

ENGG1003 - Friday Week 9

Scripts For Loops Matrix Indexing

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Scripts

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 - ▶ It sounds easier, right?
 - ▶ Very low barrier to entry
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 - ▶ It sounds easier, right?
 - ▶ Very low barrier to entry
 - ▶ Very fast to get results
 - ▶ Useless for non-trivial problems
- ▶ Scripts are used for multiple reasons:
 - ▶ They are necessary for realistic problems
 - ▶ They can be modified and re-executed
 - ▶ They can be reused by other people

Comments

- ▶ MATLAB comments start with a % symbol and end at a new line
- ▶ Comment guidelines:
 - ▶ Describe the script's purpose, inputs, and outputs at the top
 - ▶ Comment any lines which aren't "obvious"
 - ▶ Yes, this depends on the audience

Scripts And Scalar Arithmetic Example

- ▶ Example: (From last year's slides) Write a MATLAB script which calculates the rate at which the Sun loses mass due to nuclear fusion
- ▶ Data required:
 - ▶ $E = mc^2$
 - ▶ Sun's energy output: $E = 385 \times 10^{24}$ J/s
 - ▶ Speed of light: $c = 3.0 \times 10^8$ m/s

For Loops

- ▶ The MATLAB for loop syntax is:

```
for <loop variable> = [1D array of numbers]
    % Loop contents
end
```

- ▶ The [1D array of numbers] can be an array or declared in the for statement
- ▶ Each element of the 1D array gets allocated to <loop variable> once
- ▶ Run some examples...

1D Array Indexing

- ▶ Element indexing follows this general rule:
 - ▶ `name(list of elements)`
- ▶ The list is, itself, a 1D array
 - ▶ It can be a single number
 - ▶ eg: `a(2)`
 - ▶ You can create it using `[]` concatenation syntax
 - ▶ This can be hard-coded numbers or other variables
 - ▶ eg: `a([1 4 8])`
 - ▶ It can be a list of **integers** created with `A:B:C`
 - ▶ eg 1: `a(1:10)`
 - ▶ eg 2: `a(1:2:10)` % Every 2nd element
- ▶ Things can get complicated *fast*

Multi-Dimensional Indexing

- ▶ MATLAB dimensions are named:
 - ▶ Row
 - ▶ Column
 - ▶ Page
- ▶ The indexing syntax is:
 - ▶ `name(row, column, page)`
- ▶ A good visualisation is in the MATLAB documentation: <https://au.mathworks.com/help/matlab/math/multidimensional-arrays.html>

Dimensional Indexing Notes

- ▶ 1D arrays can be row or column vectors
 - ▶ The indexing is still always in the form $a(n)$
 - ▶ Indexing does not make a distinction between row and column vectors
 - ▶ Arithmetic *does*

Dimensional Indexing Notes

- ▶ 1D arrays can be row or column vectors
 - ▶ The indexing is still always in the form `a(n)`
 - ▶ Indexing does not make a distinction between row and column vectors
 - ▶ Arithmetic *does*
- ▶ There are special syntaxes we can use when indexing:
 - ▶ Index all elements with `a(:)`
 - ▶ Useful with multi-dimensional arrays
 - ▶ eg: `a(:, [2 3])`
 - ▶ When lengths are unknown you can use the `end` keyword
 - ▶ eg: `a(2:end)`

Example - Image Analysis and Editing

- ▶ Perform the greyscale assessed lab task in MATLAB with a real image
- ▶ Shrink the image by a factor of 1/10th along each axis while developing code
- ▶ Knowledge:
 - ▶ Images are read with `imread()`
 - ▶ Colour images stored as a 3D array
 - ▶ Indexing: `var(row,column,[r g b])`
 - ▶ `var(0,0,:)` is the top left pixel
 - ▶ Image data can be displayed with `image()`
 - ▶ 2D data will be displayed with a false colour map
 - ▶ Greyscale display needs custom map
- ▶ Do it live with loops and vectorization

More Examples

- ▶ Simple bightness adjustment
 - ▶ Couple of methods:
 - ▶ Add or subtract a constant value to each RGB value in each pixel
 - ▶ Apply a *transfer function*. This needs a sketch...
- ▶ Contrast adjustment
 - ▶ This applies a particular transfer function, will sketch
- ▶ All of the above can be applied to all channels equally or differently to the RGB channels