



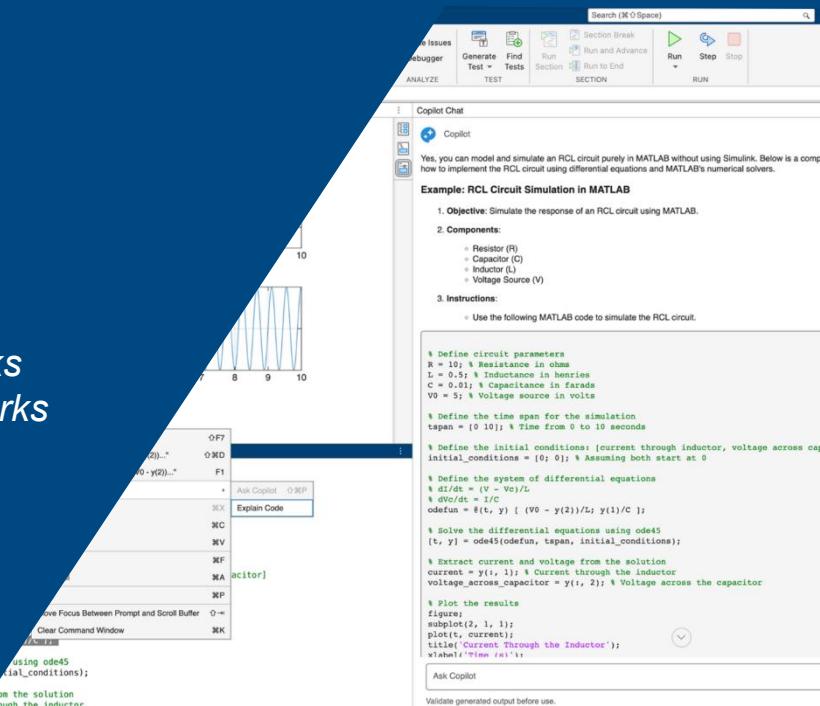
Generative AI with MATLAB for Enhancing the Chemical Engineering Curriculum

How to use generative AI tools, like MATLAB Copilot, to create engaging MATLAB curriculum.

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Agenda

- What is Generative AI, and how does it apply to chemical engineering and MATLAB?
- What GenAI tools does MathWorks provide?
- Concerned about academic integrity? We are too!
- Best practices and chemical engineering examples for learner engagement with GenAI
- Resources for Getting Started

2025

Global Skills Report

Trusted skill insights for a rapidly changing world

8M+
enrollments in GenAI, the fastest-growing skill category

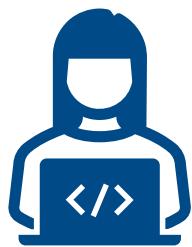
425%
YoY GenAI enrollment growth in Latin America, highest globally

- Global enrollment in GenAI courses surging 195% YOY
- 94% of employers say they're likely to hire candidates with GenAI credentials
- 75% of employers prefer hiring less-experienced candidates with GenAI skills over more experienced ones without skills

Source: <https://www.coursera.org/skills-reports/global>

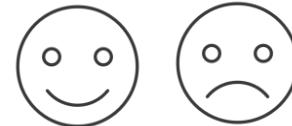
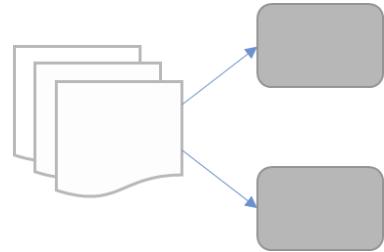
LLMs can help you solve specific problems

Generate Text



Write Code Document

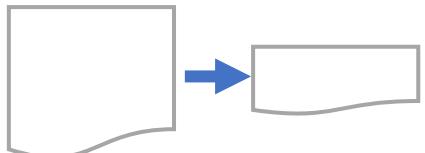
Classify Text



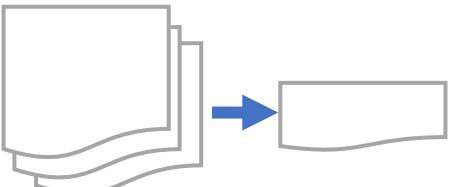
Classify Maintenance
Documents

Analyze
Sentiment

Summarize



One document



Multiple documents

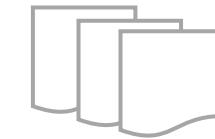
Retrieve Information



Scientific
Discovery



Requirements for
design &
engineering



Knowledge from
internal
documents

How is Generative AI used in Chemical Engineering?

- Molecular and material design & discovery
- Process Design & Optimization
- Data Augmentation & Synthetic Data Generation
- Process Control & Monitoring
- Documentation & Reporting

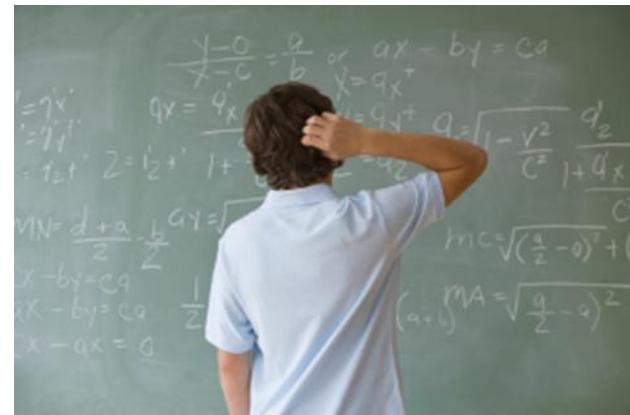
How does Generative AI apply to MATLAB in academia?

Educators



- AI as a Project Partner – help me write this code
- Create a syllabus for a new course
- ***Create lecture content based on learning objectives***
- ***Change content each term***

Students



- ***AI as a Project Partner – help me write this code***
- ***AI as a Tutor – explain this code***
- AI as a Feedback Generator – what's wrong with my code?

Researchers



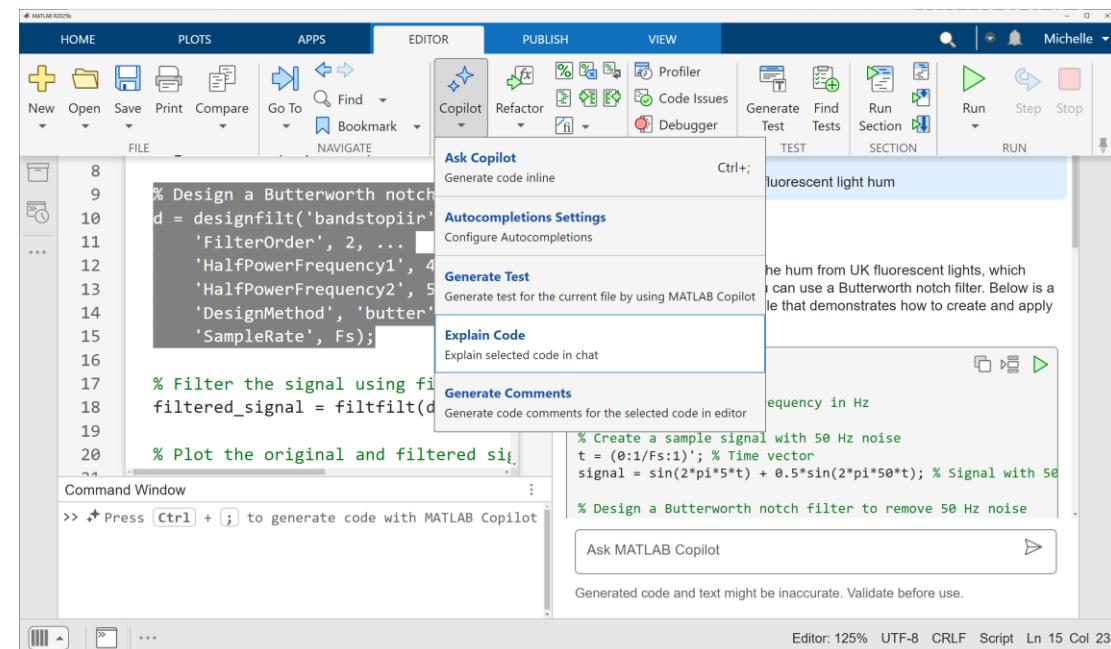
- Ask general questions on concepts
- Ask to generate images
- Summarize research/literature review

Introducing MATLAB Copilot and MATLAB Copilot Features

R2025a

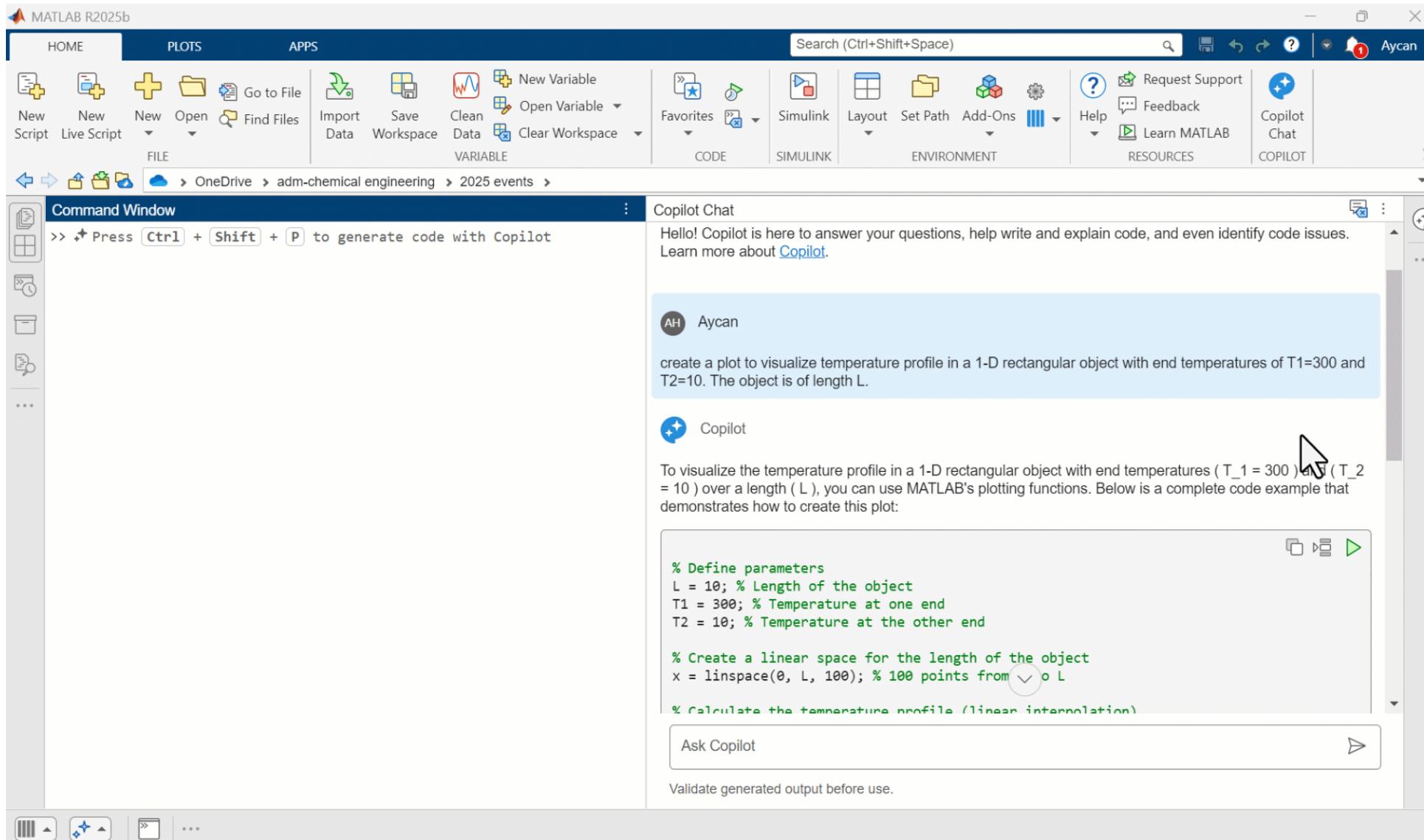


- MATLAB Copilot tightly integrated with and optimized for MATLAB
 - Responses based on the latest MATLAB documentation
 - Tuned for engineering and scientific workflows
- Copilot Chat
- Copilot in the Editor
 - Autocompletions
 - Generating Code
- Copilot Actions
 - Explain Error
 - Explain Code
 - Generate Comments
 - Generate Tests (requires MATLAB Test)



- *Requires MATLAB R2025a or newer*
- *Requires an internet connection*

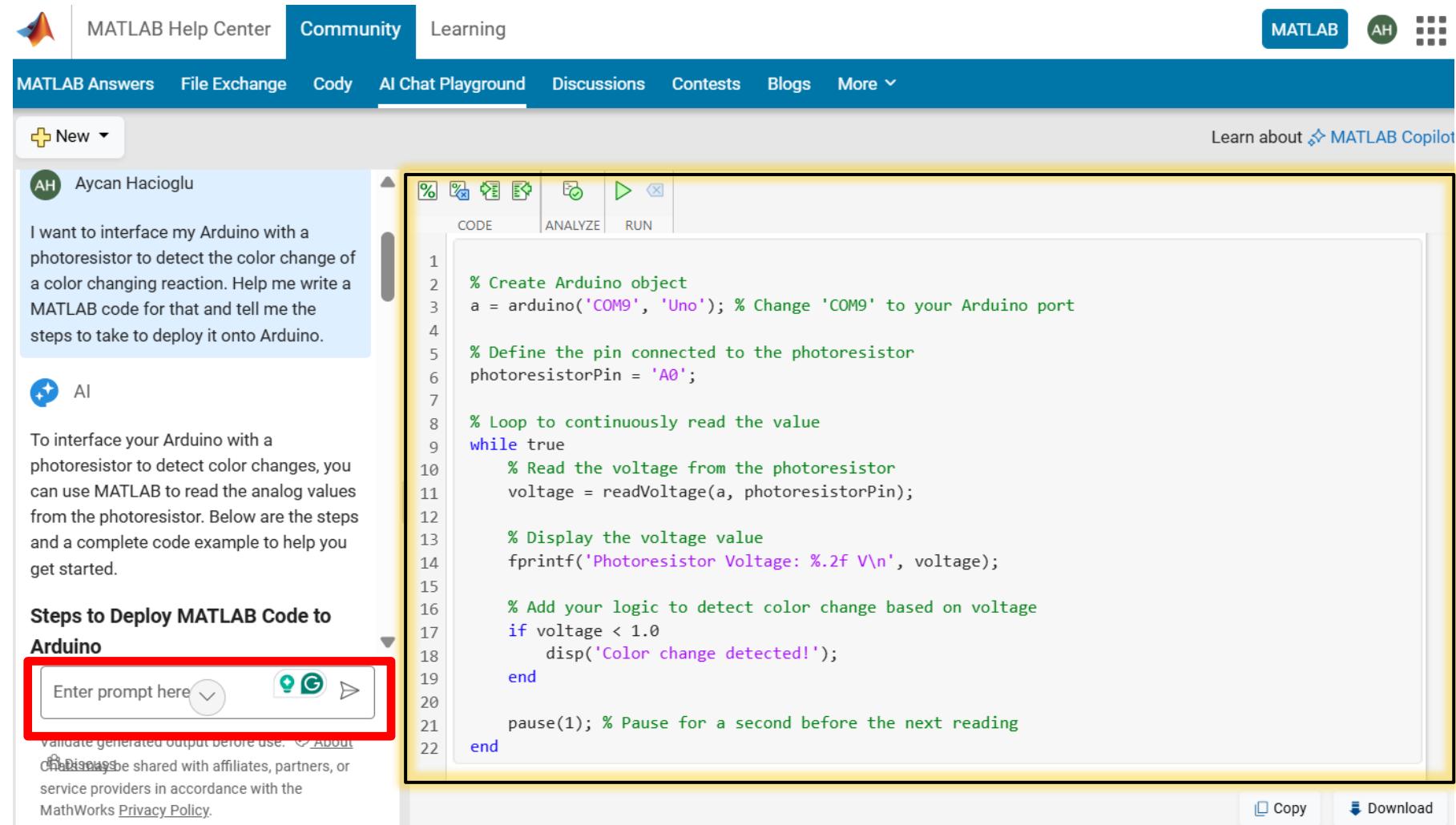
Sign-in to get started. Ask questions in Copilot Chat. Example: Plot temperature profile and explain code



MATLAB AI Chat Playground

Example: Using MATLAB with Arduino for the Chem-E-Car Competition

- **Experiment with GenAI and MATLAB to get AI-generated code and answers in a sandboxed environment**
- **Free to use (requires MathWorks Account)**
- **Combines an AI chat panel with a lightweight MATLAB editor**
 - *Realtime interaction*
- **Always validate any output and make it your own**



The screenshot shows the MATLAB AI Chat Playground interface. At the top, there are tabs for MATLAB Help Center, Community (which is selected), and Learning. Below the tabs, there are more navigation links: MATLAB Answers, File Exchange, Cody, AI Chat Playground (which is highlighted in blue), Discussions, Contests, Blogs, and More. On the right side of the top bar, there are buttons for MATLAB, AH, and a grid icon. A message from user 'Aycan Hacioglu' asks about interfacing an Arduino with a photoresistor to detect color changes. An AI-generated response provides a MATLAB code example to achieve this. Below the code, there is a section titled 'Steps to Deploy MATLAB Code to Arduino' with a red box highlighting a text input field labeled 'Enter prompt here' and a red box around the entire input field area. The MATLAB code itself is as follows:

```
% Create Arduino object
a = arduino('COM9', 'Uno'); % Change 'COM9' to your Arduino port

% Define the pin connected to the photoresistor
photoresistorPin = 'A0';

% Loop to continuously read the value
while true
    % Read the voltage from the photoresistor
    voltage = readVoltage(a, photoresistorPin);

    % Display the voltage value
    fprintf('Photoresistor Voltage: %.2f V\n', voltage);

    % Add your logic to detect color change based on voltage
    if voltage < 1.0
        disp('Color change detected!');
    end

    pause(1); % Pause for a second before the next reading
end
```

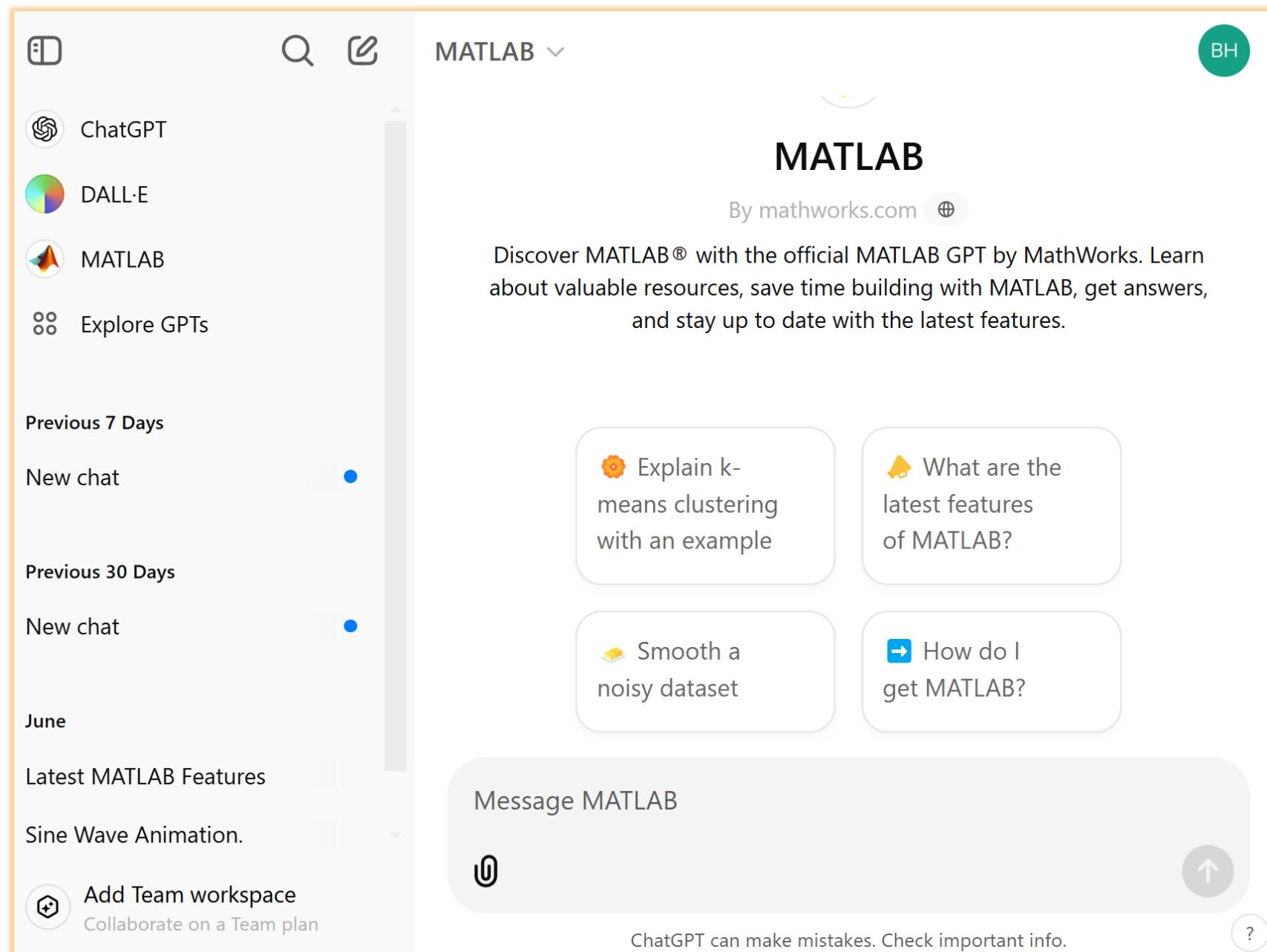
At the bottom right of the code editor, there are 'Copy' and 'Download' buttons.

MATLAB GPT

<https://chatgpt.com/>



- Best if already using **ChatGPT**
- Requires **OpenAI** account
- **Improves responses to MATLAB-related questions** in ChatGPT
- Start a conversation by typing **@MATLAB**
- Governed by **OpenAI's** terms of use and data policies



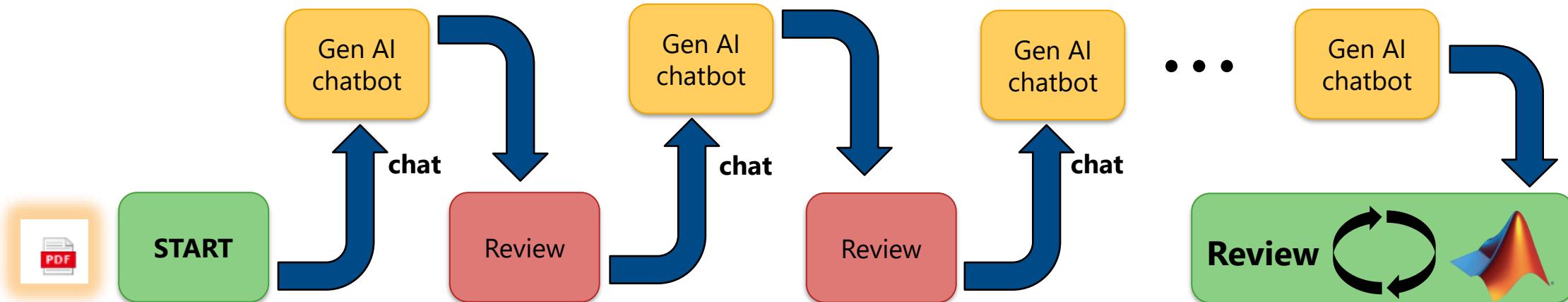
A screenshot of the MATLAB GPT interface. At the top, there is a navigation bar with icons for ChatGPT, DALL-E, MATLAB, and Explore GPTs. The main content area features the MATLAB logo and a "MATLAB" heading. Below this, there is a section titled "Discover MATLAB® with the official MATLAB GPT by MathWorks. Learn about valuable resources, save time building with MATLAB, get answers, and stay up to date with the latest features." There are four cards with MATLAB-related questions: "Explain k-means clustering with an example", "What are the latest features of MATLAB?", "Smooth a noisy dataset", and "How do I get MATLAB?". At the bottom, there is a "Message MATLAB" input field and a note: "ChatGPT can make mistakes. Check important info." A "Collaborate on a Team plan" button is also visible.

Example: Revising a Past Assignment

I have Last year's Assignment (in PDF)

I want **MATLAB GPT** to help me with

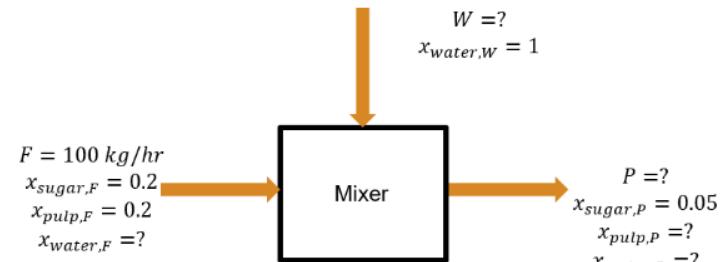
- Defining a new Problem statement
 - with similar learning outcomes as the OLD assignment
- Generate some MATLAB code for the NEW problem



Mass Balance Problem Statement

In an orange juice plant, a feed stream, F of 100 kg/hr is fed to a mixer. The feed stream consists of 20 wt% sugar, 20 wt% pulp and the balance is sugar. It is desired to reduce the sugar percent to 5 wt% by mixing the feed stream with fresh water. Assume a steady-state operation and perfect mixing in the mixer. Find the flow rate, W of the fresh water fed and find the product flow rate, P . What is the pulp and water wt% in the product?

Process Flowchart



Updating a Material Balance Course Module with MATLAB GPT

chatgpt.com/g/g-QFTjbeK3U-matlab

MATLAB 5

New chat

Search chats

Library

Projects

GPTs

Explore

MATLAB

OKR Validator

Chemical Engineering Market I...

Chats >

Aycan MathWorks Free

Upgrade

Get Plus

Share

Excellent — I've reviewed your uploaded module "Material and Energy Balances", which currently introduces a **single-unit mixer** problem (feed + water → product) and teaches symbolic mass balance analysis using MATLAB's `solve` and `symunit`.

To **update the module** while keeping similar learning objectives but making the problem **more complex and realistic**, we can expand it into a **multi-unit process** involving multiple species and both **mass and energy balances**.

Updated Learning Objectives

Students will:

1. Perform mass and energy balances for a **multi-unit process**.
2. Conduct a **degrees of freedom analysis** for complex systems.
3. Use **symbolic and numerical methods** (`solve`, `fsolve`, or Live Tasks).
4. Apply **MATLAB visualization and unit conversion tools**.
5. Explore process sensitivity (e.g., how **mole ratio** or **temperature** affects product composition).

Ask anything

ChatGPT can make mistakes. Check important info.

Using Large Language Models (LLMs) in MATLAB

Bring your own keys and connect to:

- OpenAI models
- OpenAI models via Azure
- Open-source/Open-weights models via Ollama (running locally or on a remote server)

Supports multiple modalities (Text2Text, Text2Image, Image2Text)

- Includes 10 Real-world examples
- Live Scripts include output for demos
- Supported by the Text Analytics Toolbox Team



matlab-deep-learning / llms-with-matlab

<https://github.com/matlab-deep-learning/llms-with-matlab>

Generate variations for that image.

```
[images,resp] = createVariation(mdl, imagePath, NumImages=4);  
if ~isempty(images)  
    tiledlayout('flow')  
    for ii = 1:numel(images)  
        nexttile  
        imshow(images{ii})  
    end  
else  
    disp(resp.Body.Data.error)  
end
```



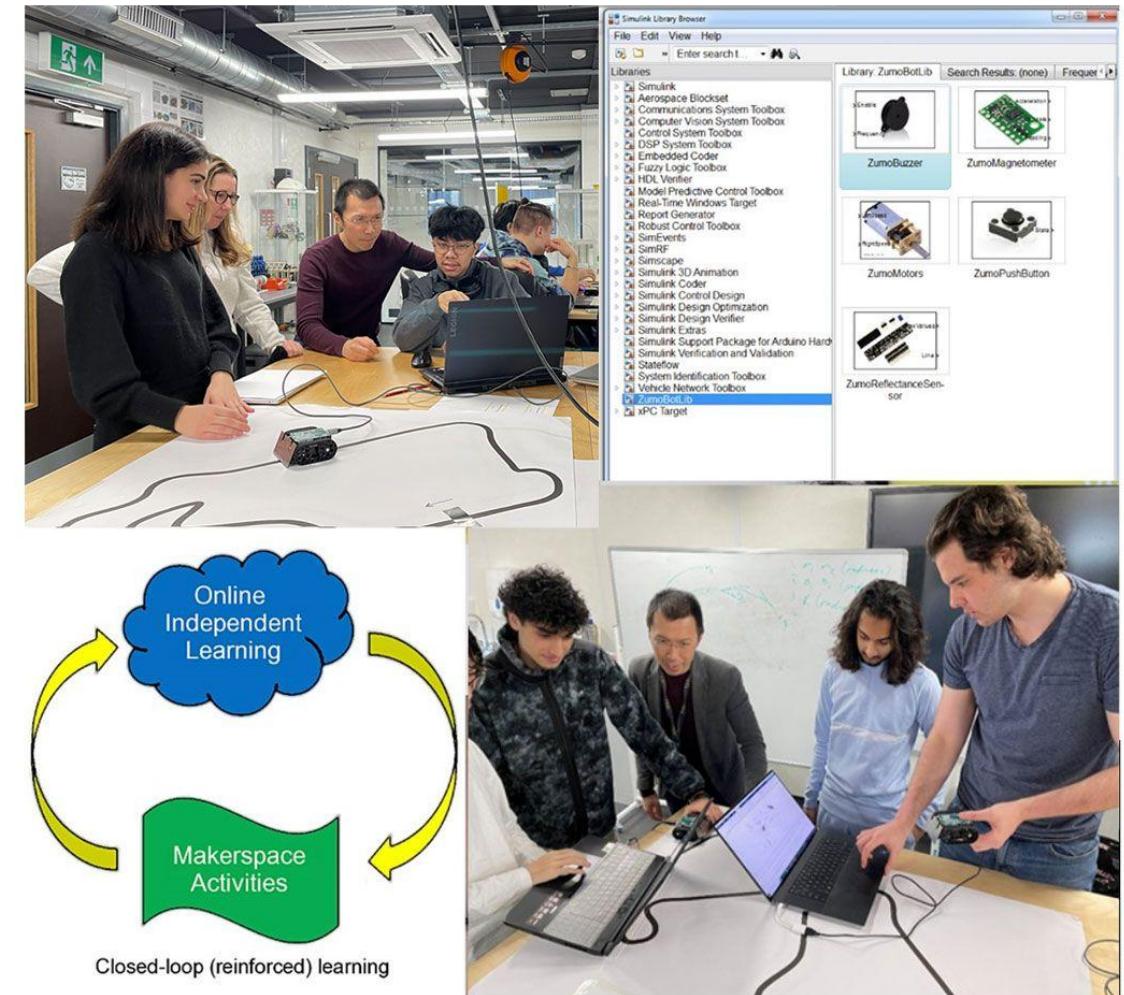
Using DALL·E™ to Create Images

Concerns about Generative AI in the Classroom

Knowing that generative AI tools are here to stay, instructors are exploring and implementing new assessments that prioritize student understanding over programming language syntax.

Examples of this include:

- Project-based learning
- Critical thinking
- Systems-level thinking



Countermeasure: Create opportunities for Student Use of Generative AI in the Classroom

1

Prompting: What are the best practices for creating prompts? How is prompting different from traditional search? What context can you provide to improve the prompt?

2

Refining and iterating: Did the generated results match your expectations? How can you get improved results from the system?

3

Analyzing: Should you trust the generated results? How do you improve your confidence in the results? How can you test the results for correctness?

Try Hands-on MATLAB Experiences instead of Assessments

MATLAB Engineering Project Ideas

Search MathWorks.com

Overview | Teach | Learn | Research | Student Programs

Featured Project Ideas

Review this sampling of research and design MATLAB project ideas and be inspired to solve challenging industry problems.

See the complete project list and find out how to get started.

 **Satellite Collision Avoidance**
Model satellites in low Earth orbit (LEO) to identify conjunctions and prevent collisions with space debris while maintaining orbital requirements.

Impact
Contribute to the success of satellite mega-constellations and improve the safety of the LEO environment.

Expertise Gained
Autonomous Vehicles, Aerospace, Satellites, Control, Modeling and Simulation

 **Traffic Data Analysis for Modeling and Prediction of Traffic Scenarios**
Analyze real-world traffic data to understand, model, and predict human driving trajectories.

Impact
Contribute to autonomous driving technologies and intelligent transportation research.

Expertise Gained
Big Data, Autonomous Vehicles, Support Vector Machines, Machine Learning, Deep Learning, Automotive

MathWorks Products Solutions Academia Support Community Events

Get MATLAB  

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Teach with MATLAB and Simulink

Overview | Teach | Learn | Research | Student Programs

Featured Courseware

Explore interactive teaching content and examples developed by MathWorks and educators from leading universities.

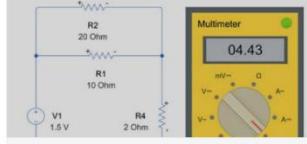
 **Virtual Labs**

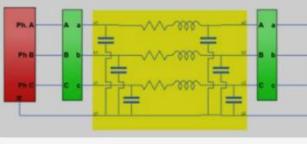
Featured Courseware

Virtual Labs

Interactive Examples

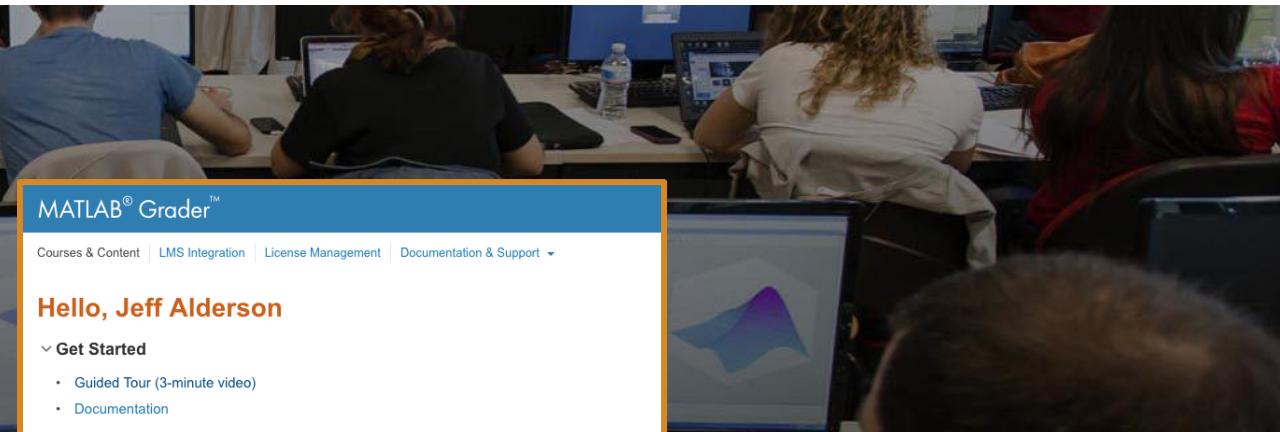
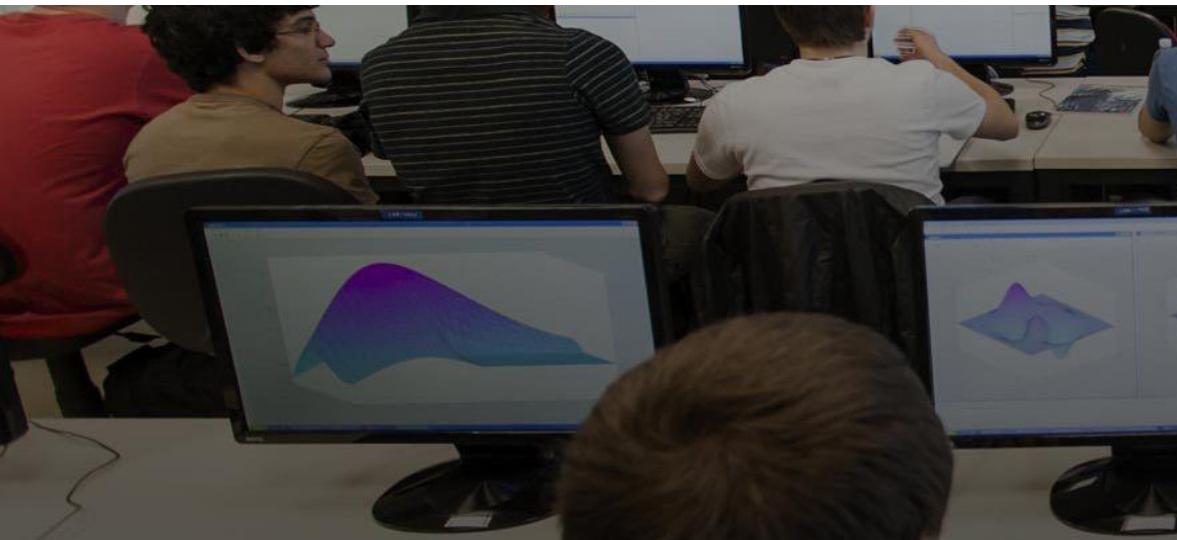
Publisher

 **ELECTRICAL ENGINEERING**
DC Circuit Analysis
MathWorks
Virtual labs for DC circuit analysis; topics such as mesh analysis, RLC circuits, and op amps are covered
Includes: Code, Models, Assignments, Video

 **ELECTRICAL ENGINEERING**
Electric Machine and Power Labs
Douglas Jussaume, University of Tulsa
Eight power labs and assignments that mimic hardware lab operation; the typical lab requires students to connect the power circuit, run and record data, and submit a lab report
Includes: Models, Assignments

<https://www.mathworks.com/academia/matlab-engineering-project-ideas.html>

MATLAB Grader



Introduction to MATLAB Programming

Dashboard / Courses / MATLAB 101 / Functions in MATLAB / Embedded

Embedded

Problem 1a: Estimating the value of Pi using Leibniz Series

One of the methods to estimate the value of π is to use the Leibniz series expansion to a reasonably large number of terms and use the expression below to estimate the value of π .

$$\pi/4 \approx 1 - 1/3 + 1/5 - \dots = \sum_{k=1}^n \frac{(-1)^{k+1}}{2k-1}$$

Using this expression, write a script to estimate the value of π using a 100 terms. Your code should include the following variables:

```
estPi % Value of pi estimated using 100 terms in the series.
```

You can use the Learner Template code provided to develop your solution.

Your Script

Save C Reset MATLAB Documentation

```
1 nTerms = 100; % Number of terms to be used in the series expansion
2 % <Enter your code here>
3 estPi = ; % Estimated value of Pi for 'N' values.
```

Run Script



Create interactive course assignments



Automatically grade student work and provide feedback



Run your assignments in any learning environment

Converts your GenAI assignments into autograded assessments



Jeff Alderson

Write a script to generate a vector of the first twenty Leibniz series terms



AI

To generate a vector of the first twenty terms of the Leibniz series, you can create a MATLAB script as follows:

```
% Leibniz series for pi: pi = 4 * (1 - 1/3 + 1/5 - 1/7 + 1/9 - ...
n_terms = 20; % Number of terms
leibniz_terms = zeros(1, n_terms); % Preallocate vector

for k = 0:n_terms-1
    leibniz_terms(k+1) = ((-1)^k) / (2*k + 1); % Calculate each term
end

disp(leibniz_terms); % Display the vector of terms
```

This script initializes a vector to hold the terms of the series, computes each term using a loop, and then displays the resulting vector. Each term is calculated based on the formula for the Leibniz series.



MATLAB Grader

Jeff Alderson

Contents Close

CSU Demo

Reorder Content

Week 1 Homework

Untitled Problem

Add Problem

Add Group

Collaborate with Instructors

CSU Demo > Week 1 Homework > Untitled Problem

Back to Add Problem | Introduction to Programming Close x

Vector Creation (Leibniz series terms)

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?

[Using GenAI with MATLAB Grader \(Video\)](#)

Resources for Getting Started

- [Teaching with MATLAB Copilot](#) (MathWorks)
- [Introduction to MATLAB Copilot](#) (Coursera)
- [MATLAB GPT in Chat GPT](#) (OpenAI / MathWorks)
- [AI Assisted MATLAB Programming with ChatGPT](#) (Coursera)
- [AI Chat Playground](#) (MathWorks)
- [AI Responses in Help Center / Documentation](#) (MathWorks)

References

- Decardi-Nelson, B., Alshehri, S., & You, F. (2024). *Generative artificial intelligence in chemical engineering spans multiple scales*. *Frontiers in Chemical Engineering*, 6, 1458156.
<https://doi.org/10.3389/fceng.2024.1458156>
- Son, Y. W., et al. (2025). *Generative transformer-based deep hierarchical VAE model for the automated generation of chemical process topologies*. *Computers & Chemical Engineering*. Advance online publication.
<https://doi.org/10.1016/j.compchemeng.2025.00XXXX>