Outline

- Introduction to MATLAB
  - Basics & Examples
- **Image Processing with MATLAB**
  - **Basics & Examples**

What is the Image Processing Toolbox?

- The Image Processing Toolbox is a collection of functions that extend the capabilities of the MATLAB's numeric computing environment. The toolbox supports a wide range of image processing operations, including:
  - Geometric operations
  - Neighborhood and block operations
  - Linear filtering and filter design
  - Transforms
  - Image analysis and enhancement
  - Binary image operations
  - Region of interest operations

Images in MATLAB

- MATLAB can import/export several image formats:
  - BMP (Microsoft Windows Bitmap)
  - GIF (Graphics Interchange Files)
  - HDF (Hierarchical Data Format)
  - JPEG (Joint Photographic Experts Group)
  - PCX (Paintbrush)
  - PNG (Portable Network Graphics)
  - TIFF (Tagged Image File Format)
  - XWD (X Window Dump)
  - raw-data and other types of image data
- Data types in MATLAB
  - Double (64-bit double-precision floating point)
  - Single (32-bit single-precision floating point)
  - Int32 (32-bit signed integer)
  - Int16 (16-bit signed integer)
  - Int8 (8-bit signed integer)
  - Uint32 (32-bit unsigned integer)
  - Uint16 (16-bit unsigned integer)
  - Uint8 (8-bit unsigned integer)

Images in MATLAB

- Binary images : {0,1}
- Intensity images : [0,1] or `uint8`, `double` etc.
- RGB images : m × n × 3
- Multidimensional images: m × n × p (p is the number of layers)

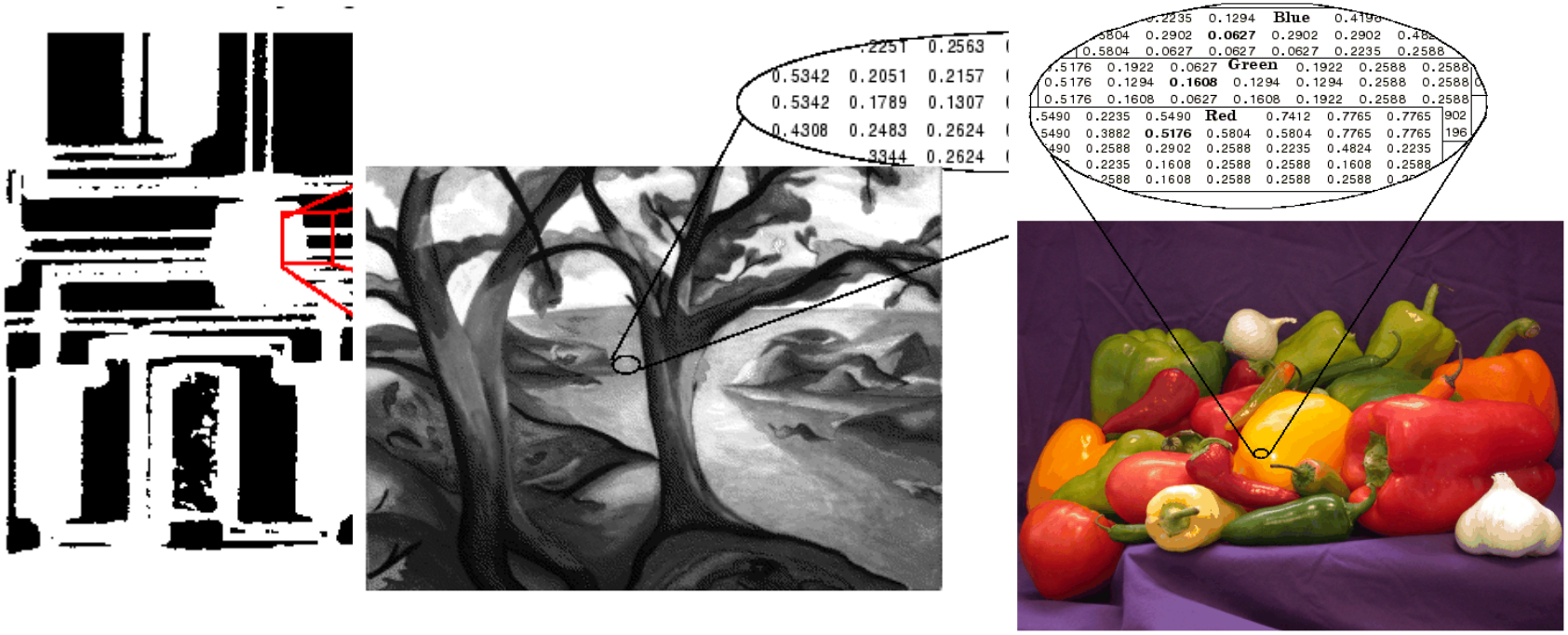


Image Import and Export

- Read and write images in Matlab

```
img = imread('apple.jpg');
dim = size(img);
figure;
imshow(img);
imwrite(img, 'output.bmp', 'bmp');
```

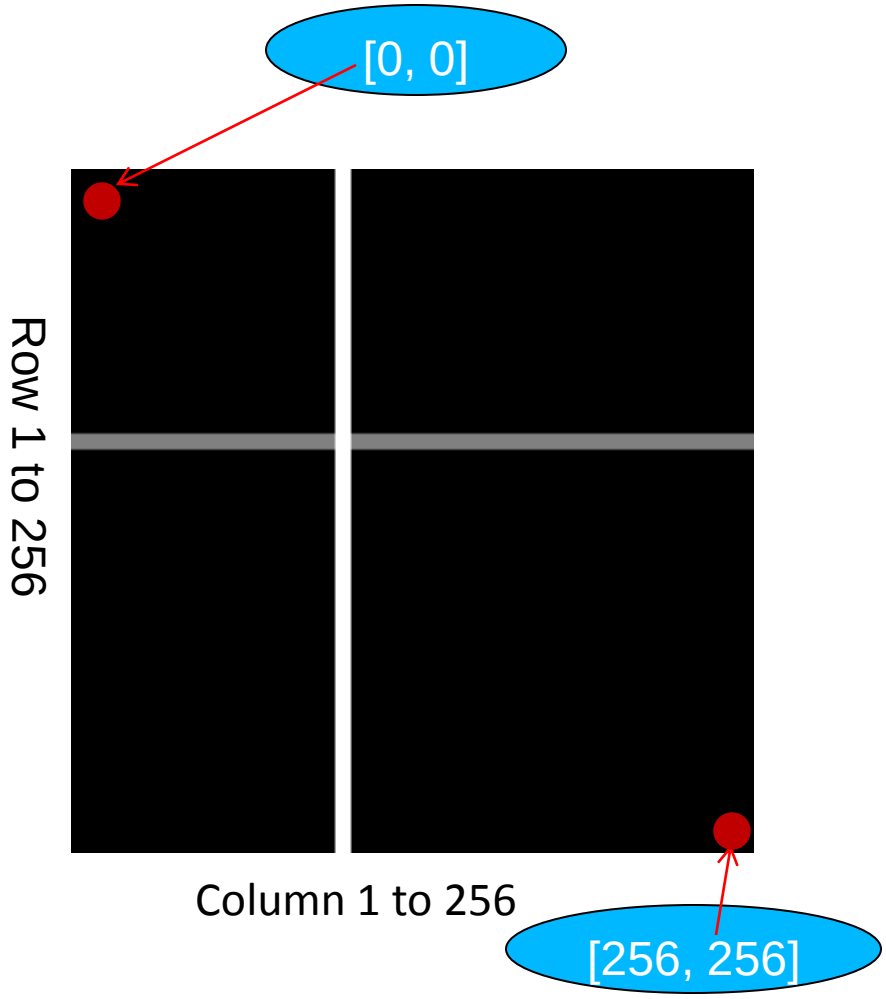
- Alternatives to `imshow`

```
imagesc(I)
imtool(I)
image(I)
```

Images and Matrices

How to build a matrix (or image)?
Intensity Image:

```
row = 256;
col = 256;
img = zeros(row, col);
img(100:105, :) = 0.5;
img(:, 100:105) = 1;
figure;
imshow(img);
```



Images and Matrices

Binary Image:

```
row = 256;
col = 256;
img = rand(row,
col);
img = round(img);
figure;
imshow(img);
```

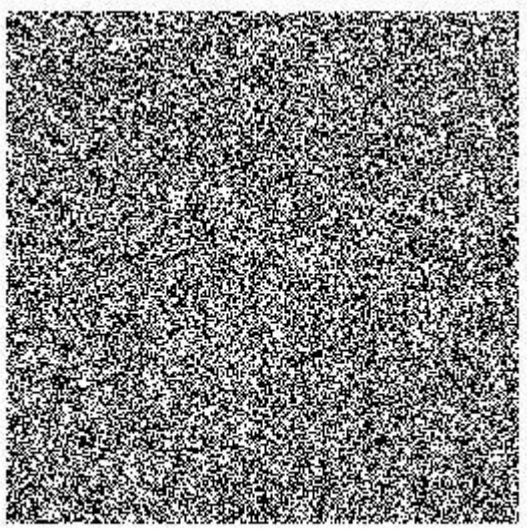


Image Display

- `image` - create and display image object
- `imagesc` - scale and display as image
- `imshow` - display image
- `colorbar` - display colorbar
- `getimage` - get image data from axes
- `truesize` - adjust display size of image
- `zoom` - zoom in and zoom out of 2D plot

Image Conversion

- `gray2ind` - intensity image to index image
- `im2bw` - image to binary
- `im2double` - image to double precision
- `im2uint8` - image to 8-bit unsigned integers
- `im2uint16` - image to 16-bit unsigned integers
- `ind2gray` - indexed image to intensity image
- `mat2gray` - matrix to intensity image
- `rgb2gray` - RGB image to grayscale
- `rgb2ind` - RGB image to indexed image

Image Operations

- RGB image to gray image
- Image resize
- Image crop
- Image rotate
- Image histogram
- Image histogram equalization
- Image DCT/IDCT
- Convolution