



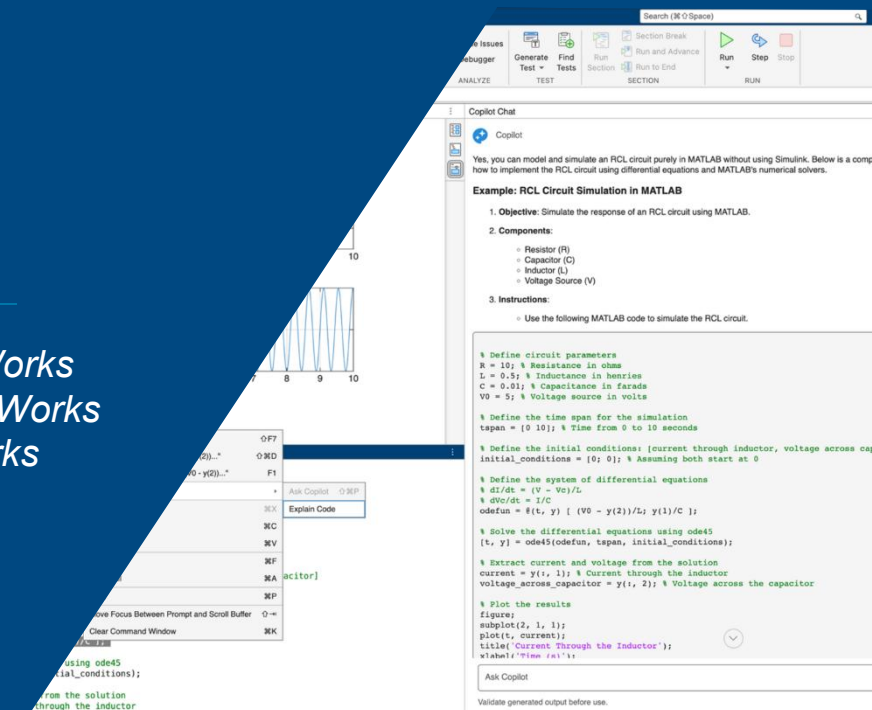
Generative AI with MATLAB for Enhancing the Chemical Engineering Curriculum

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

Aycan Hacioglu

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Seth DeLand, *Product Marketing, MathWorks*



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

coursera

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

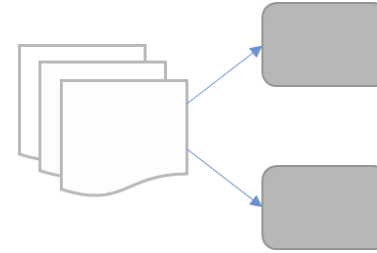


Write Code

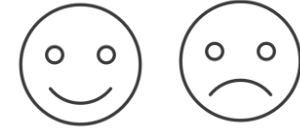


Document

Classify Text

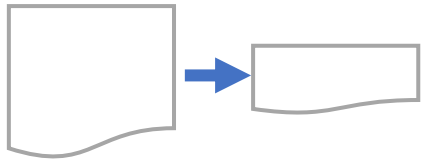


Classify Maintenance Documents

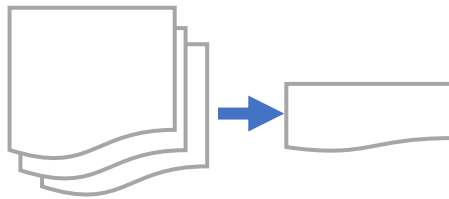


Analyze Sentiment

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

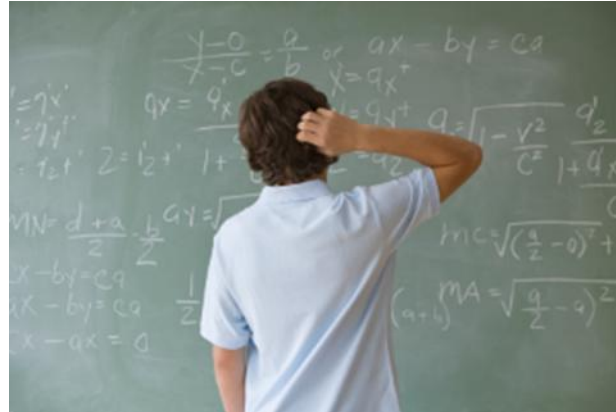
How does Generative AI apply to MATLAB in academia?

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



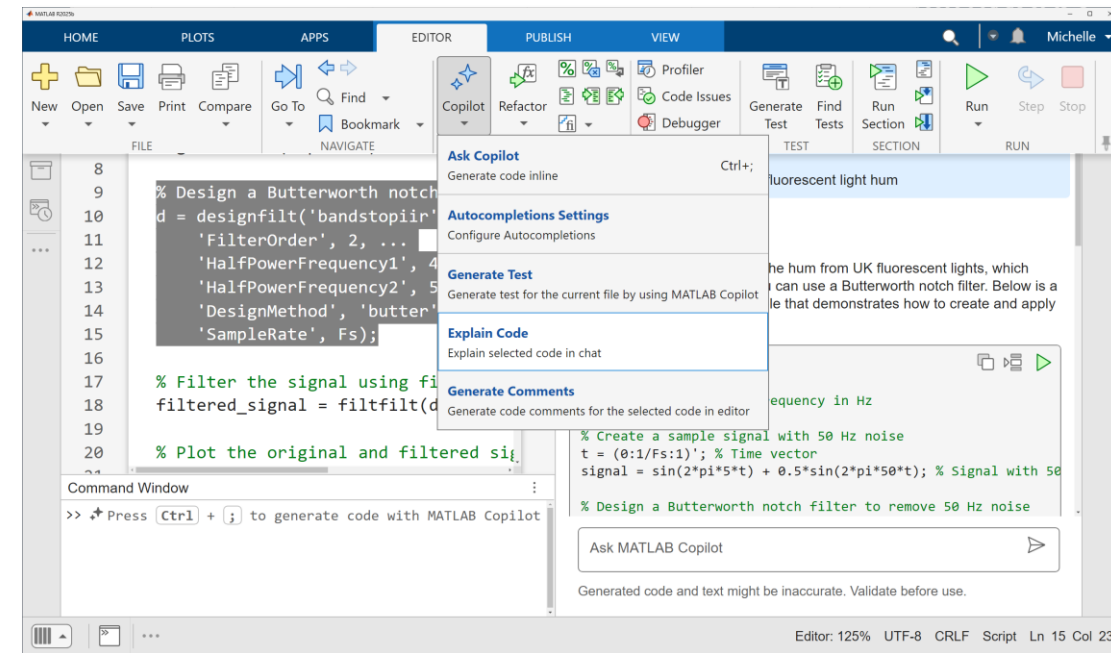
- Ask general questions on concepts
- *Ask to generate images*
- *Summarize research/literature review*

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

The image shows the MATLAB R2025b software interface. The top menu bar includes HOME, PLOTS, and APPS. Below the menu bar is a search bar and a toolbar with various icons for file operations, workspace management, and code execution. The main workspace is divided into two panes. The left pane, titled 'Command Window', displays the instruction: `>> Press Ctrl + Shift + P to generate code with Copilot`. The right pane, titled 'Copilot Chat', shows a conversation with the Copilot AI. The chat starts with a greeting from Copilot. A user named 'Aycan' asks for a plot of a temperature profile. Copilot responds with a detailed explanation and provides a complete MATLAB code example for generating the plot. The code defines parameters L, T1, and T2, creates a linear space x, and calculates the temperature profile using linear interpolation. A 'Validate generated output before use' warning is displayed at the bottom of the chat pane.

MATLAB R2025b

HOME PLOTS APPS Search (Ctrl+Shift+Space)

New Script New Live Script New Open Find Files Import Data Save Workspace Clean Data Clear Workspace

FILE VARIABLE CODE SIMULINK ENVIRONMENT RESOURCES

OneDrive > adm-chemical engineering > 2025 events >

Command Window

>> Press **Ctrl** + **Shift** + **P** to generate code with Copilot

Copilot Chat

Hello! Copilot is here to answer your questions, help write and explain code, and even identify code issues. Learn more about [Copilot](#).

Aycan

create a plot to visualize temperature profile in a 1-D rectangular object with end temperatures of T1=300 and T2=10. The object is of length L.

Copilot

To visualize the temperature profile in a 1-D rectangular object with end temperatures ($T_1 = 300$) and ($T_2 = 10$) over a length (L), you can use MATLAB's plotting functions. Below is a complete code example that demonstrates how to create this plot:

```
% Define parameters
L = 10; % Length of the object
T1 = 300; % Temperature at one end
T2 = 10; % Temperature at the other end

% Create a linear space for the length of the object
x = linspace(0, L, 100); % 100 points from 0 to L

% Calculate the temperature profile (linear interpolation)
```

Ask Copilot

Validate generated output before use.

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 displays the MATLAB AI Chat Playground interface. At the top, there are navigation tabs: MATLAB Help Center, Community, and Learning. Below these are sub-tabs: MATLAB Answers, File Exchange, Cody, AI Chat Playground (selected), Discussions, Contests, Blogs, and More. A 'New' button is visible on the left. The main content area is divided into two panels. The left panel shows a chat conversation with a user named Aycan Hacioglu asking for help with interfacing an Arduino with a photoresistor. The right panel shows a MATLAB code editor with a pre-generated script for reading voltage from a photoresistor and detecting color changes based on voltage. The code includes comments and is ready to be run. At the bottom of the chat panel, there is a text input field labeled 'Enter prompt here' with a dropdown arrow, a green AI icon, and a send button. Below the input field, there is a small disclaimer about validating generated output and a link to the MathWorks Privacy Policy.

MATLAB Help Center Community Learning

MATLAB Answers File Exchange Cody AI Chat Playground Discussions Contests Blogs More

+ New

Learn about MATLAB Copilot

AH Aycan Hacioglu

I want to interface my Arduino with a photoresistor to detect the color change of a color changing reaction. Help me write a MATLAB code for that and tell me the steps to take to deploy it onto Arduino.

AI

To interface your Arduino with a photoresistor to detect color changes, you can use MATLAB to read the analog values from the photoresistor. Below are the steps and a complete code example to help you get started.

Steps to Deploy MATLAB Code to Arduino

Enter prompt here

Validate generated output before use. [About](#)

Code is shared with affiliates, partners, or service providers in accordance with the MathWorks [Privacy Policy](#).

CODE ANALYZE RUN

```
1 % Create Arduino object
2 a = arduino('COM9', 'Uno'); % Change 'COM9' to your Arduino port
3
4 % Define the pin connected to the photoresistor
5 photoresistorPin = 'A0';
6
7 % Loop to continuously read the value
8 while true
9     % Read the voltage from the photoresistor
10    voltage = readVoltage(a, photoresistorPin);
11
12    % Display the voltage value
13    fprintf('Photoresistor Voltage: %.2f V\n', voltage);
14
15    % Add your logic to detect color change based on voltage
16    if voltage < 1.0
17        disp('Color change detected!');
18    end
19
20    pause(1); % Pause for a second before the next reading
21 end
22
```

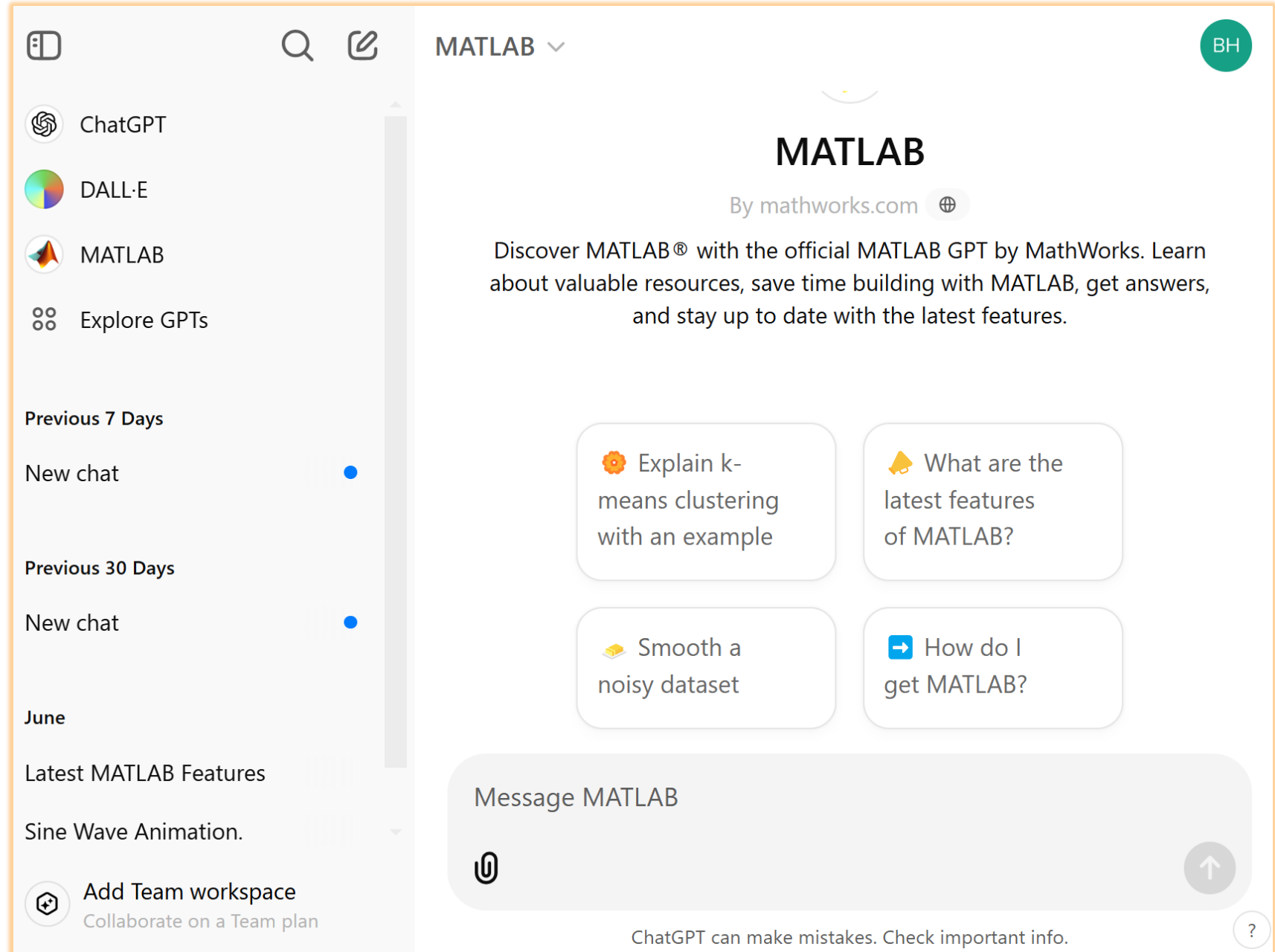
Copy Download

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



The screenshot shows the MATLAB GPT interface within the ChatGPT application. On the left is a sidebar with a search icon, a share icon, and a dropdown menu labeled 'MATLAB'. Below this are icons and labels for 'ChatGPT', 'DALL·E', 'MATLAB', and 'Explore GPTs'. A scrollable list of chat history is visible, with sections for 'Previous 7 Days' (containing one 'New chat'), 'Previous 30 Days' (containing one 'New chat'), and 'June' (containing 'Latest MATLAB Features' and 'Sine Wave Animation.'). At the bottom of the sidebar is a button to 'Add Team workspace' with the subtext 'Collaborate on a Team plan'. The main content area is titled 'MATLAB' with a subtitle 'By mathworks.com'. It contains a paragraph: '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.' Below this are four suggested prompts in rounded rectangles: '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 is a text input field labeled 'Message MATLAB' with a paperclip icon on the left and a send button on the right. A disclaimer at the very bottom states 'ChatGPT can make mistakes. Check important info.' with a help icon.

MATLAB

By mathworks.com

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.

Explain k-means clustering with an example

What are the latest features of MATLAB?

Smooth a noisy dataset

How do I get MATLAB?

Message MATLAB

ChatGPT can make mistakes. Check important info.

Example: Revising a Past Assignment

I have Last year's Assignment (in PDF)

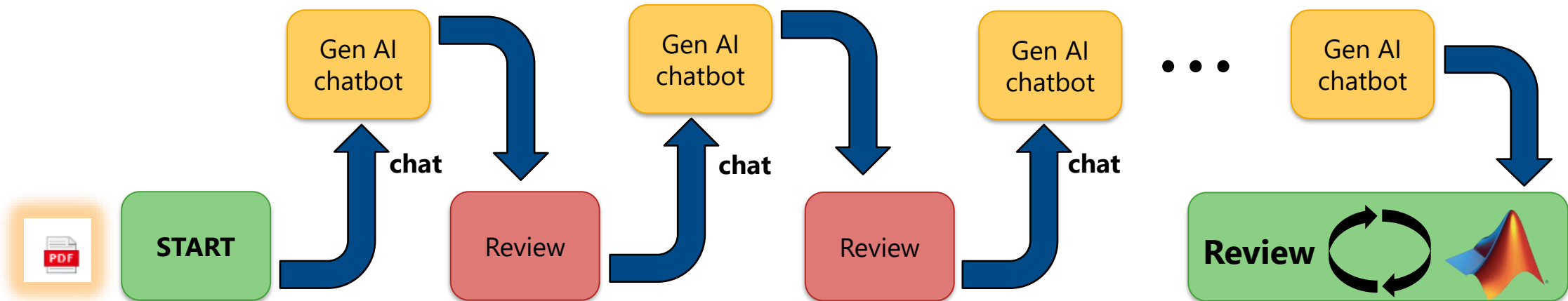
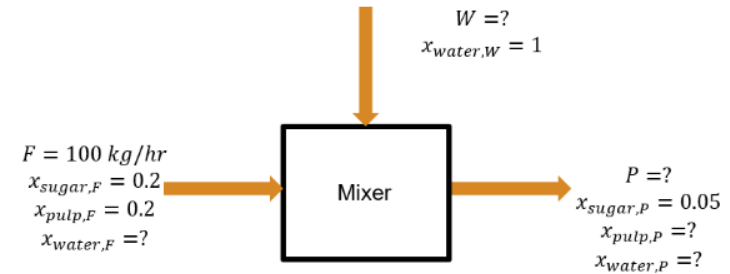
I want **MATLAB GPT** to help me with

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

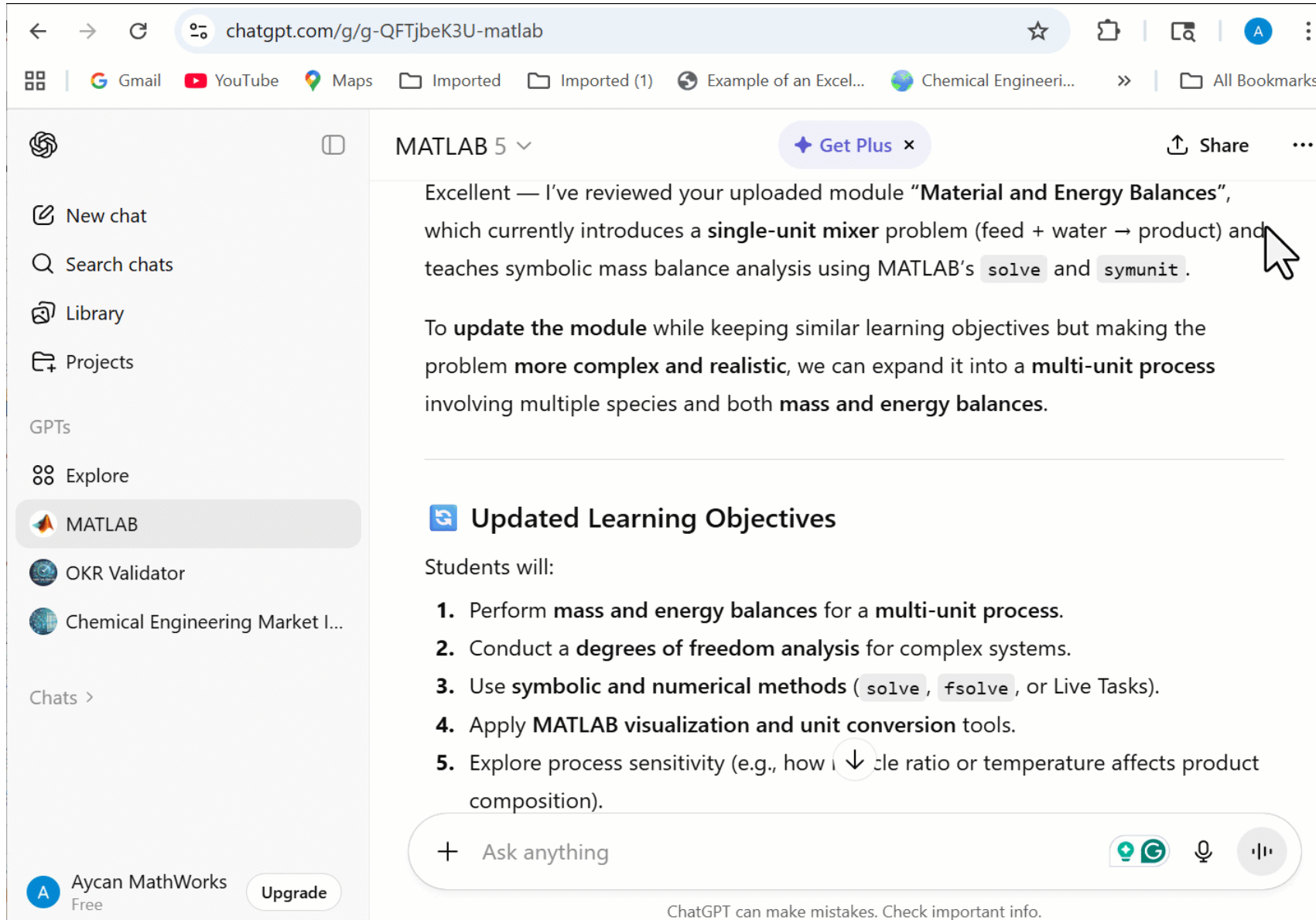
Mass Balance Problem Statement

In an orange juice plant, a feed stream, F of $100 \frac{\text{kg}}{\text{hr}}$ is fed to a mixer. The feed stream consists of 20 wt% sugar, 20 wt% pulp and the balance is water. 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



The screenshot shows a web browser window with the URL `chatgpt.com/g/g-QFTjbeK3U-matlab`. The browser's address bar and tabs are visible at the top. The ChatGPT interface has a sidebar on the left with options like 'New chat', 'Search chats', 'Library', 'Projects', 'GPTs', and 'Explore'. The 'MATLAB' GPT is selected. The main chat area shows a conversation with 'MATLAB 5'. The chat history includes a message from the user and a response from MATLAB GPT. The response discusses updating a course module titled 'Material and Energy Balances' by expanding it into a multi-unit process. Below the response, there is a section titled 'Updated Learning Objectives' with a list of five tasks for students. At the bottom of the chat area, there is a text input field with the placeholder 'Ask anything' and a 'Send' button. The bottom of the browser window shows a footer with the text 'ChatGPT can make mistakes. Check important info.'

chatgpt.com/g/g-QFTjbeK3U-matlab

Gmail YouTube Maps Imported Imported (1) Example of an Excel... Chemical Engineeri... All Bookmarks

MATLAB 5 [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 **↓** cle ratio or temperature affects product composition).

[+](#) Ask anything   

ChatGPT can make mistakes. Check important info.

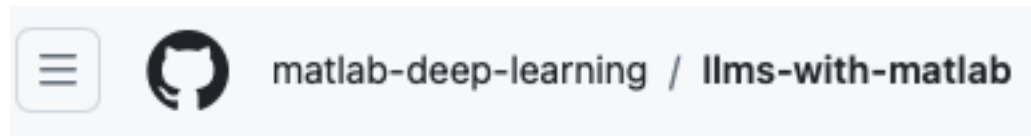
Using Large Language Models (LLMs) in MATLAB

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)

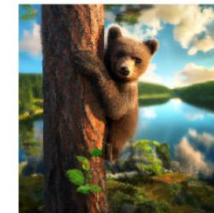
- Includes 10 Real-world examples
- Live Scripts include output for demos
- Supported by the Text Analytics Toolbox Team



<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
```



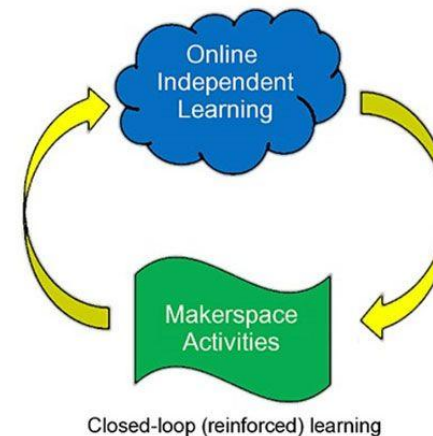
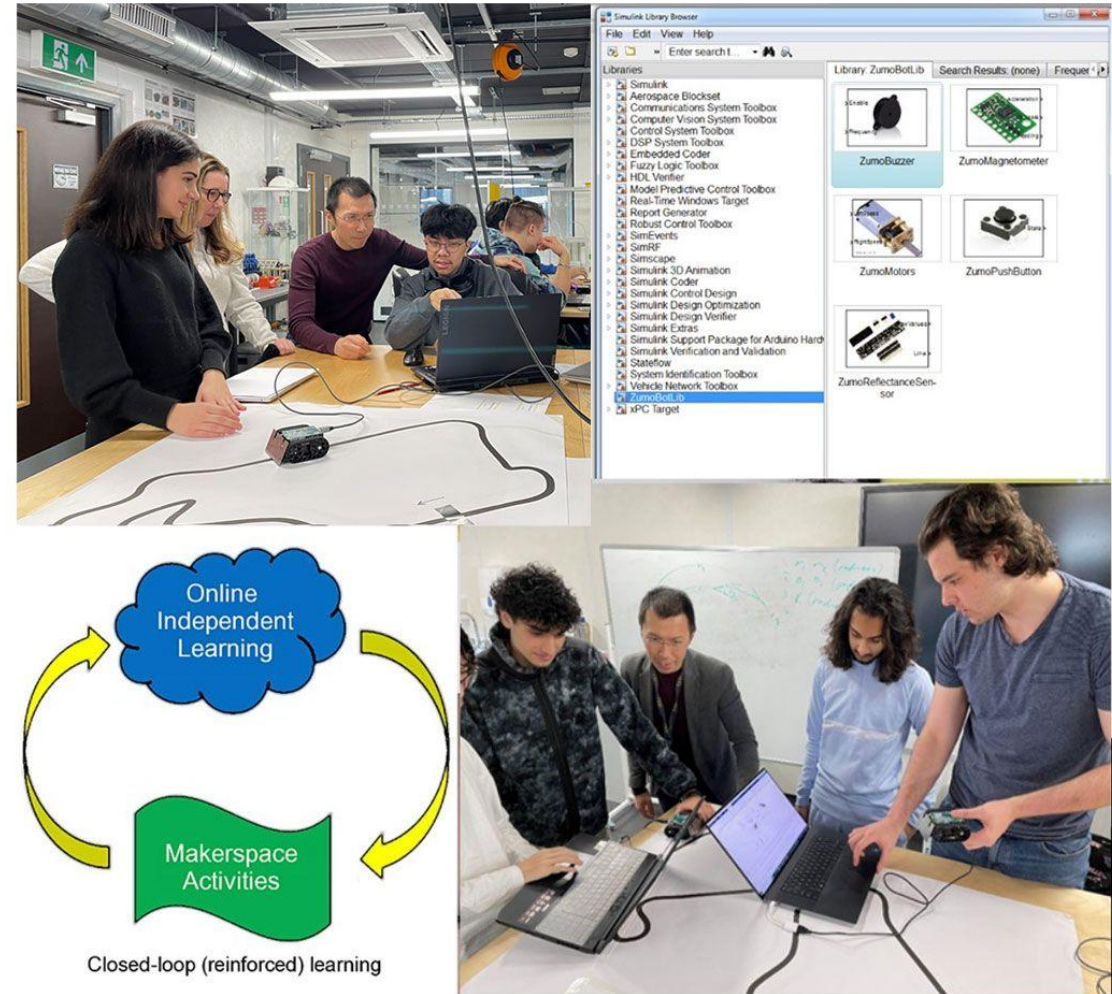
Using DALL·E™ to Create Images

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

Teach with MATLAB and Simulink

Search Courseware Courseware

Overview Teach Learn Research Student Programs

Featured Courseware

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

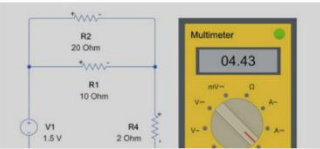
Virtual Labs

Featured Courseware

Virtual Labs

Interactive Examples

Publisher



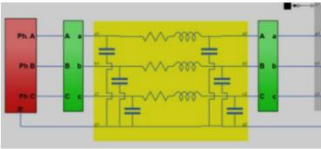
ELECTRICAL ENGINEERING

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

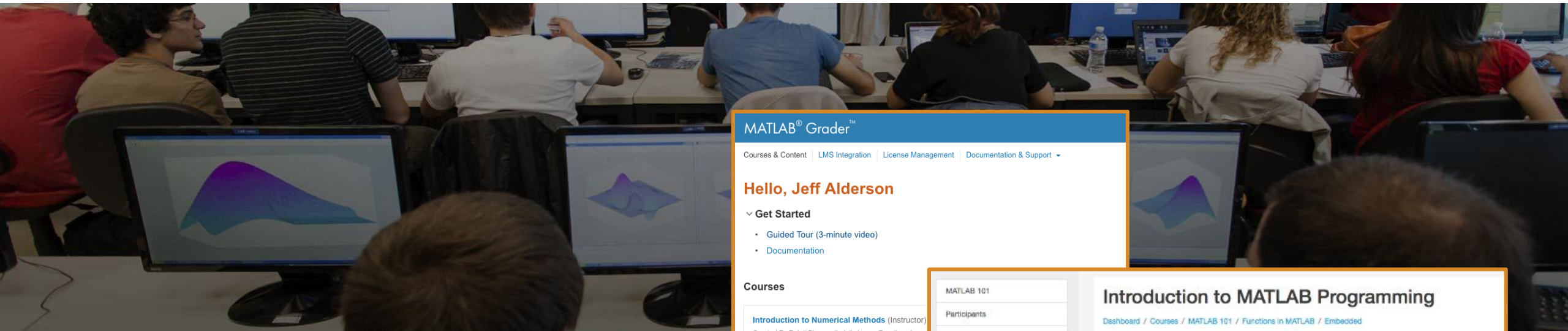
Douglas Jussaume, University of Tulsa

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



Create interactive course assignments



Automatically grade student work and provide feedback



Run your assignments in any learning environment

A screenshot of the MATLAB Grader web interface. At the top, it says 'MATLAB Grader' with navigation links for 'Courses & Content', 'LMS Integration', 'License Management', and 'Documentation & Support'. Below this is a personalized greeting 'Hello, Jeff Alderson' and a 'Get Started' section with links for 'Guided Tour (3-minute video)' and 'Documentation'. The 'Courses' section lists three courses: 'Introduction to Numerical Methods', 'Copy of Introduction to Programming', and 'Example Problems', each with details on creator, duration, and problem/student counts. There are 'ADD COURSE' and 'ADD PROBLEM' buttons. The 'Content' section has a description and an 'ADD PROBLEM' button. A sidebar on the right contains a menu with options like 'MATLAB 101', 'Participants', 'Badges', 'Competencies', 'Grades', and various toolboxes.

A screenshot of a specific assignment page in MATLAB Grader. The title is 'Introduction to MATLAB Programming'. The breadcrumb trail is 'Dashboard / Courses / MATLAB 101 / Functions in MATLAB / Embedded'. The assignment is titled 'Problem 1a: Estimating the value of Pi using Leibniz Series'. It explains the Leibniz series expansion and provides the formula $\pi/4 \approx 1 - 1/3 + 1/5 - \dots = \sum_{k=1}^n \frac{(-1)^{k+1}}{2k-1}$. It asks the user to write a script to estimate Pi using 100 terms. Below the text is a code editor with a template script:

```
estPi % Value of n estimated using 100 terms in the series.  
1 nTerms = 100; % Number of terms to be used in the series expansion  
2  
3 % <Enter your code here>  
4  
5 estPi = ; % Estimated value of Pi for 'N' values.
```

 At the bottom right is a 'Run Script' button.

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.

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



MATLAB Grader Jeff Alderson

CONTENTS Close

Courses & Content | LMS Integration | License Management | Documentation & Support

CSU Demo > Week 1 Homework >

Untitled Problem

< Back to Add Problem | **Introduction to Programming** Close x

Vector Creation (Leibniz series terms) Copy

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?

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>