Problem Set 10 · Complex Loops

Instructions

1. Use the answer sheet provided in the Assignment Files to complete this problem set. Fill out the header information. Follow any additional instructions that appear in the answer sheet. Submit your finished answer sheet with the rest of your deliverables.
2. You will need your PS07_academic_integrity function for this assignment. It must work properly.
3. Read each problem carefully before starting your work. You are responsible for following all instructions within each problem. Remember that all code submissions must follow the course programming standards.
4. Below are the expected deliverables for each problem.
    - Name your files to match the format in the table below.
    - Publish your code for each problem. See PS06 for more information.
    - Do not forget to include any data files loaded into your code.

Item	Type	Deliverable to include in Submission
Problem 1: Infinite Fin Revisit	Paired	☐ PS10_fin_revist_*login1*_*login2*.m ☐ PS10_fin_revist_*login1*_*login2*_report.pdf ☐ Flowchart (submitted in Answer Sheet)
Problem 2: Array Sorting	Individual	☐ PS10_sort_*yourlogin1*_*yourlogin2*.m ☐ PS10_sort _*yourlogin1*_*yourlogin2*_report.pdf ☐ Tracking Table (submitted in Answer Sheet)
PS10 Answer Sheet	Individual	☐ PS10_AnswerSheet_*yourlogin*.docx
Academic Integrity Statement	Individual	☐ PS07_academic_integrity_*yourlogin*.m

5. Save all files in a folder specific to PS10.
6. When you are ready to submit your assignment,
    - Compress all the deliverables into one zip file and name it **PS10_yourlogin.zip**. Be sure that you
        i. Only compress files using **.zip** format. No other compression format will be accepted.
        ii. Only include deliverables. Do **not** include the problem document, blank templates, etc.
    - Submit the zip file to the Blackboard drop box for PS10 before the due date.
7. After grades are released for this assignment, access your feedback via the assignment rubric in the My Grades section of Blackboard.

Problem 1: Infinite Fin Revisit

Paired

Learning Objectives

Below are learning objectives that may be used to assess your work on this problem. Learning objectives from past assignments may also be used to assess your work. Use the links to find the full evidence lists for each topic.

Calculations	01.00 Perform and evaluate algebraic and trigonometric operations
Variables	02.00 Assign and manage variables
Arrays	03.00 Manipulate arrays (vectors or matrices)
Import Data	06.00 Import numeric data stored in .csv and .txt files
User-Defined Functions	11.00 Create and execute a user-defined function
Selection Structures	16.00 Create and troubleshoot a selection structure
Repetition Structures	15.05 Construct a flowchart for a definite looping structure using standard symbols and pseudocode 15.09 Create test cases to evaluate a flowchart 15.10 Construct a flowchart using standard symbols and pseudocode 17.06 Code a definite looping structure
	17.03 Code an indefinite looping structure
Complex Structures	15.07 Construct a flowchart for nested structures using standard symbols and pseudocode
	19.04 Code nested looping structures that employ array indexing

Problem Setup

In PS08 Problem 2, you wrote code to determine the minimum length of a rod used to cool a heat source. For this problem, you change the function you wrote to accept different input arguments that will allow you to vary the rod diameter to determine the minimum length of a rod for a set of rod diameters.

Your new function must keep all the PS08 Problem 2 requirements but with the following changes:

- Accept 3 input arguments: minimum diameter value, maximum diameter value, and thermal conductivity value
- Add the heat source temperature and ambient air temperature as assigned variables within the code
- Increment the rod diameter by 0.5 mm
- Display the rod diameter along with its minimum length to the Command Window
- Return 1 output argument: a vector of minimum rod lengths for each rod diameter

Problem Steps

1. Reread PS08 Problem 2. Both you and your paired partner should have your own version of this code. Examine your solutions, select one file to use for this problem (you will need both the code and the flowchart), and based on the grading feedback, make any necessary corrections to the calculations and print commands.
2. Adapt your PS08 flowchart to make it include the new functionality required by this problem as well as any changes need from step 1.
3. Test your function by calling it with a minimum rod diameter of 1 mm to 10 mm for aluminium.

   Do not suppress your function call in the Command Window. This will allow the output argument display to the Command Window along with the printed display. Paste the function call and results displayed in the Command Window as comments under the `COMMAND WINDOW OUTPUTS` section of your function file.
4. Call your academic integrity function in the `ACADEMIC INTEGRITY` section.
5. Publish your function as a PDF file using any valid test case and name the file as directed in the deliverables list. Suppress your function call while publishing.

Problem 2: Array Sorting

Individual

Learning Objectives

Below are learning objectives that may be used to assess your work on this problem. Learning objectives from past assignments may also be used to assess your work. Use the links to find the full evidence lists for each topic.

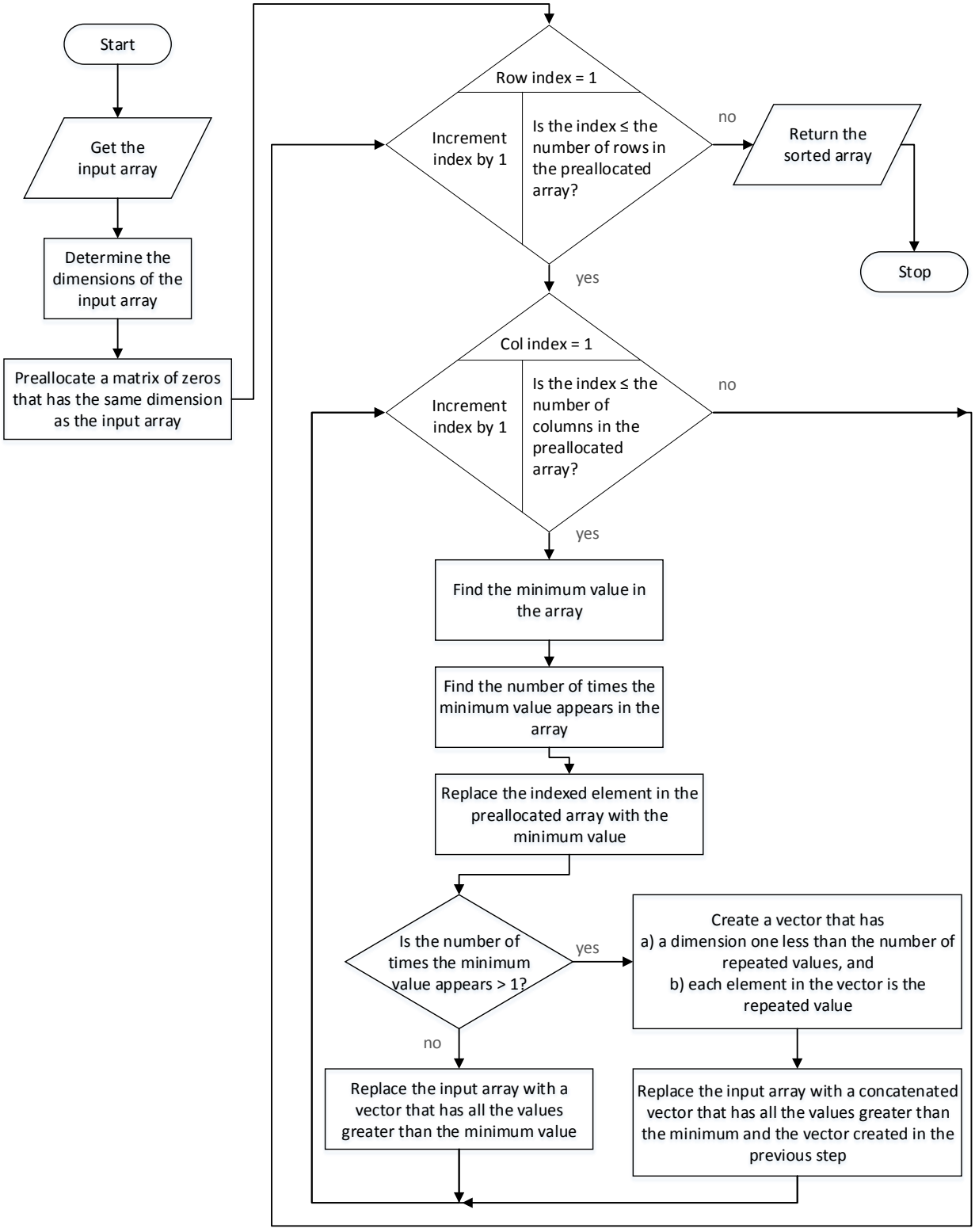
Calculations	01.00 Perform and evaluate algebraic and trigonometric operations
Variables	02.00 Assign and manage variables
Arrays	03.00 Manipulate arrays (vectors or matrices)
Import Data	06.00 Import numeric data stored in .csv and .txt files
User-Defined Functions	11.00 Create and execute a user-defined function
Selection Structures	16.00 Create and troubleshoot a selection structure
Repetition Structures	15.05 Construct a flowchart for a definite looping structure using standard symbols and pseudocode 15.09 Create test cases to evaluate a flowchart 15.10 Construct a flowchart using standard symbols and pseudocode 17.06 Code a definite looping structure
Complex Structures	15.07 Construct a flowchart for nested structures using standard symbols and pseudocode
	19.01 Convert between these nested structures representations: English, a flowchart, and code
	19.04 Code nested looping structures that employ array indexing

Problem Setup

There are many sorting algorithms in computer programming. MATLAB has some built-in sorting capabilities, but those commands may not always fit your needs. For this problem, you must rearrange the elements in an array so that the smallest value moves into is in the upper left corner of the array, the next smallest value moves to the first row second column, and so on until the largest value is in the lower right corner of the array, as shown in the example below:

$$A = \begin{bmatrix} 5 & 2 & -1 \\ 2 & 6 & 3 \\ 9 & -2 & 0 \end{bmatrix} \rightarrow A_{sorted} = \begin{bmatrix} -2 & -1 & 0 \\ 2 & 2 & 3 \\ 5 & 6 & 9 \end{bmatrix}$$

You must use the following flowchart to write a function that will accept an array of any size and sort it in the desired manner. Translate this specific flowchart into MATLAB code.


Start
Get the input array
Determine the dimensions of the input array
Preallocate a matrix of zeros that has the same dimension as the input array
Row index = 1
Increment index by 1
Is the index ≤ the number of rows in the preallocated array?
no
Return the sorted array
Stop
yes
Col index = 1
Increment index by 1
Is the index ≤ the number of columns in the preallocated array?
no
yes
Find the minimum value in the array
Find the number of times the minimum value appears in the array
Replace the indexed element in the preallocated array with the minimum value
Is the number of times the minimum value appears > 1?
yes
Create a vector that has
a) a dimension one less than the number of repeated values, and
b) each element in the vector is the repeated value
no
Replace the input array with a vector that has all the values greater than the minimum value
Replace the input array with a concatenated vector that has all the values greater than the minimum and the vector created in the previous step

Problem Steps

1. **Before you start to code**: Review the flowchart to understand the process for sorting the array.
2. In your Word answer sheet, complete the variable tracking table by hand for the execution of the nested loops using the provided input argument.
3. Translate the flowchart above to a MATLAB user-defined function using the proper template. Comment your code appropriately and follow the ENGR132 Programming Standards.
4. Test your function by calling it with the test case provided in Step 2. Add the following test cases:

   a. $B = [100 \quad -72 \quad 14 \quad 30 \quad 27]$

   b. $C = \begin{bmatrix} 2 & 0.5 & -5 & 3 & 6 \\ -5 & 4 & -3 & 4 & 6 \\ 8 & 2.5 & 1 & -2 & -1 \end{bmatrix}$

   Do not suppress the output when you call your function. Paste the function call and results displayed in the Command Window as comments under the `COMMAND WINDOW OUTPUTS` section of your function file.
5. Call your academic integrity function in the `ACADEMIC INTEGRITY` section.
6. Publish your function as a PDF file using any valid test case and name the file as directed in the deliverables list. Suppress your function call while publishing.