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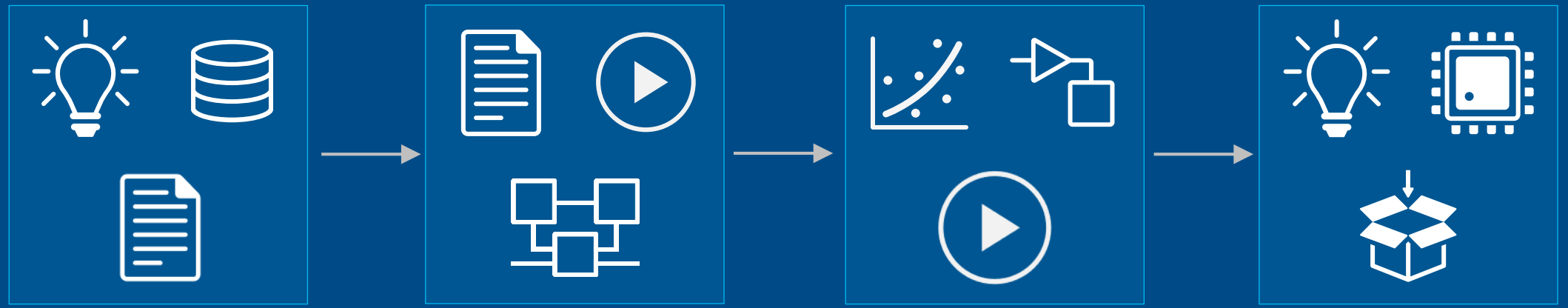
Evaluating Architectures



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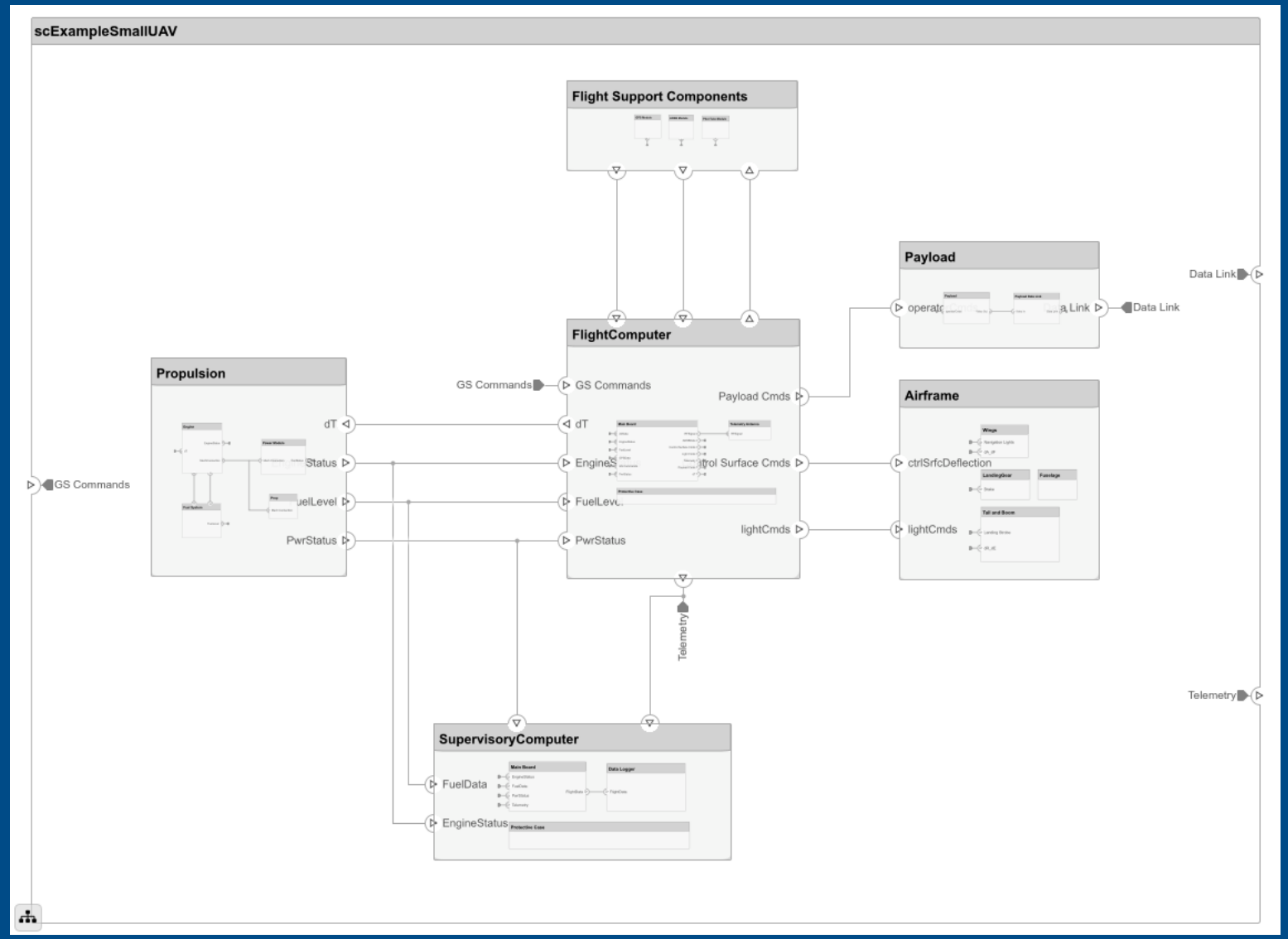
Designing System and Software Architectures



System Composer

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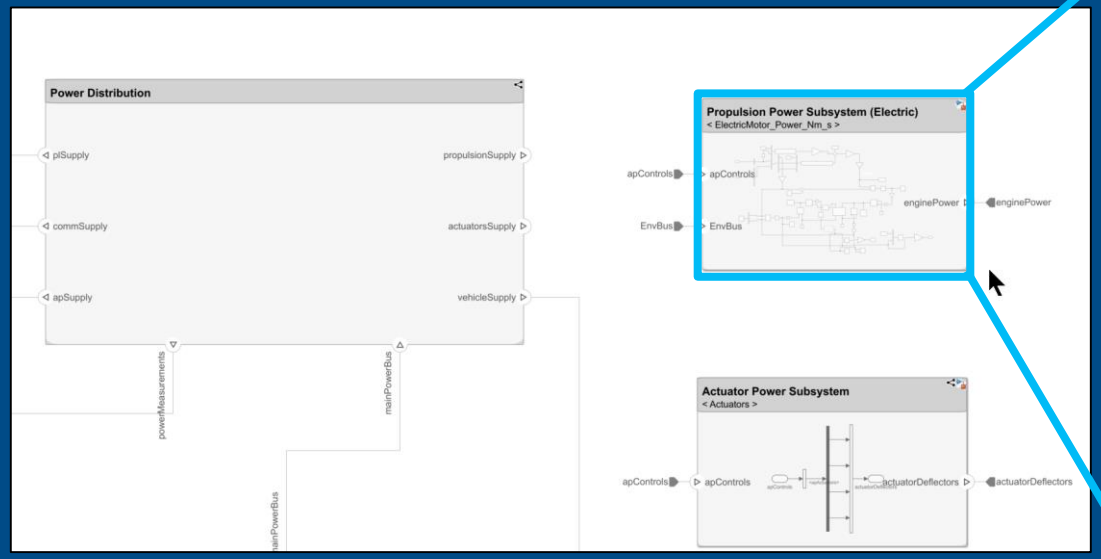
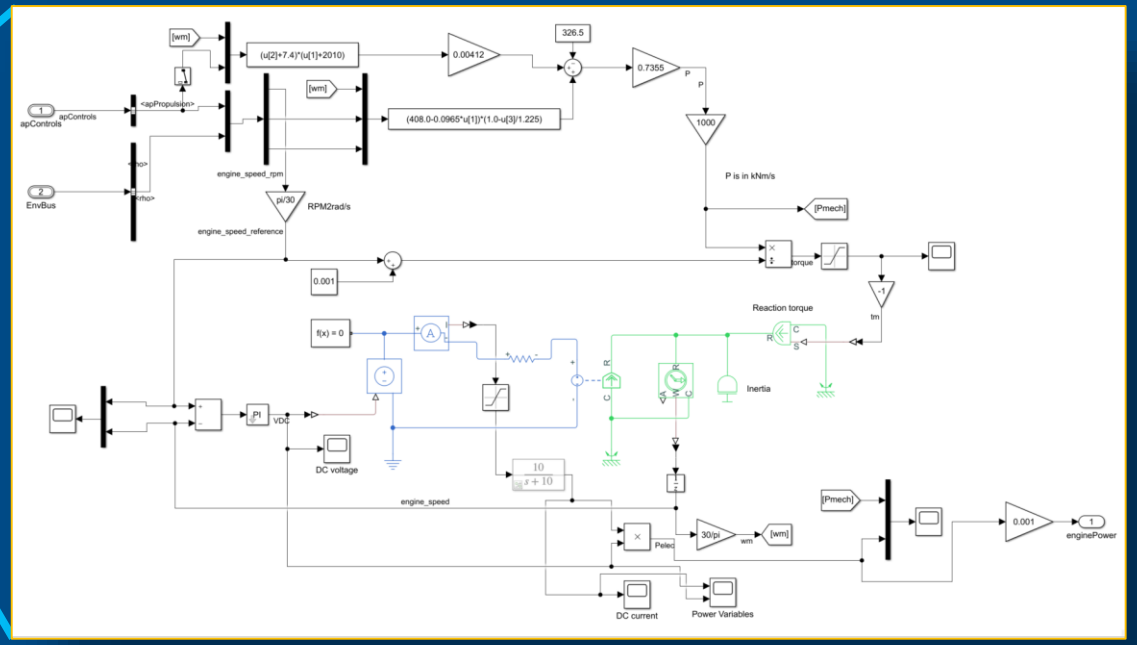
Designing System and Software Architectures





System Composer

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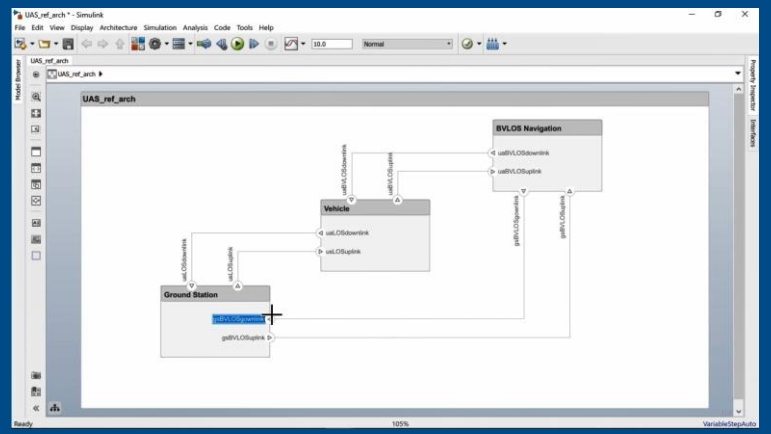
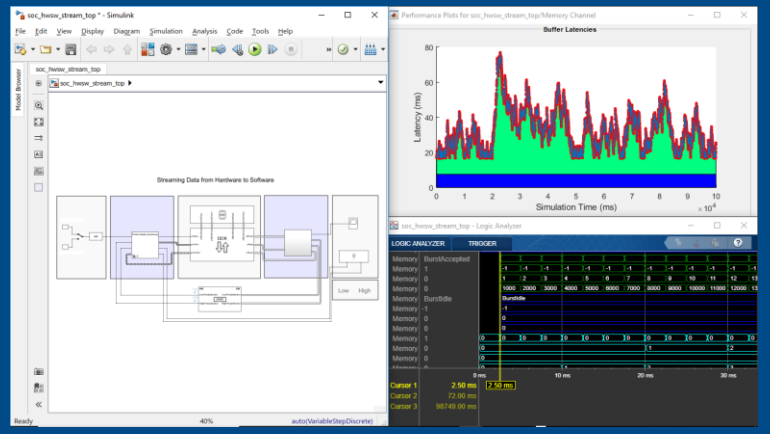
Designing Beyond System and Software Architectures

Systems and Software



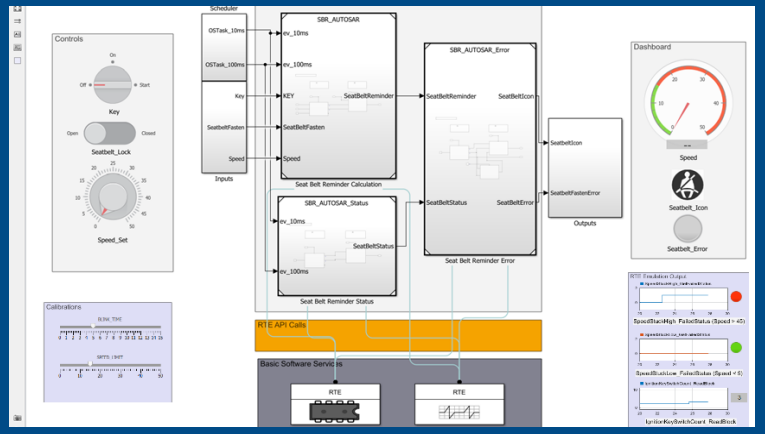
System Composer

SoC Hardware and Software



SoC Blockset

AUTOSAR Software



AUTOSAR Blockset

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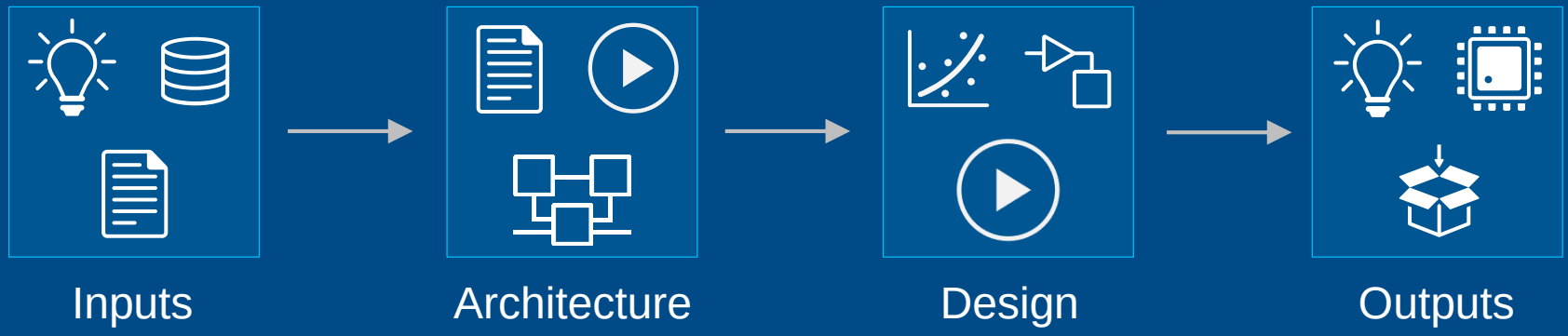
Using MATLAB & Simulink to Build Algorithms in Everything



Test & Verification

Collaboration

Scaling

MATLAB&SIMULINK

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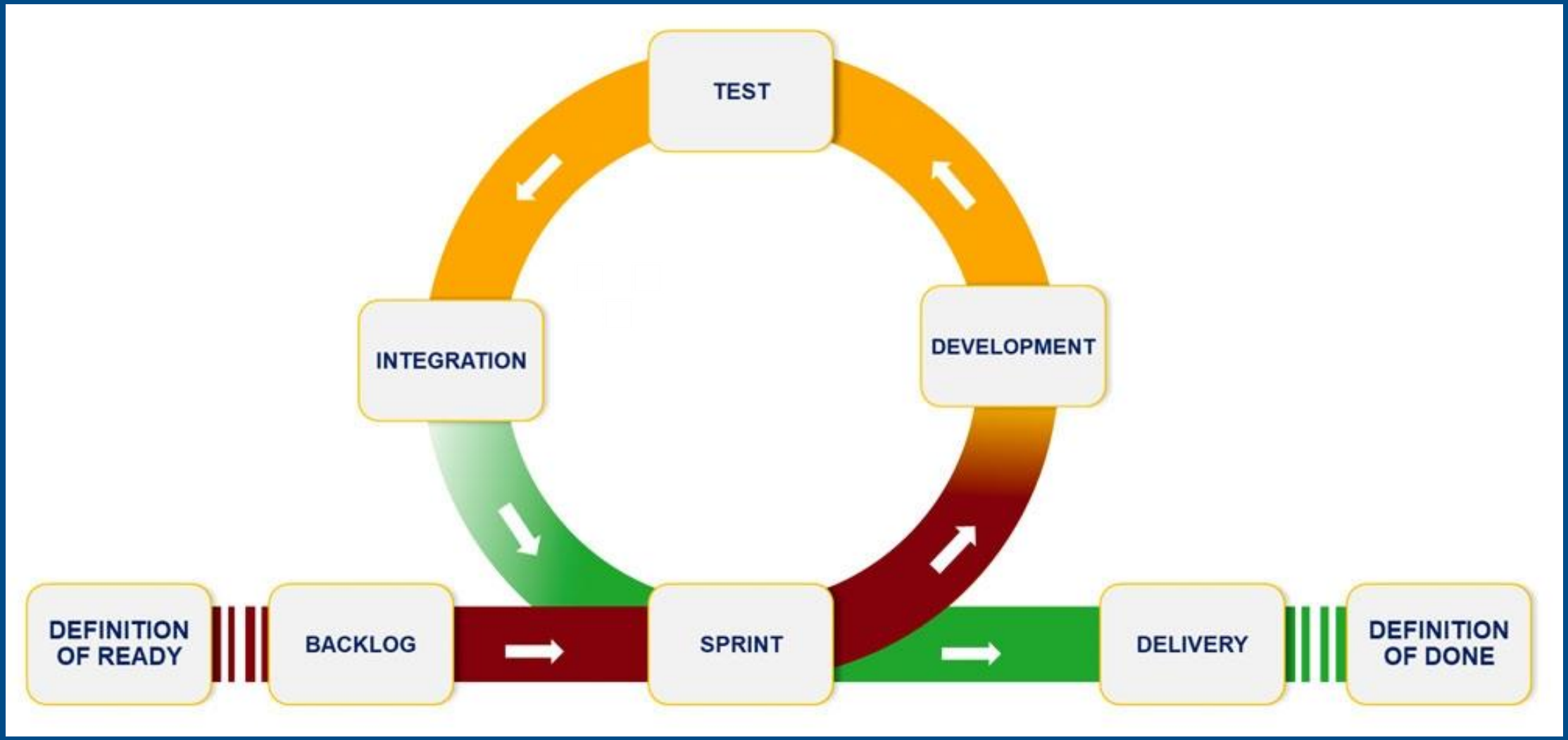
Using MATLAB & Simulink to Build Algorithms in Everything



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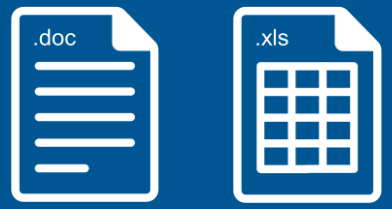
Integrating with Third-party Requirements Tools

External Requirements



Requirements Management Tools

R2019a

ReqIF

Simulink Requirements

External Requirements

Authored Requirements

Simulink Requirements

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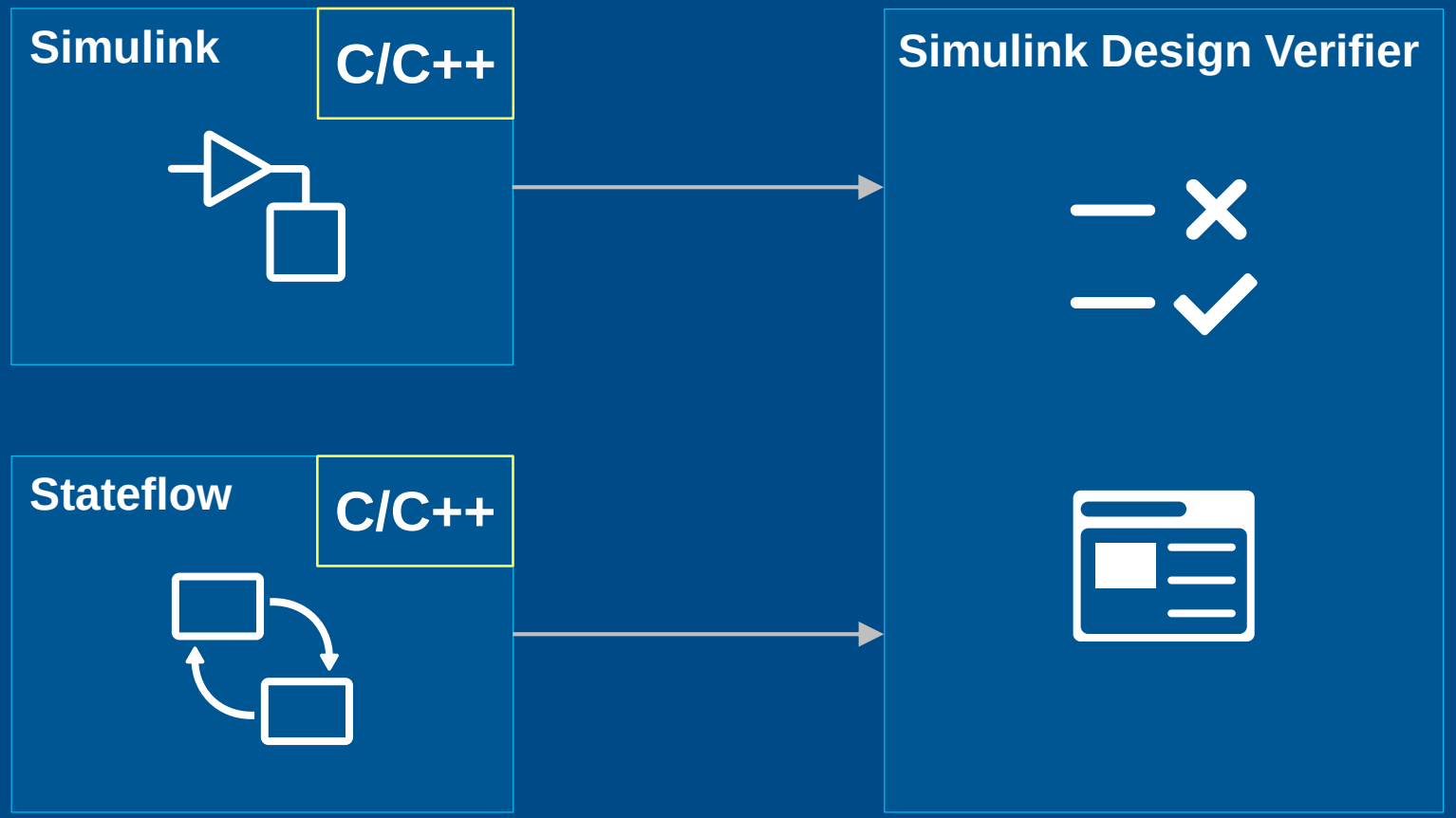
Include Custom Code in Test & Verification



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Using the MATLAB Unit Test Framework

Test & Verification

```
>> result.table
ans =
  2×6 table
                 Name                    Passed    Failed    Incomplete    Duration      Details
    ____________________________________ ______    ______    __________    ________    ____________
    'test_Predictions/Test_ModelType'     true      false       false       0.12241     [1×1 struct]
    'test_Predictions/Test_Prediction'    false     true        true        0.11542     [1×1 struct]
```


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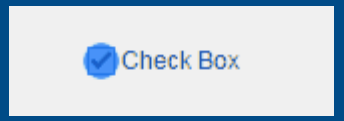
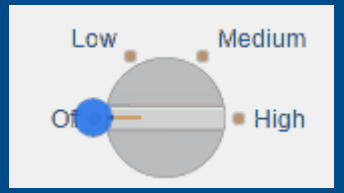
Using the MATLAB App Testing Framework

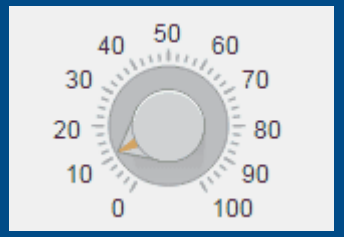
```
testCase.press(myApp.checkbox)
```



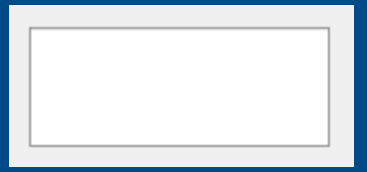

```
testCase.choose(myApp.discreteKnob, "Medium")
```




```
testCase.drag(myApp.continuousKnob, 10, 90)
```




```
testCase.type(myApp.editfield, myTextVar)
```



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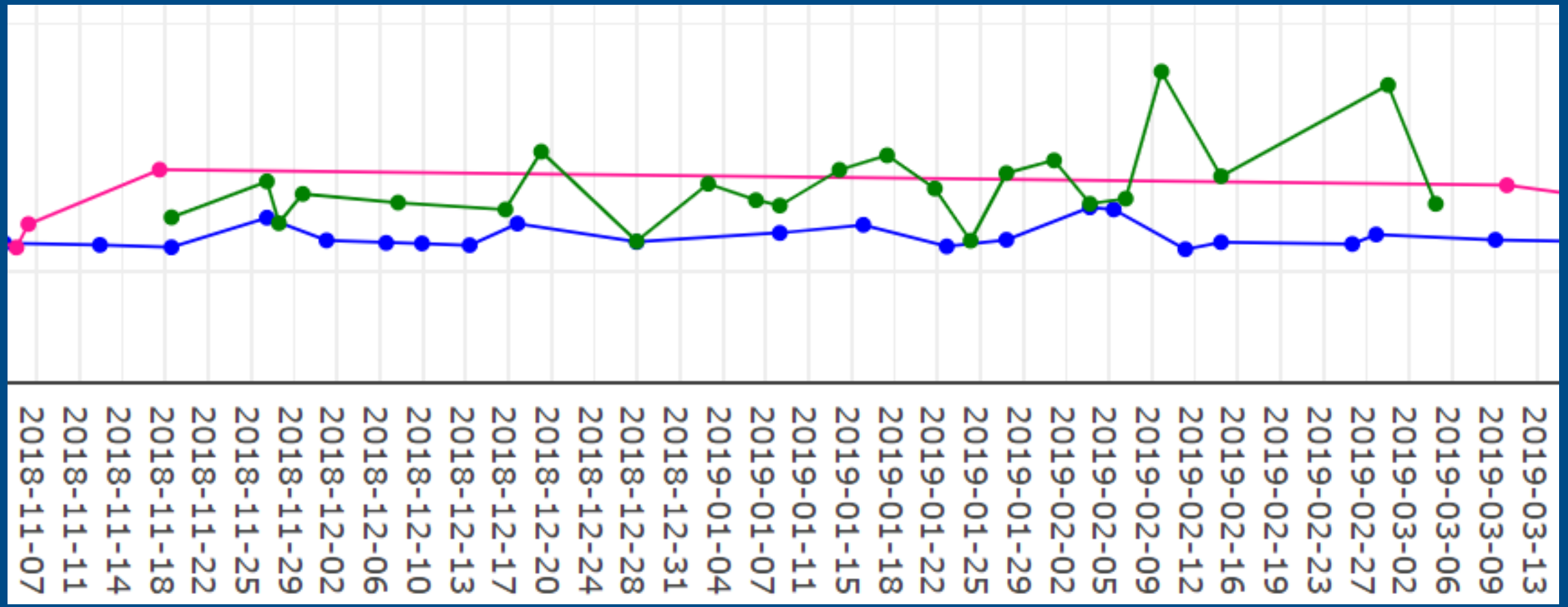
Using the MATLAB Performance Testing Framework



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Using Continuous Integration

MATLAB https://plugins.jenkins.io/

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Using Continuous Integration

Jenkins

Blog Documentation

← Find plugins

MATLAB 1.0.0

Minimum Jenkins requirement: 2.7.3
ID: matlab

Installs: No usage data available
GitHub →
Last released: 2 days ago

Maintainers

MathWorks

Dependencies

bouncycastle API v.2.16.0 (implied) (what's this?)
Command Agent Launcher v.1.0 (implied) (what's this?)
JDK Tool v.1.0 (implied) (what's this?)
JAXB v.2.3.0 (implied) (what's this?)

The Jenkins plugin for MATLAB® enables you to easily run your MATLAB tests and generate test artifacts in formats such as JUnit, TAP, and Cobertura code coverage reports.

Features

- Support to run MATLAB tests, present in the Jenkins workspace automatically. (This also includes the tests present in .prj files)
- Generate tests artifacts in JUnit , TAP & Cobertura code coverage formats.
- Support to run tests, using custom MATLAB command or custom MATLAB script file.

MATLAB **https://plugins.jenkins.io/matlab**

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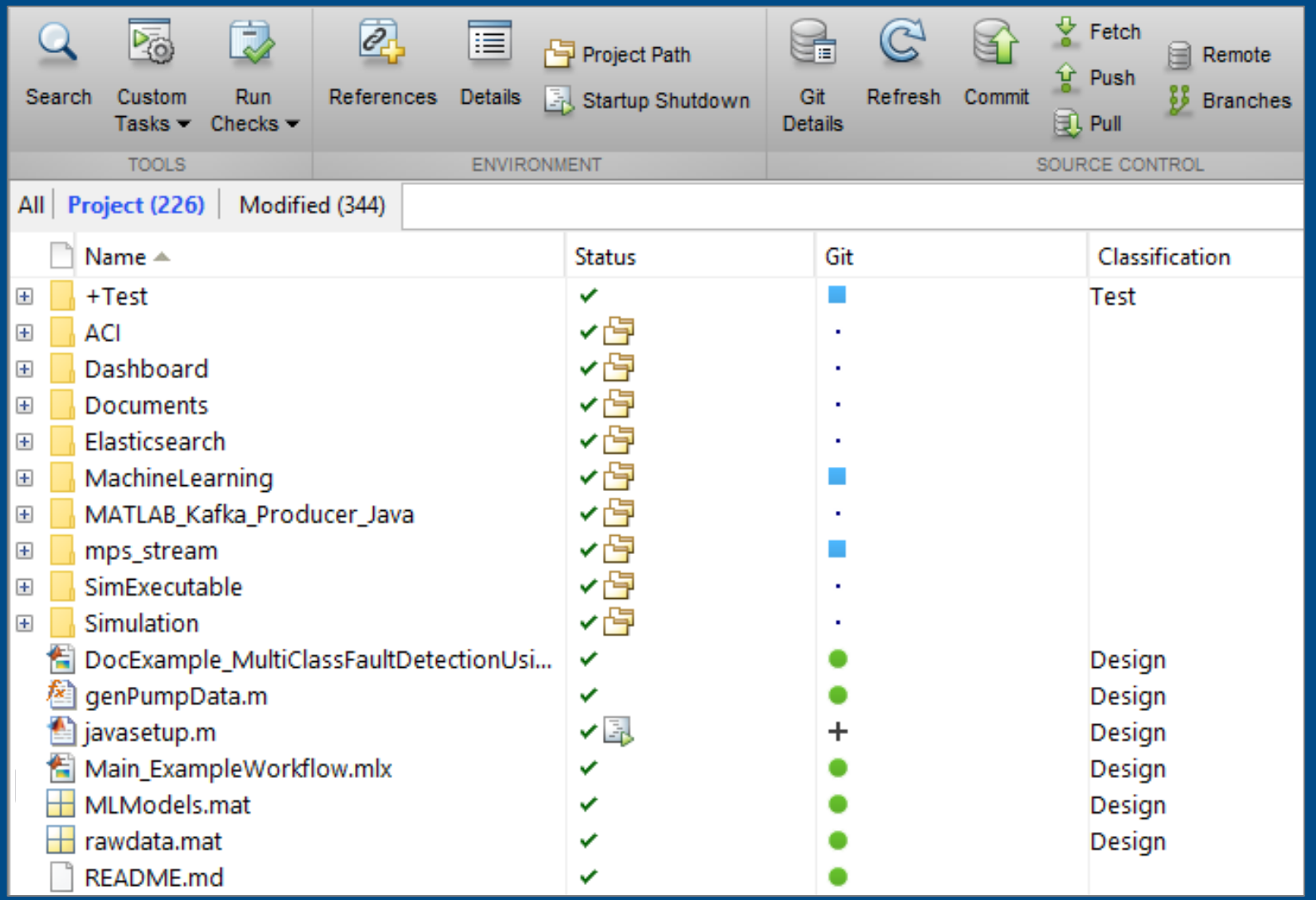
Using Projects in MATLAB

Collaboration



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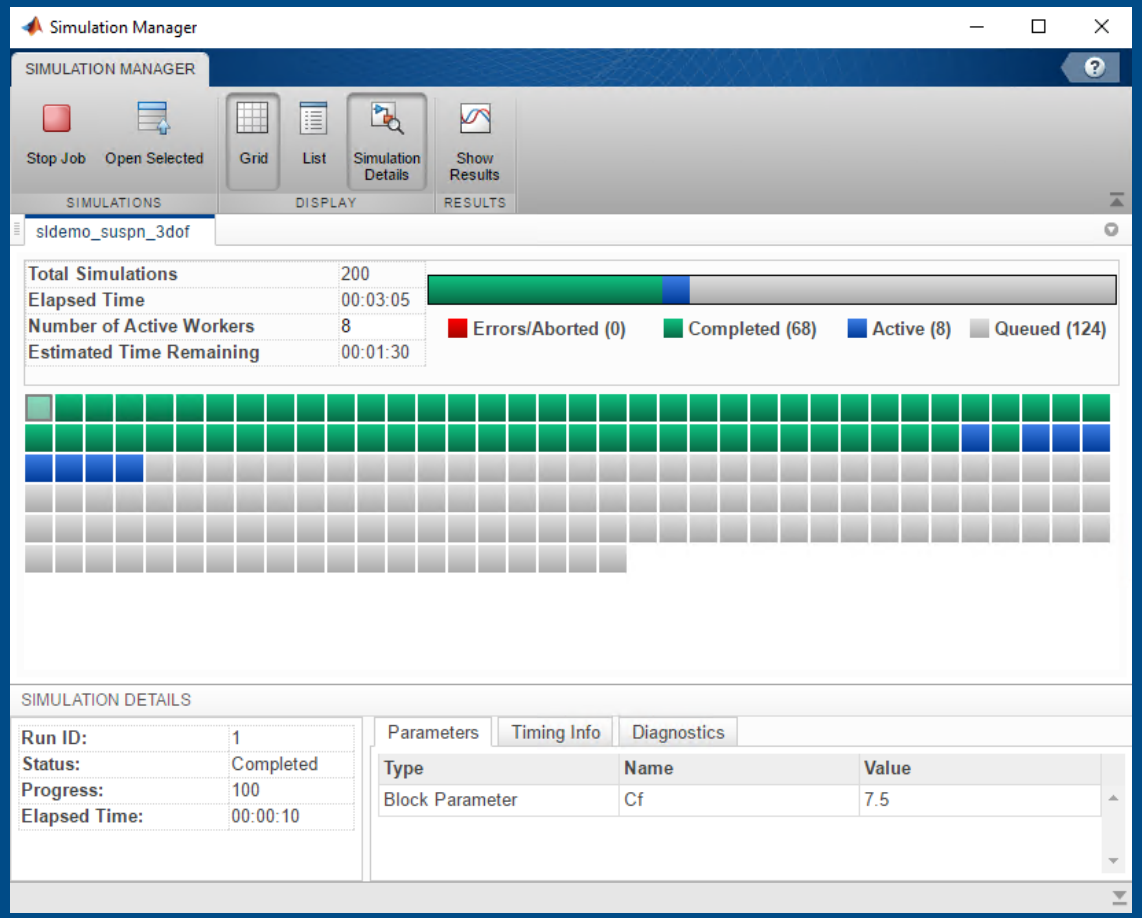
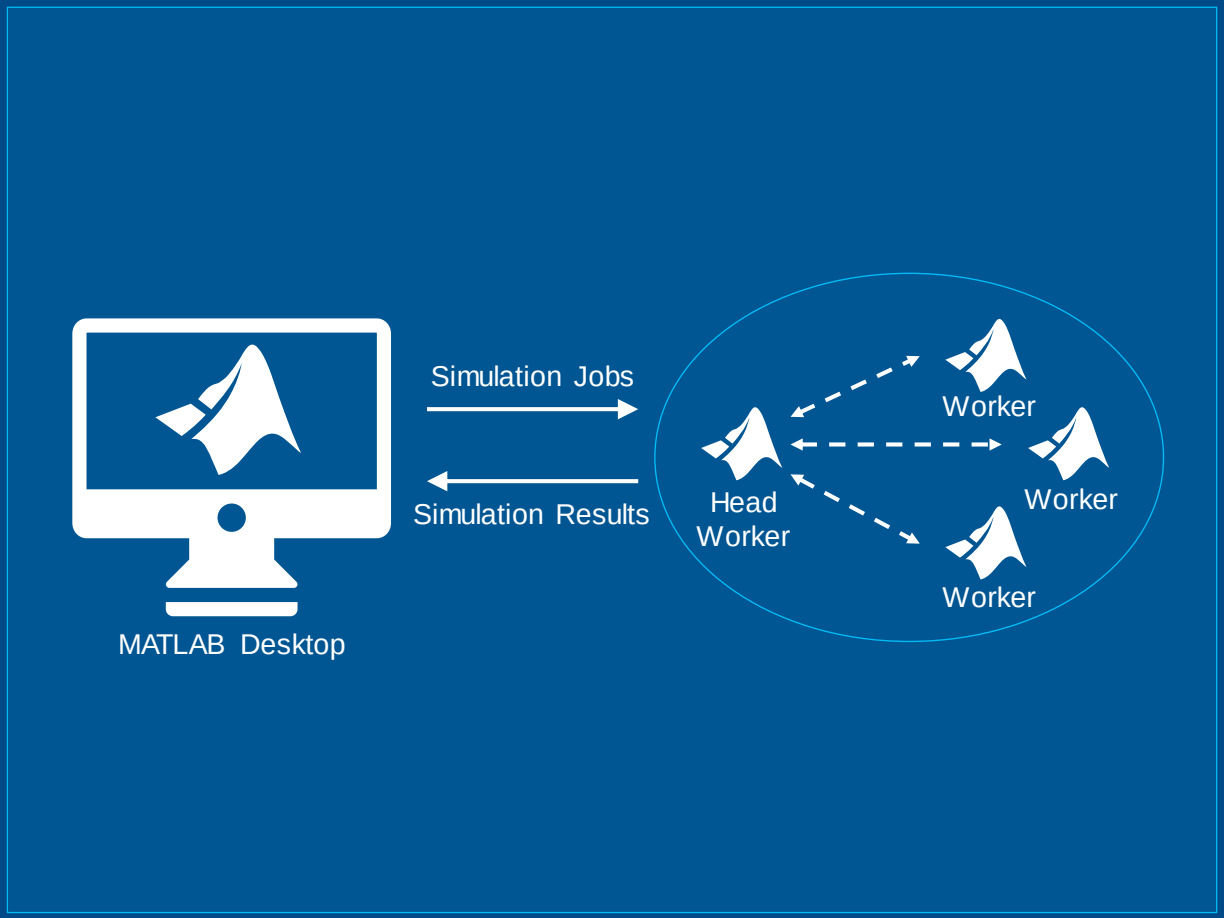
Parallel Simulations in Simulink

Scaling

Simulation Manager



`batchsim`



Simulink
Parallel Computing Toolbox

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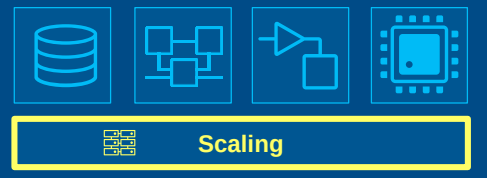
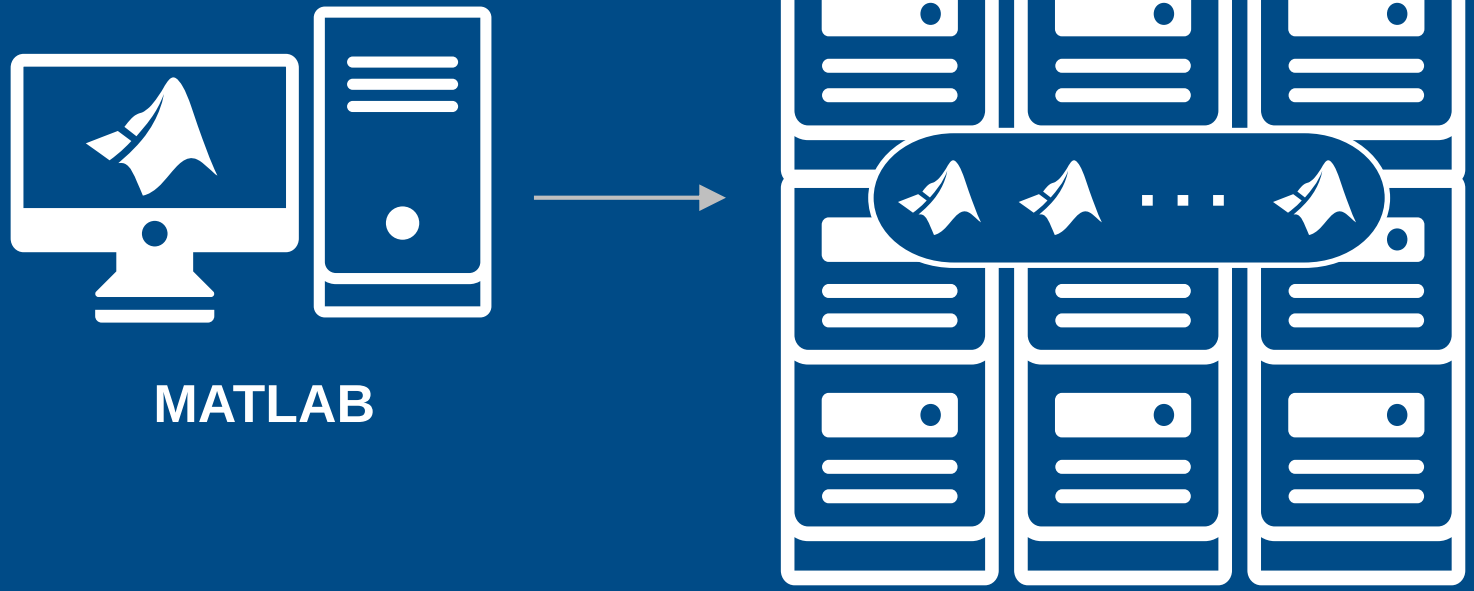
Scaling Computations on Clusters and Clouds





MATLAB

Parallel Computing Toolbox

MATLAB Parallel Server

Cloud

GPU

Multi-core CPU

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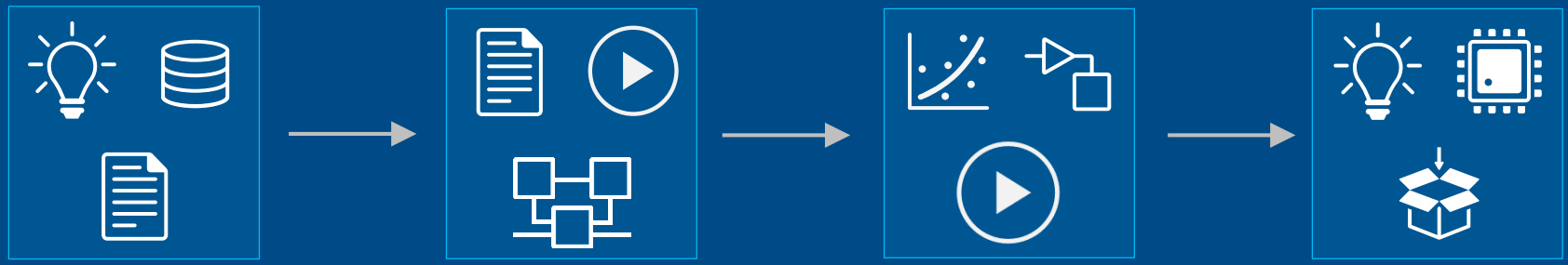
Using MATLAB & Simulink to Build Algorithms in Everything



Test & Verification

Collaboration

Scaling

MATLAB&SIMULINK

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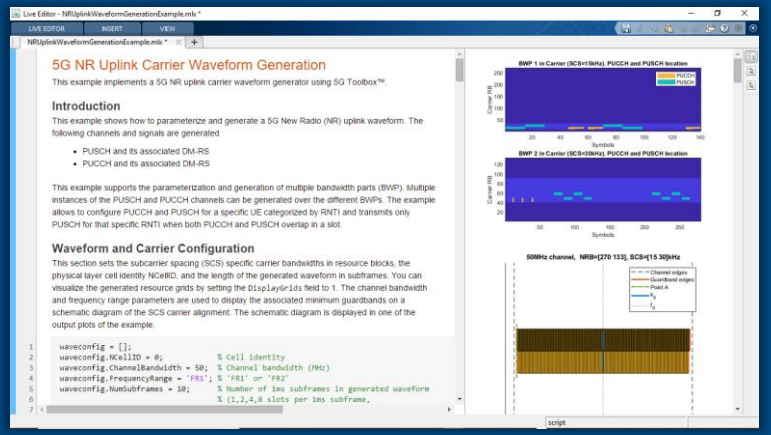
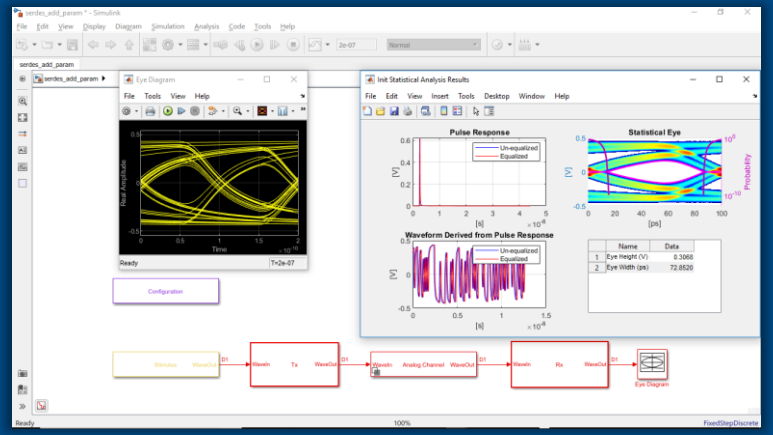
Specialized Tools for Building Algorithms in Everything

Communications



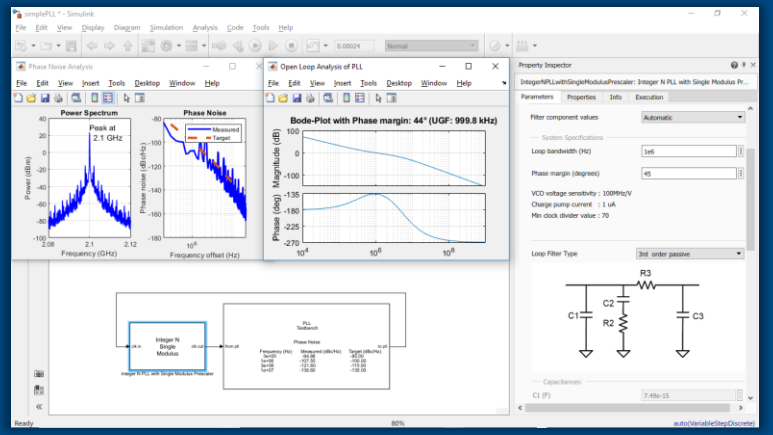
5G Toolbox

Physical interconnects



SerDes Toolbox

Analog Mixed-Signal



Mixed-Signal Blockset

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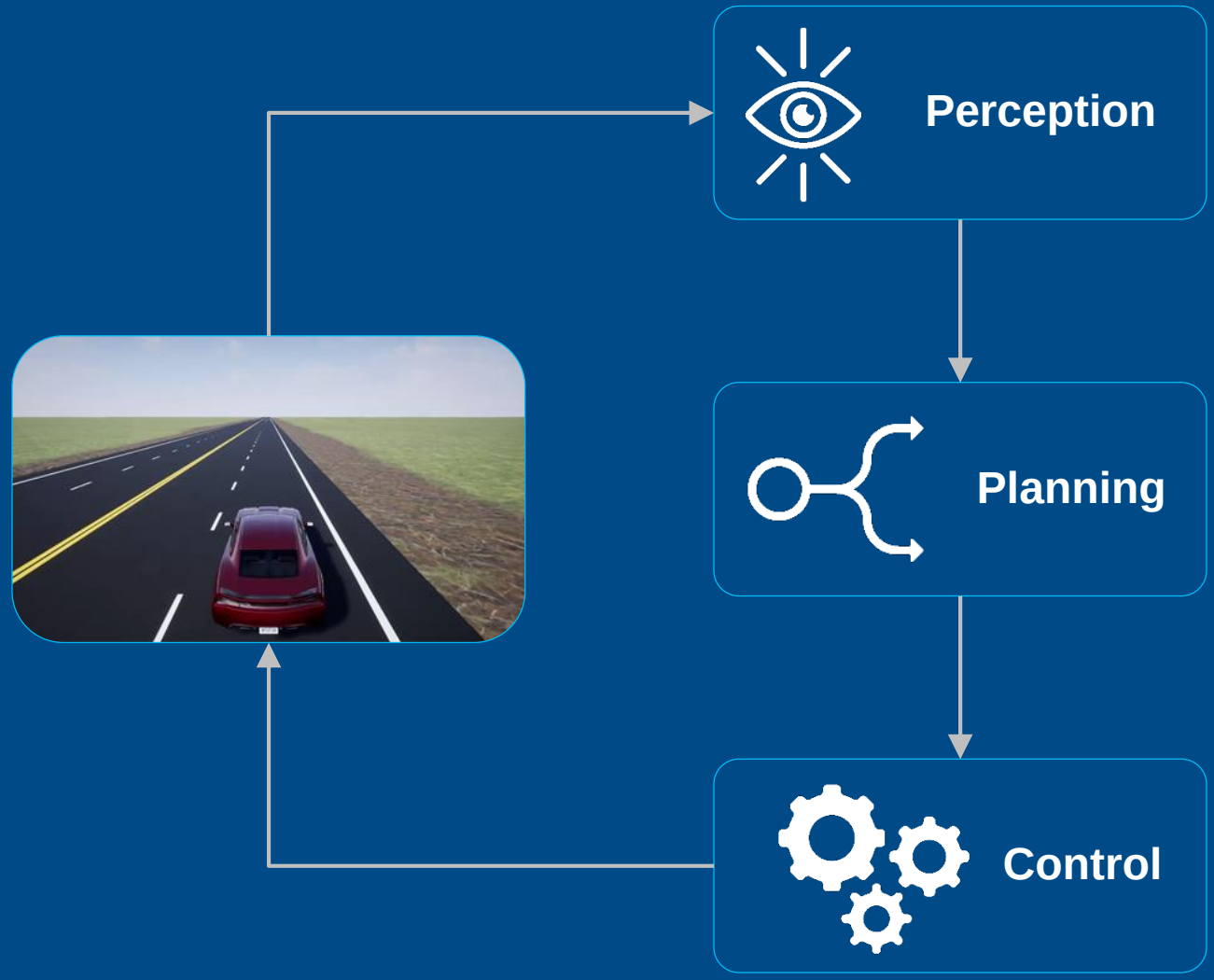
Developing Autonomous Systems



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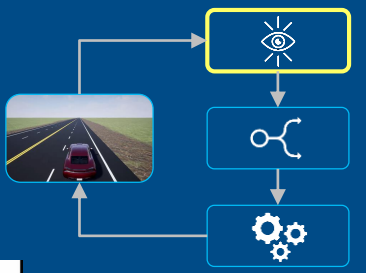
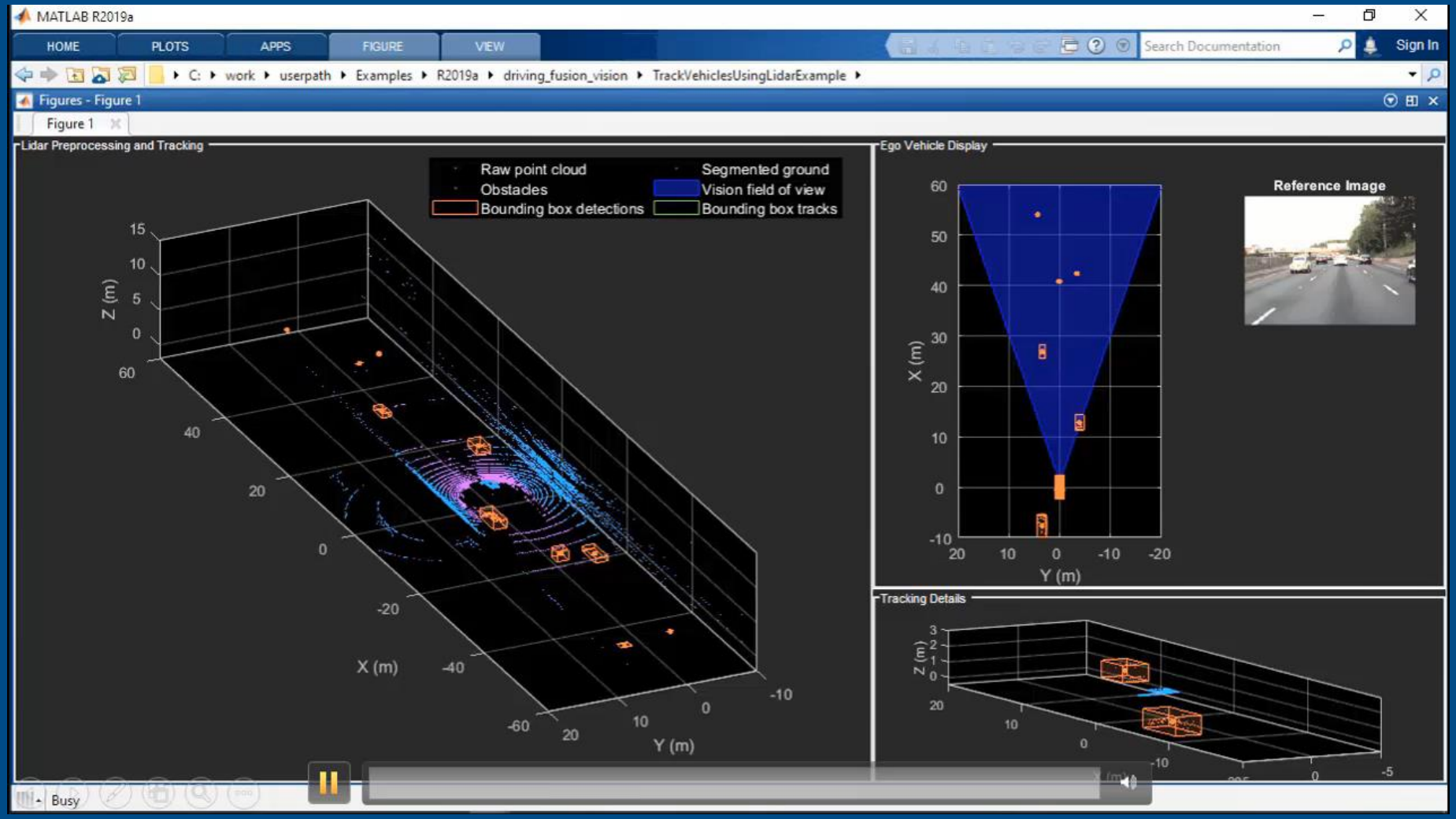
Evaluate Sensor Fusion Architectures





Sensor Fusion and Tracking Toolbox

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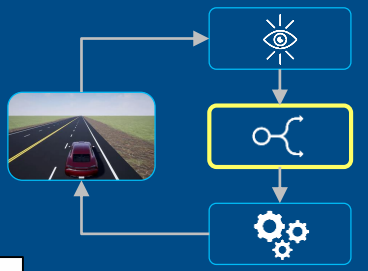
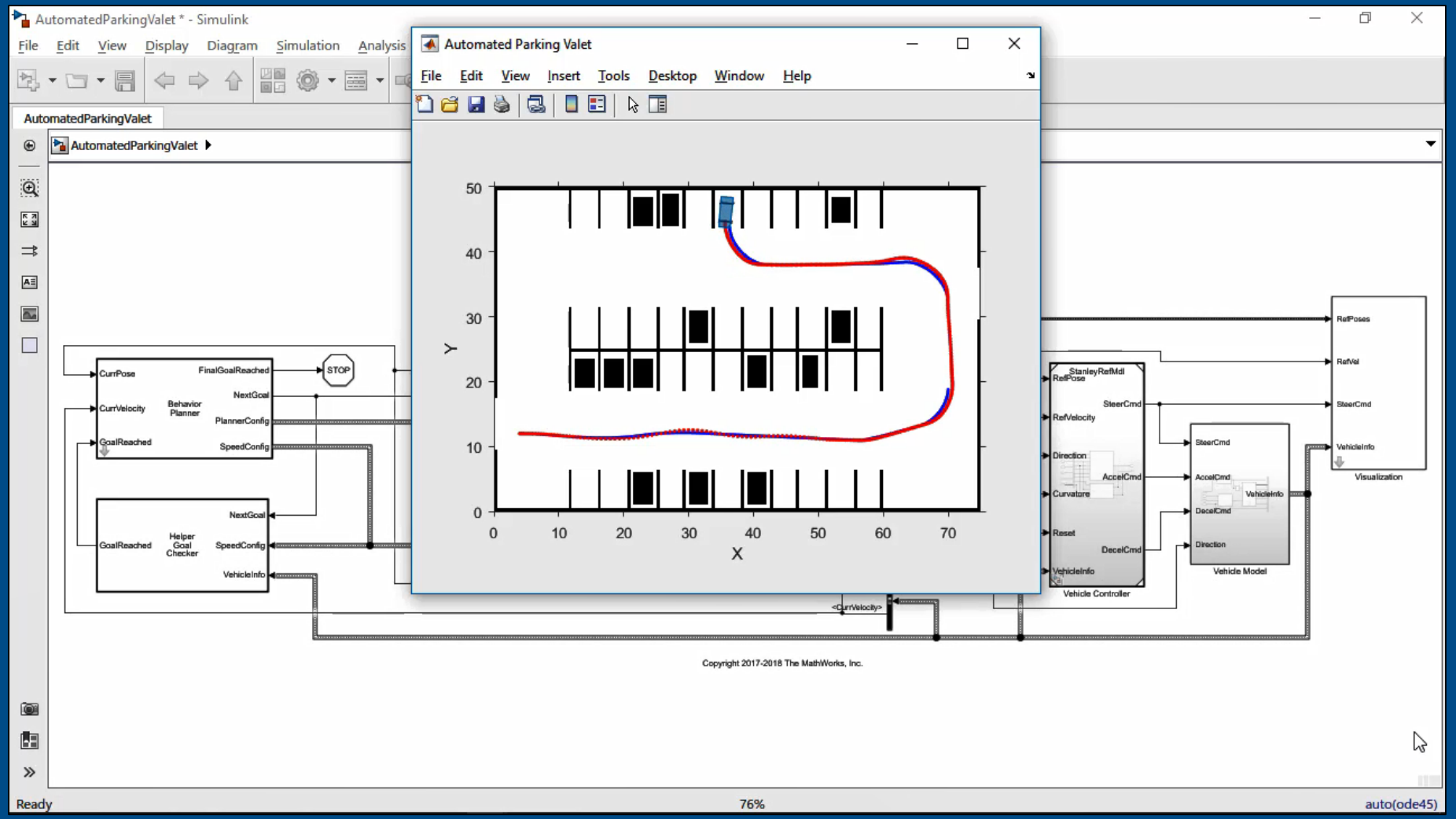
Simulate Path Planning Algorithms





Automated Driving Toolbox

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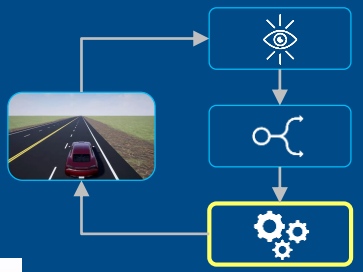
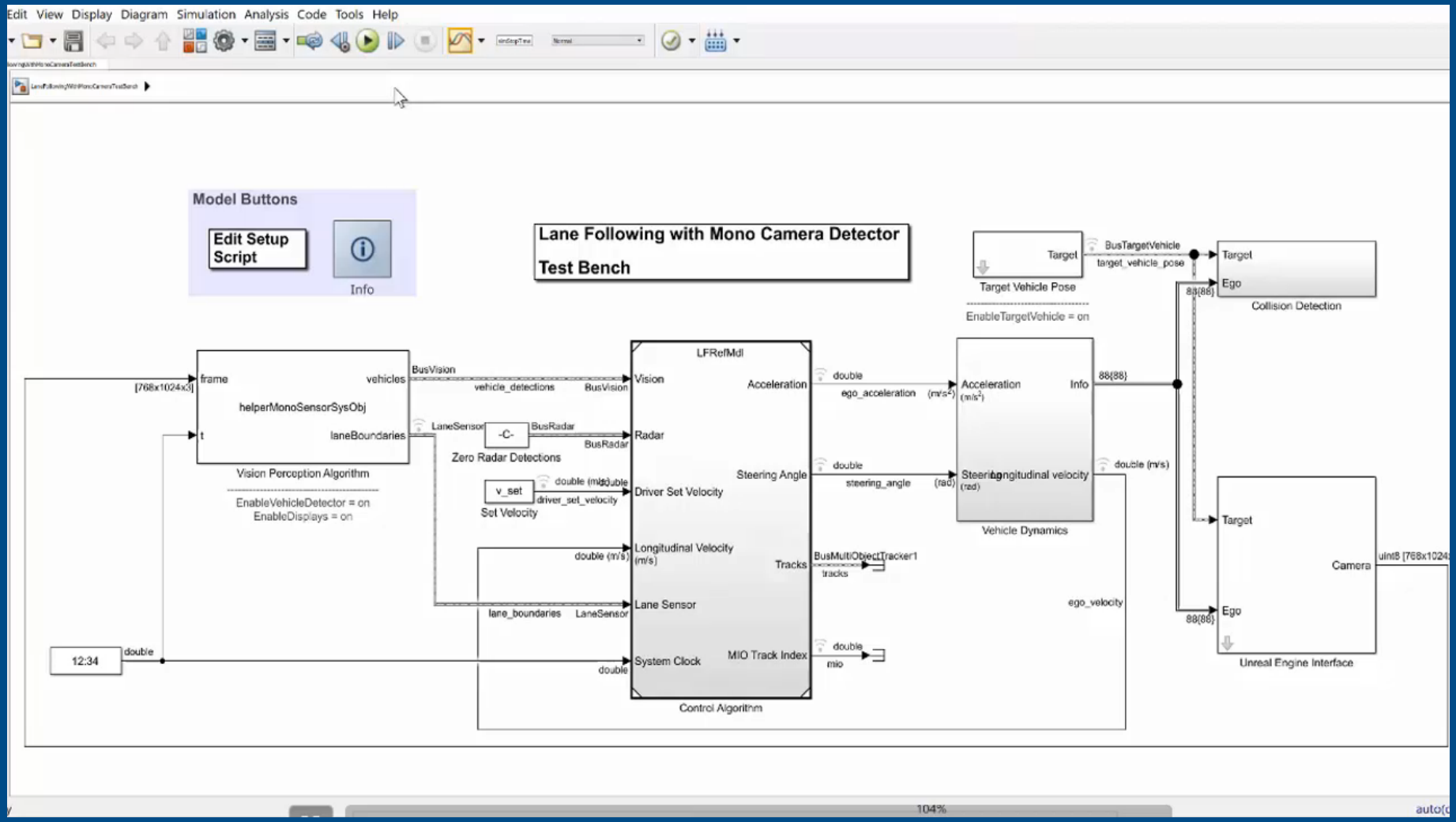
Design Lane-following and Spacing Control Algorithms





Model Predictive Control Toolbox

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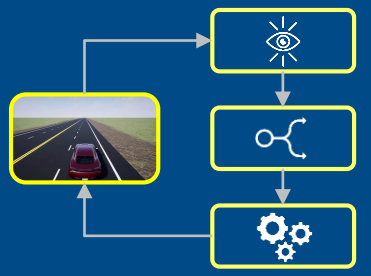
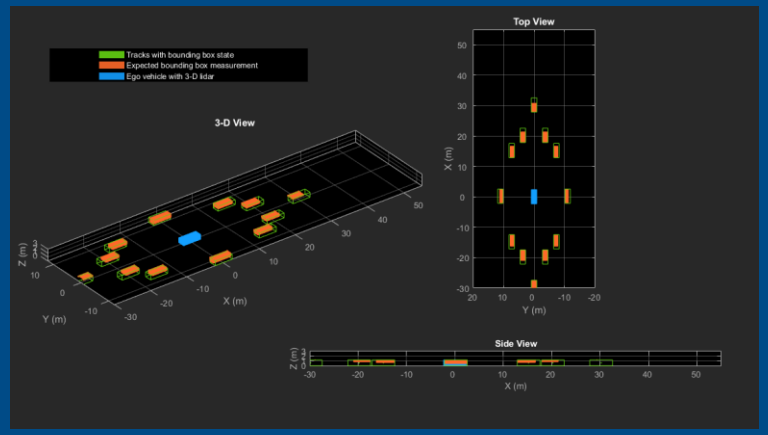
Developing Autonomous Systems

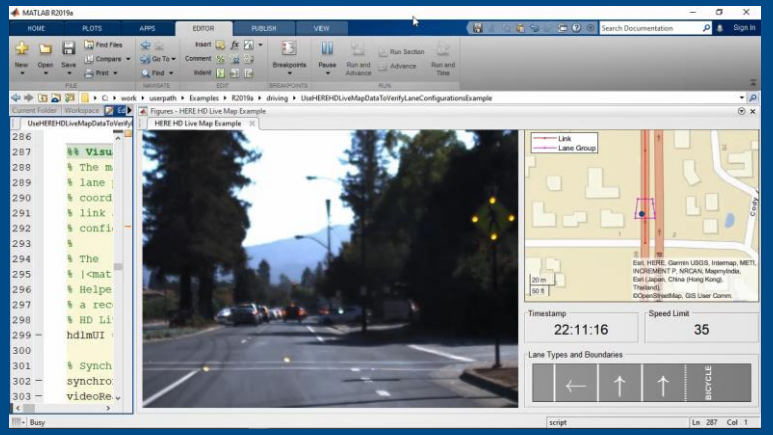


Lidar Processing & Tracking



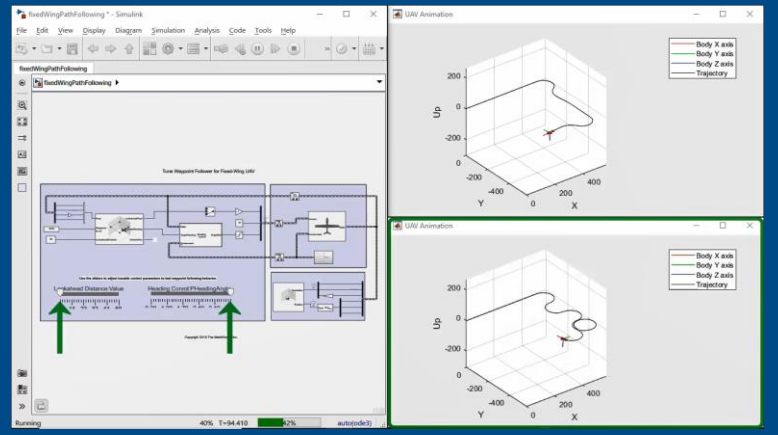
Computer Vision Toolbox

HERE HD Maps & OpenDRIVE Roads



Automated Driving Toolbox

UAV Algorithms



Robotics System Toolbox

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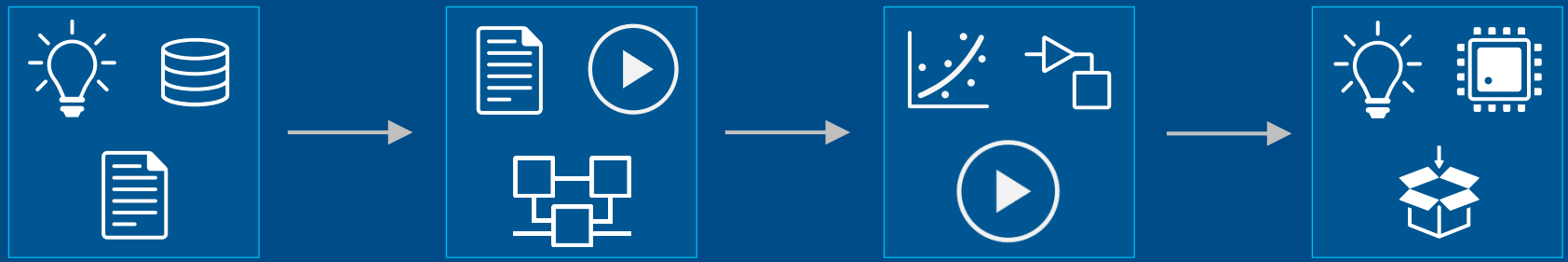
Using MATLAB & Simulink to Build Algorithms in Everything



Test & Verification

Collaboration

Scaling

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Read the Release Notes

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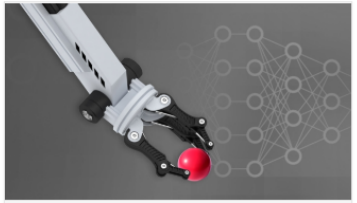
Release Highlights



Deep Learning

Develop controllers and decision making systems using reinforcement learning, train deep learning models on NVIDIA DGX and cloud platforms, and apply deep learning to 3-D data.

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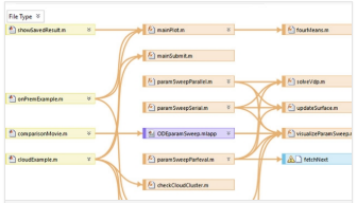

Projects

Use projects in MATLAB and Simulink to organize, manage, and share your work.

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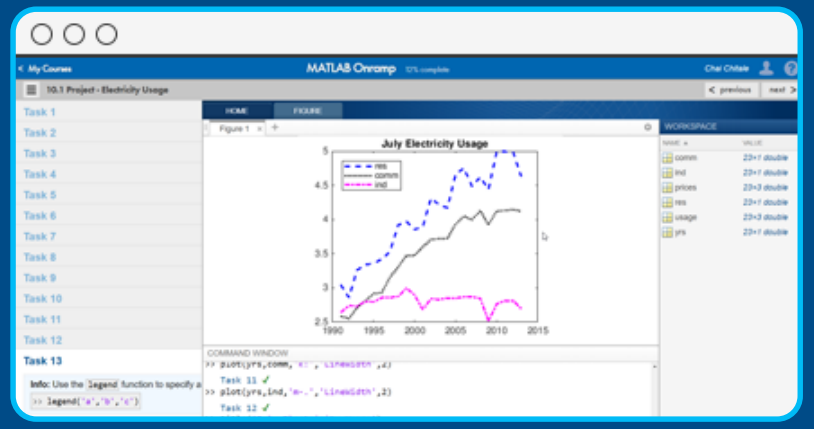
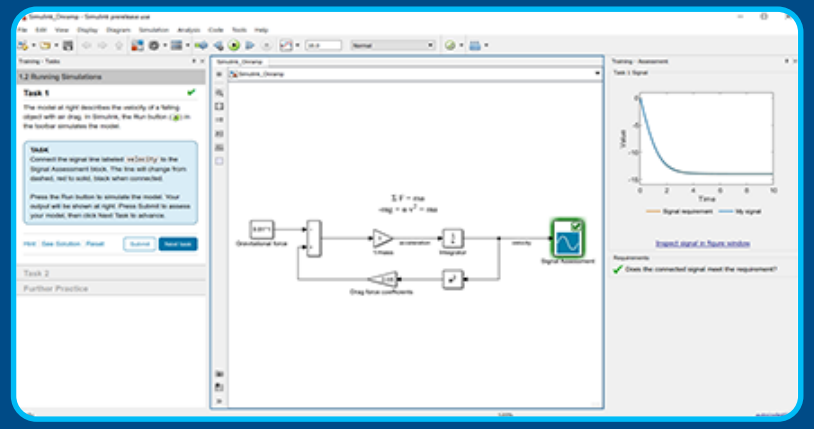
Get Started



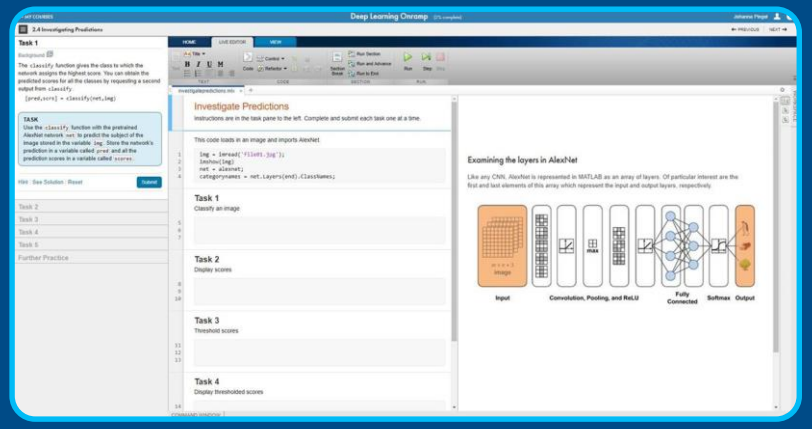
MATLAB Onramp

Quickly learn the essentials of MATLAB.



Simulink Onramp

Learn to create, edit, and troubleshoot Simulink models.



Deep Learning Onramp

Learn to use deep learning techniques in MATLAB for image recognition.

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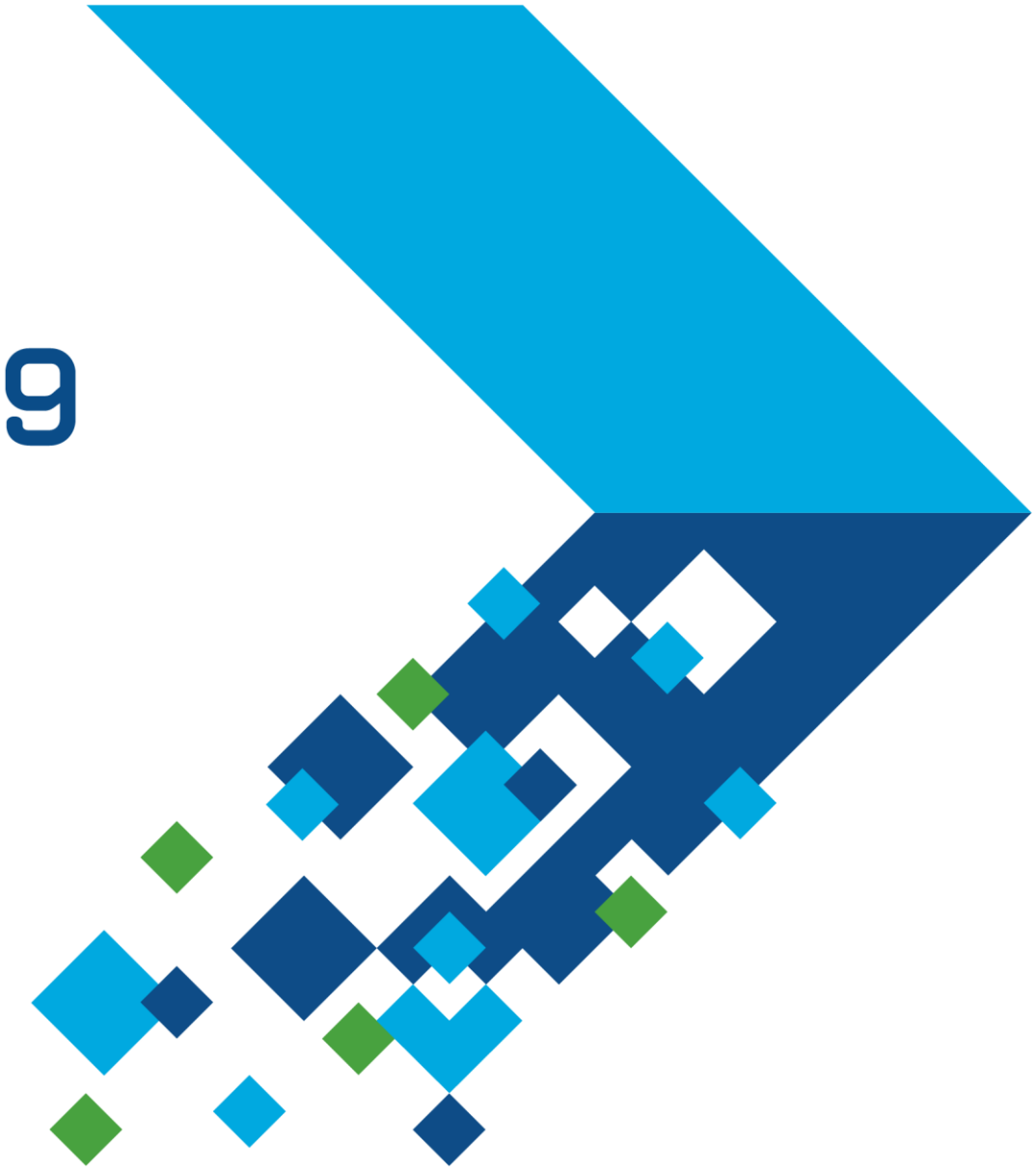
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