

Images in Matlab

L02

Goal: To look at how images are stored, especially in Matlab.

Storing Digital Images

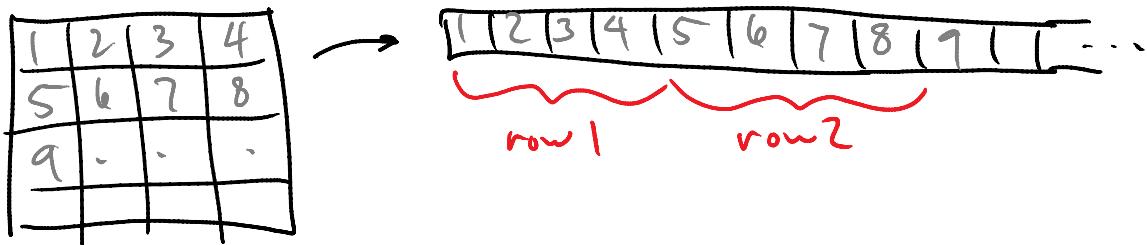
Images are just arrays of numbers

- 2D, 3D or higher.
- colour (3 images, one for each colour channel, Red, Green, Blue ... "R,G,B").

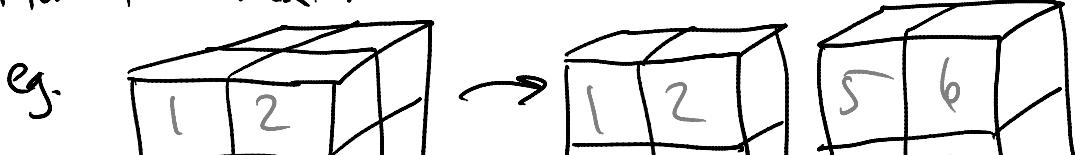
Each element of the array is called a "**pixel**", which comes from "**picture element**". For a 3D array (representing a volume), the elements are called **voxels**.

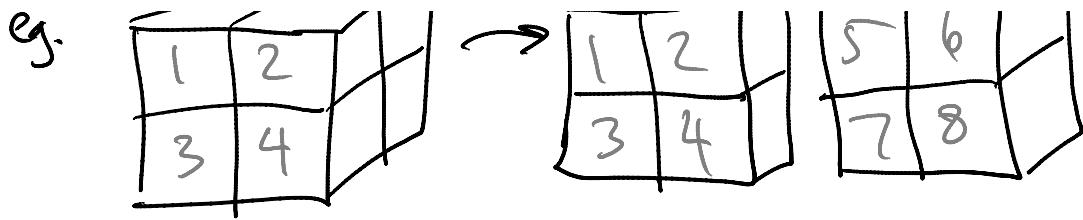
On disk, or in memory, the data is stored in a 1D array, so we need a convention to convert high-dim. arrays to 1D arrays

A common method:



Storing a volume is simply a matter of storing many consecutive 2D images (slices), one image after the next.





Hence, to read a volume into memory...

```

for z=1 to Z
    for y=1 to Y
        for x=1 to X
            f(x,y,z) ← read value
            next x
        next y
    next z

```

Colour

We will deal almost entirely with graylevel images in this course (one value per pixel/voxel).

However, some applications save graylevel images as colour images with 3 identical colour channels.

Be aware of this, and make sure you aren't inadvertently using colour data.

Matlab Coordinates

Something that makes coordinates awkward is the fact that Matlab indexes its arrays using **(row, col)** format (like one would when specifying an element of a matrix).

eg $f = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \\ 10 & 11 & 12 \end{bmatrix}$ element (2,3) is row 2, column 3 \Rightarrow 6

But if we think of f as an image in the xy-plane using (x,y) coordinates, then $(2,3)$ gives us 5.

Moreover, Matlab's indexing is **base-1** ... the 1st element in an array has index 1. In C and C++ (among others), indexing starts at 0.

We can think of these differences as a coordinate system transformation.

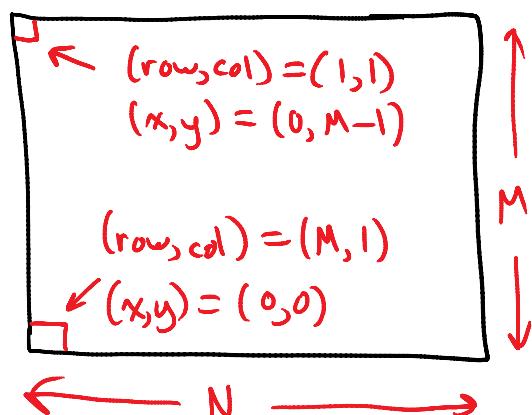
Coordinate System Transformations

It's not hard to see that we can convert between $(\text{row}, \text{col}) \leftrightarrow (x, y)$.

Suppose our image matrix has M rows and N cols.

$$\begin{cases} x = \text{col} - 1 \\ y = M - \text{row} \end{cases}$$

$$\begin{cases} \text{row} = M - y \\ \text{col} = x + 1 \end{cases}$$



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