22437 - Industrial Vision
Lab 1: Introduction to Matlab and the Image Processing Toolbox

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Matrices and Matlab

Before beginning this lab, READ the first thirteen chapters of the Matlab's quick start guide[1]. For obtaining information about the functions available in Matlab to work with matrices, use the following command:

```
>> help elmat
```

Now perform the tasks written below. These tasks should be solved, in most cases, using only one Matlab command:

1. Create a 5×5 matrix of ones (A).
2. Create a 5×3 matrix of ones (B).
3. Create a 3×3 matrix of zeros (C).
4. Create a 4×4 matrix with equal row, column, and diagonal sums (D).
5. Create a 4×4 random matrix whose values are uniformly distributed between 0 and 1 (E).
6. Create a 5×5 identity matrix (F).
7. Sum the matrices A and F.
8. Subtract the matrices A and F.
9. Sum the matrices A and C. Is it possible?.
10. Compute D^{20}.
11. Compute $F \times 2$.
12. Compute $A \times F$.
13. Compute $A \times F$, element by element.
14. Compute the transpose matrix of E.
15. Compute the inverse matrix of E.
16. Compute the determinant of matrix C.
17. Store the size of matrix B in two variables, $rows$ and $cols$.
18. Given the matrix F, obtain the linear indices of the elements whose value is not zero. Hint: $find$
19. Set the detected values in the previous point to -1.

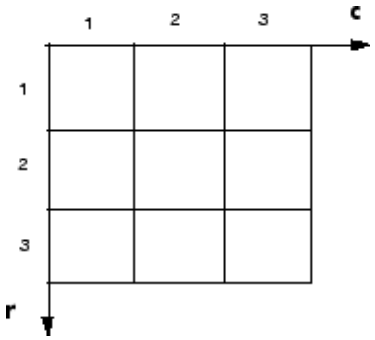
[1] https://es.mathworks.com/help/matlab/getting-started-with-matlab.html

20. Given those indices, transform them to subscripts (row and column).
21. Use those indices to set to -2 all positions in the matrix that are just above a value equal to -1 (except in row 1).
22. Given a 10×10 matrix, set the values of the even columns to zero.
23. Create a 10×10 matrix where the values of each row coincide with the row number.
24. Given a 10×10 matrix, set the values of the fourth row to zero.
25. Given a 10×10 matrix, set the values of the second column to zero.
26. Given a 10×10 matrix, set the values of the fifth column to the values of the first column.
27. Given a 10×10 matrix, set all the values to zero, except the rows and columns in the edges of the matrix.

Introduction to Image Processing Toolbox

Useful functions: *imread*, *imwrite*, *im2double*, *mat2gray*, *rgb2gray*, *mesh*, *surf*, *gray2ind*.

A gray-scale image can be defined as a two-dimensional function $f(x, y)$, where x and y are called *spatial coordinates*, and the value of f at each pair (x, y) is called the *intensity* of the image at this point. In Matlab, a digital image can be represented as a matrix, where each element of this array is called *picture element*, or *pixel*. The coordinate conventions are defined as:

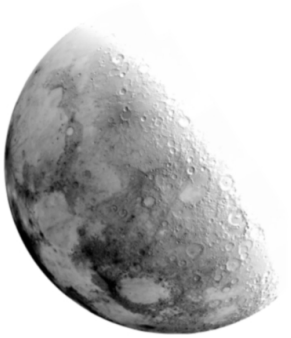


where r and c are the row and column numbers, respectively. Note that the indices start from 1 and not 0 like other programming languages. For a reference on image handling in Matlab, use the following command:

```
>> help images
```

Perform the following tasks using Matlab:

1. Open and display the image *landscape.jpg*. Determine the dimensions of the image. Is this a color image?
2. Convert the image to grayscale, and display the result. Then, save this resulting image into another file called *landscapegray.jpg*. What is the data type of the pixels?
3. Rescale the pixel values to the range [0, 1] and convert the image to *double* precision.
4. Display the gray scale image as a three-dimensional plot. Compare the results using two functions: *mesh* and *surf*.
5. Convert the gray scale image to an indexed image with a colormap of 16 components and display the result. Do you observe differences between the original and the indexed images?
6. Write a Matlab script for generating the negative of the image *moon.bmp*. First of all do it using nested loops, and then using the matlab's ability to perform vectorized operations. The final results should look like this:



7. Write a Matlab script which flips the image *moon.bmp* vertically. Don't use nested loops. Use only subscripting. Have a look to functions like $flipud$ or $fliplr$, but don't use them this time. The final result should look like this: