Reinforcing Computational Thinking Throughout Chemical Engineering Curriculum with MATLAB and Simulink

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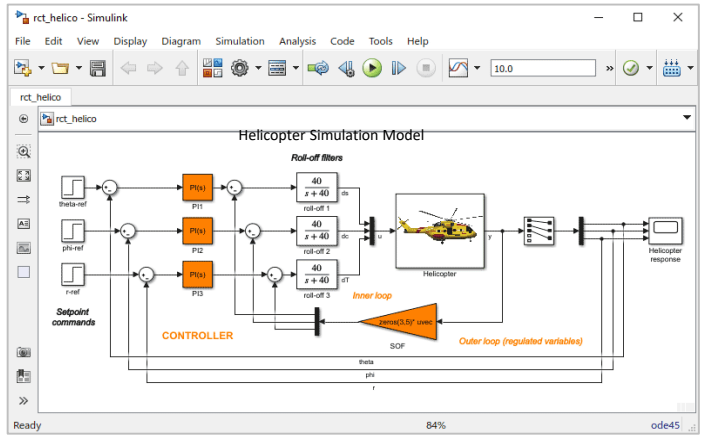
Customer Success Engineer
Samvith Rao (samvithr@mathworks.com)
Industry Marketing

Our Products

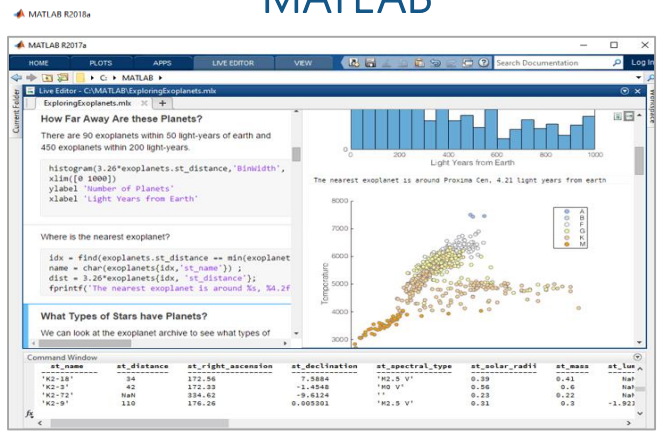
MATLAB® & SIMULINK®

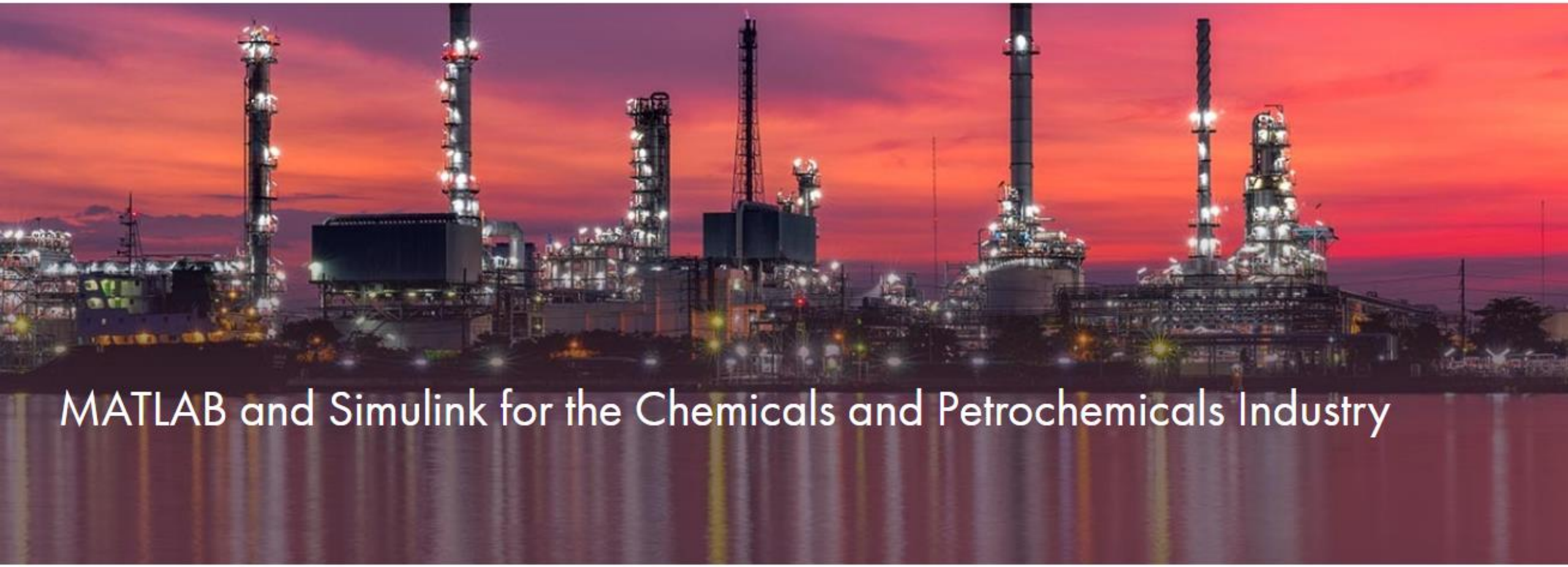
- MATLAB is a programming environment for algorithm development, data analysis, visualization, and numeric computation.
- Simulink is a graphical environment for designing, simulating, and testing systems.
- 100 add-on products for specialized tasks.

Simulink



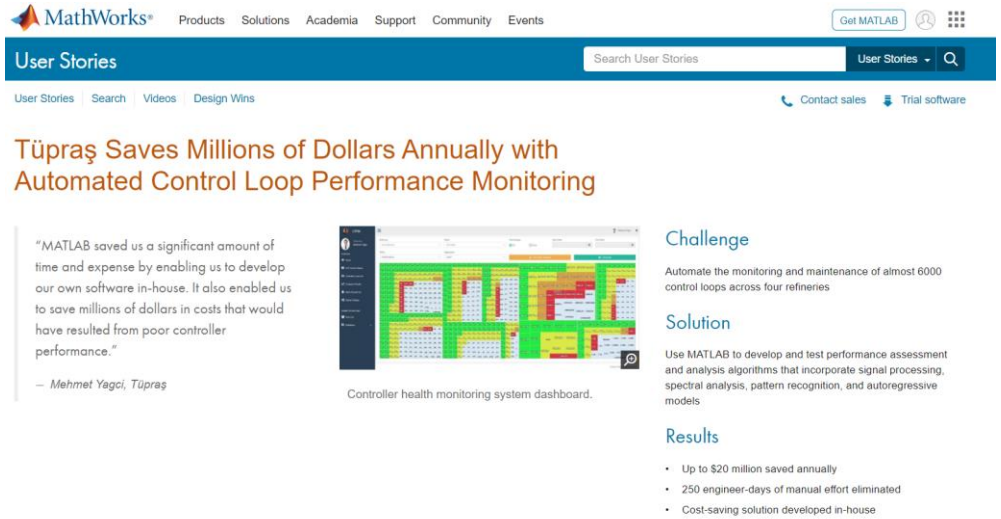
MATLAB

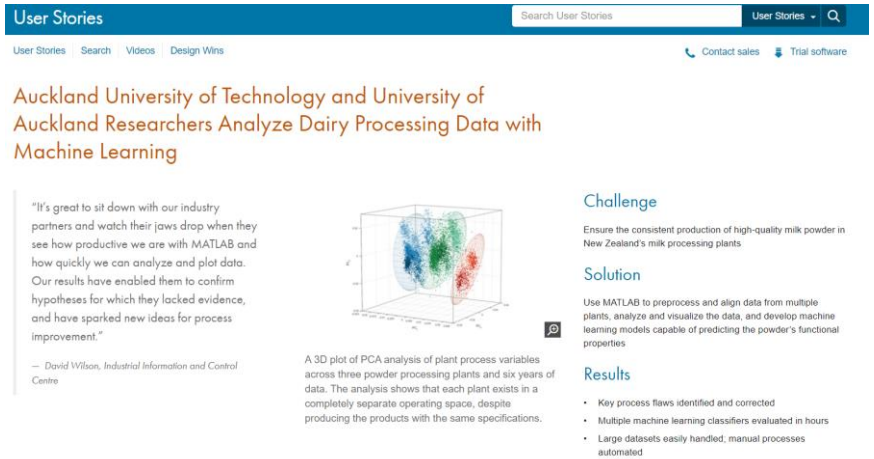


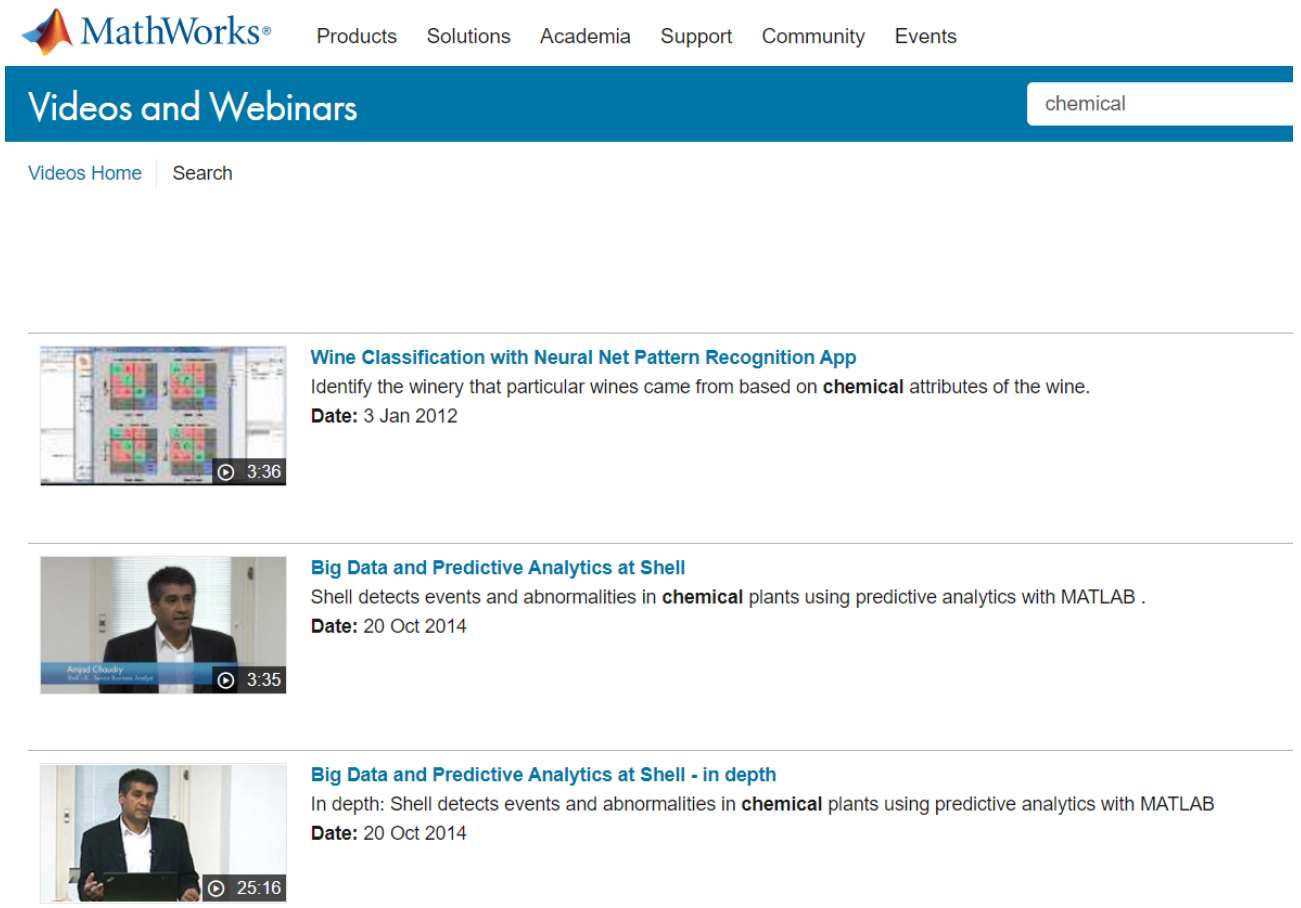


https://www.mathworks.com/solutions/chemicals-and-petrochemicals.html

MathWorks Tools in Process Industries







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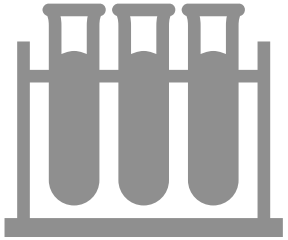
Integrating Computational Thinking to Chemical Engineering Curriculum

Introduce

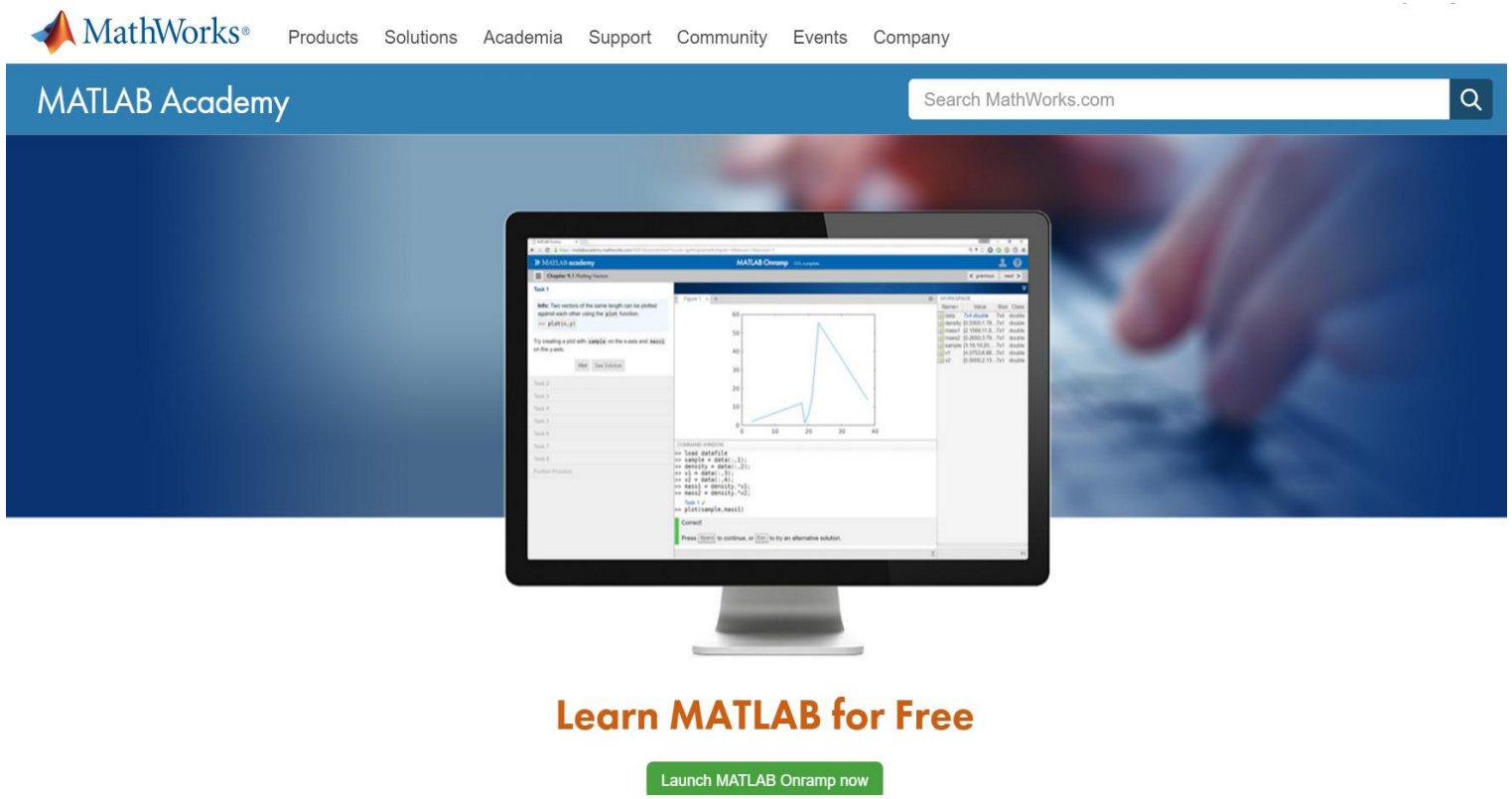
Reinforce



Apply

Getting Help

Self-paced courses



FREE COURSES (2-3 hours)

- MATLAB Onramp
- Simulink Onramp
- Stateflow Onramp
- Machine Learning Onramp
- Deep Learning Onramp
- Image Processing Onramp
- Signal Processing Onramp
- Control Design Onramp with Simulink

FOCUSED COURSES

FOUNDATIONAL COURSES (17-21 hours)

- MATLAB Fundamentals
- MATLAB Programming Techniques
- MATLAB for Financial Applications
- MATLAB for Data Processing and Vizualization
- Machine Learning with MATLAB
- Deep Learning with MATLAB

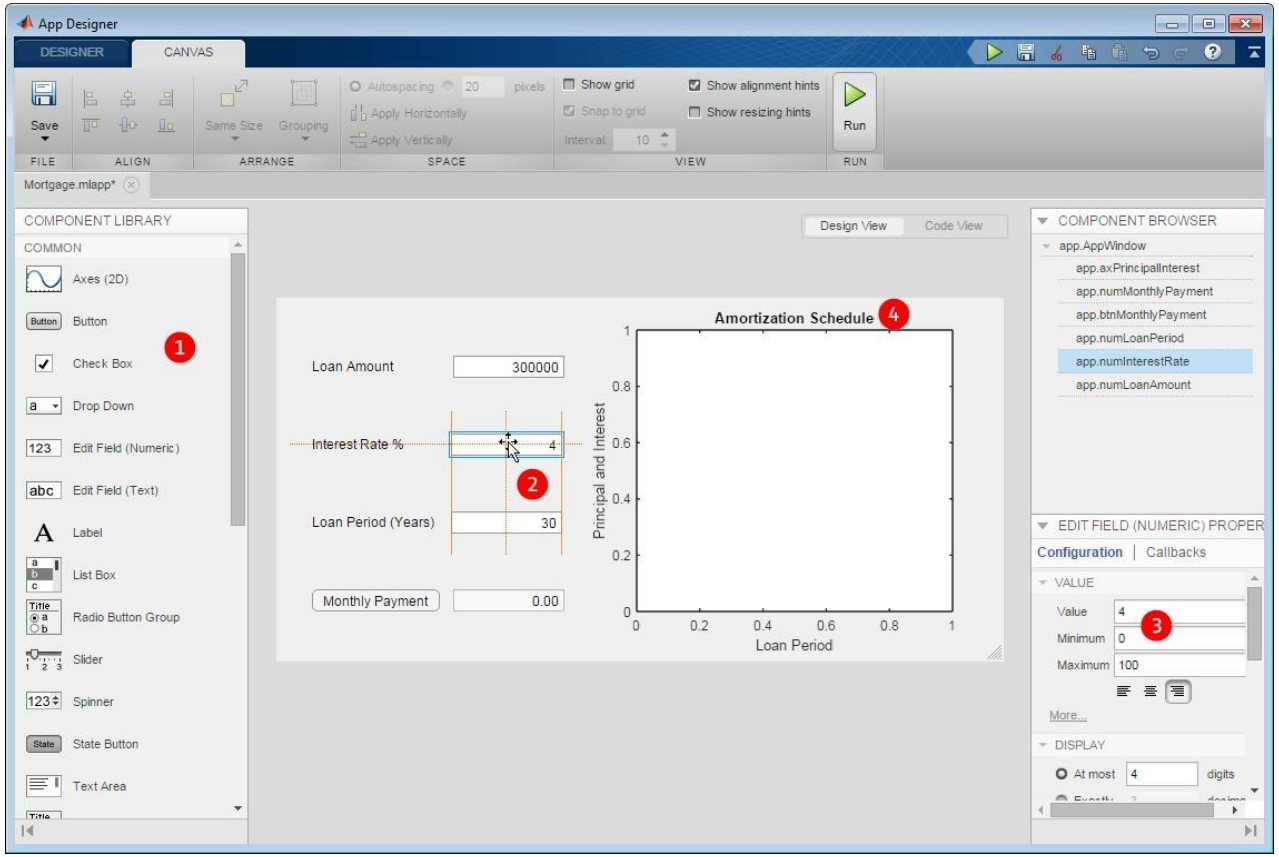
COMPUTATIONAL MATH COURSES (2-3 hours)

- Introduction to Linear Algebra
- Solving Ordinary Differential Equations
- Introduction to Statistical Methods
- Solving Non-Linear Equations
- Introduction to Symbolic Math

https://www.mathworks.com/academia/targeted/online-learning.html
https://matlabacademy.mathworks.com/

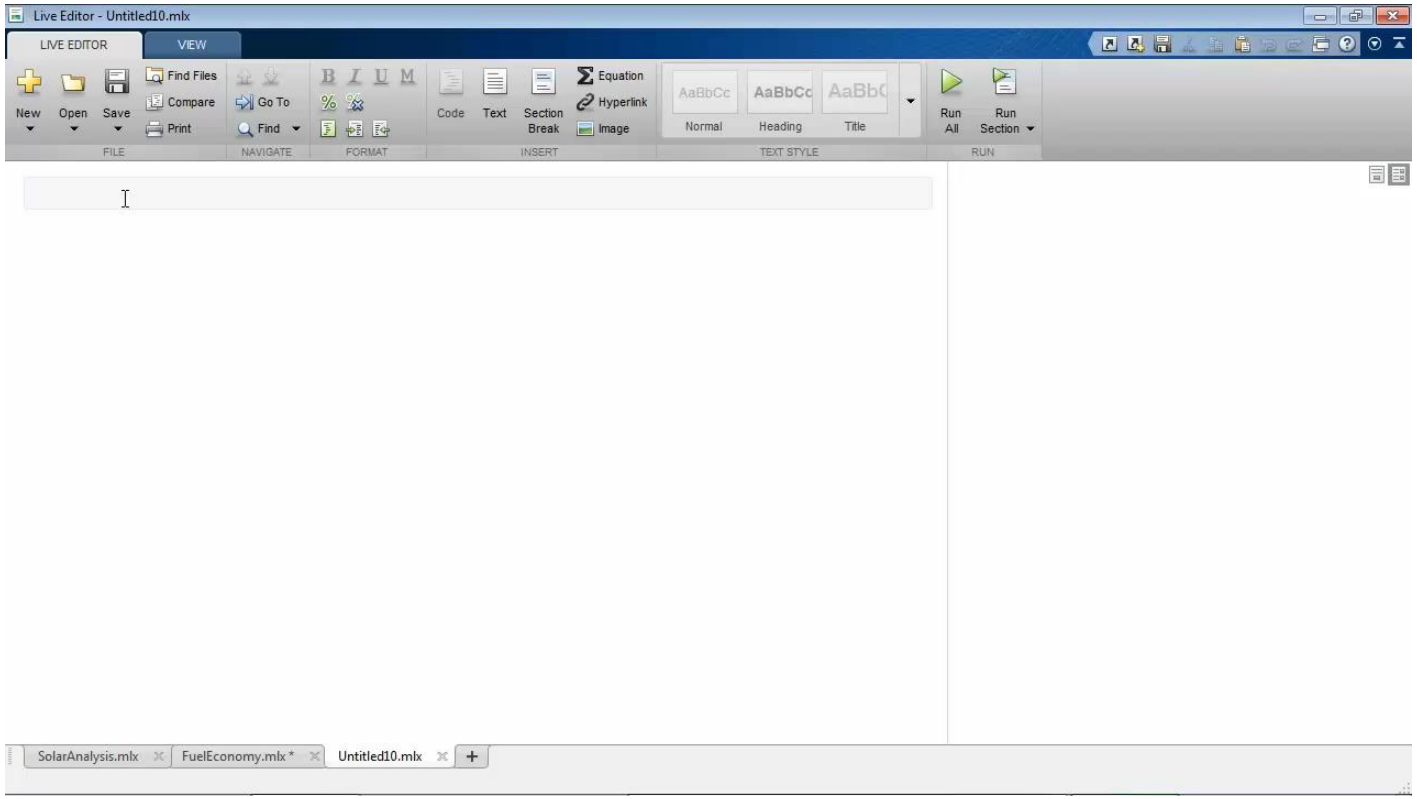
MATLAB Apps

App Designer



www.mathworks.com/products/matlab/app-designer.html

Interactive programming with Live Editor



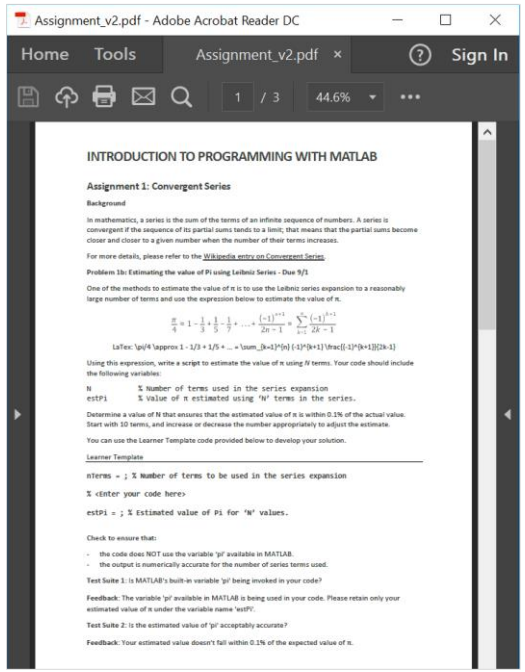
Features

- Teach with interactive documents
- Accelerate exploratory programming
- Create an interactive narrative
- Publish consistent reports

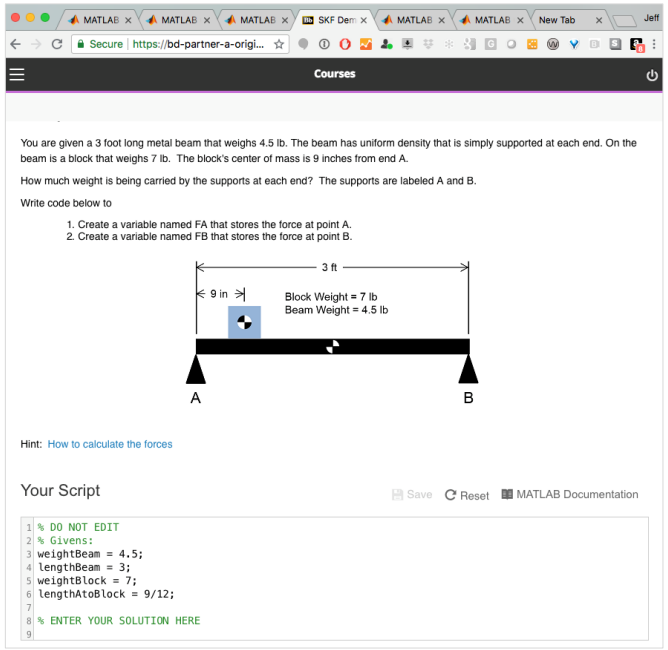
www.mathworks.com/products/matlab/live-editor.html
https://www.mathworks.com/products/matlab/live-script-gallery.html

MATLAB Grader

Automatically grade MATLAB code in any learning environment.



DIGITAL/PHYSICAL HANDOUTS



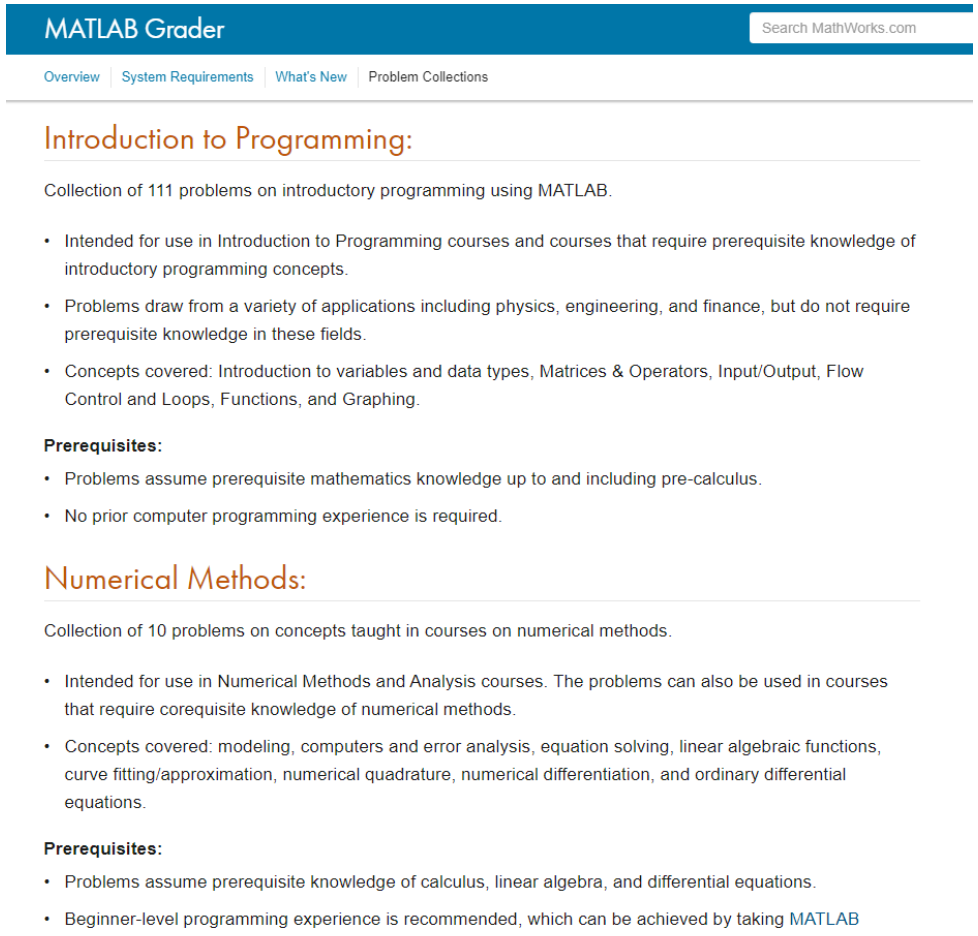
ONLINE AUTOGRADING ENVIRONMENT

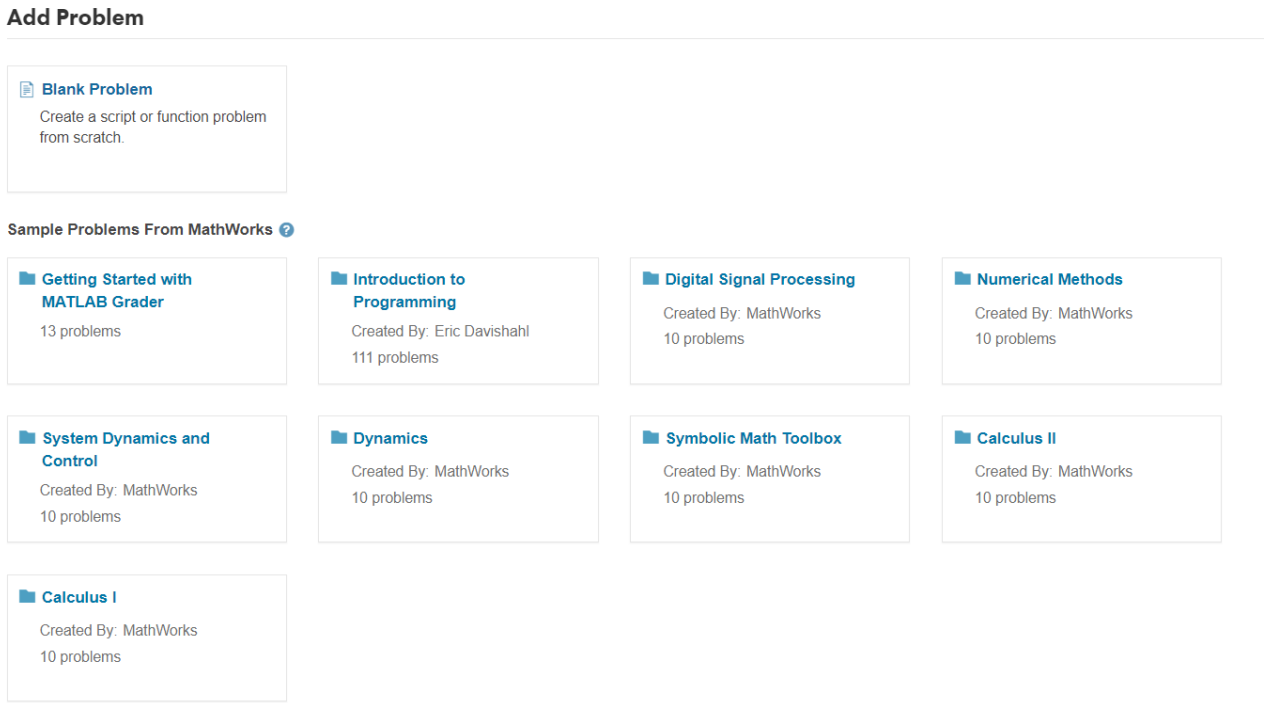
"The approach enables students to learn more quickly from their mistakes on their own."

– Dr. Bob Canfield, Virginia Tech

https://www.mathworks.com/products/matlab-grader.html
http://grader.mathworks.com

MATLAB Grader Problem Collections





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Integrating Computational Thinking to Chemical Engineering Curriculum

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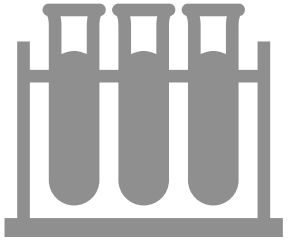

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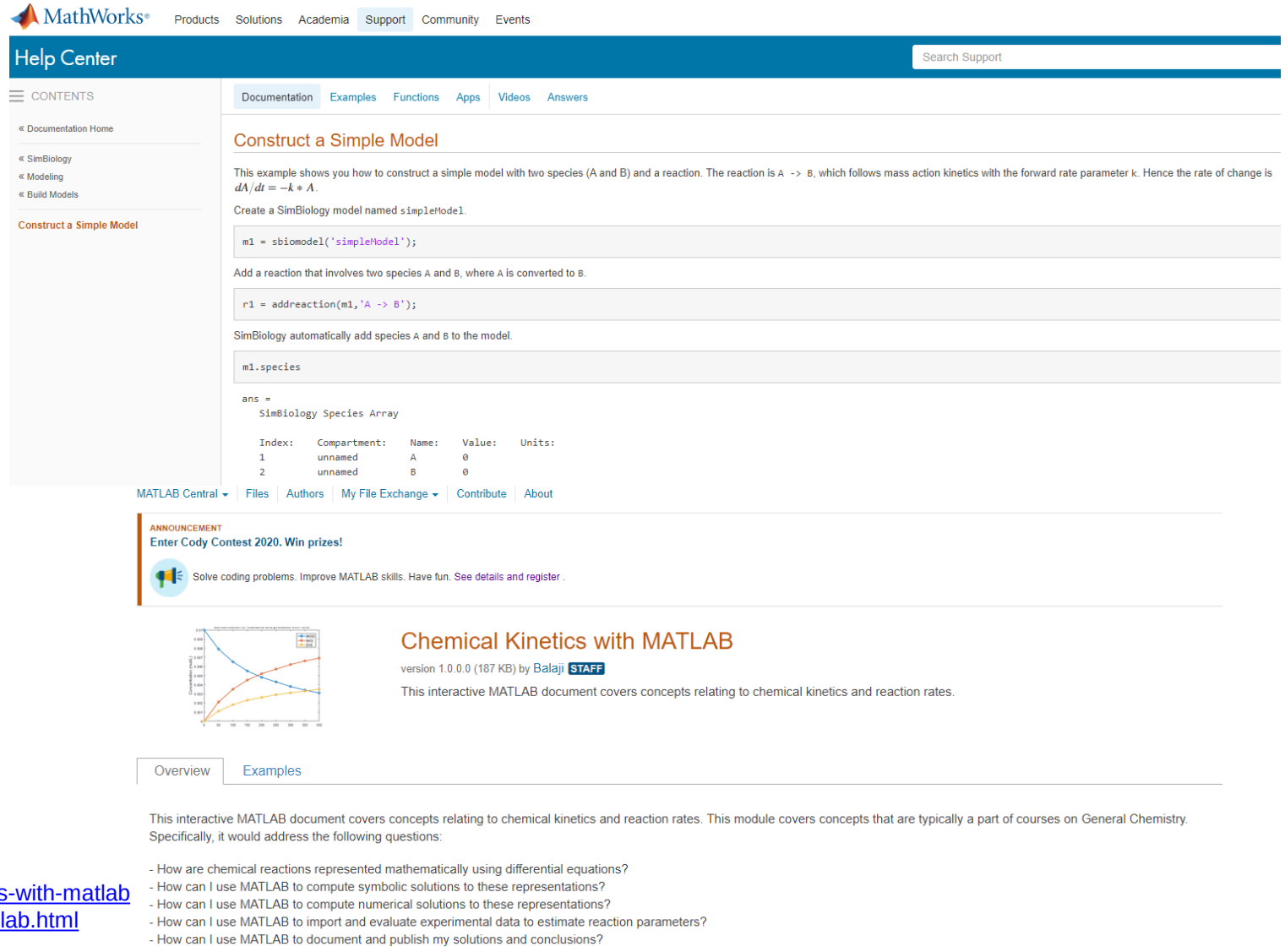
Getting Help

Reaction Kinetics



https://www.mathworks.com/matlabcentral/fileexchange/63104-chemical-kinetics-with-matlab
https://www.mathworks.com/academia/courseware/teaching-chemistry-with-matlab.html
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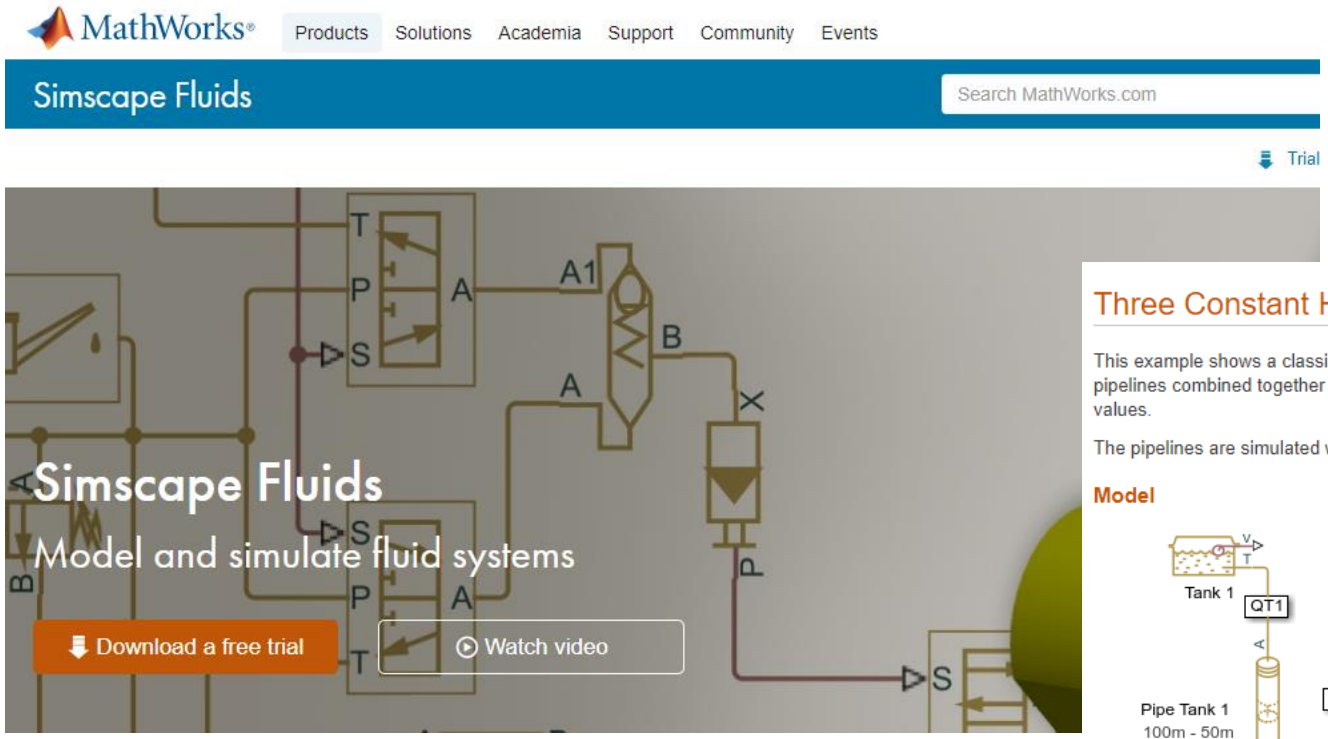
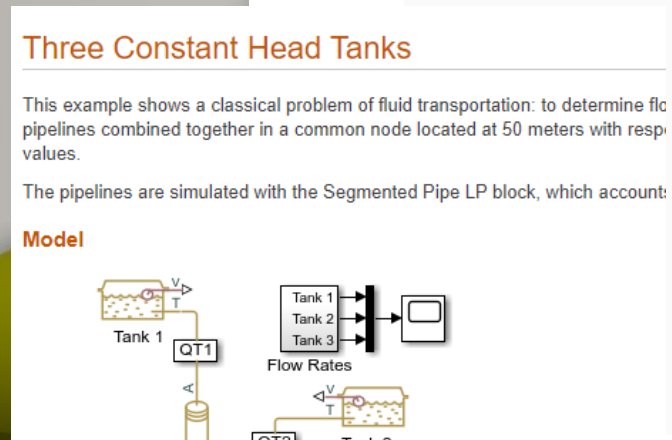
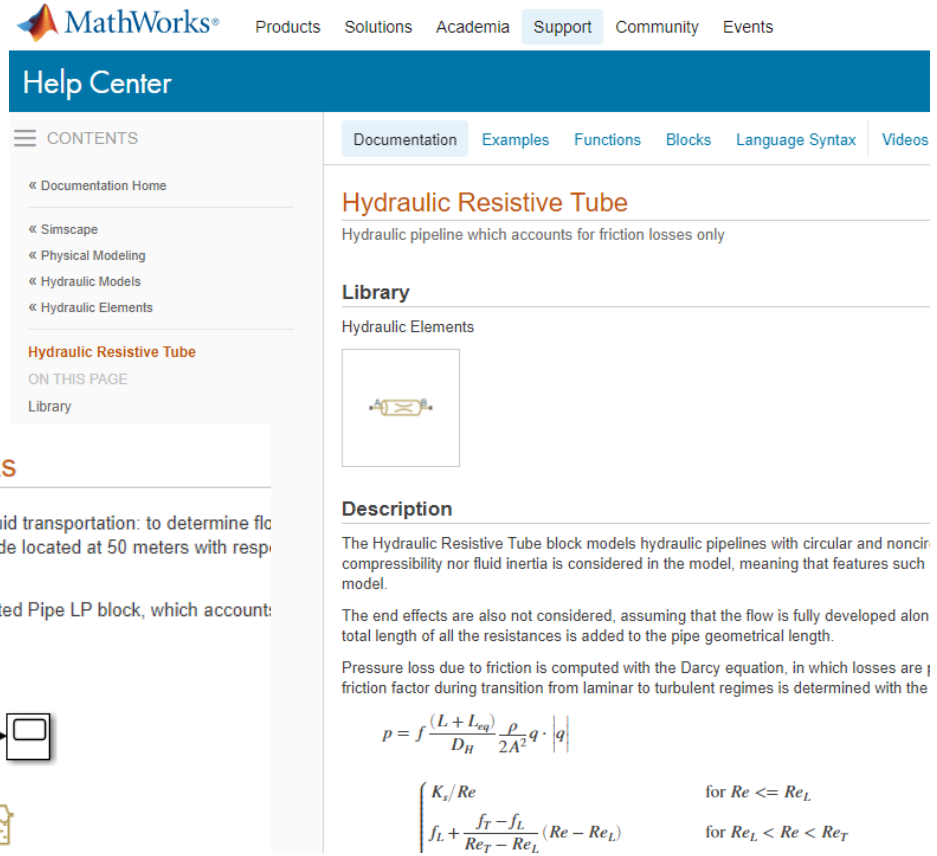
Fluid Dynamics







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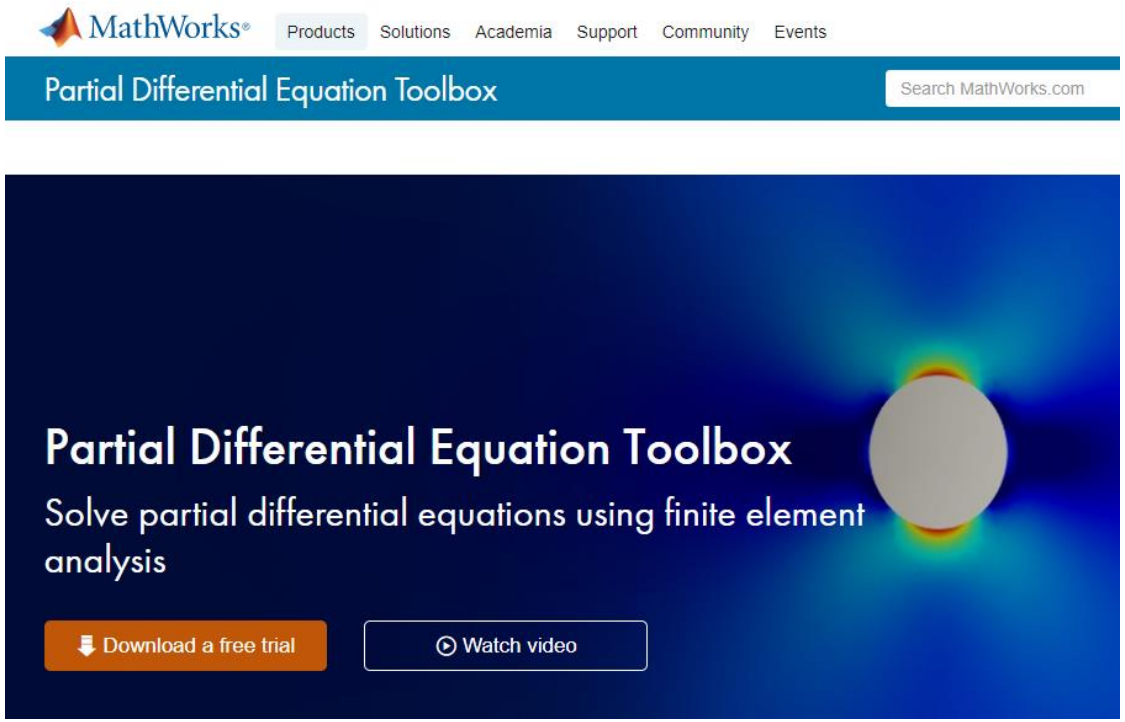
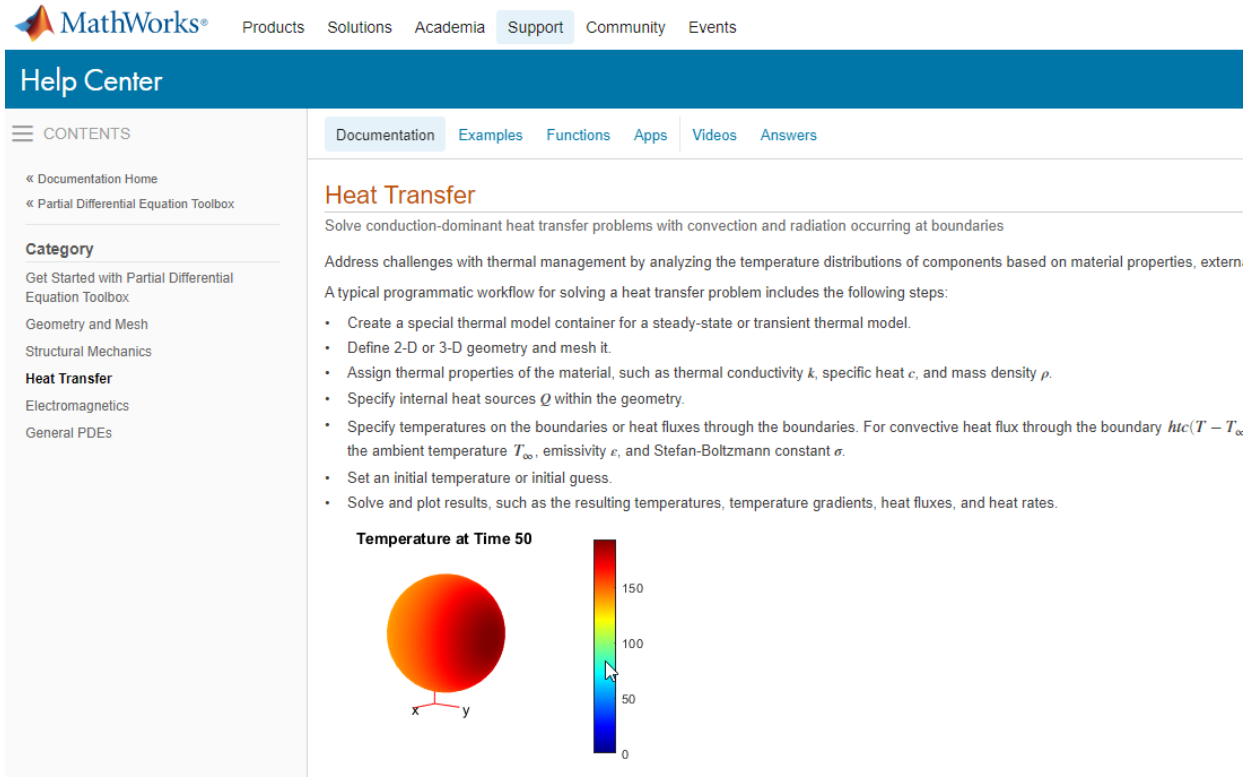
Heat Transfer





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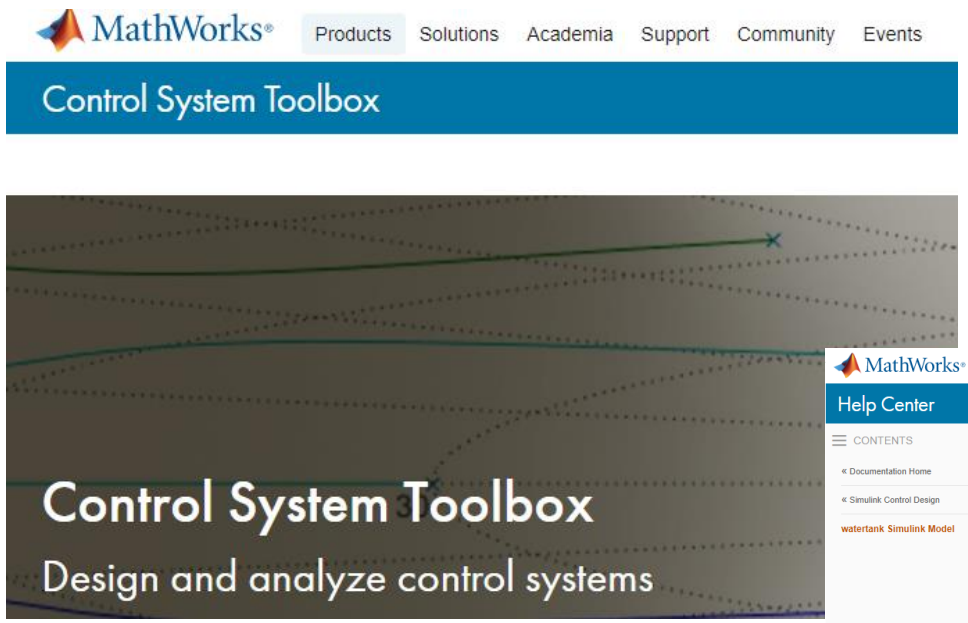
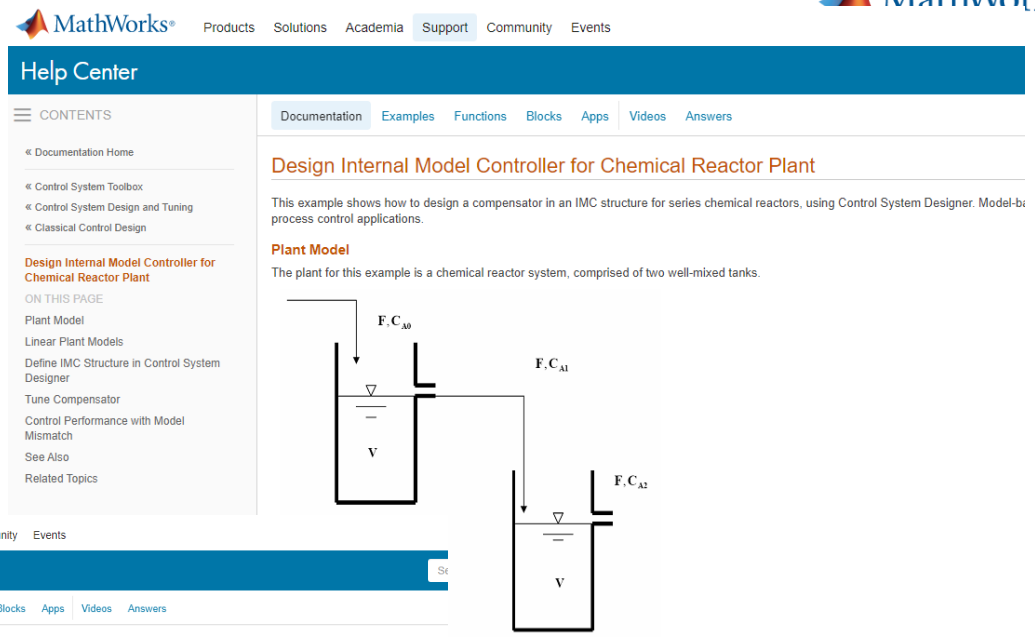
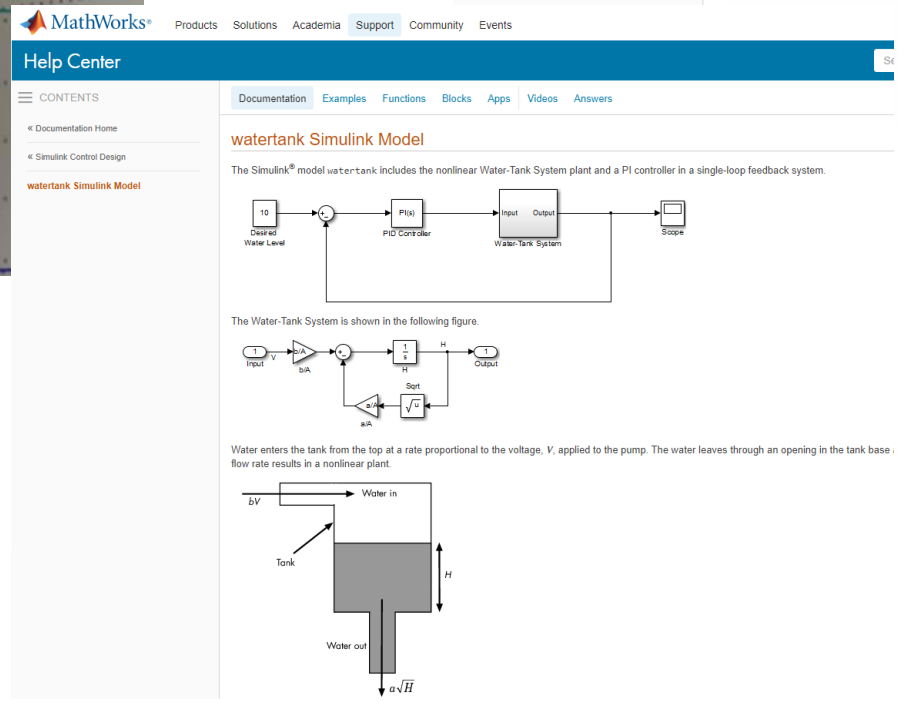
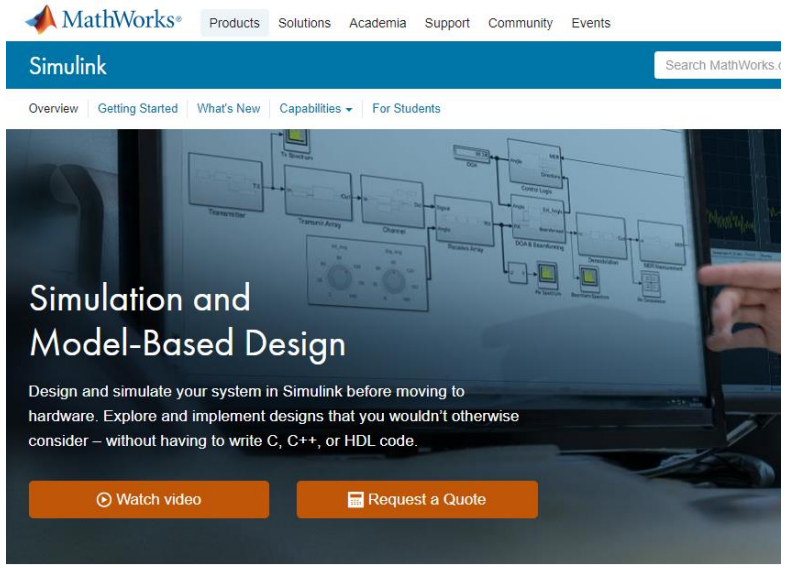
https://www.mathworks.com/products/pde.html

Process Control









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Process Design

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Distillation Tower

Build High-Fidelity Plant Model in Aspen Plus Dynamics

Linearize Plant Using Aspen Plus Control Design Interface

Create Scaled and Reduced LTI State-Space Model

Test Accuracy of the Linear Plant Model

Design Model Predictive Controller

Cosimulate MPC Controller and Nonlinear Plant

See Also

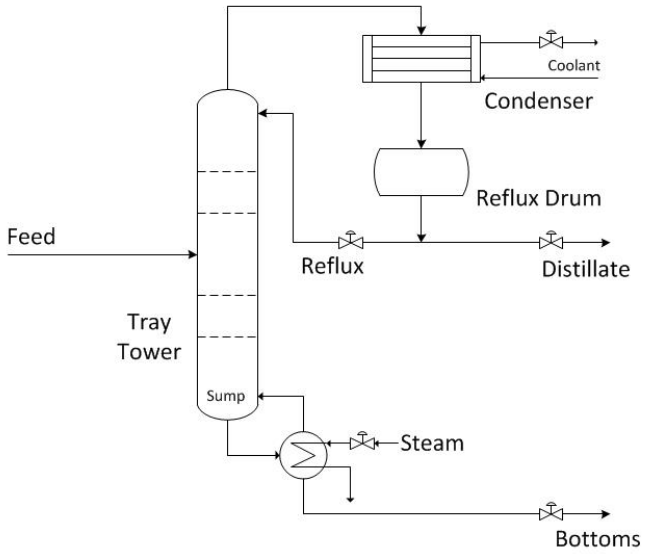
Documentation Examples Functions Blocks Apps Videos Answers

Design and Cosimulate Control of High-Fidelity Distillation Tower with Aspen Plus Dynamics

This example shows how to design a model predictive controller in MATLAB for a high-fidelity distillation tower model built in Aspen Plus Dynamics®. The controller performance is then verified through cosimulatio and Aspen Plus Dynamics.

Distillation Tower

The distillation tower uses 29 ideal stages to separate a mixture of benzene, toluene, and xylenes (represented by p-xylene). The distillation process is continuous. The equipment includes a reboiler and a total co below:



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Chemicals and Petrochemicals

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Overview Getting Started Connecting to Process Simulators Trial software Contact us

Researchers and engineers have connected MATLAB® with process simulators for a variety of purposes—optimization, machine learning, controls, and several others. You can find a list of papers on the topic here. Explore three ways MATLAB can connect to process simulators like Aspen Plus.

Option 1: Native Integration

- **Aspen Dynamics**: The Control Design Interface tool, included in Aspen Dynamics, enables you to extract a linear state space model from Aspen Dynamics. You can load this into MATLAB and use it with Control System Toolbox™ when designing a process control system.
- **UniSim**: Honeywell's UniSim Design Suite lets you design processes and perform process simulations. UniSim Design links to MATLAB, making it easier to leverage the strengths of both applications.

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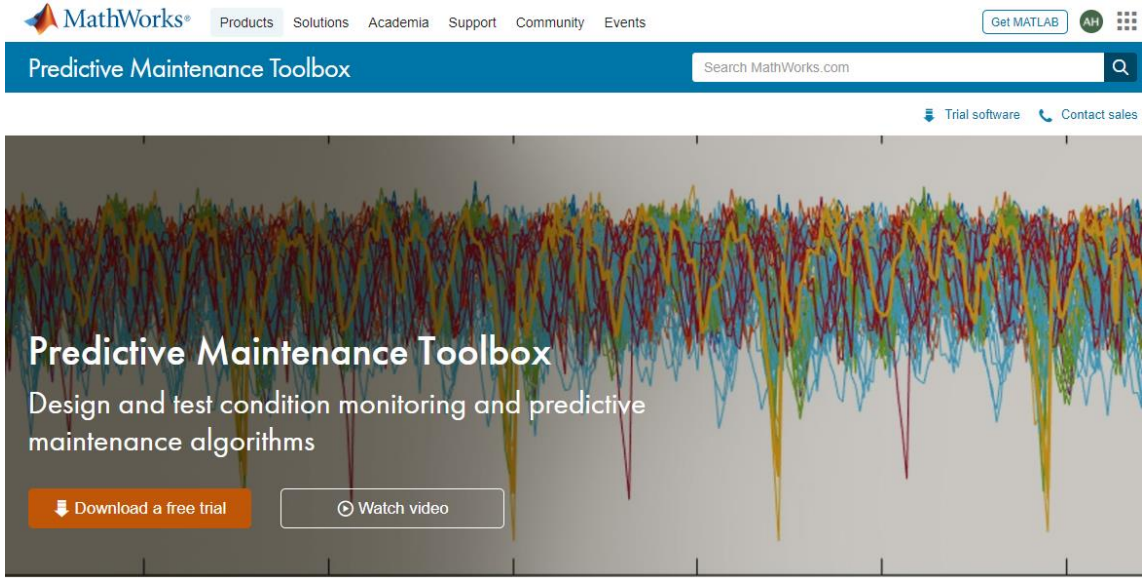
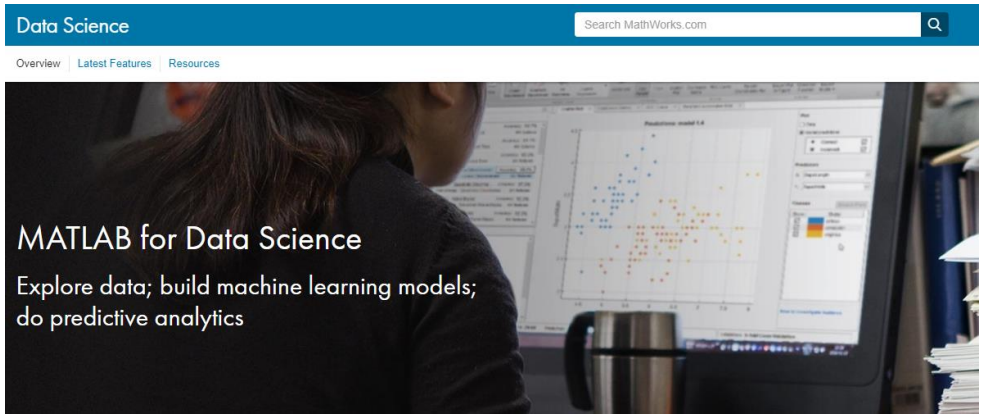
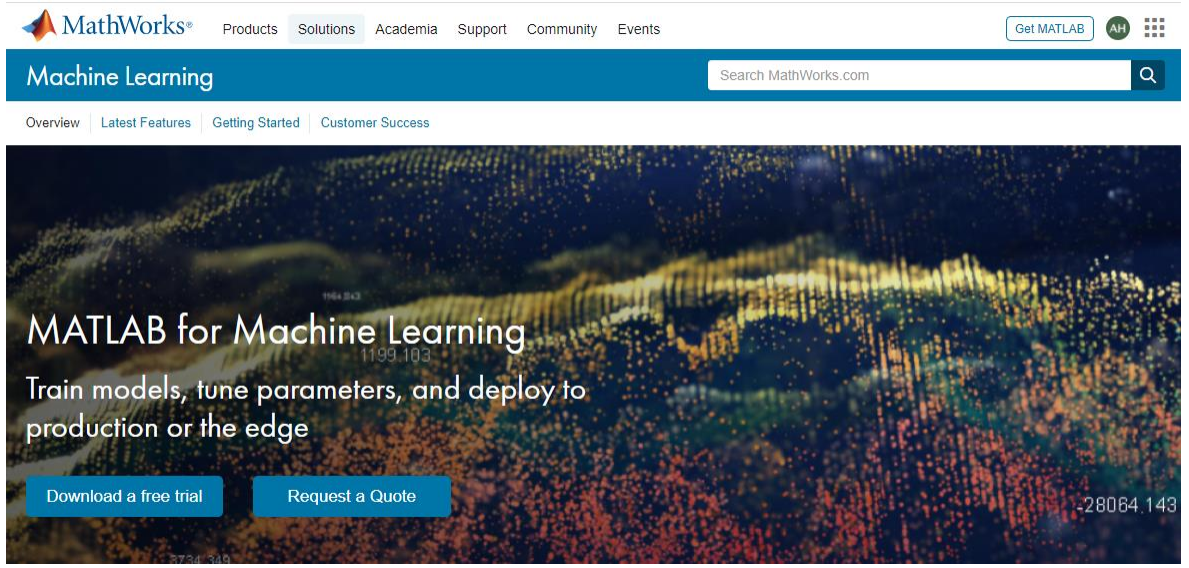
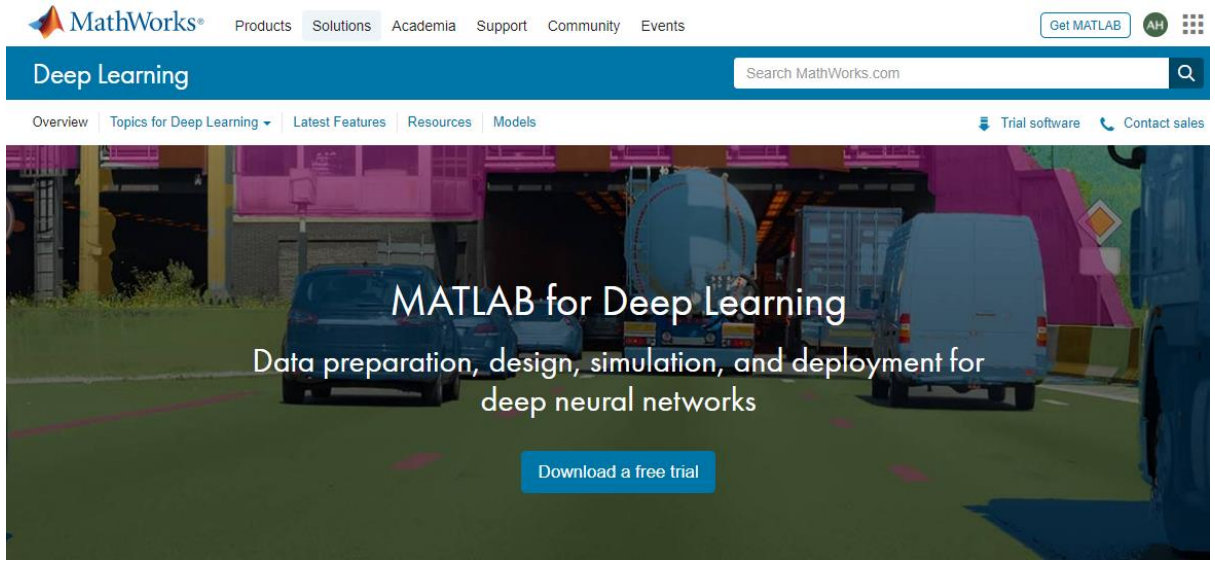
https://www.mathworks.com/help/mpc/ug/design-and-cosimulate-control-of-high-fidelity-distillation-tower-with-aspen-plus-dynamics.html

Predictive Maintenance & Data Science









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Integrating Computational Thinking to Chemical Engineering Curriculum

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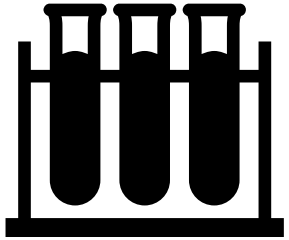
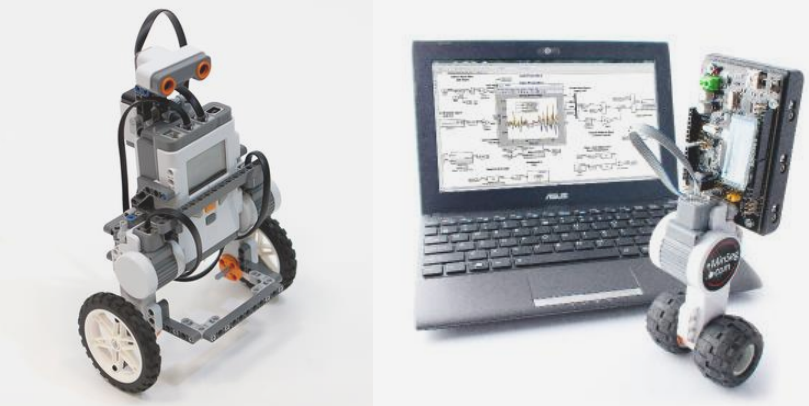


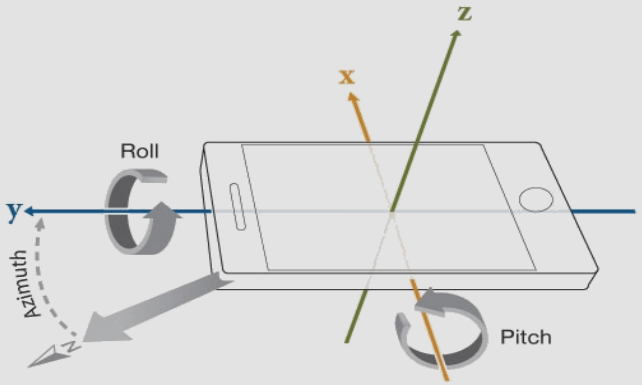
Apply

Getting Help

Project-based learning with low-cost hardware



Self-balancing robots using
LEGO and Arduino



Sensor support for Android
and iOS devices

http://hardware.mathworks.com
https://www.mathworks.com/products/matlab-mobile.html

ThingSpeak

IoT analytics platform

Collect

Send sensor data privately to the cloud.

Analyze

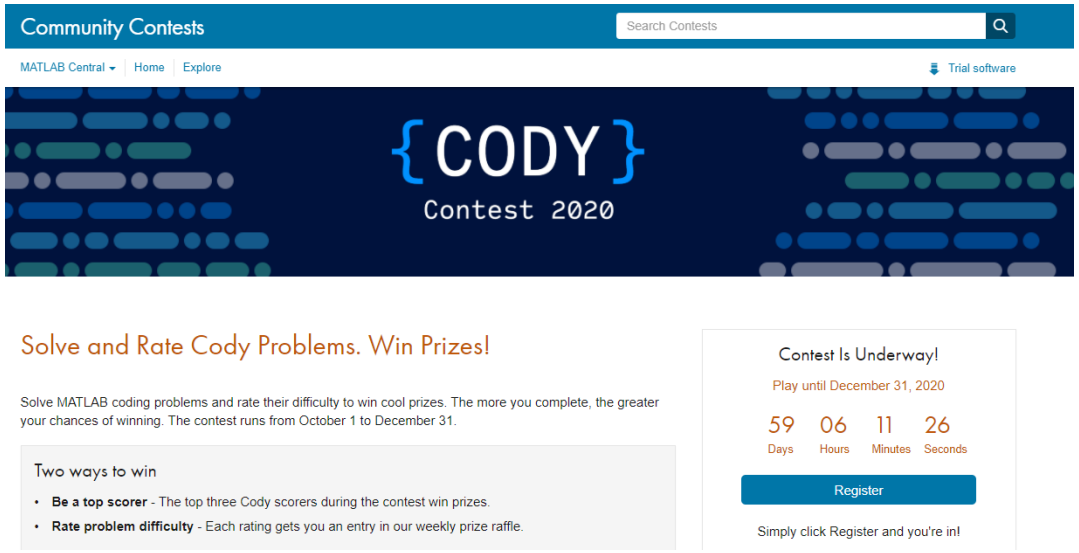
Analyze and visualize your data with MATLAB.

Act

Trigger a reaction.

https://thingspeak.com/

Student Competitions and Community Contests



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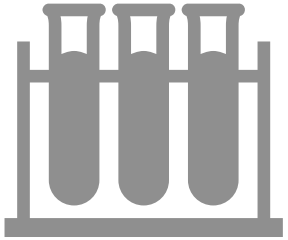

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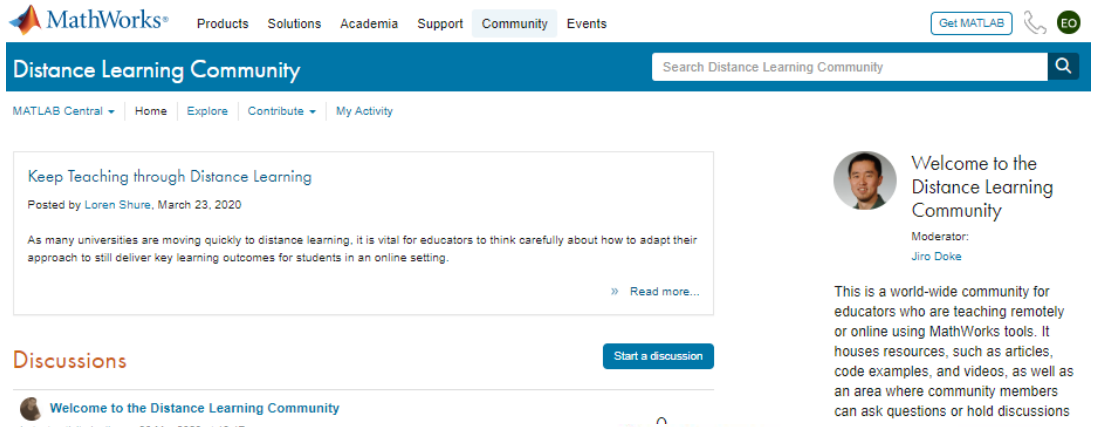
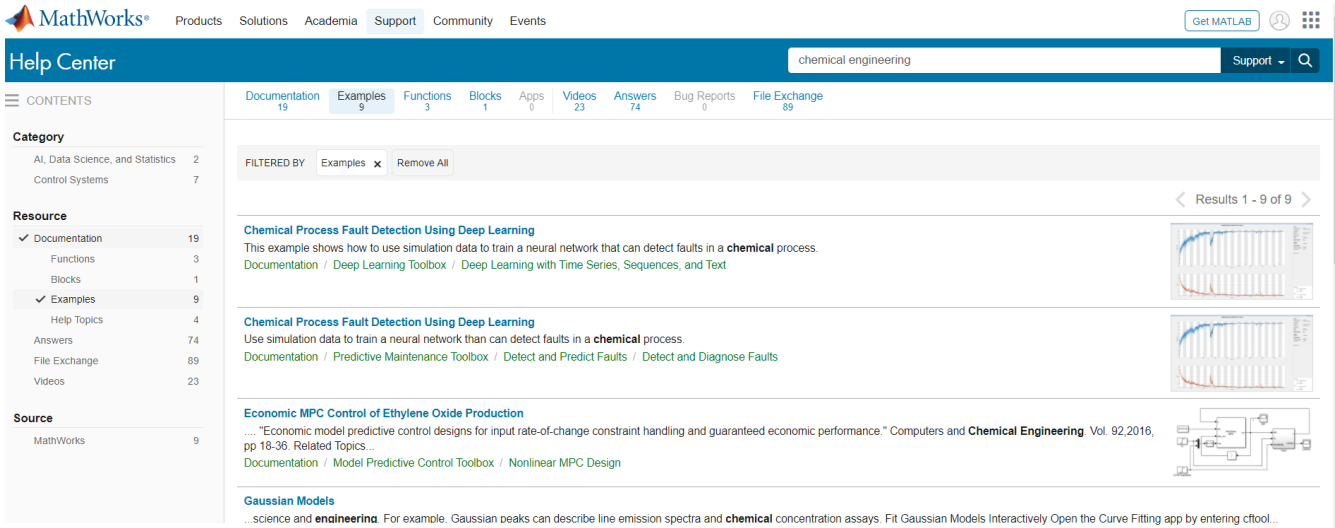
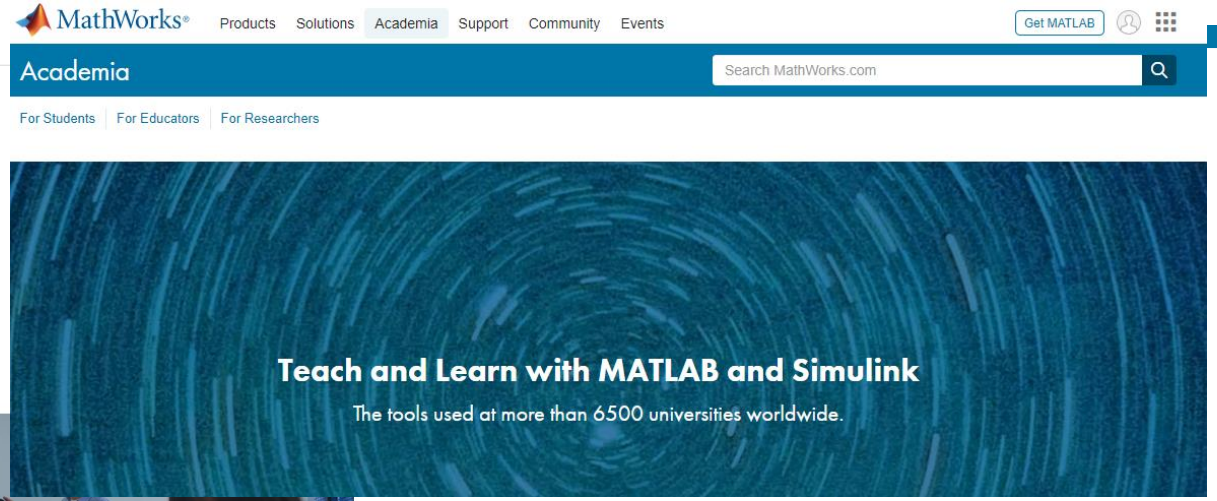
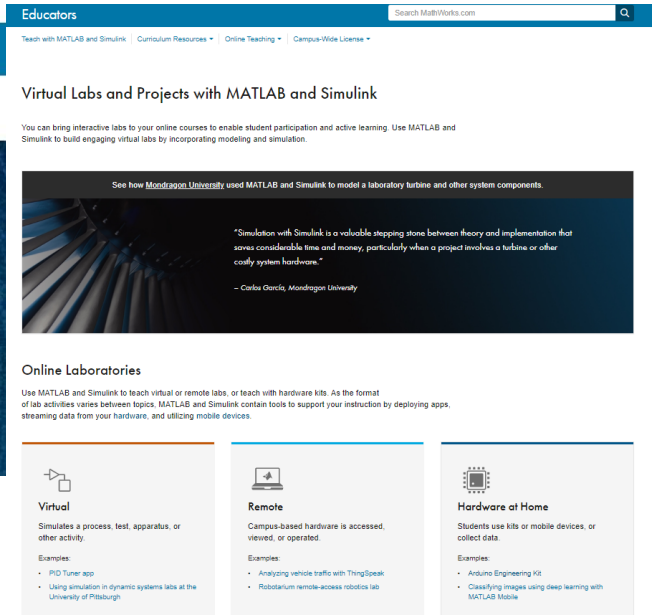
Getting Help

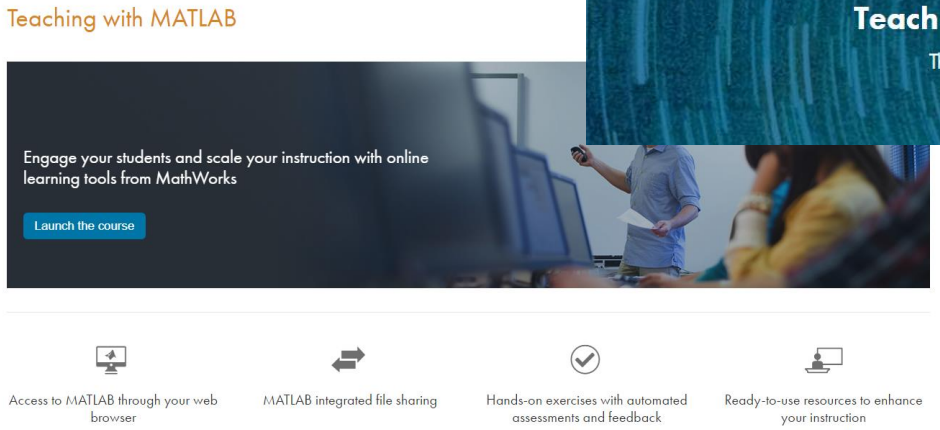
Resources for Educators











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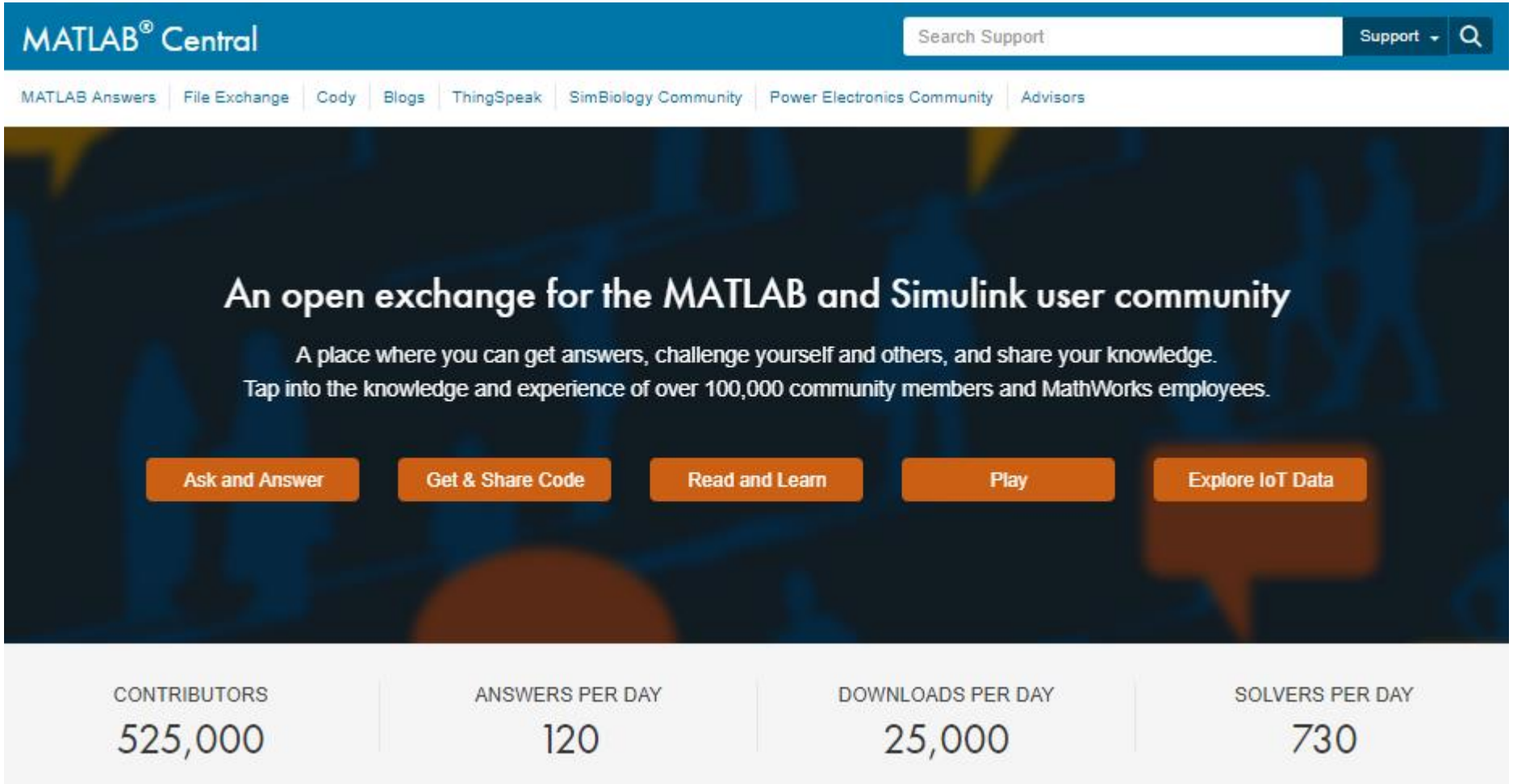
MATLAB Central



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MathWorks Customer Success Engineers

consult with faculty and researchers to support them with their STEM initiatives,
including integrating computational or systems thinking into their curriculum.