

Practical 4 - Nested Loops and 2D Vectors

- Due 19 Aug by 23:59
- Points 20
- Submitting an external tool

This practical exercise is to be prepared for in your own time and in your computer exercise class.

These questions are intended to be completed **individually** but you are allowed to consult other resources to answer generic questions that help you complete small parts of each question.

Please consult the **rubric** of this practical assignment for information on the marking scheme.

For this exercise you must:

1. Complete the exercises below. Do what you can prior to class and come into class to have questions answered.
2. Prior to the due-date submit your answers (MATLAB scripts and text files) via this assignment link in Gradescope.
3. You can choose to have your tutor mark you in person (recommended for feedback) in your practical or workshop session

This week's topic

This week's topic is working with 2D arrays and nested loops using images. The exercises below require you to compose and transform images, represented as 2D arrays using nested loops. Before you start this week's exercise you should make a folder called:

```
week4practice
```

to put all of the scripts and testing files described below.

Preparation

Save the following code into a MATLAB script called `makeImage.m`:

```
% make a 2d array of values.
imageData = []; % set up an empty array
imSize = 100;
numRows = imSize;
numCols = imSize;

%populate using a nested loop
for row=1:numRows
    imageRow = []; %empty vector for row
    for col = 1:numCols
        pixelVal = uint8((row+col)/(imSize*2) * 255); % make a pixel val in 0..255
        imageRow = [imageRow pixelVal]; %add value for pixel
    end
    imageData = [imageData; imageRow]; % add row of pixels
```

```
end

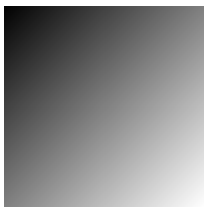
% display as an image
imshow(imageData);

% save as an image
imwrite(imageData,'test.png');

% load an image
newImageData = imread('test.png');

% print information about what is stored in the variable
whos newImageData;
```

The code above makes a 100 by 100 pixel image that is dark in the top left corner and diagonally shades to light in the bottom right corner like so:



<https://myuni.adelaide.edu.au/courses/95033/files/15473304/download?wrap=1>

it then saves the image into a png file called test.png.

Before continuing, spend time to understand why this image is generated. What is the value stored in the top left (row 1, column 1)? What is the value stored in the bottom right (row 100, column 100)? What value represents black? What value represents white? What row and column numbers would you expect to be exactly half black and half white? What value is stored at those row and column numbers?

uint8() converts the value to the smallest amount of storage needed to store 256 different values (0...255). You MUST convert your pixel values to uint8() before storing them in your matrix.

In the questions below you are to create a range of different images using nested for loops and 2D arrays. Each question consists of a problem definition. A test section describing how the image should look and a code specification.

IMPORTANT Submission Notes

Submit your .m files and the .png files **saved by your script**.

- Do **NOT** save and submit the pop-up images as these will differ from your saved files.
- All file names used in the submission and code must exactly match those specified in this practical.

Question 1

Problem Definition

Write a MATLAB script that uses nested loops to create a 100 by 100 element 2D array representing an image that shades from black at the top to white at the bottom. Your script

should save the image in a file called test1.png.

Testing

The image file produced should be shaded from black at the top of the image to white at the bottom of the image like so:



Coding

Write your code in a MATLAB script called q1.m and save it into your week4practice folder.

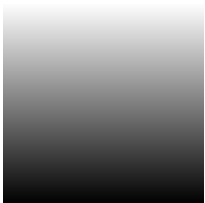
Question 2

Problem Definition

Write a MATLAB script that uses nested loops to create a 100 by 100 element 2D array representing an image that shades from white at the top to black at the bottom. Your script should save the image in a file called test2.png.

Testing

The image file produced should be shaded from white at the top of the image to black at the bottom of the image like so:



Coding

Write your code in a MATLAB script called q2.m and save it into your week4practice folder.

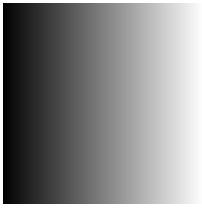
Question 3

Problem Definition

Write a MATLAB script that uses nested loops to create a 100 by 100 element 2D array representing an image that shades from black at the left of the image to white at the right of the image. Your script should save the image in a file called test3.png.

Testing

The image file produced should be shaded from black at the left of the image to white at the right of the image like so:



Coding

Write your code in a MATLAB script called q3.m and save it into your week4practice folder.

Question 4

Problem Definition

Write a MATLAB script that uses nested loops to create a 100 by 100 element 2D array representing an image that shades from white at the left of the image to black at the right of the image. Your script should save the image in a file called test4.png.

Testing

The image file produced should be shaded from white at the left of the image to black at the right of the image like so:



Coding

Write your code in a MATLAB script called q4.m and save it into your week4practice folder.

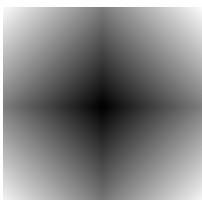
Question 5

Problem Definition

Write a MATLAB script that uses nested loops to create a 100 by 100 element 2D array representing an image that shades from white at the image edges to black in the image centre (see image below). Your script should save the image in a file called test5.png.

Testing

The image file produced should shade from white at the image edges to black in the image centre. Any image that graduates colour continuously from light at the edges to black in the centre is acceptable. An image that comes from one simple implementation is:



Coding

You can implement this code by making the pixel intensity increase with distance from the centre of the image. Think of how you might measure this distance for rows and columns. Write your code in a MATLAB script called q5.m and save it into your week4practice folder.

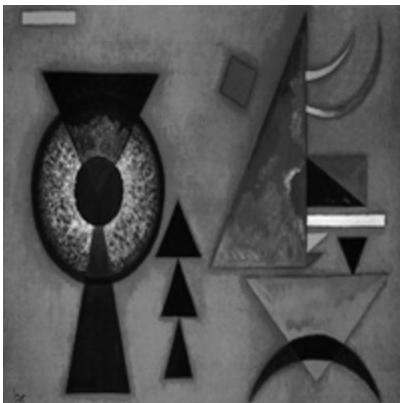
Question 6

Problem Definition

Download the following image file: [Kand.png](https://myuni.adelaide.edu.au/courses/95033/files/15473304/download?wrap=1)

(<https://myuni.adelaide.edu.au/courses/95033/files/15473304/download?wrap=1>)

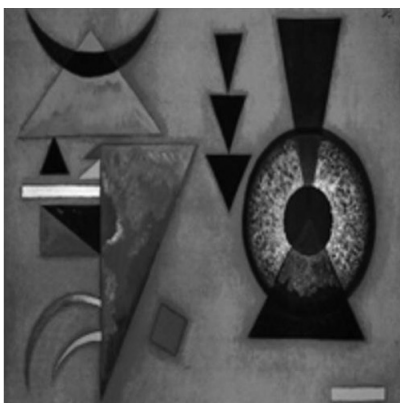
(https://myuni.adelaide.edu.au/courses/95033/files/15473304/download?download_frd=1) This file is a greyscale image of a Kandinsky painting:



Write a MATLAB script that uses for-loops to build a 2D array to make a version of this image that is flipped both vertically and horizontally and save it into a file called **KandFlipped.png**.

Testing

The output image should be the same size but flipped both horizontally and vertically like so:



Coding

There are several ways to implement this program but one way is to experiment with loop ranges. Save your code in a MATLAB script file called q6.m.

End of Questions.

Assesment

Submit your **MATLAB files AND your generated image files**

Marks are awarded for

- **functionality** (the code runs and produces expected results - 2 marks per question) - 12 marks
- **style** 4 marks (the code adheres to [MATLAB Style Guidelines](https://myuni.adelaide.edu.au/courses/95033/files/15473409?wrap=1) (<https://myuni.adelaide.edu.au/courses/95033/files/15473409?wrap=1>)_ (<https://myuni.adelaide.edu.au/courses/95033/files/15473409/download>)_ for this practical we will be assessing adherence to:
 - **Naming Conventions**: for variables (all sections **other than** Structures, Functions.
 - **Statements**: sections Variables and Constants and Loops,
 - **General**: sections *before* "Use the natural, straightforward form for logical expressions".
 - **Layout, Comments and Documentation** : all aspects other than those that mention *functions*
- **testing** 4 marks - image files uploaded

This tool needs to be loaded in a new browser window

Load Practical 4 - Nested Loops and 2D Vectors in a new window

