Problem Set 02 · Relational & Logical Operators

Instructions

1. Starting with PS02, you will publish your final MATLAB m-files to a PDF file.
    - Read the instructions for publishing scripts in the "MATLAB Publishing - Scripts" document, included in the PS02 Assignment folder, to learn how to format your code and how to publish.
    - If you encounter a problem with publishing, use "MATLAB Publishing - Common Issues", also included in the PS02 Assignment folder, to troubleshoot the issue.
2. 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.
3. Below are the expected deliverables for each problem.
    - Use problem-specific templates when provided.
    - Name your files to match the format in the table below.
    - Your deliverables must include your published code, your original m-file, and any data files required to execute your code.

Item	Type	Deliverable to include in Submission
Problem 1: Professional Engineering School	Individual	☐ PS02_PES_*yourlogin*.m ☐ PS02_PES_*yourlogin*_report.pdf ☐ Data_PES_survey_record.csv
Problem 2: Volcano Remote Sensing	Individual	☐ PS02_volcano_*yourlogin*.m ☐ PS02_volcano_*yourlogin*_report.pdf ☐ Data_volcano_list.csv
Problem 3: Weed Control in Crop Fields	Individual	☐ PS02_crop_weeds_*yourlogin*.m ☐ PS02_crop_weeds_*yourlogin*_report.pdf ☐ Data file loaded into your m-file

4. Save all files to your Purdue career account in a folder specific to PS02.
5. When you are ready to submit your assignment,
    - Compress all the deliverables into one zip file and name it **PS02_*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 PS02 before the due date.
6. After grades are released for this assignment, access your feedback via the assignment rubric in the My Grades section of Blackboard.

Notes Before You Start

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.

`find` Command in the MATLAB Editor

If you use the `find` command and edit your code within the MATLAB editor, you may find that MATLAB produces a warning on the lines with the find command. MATLAB may suggest that you use logical indexing, which allows you to use logical 1s and 0s to identify which values in a vector correspond to the 'true' condition. You can use either method, `find` or logical indexing, on this assignment. You should know how the `find` command works for exams.

Helpful MATLAB Commands

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

```
min, max, mean, length, sum, size, numel
```

Problem 1: Professional Engineering School

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.

Scripts	04.00 Create and execute a script
Variables	02.00 Assign and manage variables
Arrays	03.00 Manipulate arrays (vectors or matrices)
Text Display	05.00 Manage text output
Import Data	06.00 Import numeric data stored in .csv and .txt files
Relational & Logical Operators	14.00 Perform and evaluate relational and logical operations
	14.02 Employ relational operators with arrays (scalars, vectors, matrices)
	14.03 Employ order of operations to perform calculations, comparisons, and logical operations
	14.05 Employ comparison functions with vectors and matrices: find
	14.06 Employ logical operations with arrays (scalars, vectors, matrices)

Problem Setup

You are a recruiter for a large corporation who participates in Purdue's Industrial Roundtable (IR). Your company hires interns in its civil engineering, electrical engineering, and mechanical engineering departments. You want to learn more about the types of first-year engineering (FYE) students who express an interest in an internship with your company so that you can improve your recruiting.

After speaking with FYE students at IR, you ask them to complete a simple survey that asks them to state their Purdue GPA and to rank the professional engineering school or schools they might be interested in attending. They can choose between Civil Engineering (CE), Electrical & Computer Engineering (ECE), and Mechanical Engineering (ME). They will rank their first choice as 1, their second choice as 2, their third choice as 3, and 0 if they are not interested in the school.

The survey produces a text file for you to analyze. **Data_PES_survey_record.csv** contains

- a 4-digit survey identification number for each entry
- an indication of interest by the student for each school (0, 1, 2, or 3 as specified above)
- the student's overall GPA.

Your task is to create a script that will use relational and logical operators and MATLAB built-in functions to answer the following questions about the data. Note that "indicated an interest in" a school means that a student gave the school a 1, 2, or 3 in the survey.

A. What are the row indices of the students who failed to select any school?

B. How many students failed to select any school?

C. How many students indicated an interest in only one school?

D. What is the minimum GPA of the students who indicated an interest in both ECE and CE but not ME?

E. What are the survey identification numbers of the students who indicated an interest in all three schools?

F. How many students indicated that their first choice was CE and their third choice was ME?

G. Counting only the students who indicated interest in ECE, what was the average level of interest in ECE?

H. What is the average GPA of the students whose GPA is higher than 3.5 and who selected either ECE or ME as their first choice?

Problem Steps

1. Open the script **PS02_PES_template.m** file. Complete the header information. Save your script with the name format required by the deliverables list.
2. Import the data into MATLAB using appropriate commands. Do **NOT** change the data file in any way before you load it into MATLAB.
3. Write the code to answer the questions in the Problem Setup.
4. Print your results for questions B, C, D, and G to the Command Window using professionally formatted text displays. Do not hardcode any numeric values in your fprintf statements. Your print display should answer **only questions B, C, D, and G**.

   Suppress your calculations using semicolons at the end of each line of code. The only information displayed to the Command Window should be output from your fprintf statements.
5. Publish your script as a PDF and name it as required in the Deliverables List.

Problem 2: Volcano Remote Sensing

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.

Scripts	04.00 Create and execute a script
Variables	02.00 Assign and manage variables
Arrays	03.00 Manipulate arrays (vectors or matrices)
Text Display	05.00 Manage text output
Import Data	06.00 Import numeric data stored in .csv and .txt files
Relational & Logical Operators	14.00 Perform and evaluate relational and logical operations
	14.02 Employ relational operators with arrays (scalars, vectors, matrices)
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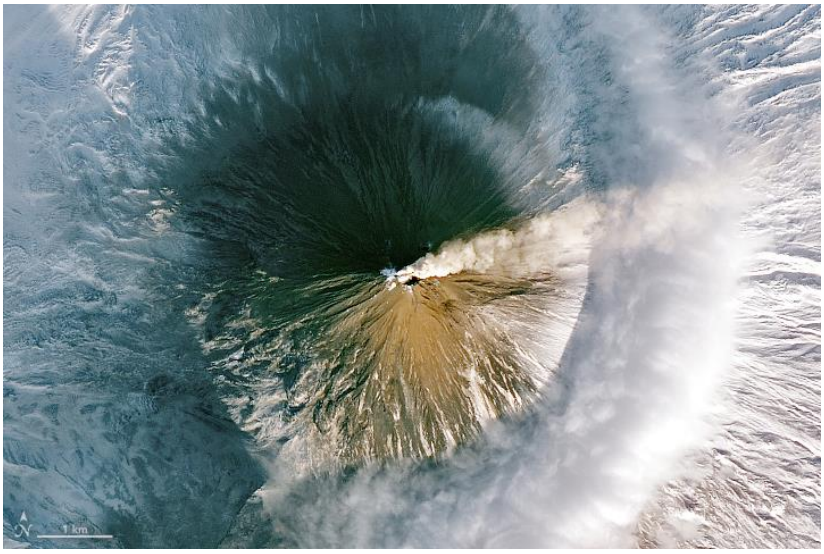
	14.05 Employ comparison functions with vectors and matrices: find
	14.06 Employ logical operations with arrays (scalars, vectors, matrices)

Problem Setup



Volcanic activity is constant on Earth. Some active volcanoes regularly cause local seismic activity, emit gasses and particulates, and change shape over time. Other volcanoes are quiet until undergoing rapid changes before an eruption. Eruptions can have significant local and global consequences. Nearby communities are at risk from the direct effects of an eruption. Gasses and particulates sent into the atmosphere can stop air travel and can temporarily change global climate. Understanding volcanic activity may help aid eruption predictions and preparedness.

One tool for monitoring volcanoes is via remote sensing. You are a data processing engineer working with a team of volcanologists who want to repurpose old high-altitude imaging data to learn more about past volcanic activity. The team has given you a file, named **Data_volcano_list.csv**, that contains volcano type, name, country, latitude, longitude, and elevation above sea level for volcanoes from around the world.

You need to help the science team understand what data you can provide for their list of volcanoes. You know the limitations of the old imaging data, as shown in Table 1.

Table 1. Imaging data limitations, listed by instrument that collected the data.

Instrument	Limitations
ACP-1	Images limited to latitudes within -39.5 to 39.5 decimal degrees, inclusive
VII	Images show elevations higher than 2500 m at latitudes less than or equal to 0 decimal degrees
MASC	Some images lost due to equipment malfunction. Recovered images in the following longitude ranges: • 100 to 145 decimal degrees, inclusive of 100 but not 145 • -140 to -120 decimal degrees, inclusive of -120 but not -140
PoLAR Viewer	Images limited to latitudes 50 decimal degrees or higher.

You must write a MATLAB script that can answer the following:

A. How many volcanoes are visible in the PoLAR Viewer images and what is their average elevation?

B. How many stratovolcanoes are visible in the VII images and what is the minimum and maximum elevation found in the stratovolcanoes visible to VII?

C. How many stratovolcanoes and how many non-stratovolcanoes are visible in the ACP-1 images?

D. How many stratovolcanoes are visible in the MASC images and what is their average elevation?

Do **NOT** change the data file in any way before you load it into MATLAB.

Problem Steps

1. Open the script **PS02_volcanoes_template.m** file. Complete the header information. Save your script with the name format required by the deliverables list.
2. Write a script that allows you to answer each of the questions in the Problem Setup.
3. In the `FORMATTED TEXT DISPLAYS` section, display your answers to questions A, B, C, and D in the Command Window using professionally formatted text displays. Do not hardcode any values in your fprintf statements.

   Suppress your variable assignments and calculations using semicolons at the end of each line of code. The only information displayed to the Command Window should be output from your fprintf statements.
4. Publish your script as a PDF and name it as required in the Deliverables List.

Reference: http://volcano.oregonstate.edu/volcano_table

Image: https://earthobservatory.nasa.gov/IOTD/view.php?id=91568

Problem 3: Weed Control in Crop Fields

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.

Scripts	04.00 Create and execute a script
Variables	02.00 Assign and manage variables
Arrays	03.00 Manipulate arrays (vectors or matrices)
Text Display	05.00 Manage text output
Import Data	06.00 Import numeric data stored in .csv and .txt files
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	14.06 Employ logical operations with arrays (scalars, vectors, matrices)

Problem Setup

Another use for remote sensing is in agriculture. Weeds can cause significant harm to crops. Weeds compete with the crop plants for soil resources and light. If weeds outgrow the crop plants, particularly when the crops are early in the growing cycle, then the weeds can kill the crop plants. Farmers can use herbicides to control weeds; however, weeds become resistant to herbicides over time, herbicides can have other environmental effects, and herbicides have production costs. Limiting the use of herbicides is beneficial to both the farmers and the consumers.

You are an agricultural engineer working on a weed control method that maps farm fields using remote sensing and then indicates the prevalence of weeds within the present vegetation. The method divides a farm field into square “field pixels”. Each field pixel has a weed percentage from 0-1. A 0 means that 0% of the crop plants are covered by weeds in that pixel. A 1 means that 100% of the crop plants are covered by weeds in the pixel. Eventually, your team wants to be able to help farmers identify the sections of their fields with weeds, so that farmers can target weed treatments at only the parts of the field that need it.

Using a research field, your team created the vegetation map that indicates the weed prevalence. They also created a data file from the map that contains each plot’s weed percentage. That data is in the text file **Data_weed_percent_fieldA152nF.txt**.

Your task is to create a script that can answer the following questions about the field:

A. How many field pixels are in the data set?

B. Which **column** has the highest **average** weed percent, and what is its average weed percent?

C. Weed percentages of less than 15% at this point in the growing cycle mean the crop plants are dominant. How many field pixels are in this category, and what is the average weed percentage in the crop-dominant pixels?

D. Weed percentages in the range of 75-95%, inclusive of both, require urgent weed treatment. How many field pixels are in this category?

E. Any pixel with a weed percentage greater than 95% require a person to visually inspect the pixel. What pixel locations, using row and column indices, require visual inspection?

Problem Steps

1. Open the script **PS02_crop_weeds_template.m** file. Complete the header information. Save your script with the name format required by the deliverables list.
2. Import the data into MATLAB using appropriate commands.
3. Write the code to answer the questions in the Problem Setup.
4. Print your results to the Command Window using professionally formatted text displays. Do not hardcode any numeric values in your fprintf statements. Your print display should answer questions A-E.

   Suppress your variable assignments and calculations using semicolons at the end of each line of code. The only information displayed to the Command Window should be output from your fprintf statements.
5. Publish your script as a PDF and name it as required in the Deliverables List.