A05 · MATLAB Arrays and Scripts

Introduction

Assignment Goals

This assignment will give you experience working with matrices and will allow you to format and run a MATLAB script with an engineering context.

Successful Completion

This assignment has two (**2**) problems.

1. Read *Notes Before You Start*, on **Page 1**.
2. Be familiar with the course programming standards; all programs in the class are expected to follow these standards.
3. Read each problem carefully. You are responsible for following all instructions within each problem.
    a. The deliverables list within each problem contains everything you are expected to submit.
    b. You will need the problem generator **A05_skills.p** for problem 1.
4. Complete the problems using the problem-specific templates when a template is provided in the assignment download.
5. For any file, replace *template* or *login* in the filename with your Purdue Career Account login.

    Example: `A05Prob1_context_template.m` will be renamed `A05Prob1_context_pboilerm.m` for a student whose Career Account login is pboilerm.
6. Review your work using the learning objective evidences.
7. When your work is complete, confirm your deliverables are submitted to Gradescope.
    a. You can resubmit your work as many times as you want; only the final submission will be graded.
    b. Do **NOT** upload any document not listed in the deliverables. Do not upload temporary versions of m-files (*.m~ or *.asv) – these files will be ignored by Gradescope.
2. Late submissions will be accepted up to 24 hours after the due date and will result in a 25% penalty.

Learning Objectives & Grading

This course uses learning objectives (LOs) to assess your work. You can find a full list of the course LOs here. Review the grading outline at the end of each problem in this assignment to see each problem's LOs.

Notes Before You Start

Helpful MATLAB Commands

Learn about the following built-in MATLAB commands, which might be useful in your solutions:

`sum`

Document, Test, Debug, and Finalize Your Code

- Comment your code **while you are coding, not afterwards**. It is easy to forget what each line of code represents if you delay commenting and waiting until the end to add comments increases the time you will spend on commenting.
- Re-save, run, and debug your code often, preferably after each new line or closely related 2-5 new lines of code are added. This allows you to identify the true location of problems more easily. MATLAB identifies the first line of code that fails, but the actual error could be on any previous line.
- Suppress printing of code that is functioning properly. Only formatted displays should be printed in the Command Window once your code is functional.
- Ensure your script will run when the Workspace is empty. A properly functioning script should contain all the necessary commands within the script itself. Be careful if you test commands or store variables in the Workspace that are not created from the script. To test your final code, clear the Workspace completely and then run the script from the command prompt. Only variables created by your script should remain in the Workspace and no errors appear in the Command Window.

Gradescope

You will submit all your deliverables to Gradescope for grading. View the Gradescope help for online assignments if you need assistance with submitting your work.

- You can resubmit to Gradescope as many times as you need. Only your final submission is graded.
- If you cannot copy-paste into Gradescope, then you may need to refresh or update your browser. Use Google to find a solution for your specific browser.

Need to access Gradescope?

1. Log into Brightspace and open your ENGR 132 course.
2. Click **Content** from the black menu ribbon at the top of the page.
3. Click **Gradescope** from the Table of Contents in the left sidebar.
4. Click the top item, which is a link that will open your section's Gradescope course.
5. Select the assignment you are ready to submit.

Be careful to name your deliverables correctly before you submit them. Submit all the files requested. Do not include files not listed in the deliverables.

Opening Gradescope through Brightspace will auto-enroll you in the Gradescope course for your section. You can access Gradescope through Brightspace throughout the semester.

Problem 1: Matrix Manipulation

Introduction

This problem allows you to practice array indexing and concatenation of arrays. You will perform all the commands in the Command Window. Be sure to follow any extra instructions in Gradescope as well.

Problem Generator Information

If you have questions about how to use the problem generator, review this link that shows step-by-step instructions.

File Name	PUID	Problem Number
A05_skills	Your 8-digit PUID	1

Submission

Gradescope Assignment	A05 – All Problems	Assignment Type	Individual
Deliverables	☐ Requested information and solutions		

Problem

This problem has six (6) steps. You will start by creating a simple matrix and will then use array indexing and concatenation to revise the matrix.

1. Enter the problem generator function call into the MATLAB Command Window prompt. This will generate a large amount of instruction text.
2. Read the written instruction text that appears in the Command Window. Each step requires completion of the step before it. For each step:
    a. Write the required command(s) to complete the steps. Read and follow any extra instructions provided in Gradescope.
    b. Work through the steps in order.
    c. Where applicable, assign the result to the variable name stated in the instruction text.
    d. You will only submit the commands to Gradescope, not any numeric results. You should never hardcode values from the matrix into a command, but you can hardcode index values and coefficient values.
    e. You may find it helpful to save your commands to Gradescope after each step.
3. Submit your instruction text with run receipt and solutions into Gradescope. Follow any extra instructions that appear in Gradescope.
4. Save your answers in Gradescope. See this video for help (this is an untimed assignment).

Grading

LOs: PC05, MAT02, MAT03

Point value: 8 points. The partial credit may be more specific than what is in the course LOs and is based on evidence MAT02(3), MAT03 (1) and (2).

You must meet the PC05 expectations for each question. If you do not meet these, you will lose additional credit.

Evidence	Penalty
PC05 (1)	Lose full credit on problem
PC05 (2)	Lose 25% of full credit on problem
PC05 (3)	Lose 25% of full credit on problem
PC05 (8)	Lose 10% of full credit on problem

Problem 2: Anti-reflective Coating

Introduction

Good programming standards allow you to keep your code well-organized, easy to interpret, and more flexible. Practice making a provided script follow good programming standards.

Submission

Gradescope Assignment	A05 – All Problems	Assignment Type	Individual
Deliverables	☐ A05Q2_ARcoating_*login*.m		

Problem

Nighttime drivers who wear eyeglasses can experience glare from the light of other vehicles. A chemical engineer has developed an anti-reflective coating for eyeglasses that improves the issue of glare by increasing the amount of light transmitted through the lenses of eyeglasses. The engineer started a script to perform the calculations necessary to determine the intensity of light passing through a coated lens and a non-coated lens. This information will allow the engineer to understand how well the coating works.

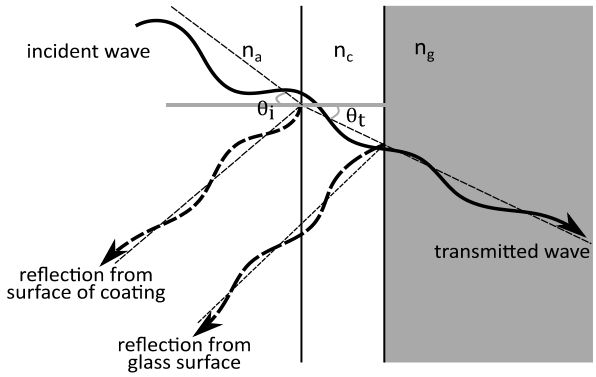
You have been given an m-file named **A05Q2_ARcoating_template.m** that contains the engineer's script in a standard ENGR 132 template. The script does not follow good programming standards, but you can assume that all calculations within script are correct and that the script functions as expected (i.e., no need to debug).

You must reformat the script to make it follow good programming standards. You may need to create new variables or change variable names within calculations. Do not change anything within the `fprintf` statements.

Read the following context to understand the values and equations within the script.

Context

The schematic below shows an incident wave travelling through air, with majority of the wave being transmitted through the lens and part of it being reflected through two surfaces, the surface of the reflective coating and the surface of the glass. The chemical engineer wants to calculate the transmitted intensity through the eyeglasses with the coating ($T_{coating}$) and compare it to the light transmitted without the coating ($T_{nocoating}$). The higher the transmitted intensity, the lower the glare on the eyeglasses with a transmitted intensity of 1 meaning that all the light is transmitted and there is no glare. For simplicity, we are assuming the angle of the transmitted wave, θ_t, to be unchanged between the coating and glass.



The chemical engineer uses the equations below to calculate the percentage of transmitted light with and without the coating.

With coating

$$R_{coating} = \left(\frac{n_c \cos\theta_i - n_a \cos\theta_t}{n_c \cos\theta_i + n_a \cos\theta_t} - \frac{n_g \cos\theta_i - n_c \cos\theta_t}{n_g \cos\theta_i + n_c \cos\theta_t}\right)^2$$

$$T_{coating} = 1 - R_{coating}$$

Without coating

$$R_{nocoating} = \left(\frac{n_g \cos\theta_i - n_a \cos\theta_t}{n_g \cos\theta_i + n_a \cos\theta_t}\right)^2$$

$$T_{nocoating} = 1 - R_{nocoating}$$

Where,

n_a is the refractive index of air (unitless)

n_g is the refractive index of glass (unitless)

n_c is the refractive index of the coating (unitless)

θ_i is the incident angle in deg

θ_t is the transmitted angle in deg

$R_{coating}, R_{nocoating}$ is the reflected intensity with and without coating respectively (unitless)

$T_{coating}, T_{nocoating}$ is the transmitted intensity with and without coating respectively (unitless)

The incident angle is taken to be 45 degrees and the transmitted angle is 33 degrees. The refractive index of the coating is 1.3, the refractive index of the glass used to make the lens in the eyeglasses is 1.8 and the refractive index of air is 1. The chemical engineer finds that the transmitted intensity with the coating is 0.999 and that without the coating is 0.958.

Instructions

1. Read and become familiar with the course Programming Standards.
2. Rename the template file to match the format in the Deliverables list.
3. Open the template file and examine the code. Run the script to see how it works and what it displays.
4. Reformat the script to make it follow good programming standards.
5. Rerun the script to ensure your changes did not affect the final display of the two transmitted intensity values (i.e., you did not introduce any errors into the code).
6. Submit your final m-file to Gradescope. See this video for help (this is an untimed assignment).
    a. Submit **only** your m-file solution. Do not include extra files.

Grading

LOs: PC05, MAT01, MAT08

Point value: 7 points. Partial credit is possible; see the LO table below for details. You must meet the PC05 expectations. If you do not meet these, you will lose additional credit.

LO Table

Evidence	PC05	MAT01	MAT08
(1)	-100%	0.84	0
(2)	-25%	0	0.7
(3)	0	0.56	0.7
(4)	-15%	0.84	0
(5)	0	0.84	0
(6)	0	0.84	0
(7)	0	0.84	0
(8)	-10%	0.84	0

Grading Process