



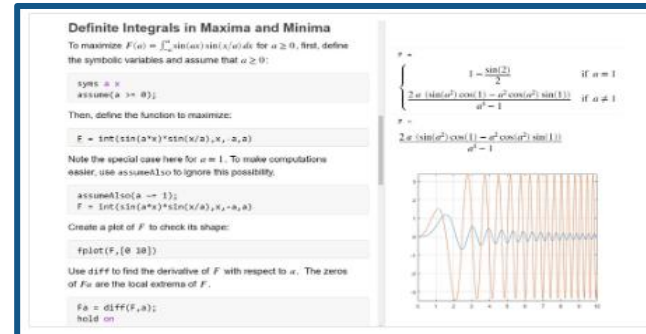
Online Learning and Virtual Labs with MATLAB and Simulink



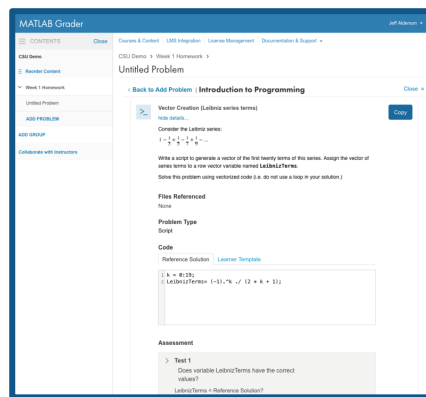
Online course example



MATLAB Online



Live Scripts



MATLAB Grader

Learn techniques to interpret and solve differential equations



XSeries Program in
18.03x Differential Equations

I'm interested

Learner Testimonials

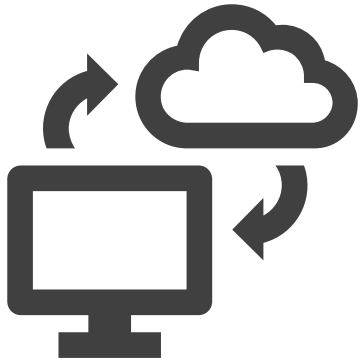
"Wonderful course on differential equations. The teachers provide a **nice computational tool to depict the dynamics of solving the equations, which is very useful for students to grasp the key ideas and concepts.**" - Jiting (completed this course, spending 10 hours a week on it and found the course difficulty to be medium)

"Interesting course. **Lectures, homeworks and review exercises of any part are really well setup.** One of the best MOOC on topic of differential equations." - Gaetano (completed this course, spending 4 hours a week on it and found the course difficulty to be medium)

"Another excellent course from MIT. The lecture videos are excellent and so are the exercises. This course also has **MATLAB based exercises which is wonderful.** The problem sets are excellent and so are the staff and the community teaching assistants who are always there to help any time." - Dna47a (completed this course, spending 8 hours a week on it and found the course difficulty to be medium)

Source: <https://www.edx.org/xseries/mitx-18.03x-differential-equations>

Virtual course design



Access



Instruction



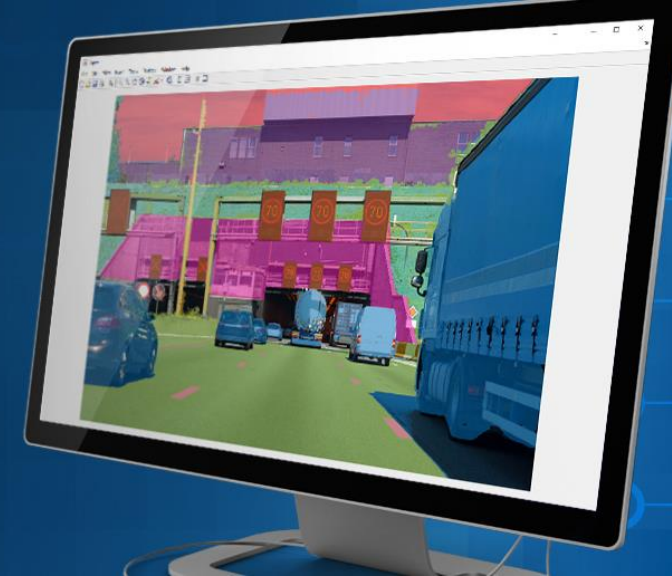
Assessment



Getting Help

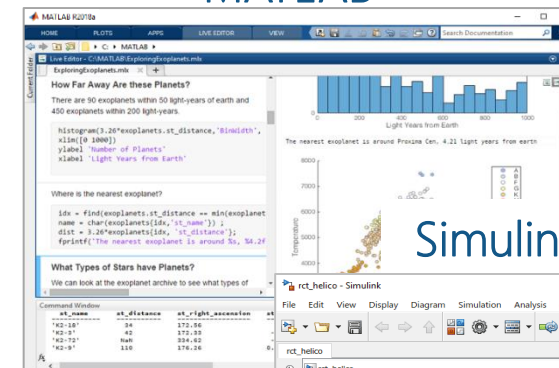
Our Products

MATLAB® & SIMULINK®

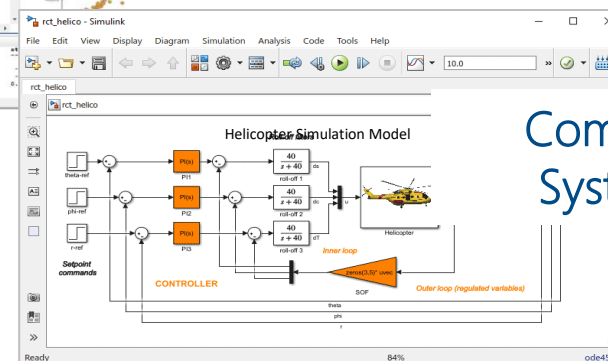


- MATLAB is a programming environment for algorithm development, data analysis, visualization, and numeric computation.
- Simulink is a graphical environment for designing, simulating, and testing systems.
- 100 add-on products for specialized tasks.

MATLAB



Simulink



Computer Vision System Toolbox

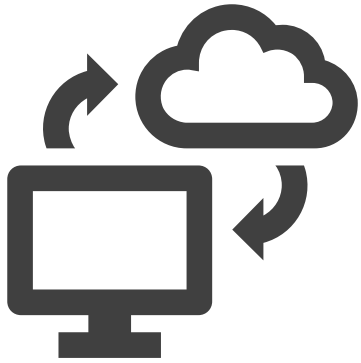


ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP



Access



Instruction



Assessment



Getting Help

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GETTING HELP

Campus-wide access

The screenshot shows the MathWorks website for campus-wide access. At the top is the MathWorks logo. Below it is a navigation bar with links: "Get Software", "Learn MATLAB", "Teach with MATLAB", and "What's New". The main heading reads "MATLAB Access for Everyone at Your School Here". To the right is the "MATLAB & SIMULINK" logo. Below the heading is a blue banner with a photo of students and the text: "Where will MATLAB and Simulink take you? 82% of Fortune 100 companies use MATLAB, which means that you'll take your ideas beyond the classroom to help drive new technology and advance your career." Below this is a section titled "Get MATLAB and Simulink" with a link "See list of available products". A dark box contains the text "Desktop. Online. Mobile. Free through your school's license." and a "Sign in to get started" button. On the right is a large image of a computer monitor displaying MATLAB code and a plot. At the bottom, there is a link "Need installation help? Contact MathWorks Support" with a wrench icon.

MathWorks®

Get Software | Learn MATLAB | Teach with MATLAB | What's New

MATLAB Access for Everyone at
Your School Here

MATLAB® & SIMULINK®

Where will MATLAB and Simulink take you?
82% of Fortune 100 companies use MATLAB,
which means that you'll take your ideas beyond the classroom to help drive new
technology and advance your career.

Get MATLAB and Simulink
[See list of available products](#)

Desktop. Online. Mobile.
Free through your school's license.

[Sign in to get started](#)

[Need installation help? Contact MathWorks Support](#)

ACCESS

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GETTING HELP

MATLAB Online



Simulink Online



MATLAB Drive



No download or installation required

Access to the latest version

No minimum device specs other than that for your web browser

ACCESS

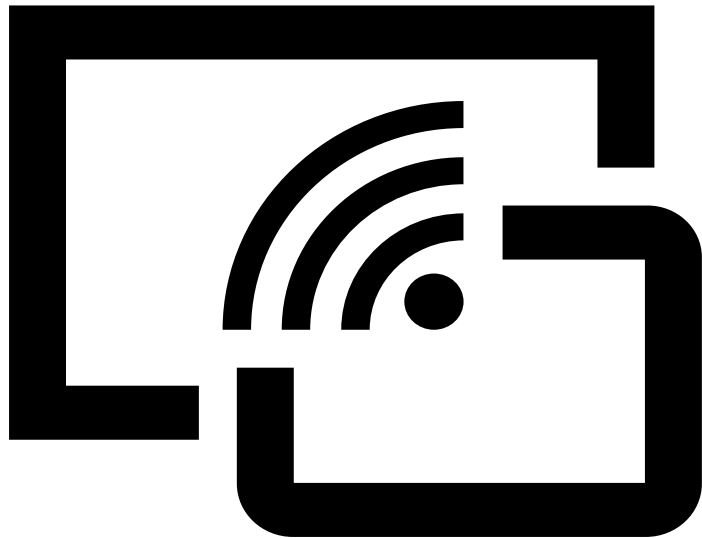
INSTRUCTION

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GETTING HELP

Access for universities without campus licenses

If available, access secure connection



For immediate needs, download 30 day trial


MathWorks®


Free MATLAB Trial


Get Started Now with Your Free 30-Day Trial

Join the millions of engineers and scientists who use MATLAB, Simulink, and other add-on products to solve complex design challenges.

Download Trial Software

 Log in or create account

 Choose your trial package

 Download and install

Are you a student?
Your school may provide MATLAB without the 30-day limitation of a trial.

[Check for campus license](#)

*Work or university email

*By clicking 'I agree', I confirm that I will use the products only to evaluate them for possible purchase as an end user.

☒ I agree.

[Submit](#)

We will not sell or rent your personal contact information. [See our privacy policy for details.](#)

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GETTING HELP



Access



Instruction



Assessment



Getting Help

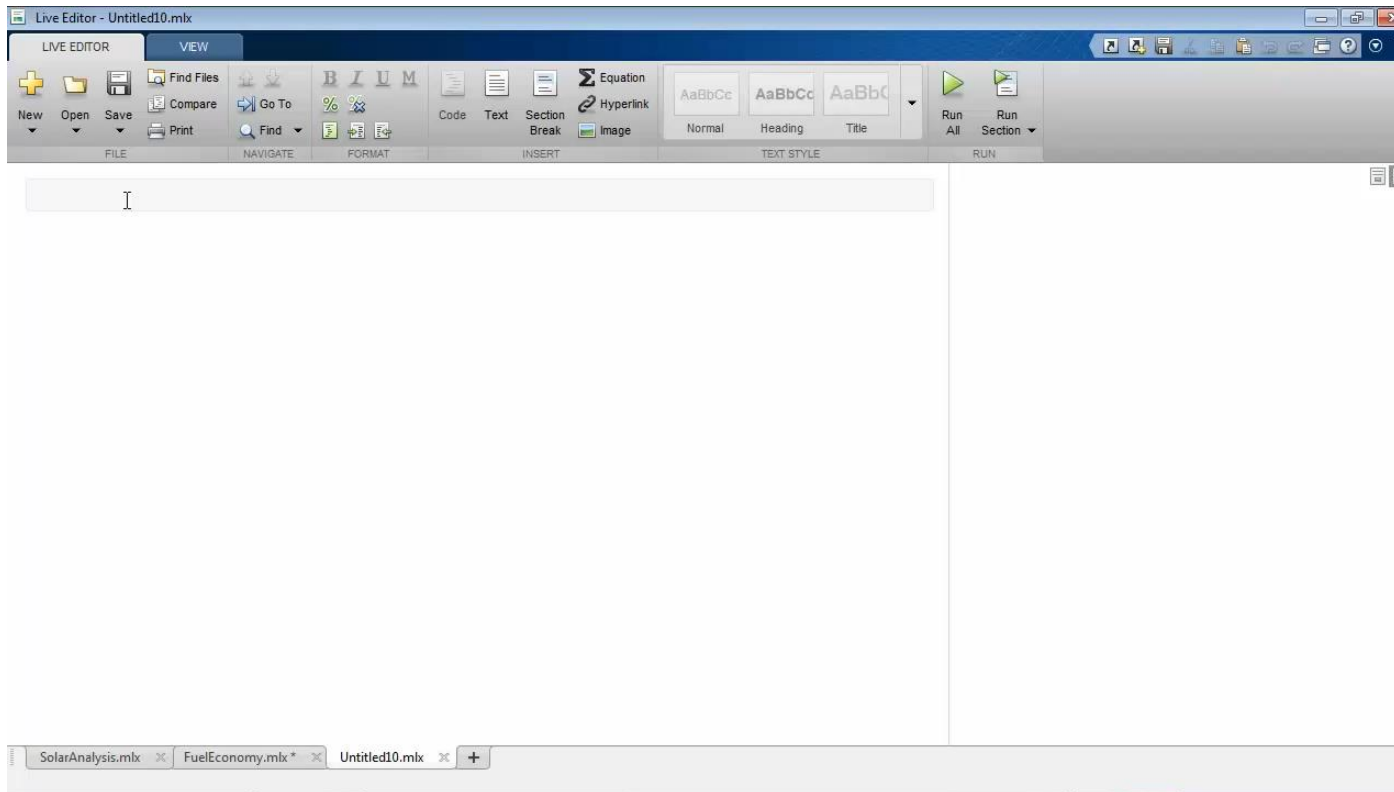
ACCESS

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GETTING HELP

Interactive programming with Live Editor



Features

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

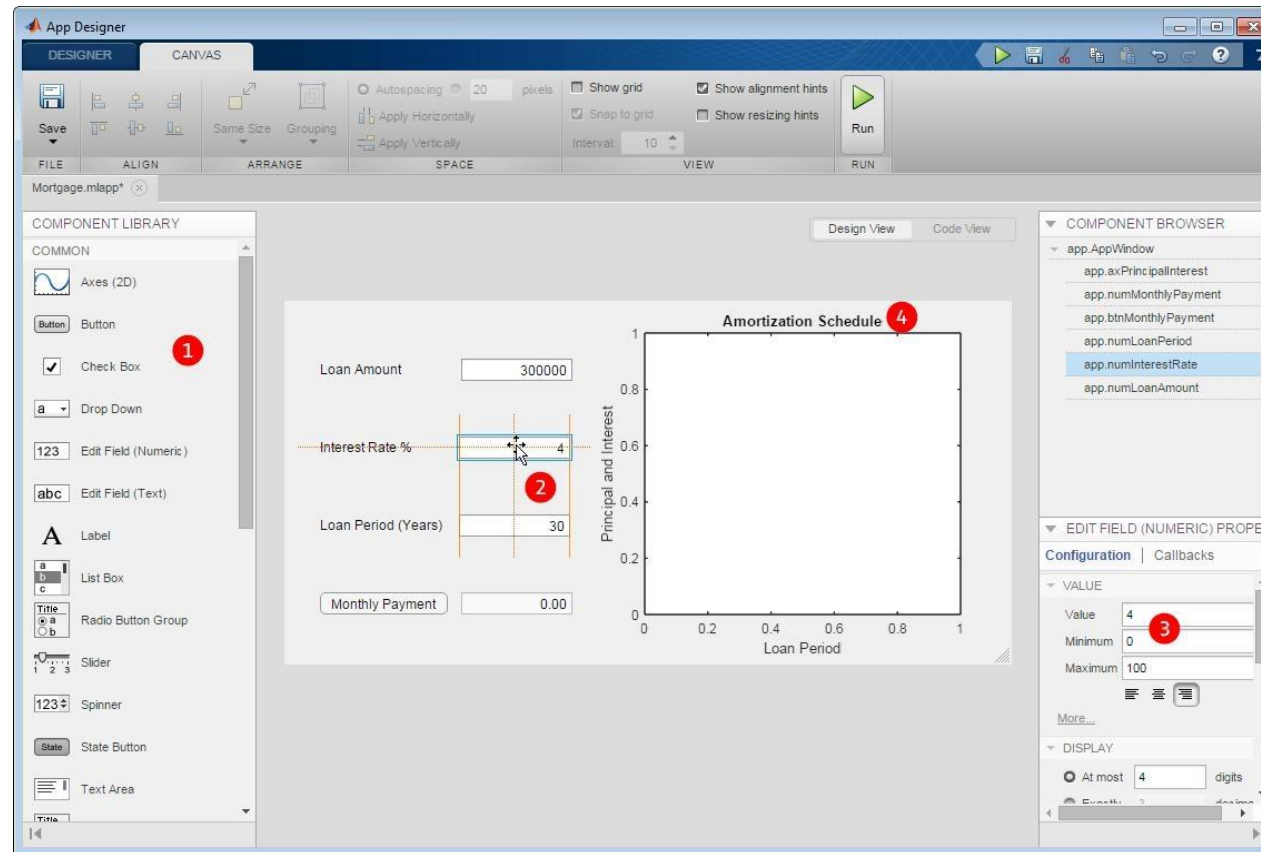
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MATLAB App Designer



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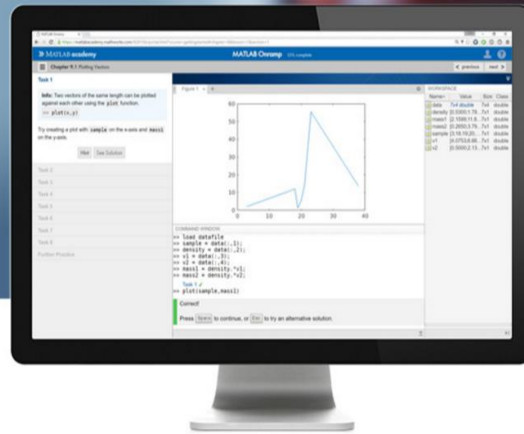
GETTING HELP

Self-paced courses


[Products](#) [Solutions](#) [Academia](#) [Support](#) [Community](#) [Events](#) [Company](#)

MATLAB Academy

Search MathWorks.com



Learn MATLAB for Free

Launch MATLAB Onramp now

"The interactive MATLAB tutorials were perfect for engaging students and getting them up to speed quickly."

—Dr. Yu-li Wang, Carnegie Mellon University

FREE COURSES (2-3 hours)

MATLAB Onramp	Simulink Onramp
Stateflow Onramp	Image Processing Onramp
Machine Learning Onramp	Deep Learning Onramp
Signal Processing Onramp	Optimization Onramp
Circuit Simulation Onramp	Simscape Onramp
Reinforcement Learning Onramp	Wireless Communications 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 Viz](#)
[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 with MATLAB](#)

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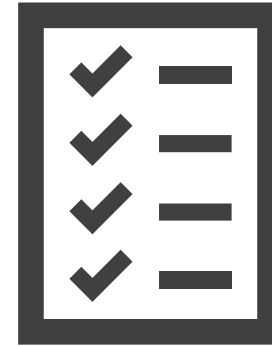
GETTING HELP



Access



Instruction



Assessment



Getting Help

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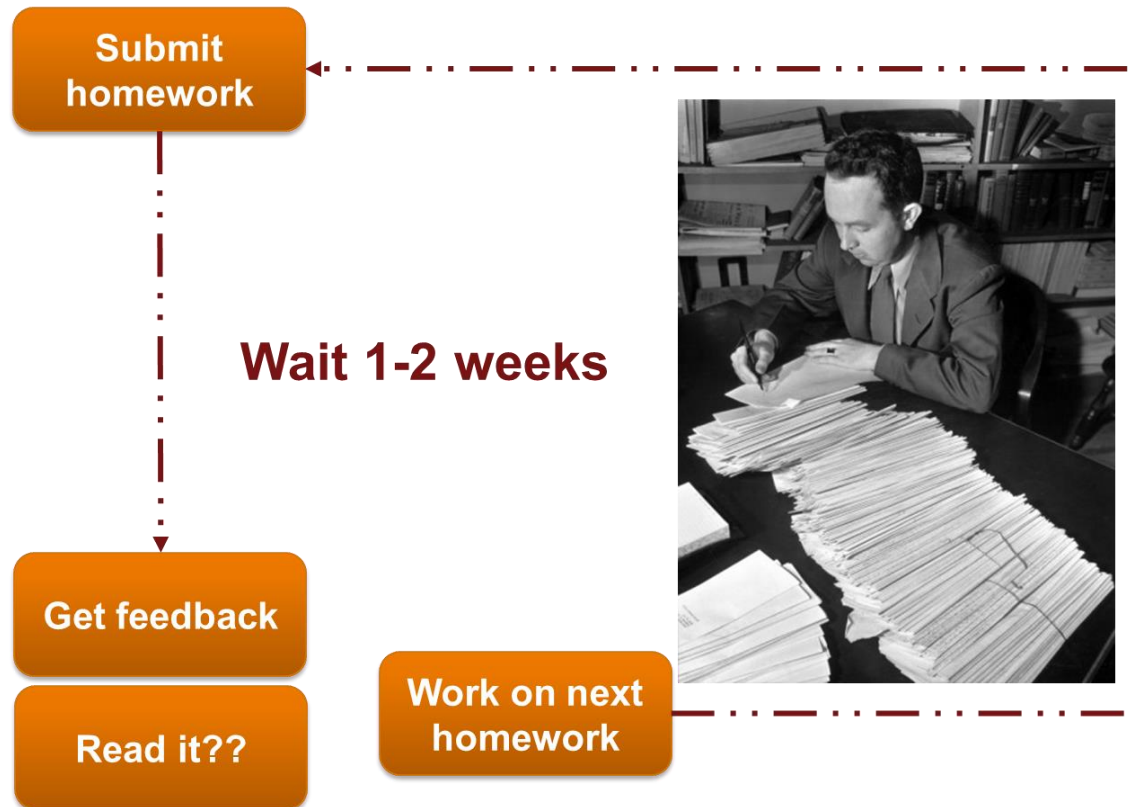
INSTRUCTION

ASSESSMENT

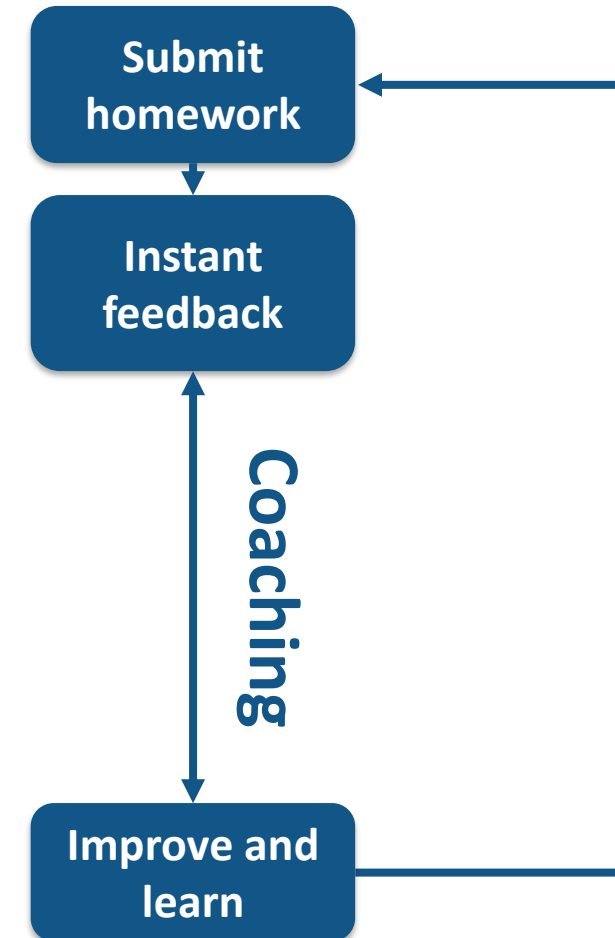
GETTING HELP

Autograde MATLAB Assignments

Traditional Grading



Autograding

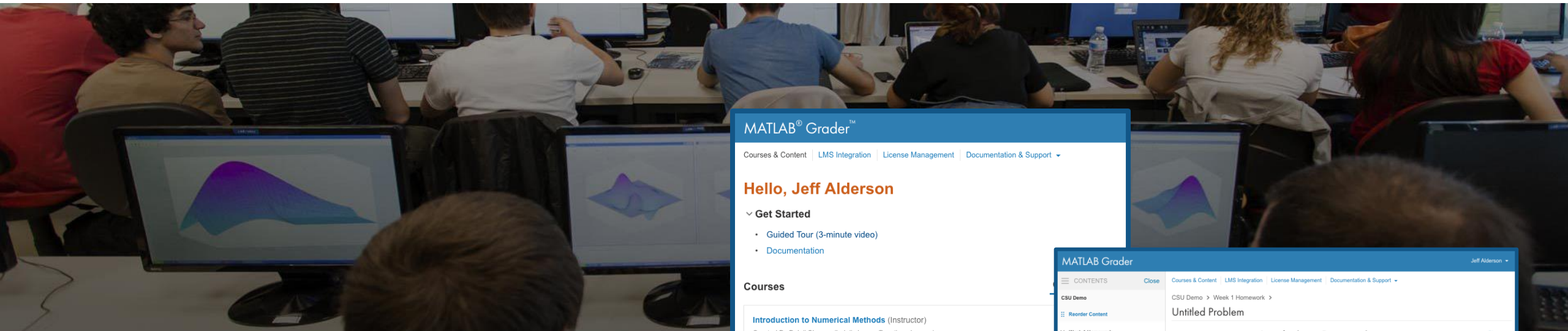


ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP



Create interactive course assignments



Automatically grade student work and provide feedback



Run your assignments in any learning environment

MATLAB[®] Grader[™]

[Courses & Content](#) | [LMS Integration](#) | [License Management](#) | [Documentation & Support](#)

Hello, Jeff Alderson

Get Started

- Guided Tour (3-minute video)
- Documentation

Courses

Introduction to Numerical Methods (Instructor)

Created By Balaji Sharma (balaji.sharma@mathworks.com)

Duration (EDT): 01 Jan 2018 - 03 Sep 2018

3 Problems | 3 Students

Copy of Introduction to Programming (Instructor)

Created By Eric Davishahi (edavishahi@everettcc.edu)

Duration (PDT): 03 Apr 2018 - 15 Sep 2018

94 Problems | 0 Students

Example Problems (Instructor)

Created By Aditya Jain (aditya.jain@mathworks.com)

Duration (UTC): Not Specified - Not Specified

11 Problems | 0 Students

ADD COURSE

Content

Create problems outside of a course, storing them in collections. You can later use these problems in courses.

ADD PROBLEM

MATLAB Grader

[Courses & Content](#) | [LMS Integration](#) | [License Management](#) | [Documentation & Support](#)

CSU Demo > Week 1 Homework >

Untitled Problem

Back to Add Problem | Introduction to Programming

Vector Creation (Leibniz series terms)

hide details...

Consider the Leibniz series:

$$1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \frac{1}{9} - \dots$$

Write a script to generate a vector of the first twenty terms of this series. Assign the vector of series terms to a row vector variable named **LeibnizTerms**.

Solve this problem using vectorized code (i.e. do not use a loop in your solution.)

Files Referenced

None

Problem Type

Script

Code

Reference Solution | **Learner Template**

```

1 k = 0:19;
2 LeibnizTerms = (-1).^k ./ (2 * k + 1);

```

Assessment

Test 1

Does variable LeibnizTerms have the correct values?

LeibnizTerms = Reference Solution?

ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

Student Experience

The image displays three sequential screenshots of the MathWorks student interface, illustrating the workflow from course navigation to assessment.

Left Screenshot (Navigation): Shows a sidebar menu for 'My first course'. The 'Topic 1' folder is selected and highlighted in blue. Other visible items include Participants, Badges, Competencies, Grades, General, Topic 2, Topic 3, Topic 4, Topic 5, Home, Dashboard, Calendar, Private files, My courses, and My first course.

Middle Screenshot (Code Editor): Shows the 'My first course' page with the 'Topic 1' folder selected. The main content area displays MATLAB code for 'Navigating a Robot':

```
1 pRobotWorld = randi([-5 5], 1, 2);
2 theta = 2*pi*rand;
3 pObjectWorld = randi([-5 5], 1, 2);
4
5 % Calculate T
6 T = [cos(theta), -sin(theta), 0;
7      sin(theta), cos(theta), 0;
8      0, 0, 1];
9 % Use the inverse of T (or back transformation) to get
10 % position in the robot frame
11 pObjectRobot = inv(T)*pObjectWorld;
12 % Now take only the first two dimensions
13 pObjectRobot = pObjectRobot(1:2);
14
15
```

Right Screenshot (Assessment): Shows the 'Assessment: All Tests Passed' section. Two test questions are listed, both marked as passed with green checkmarks:

- ✓ Is the transformation matrix correct?
- ✓ Is the destination position in the robot coordinate frame correct?

Buttons for 'Run Script' and 'Submit' are visible.

"The fact that you can get immediate feedback ... is really neat, and without it, debugging your own code would really be a mess. It also motivated me to get 100% score on all the MATLAB assignments."

– Student, Virginia Tech

ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

Grading and Learning Metrics

The screenshot displays the MathWorks Grader interface. On the left is a sidebar with navigation options: 'My first course', 'Participants', 'Badges', 'Competencies', 'Grades' (highlighted), 'General', 'Topic 1', 'Topic 2', 'Topic 3', 'Topic 4', 'Topic 5', and 'Home'. The main content area is titled 'My first course: View: User report' with a breadcrumb trail: 'Home / My courses / My first course / Grades / Grade administration / User report'. Below this, the section 'User report - Sam Student' has two tabs: 'Overview report' and 'User report'. A table displays the student's performance:

Grade item	Calculated weight	Grade	Range	Percentage	Feedback	Contribution to course total
My first course						
Navigating a Robot	100.00 %	100.00	0-100	100.00 %		100.00 %
Σ Course total	-	100.00	0-100	100.00 %		-

“The approach enables students to **learn more quickly** from their mistakes on their own.”

– Dr. Bob Canfield, Virginia Tech

ACCESS

INSTRUCTION

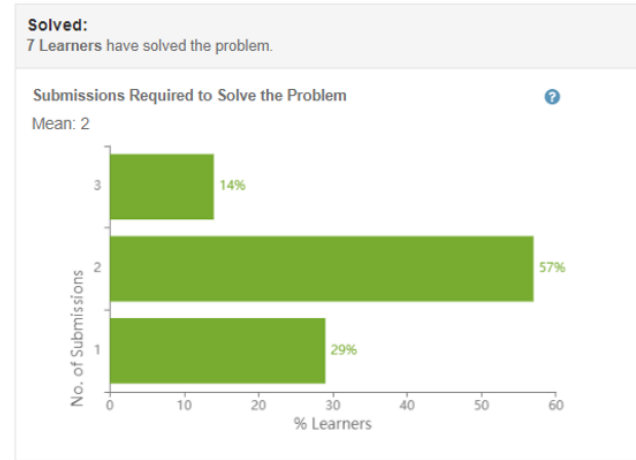
ASSESSMENT

GETTING HELP

Grading and Learning Metrics

“With MATLAB Grader, students can learn at their own pace until they are satisfied, and I am noticing deeper understandings from my students.”

- Dr. Masatide Abe
Tohoku University



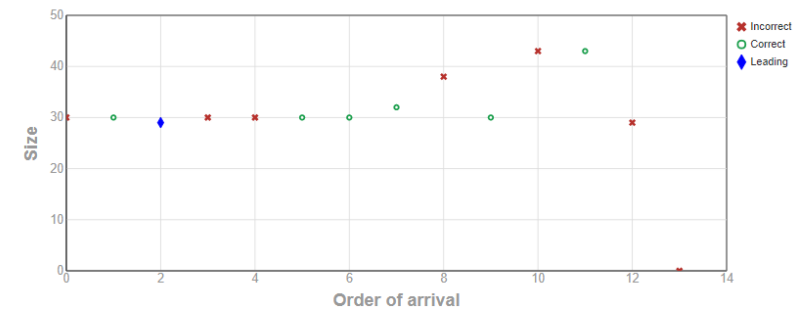
Vector Creation (creating equally spaced vectors)

Learner Analytics

Class Overview Learner Solutions

Map View List View

Search by last name, code or solution ID



Click on any solution marker in the graph to display solution in this box.

MATLAB Grader Extra Course Highway

CONTENTS Close Courses & Content LMS Integration Documentation & Support

Introduction to Programming in MATLAB Introduction to Programming in MATLAB > Homework 2: Matrix operations >

Reorder Content

Homework 1: Programming Basics

Homework 2: Matrix operations

Vector Creation (creating equally spaced vectors)

Problem Summary

Write a script with commands to create the following vectors and assign to the indicated variable names.

- Create an evenly-spaced row vector `x` with elements starting at 0 and ending at 50 with increments of 0.5.
- Create a row vector `h` with 80 evenly-spaced elements starting at 0 and ending at $\pi/2$.
- Create a row vector `c` that is an unsigned 8-bit integer data type with elements counting backward from 200 to 0 in increments of 5.

Your code should not include the following MATLAB functions or keywords: `for`, `while`

Learner Analytics: How Learners Are Doing on the Problem

Class Overview

- Percent solved / not solved
- Average number of submissions
- Which tests are hardest

Learner Solutions

- Search solutions
- Map and List views of solutions

ADD PROBLEM

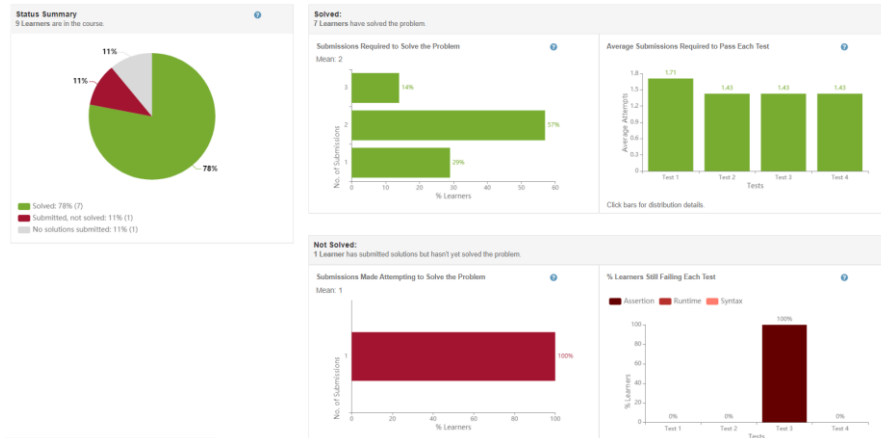
ADD ASSIGNMENT

Manage People

Vector Creation (creating equally spaced vectors)

Learner Analytics

Class Overview Learner Solutions



ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP



Access



Instruction



Assessment



Getting Help

ACCESS

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ASSESSMENT

GETTING HELP

MATLAB Courseware

Teaching resources created by your peers

MATLAB Courseware

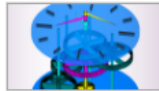
[Educator Home](#) | [Classroom Resources](#) ▾ | [Hardware Support](#) | [License Options](#) ▾ | [Research](#)

Introduction to Engineering



Engineering Models I

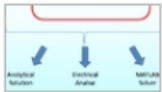
*Professor Kathleen Ossman
Professor Gregory Bucks
University of Cincinnati*



Engineering Models II

*Professor Kathleen Ossman
Professor Gregory Bucks
University of Cincinnati*

Bioengineering and Biological Sciences



Bioengineering Mass Transport and Systems

*Professor Alyssa Taylor
University of Washington*



Instrumentation, Measurement and Control in Biological Systems

*Professor Kumar Mallikarjunan
Virginia Polytechnic Institute & State University*

Earth, Ocean, and Atmospheric Sciences



Teaching Geoscience with MATLAB

from SERC@Carleton

Teaching Kits for Free

Download content consisting of:

- Lecture Notes
- Project Ideas
- Accompanying Code

ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

Training for Educators

Engage your students and scale your instruction with online learning tools from MathWorks

Launch the course



Access to MATLAB through your web browser



MATLAB integrated file sharing



Hands-on exercises with automated assessments and feedback



Ready-to-use resources to enhance your instruction

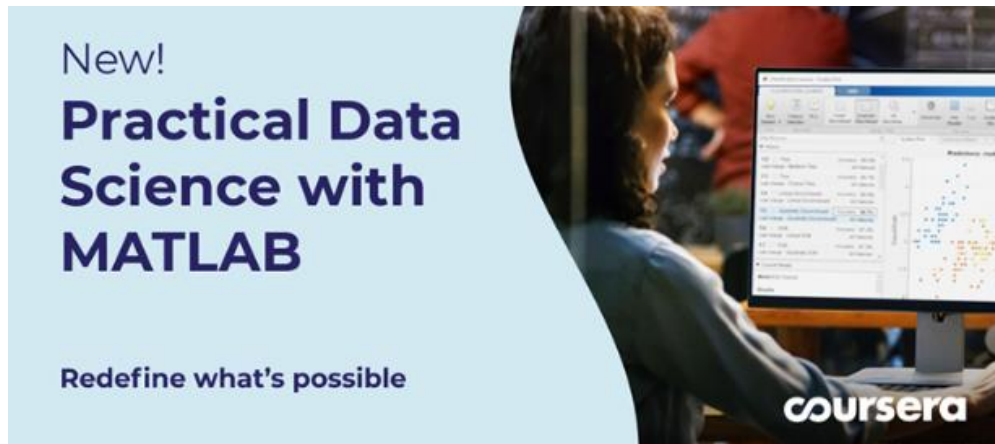
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GETTING HELP

MathWorks MOOCs



Four courses (approx. 2 months to complete)

- Exploratory Data Analysis with MATLAB
- Data Processing and Feature Engineering with MATLAB
- Predictive Modeling and Machine Learning with MATLAB
- Data Science Project: MATLAB for the Real World



Free Online MATLAB course is a top MOOC

- Functions
- Linear Algebra
- Loops and Data Types
- File Input/Output

ACCESS

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ASSESSMENT

GETTING HELP



Products Solutions Academia Support Community Events

Get MATLAB



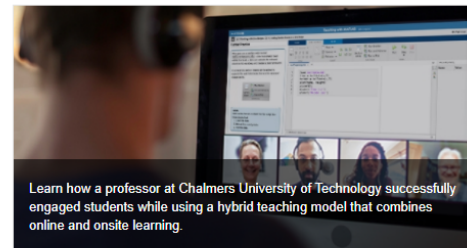
Educators

Search MathWorks.com

Teach with MATLAB and Simulink Curriculum Resources Online Teaching Campus-Wide License

Online Teaching with MATLAB and Simulink

Whether you are transitioning a classroom course to a hybrid model, developing virtual labs, or launching a fully online program, MathWorks can help you foster active learning no matter where it takes place. Here you will find resources and ideas for providing hands-on experiences with MATLAB and Simulink, plus tools for delivering instruction, engaging students, and assessing outcomes.



Learn how a professor at Chalmers University of Technology successfully engaged students while using a hybrid teaching model that combines online and onsite learning.



Instructional Resources



Virtual Labs and Projects



Online Assessments

Create Engaging, Interactive Course Materials

Make your courses more interactive, promote self-directed learning, and increase student engagement through Live Editor and MATLAB apps.

Use MATLAB on the desktop or MATLAB Online to create live scripts. Share live scripts with students through your university's learning management system or using MATLAB Drive. Learn more about creating and sharing live scripts for applications such as flipped classrooms on the [Instructional Resources page](#).

In addition, you can host and run a collection of MATLAB apps on your own MATLAB Web App Server at your university.



Products Solutions Academia Support Community Events

Distance Learning Community

Search Dis

MATLAB Central Home Explore Contribute My Activity

Keep Teaching through Distance Learning

Posted by [Loren Shure](#), March 23, 2020

As many universities are moving quickly to distance learning, it is vital for educators to think carefully about how to adapt their approach to still deliver key learning outcomes for students in an online setting.

» Read more...

Discussions

Start a discussion



Welcome to the Distance Learning Community

Latest activity by [jiro](#) on 30 Mar 2020 at 13:17

Tags: [distance_learning](#)

0

replies



Tell us your story

Latest activity by [jiro](#) on 30 Mar 2020 at 13:05

Tags: [distance_learning](#)

0

replies

» View all discussions

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GETTING HELP

Next Steps Checklist

- ✓ Complete the [Online Training for Educators](#)
- ✓ Add [MATLAB Onramp and/or Simulink Onramp](#) to courses
- ✓ Convert coding examples to interactive [Live Scripts](#)
- ✓ Tell your LMS administrator to add [MATLAB Grader](#) to your LMS
- ✓ Virtualize your labs with [MATLAB Mobile](#) and [ThingSpeak](#)

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Customer Success Engineers

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

info@terasoft.com.tw



ACCESS

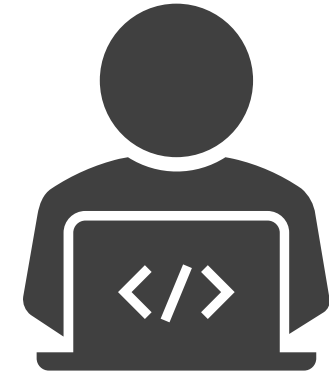
INSTRUCTION

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GETTING HELP

Learn by doing

... and learn from mistakes



"Mistakes... are the portals of discovery."
—James Joyce



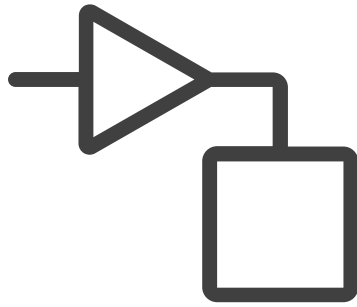
ACCESS

INSTRUCTION

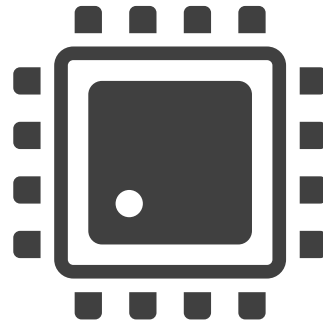
ASSESSMENT

GETTING HELP

Laboratory Models



Virtual



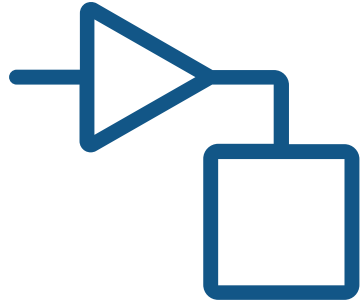
Hardware
at Home



Remote

Complexity	High	Low	High
Interactivity	High	High	Low
Hands-On	Low	High	Low
Realism	Low	Low	High

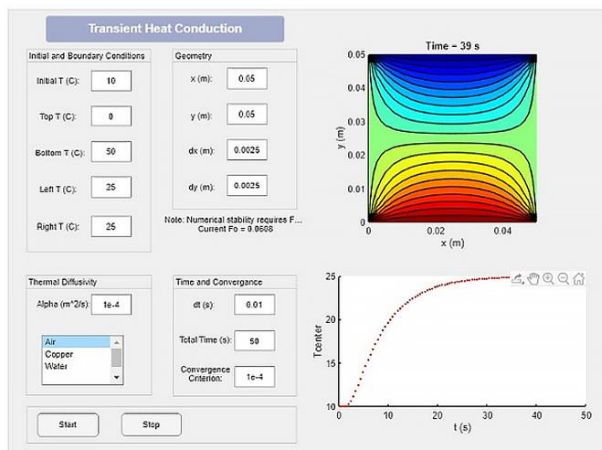
Fully-Virtual Labs



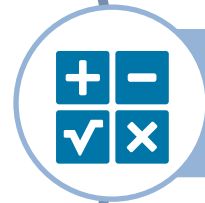
Complexity
Interactivity



Realism
Hands-On



Graphical Interface with Visualization



Mathematical Model of Processes



Equipment or Hardware Simulations

Challenges:

- Incorporating sufficient visuals
- Replacing the hands-on component
- May lose real-world factor

ACCESS

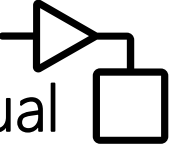
INSTRUCTION

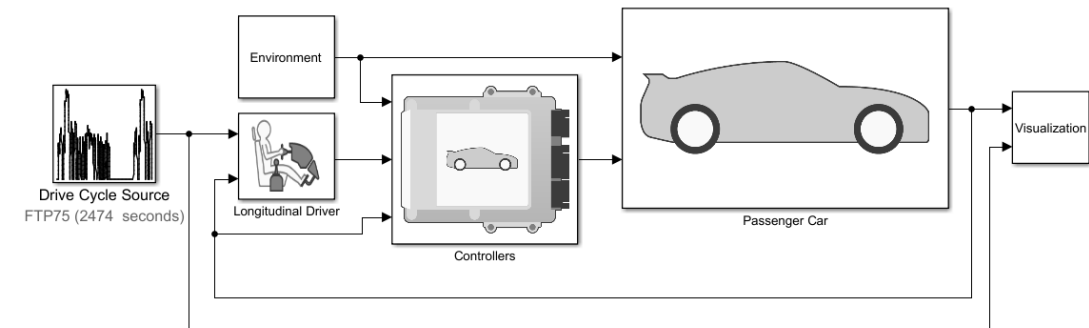
ASSESSMENT

GETTING HELP

SIMULINK®

Simulation and Model-Based Design

Virtual 



ACCESS

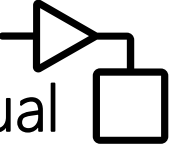
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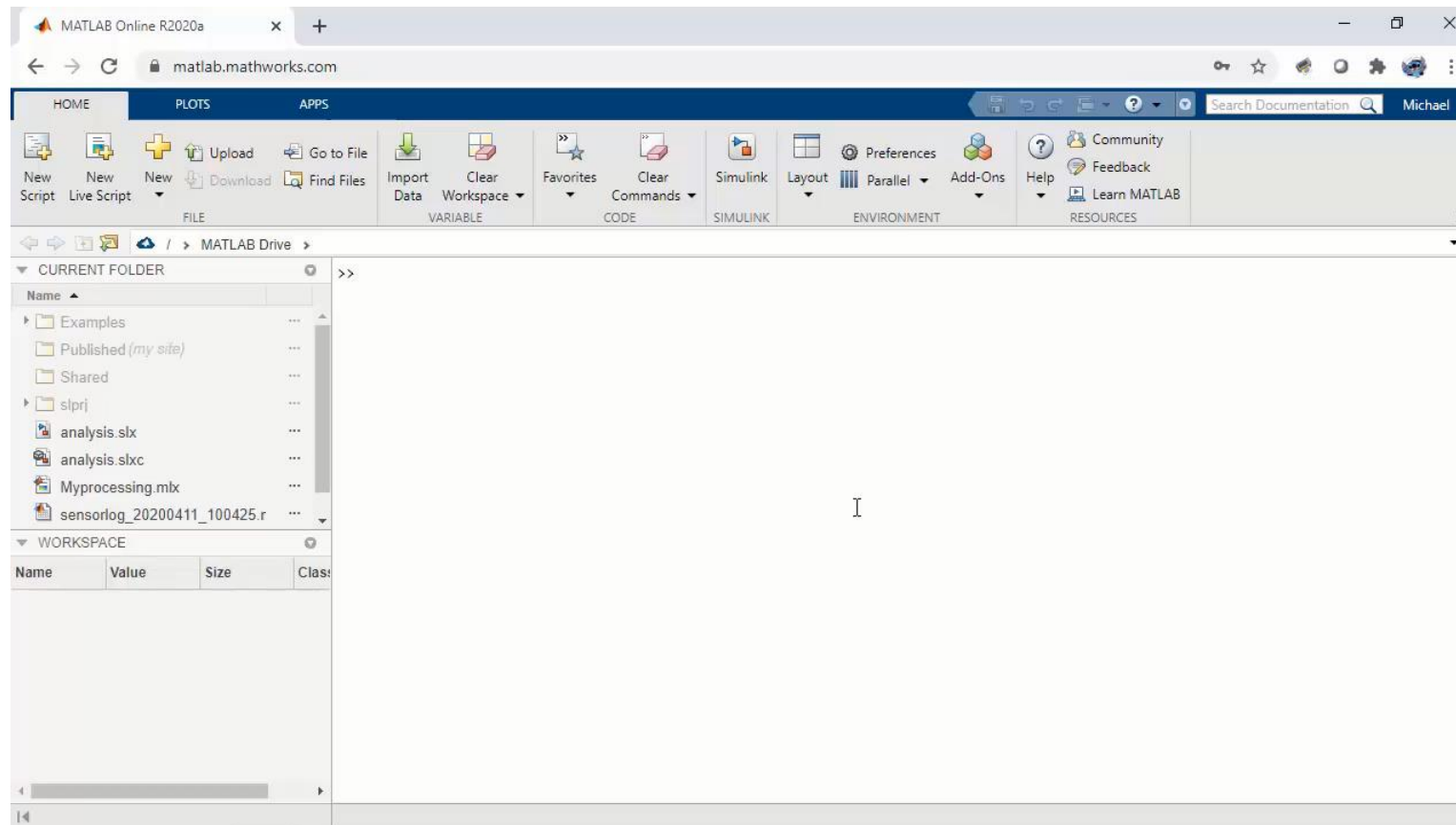
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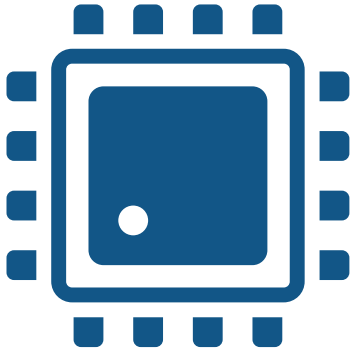
SIMULINK®

Simulation and Model-Based Design

Virtual 



Hardware at Home Labs



Hands-On
Interactivity



Realism
Complexity

ENGINEERING KIT R2



Hardware Kits



Data Collection with Sensors



Mobile Devices

Challenges:

- Kit and hardware logistics
- Too simplistic
- Safety and oversight of students

ACCESS

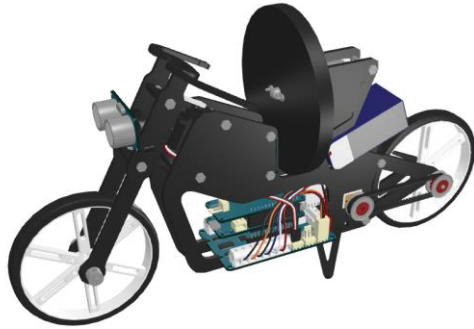
INSTRUCTION

ASSESSMENT

GETTING HELP

Project-based learning with low-cost hardware

Hardware 



Self-balancing robots using
Arduino



Edge Detection using
Raspberry Pi

"I really enjoyed, 'Edge AI with Raspberry Pi using MATLAB' to deploy face detection and age prediction algorithms on a Raspberry Pi. I have no experience in hardware, but I completed the tutorial and now have a strong curiosity."

-Katie Amrine, PhD
Decision Scientist, Facebook

ACCESS

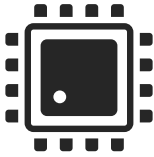
INSTRUCTION

ASSESSMENT

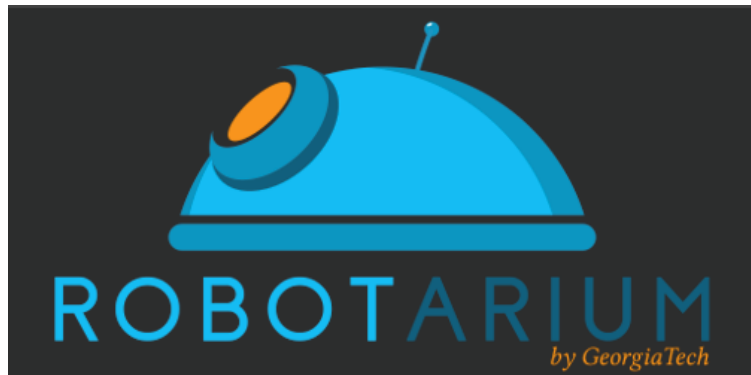
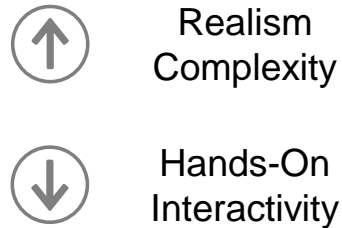
GETTING HELP

MATLAB Mobile

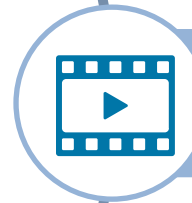
Hardware



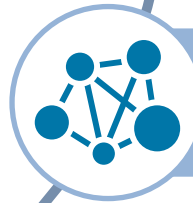
Remote-Access Labs



Remote Control of Equipment



Live Stream from University Lab



Internet of Things

Challenges:

- Students need more than watching
- Incorporating sufficient interactivity
- Replacing the hands-on component

ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

ThingSpeak
IoT analytics platform

Remote 



 Collect

Send sensor data privately to the cloud.

 Analyze

Analyze and visualize your data with MATLAB.

 Act

Trigger a reaction.

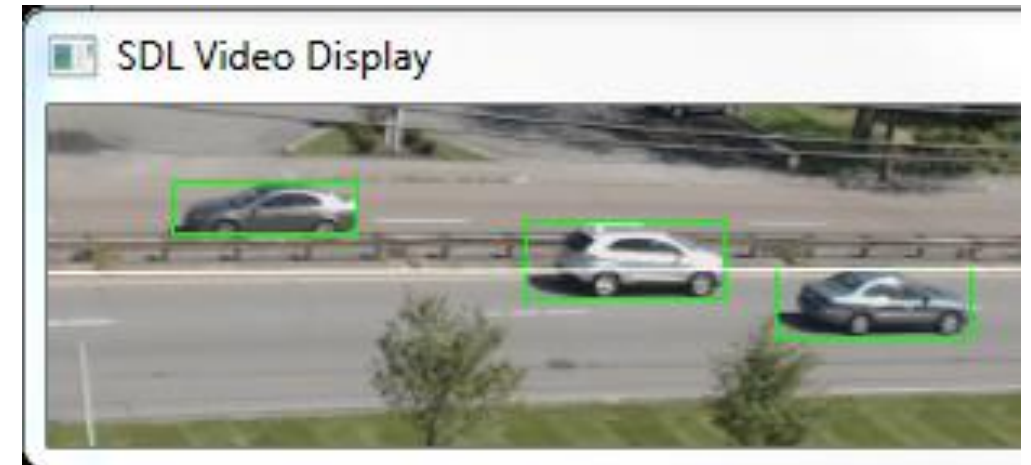
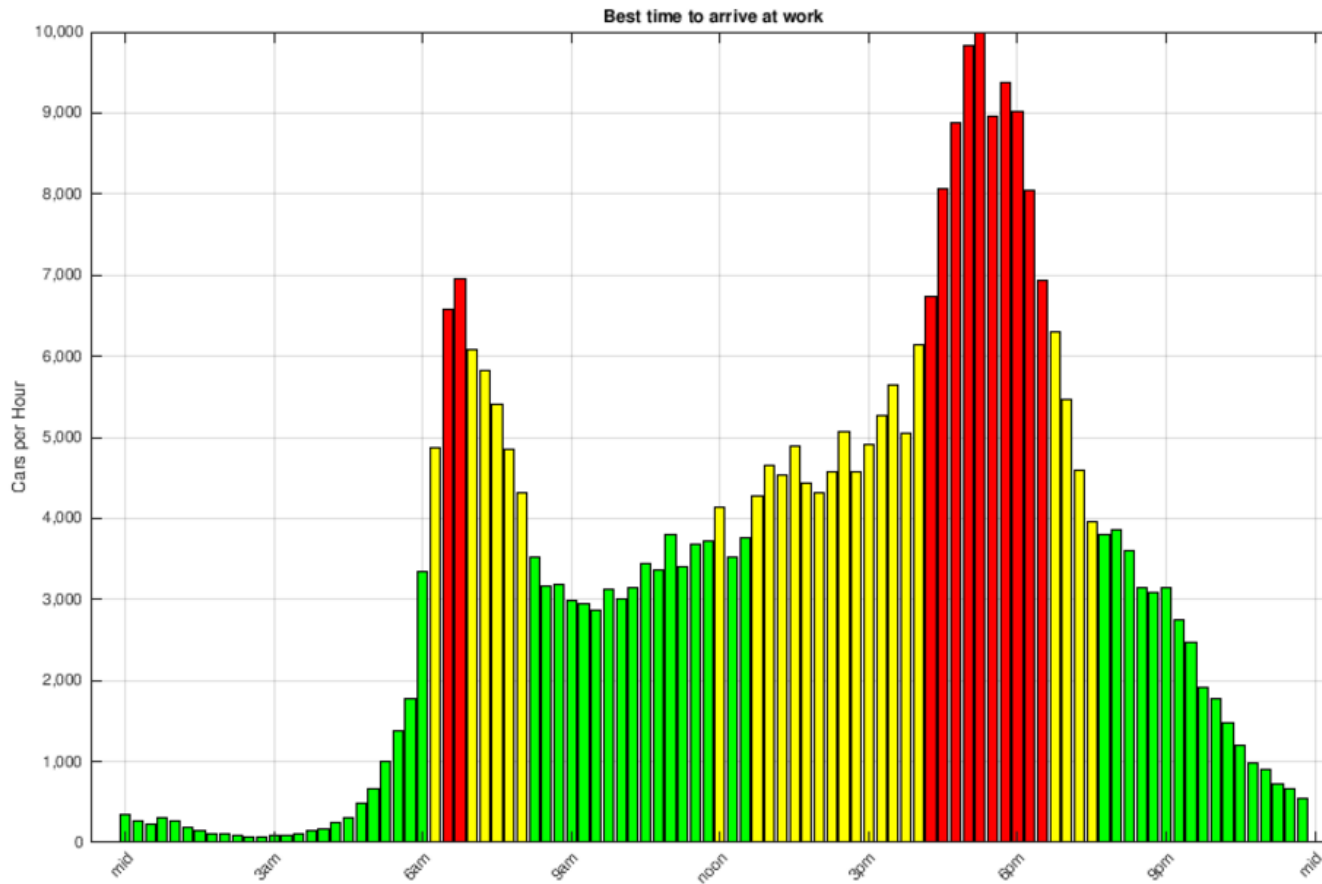
ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

Traffic Analysis

Remote 

ACCESS

INSTRUCTION

ASSESSMENT

GETTING HELP

Remote Labs

Robotarium at Georgia Tech

