Multimedia Systems

Part 10

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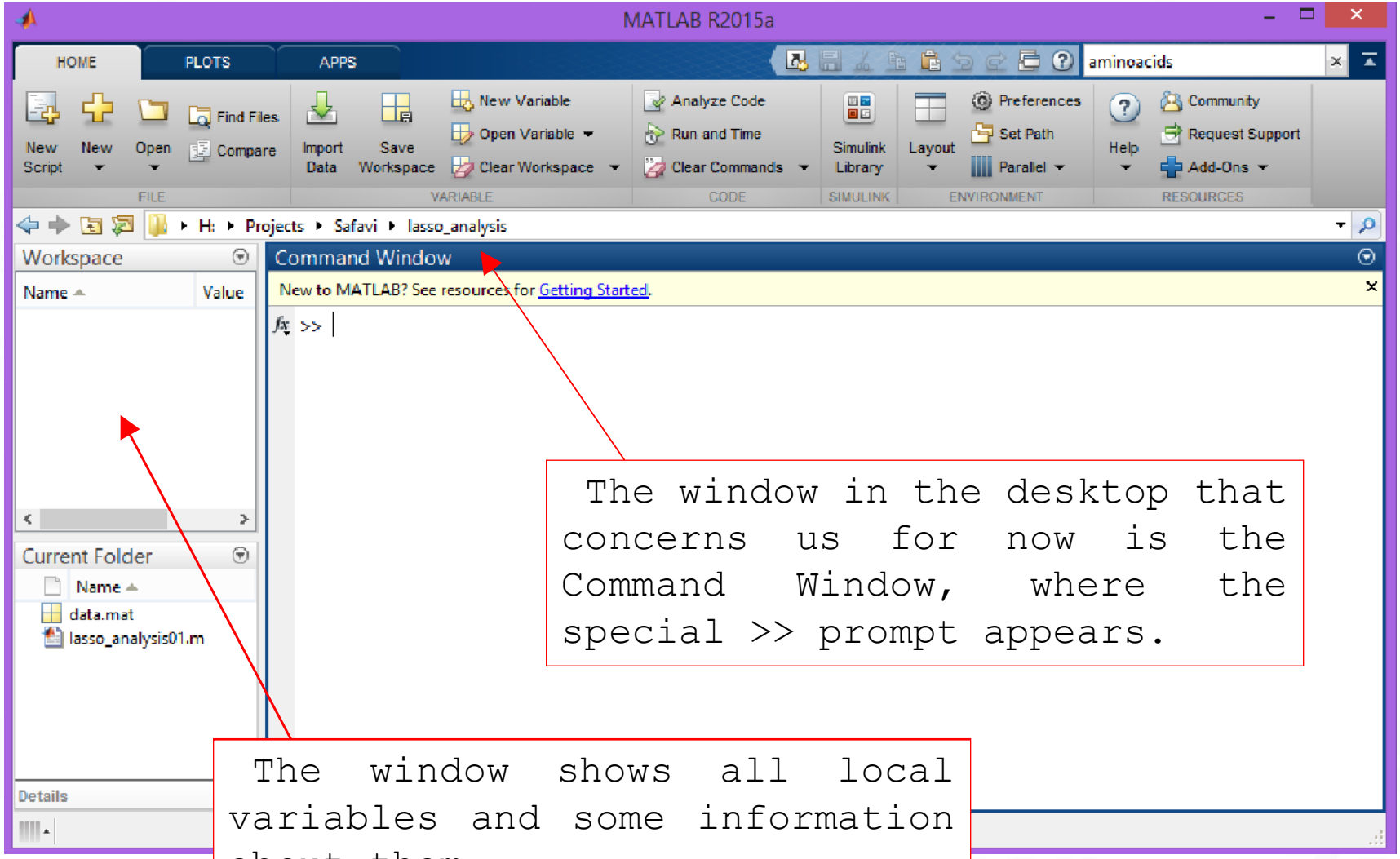
MATLAB

MATLAB, **MAT**rix **LAB**oratory, is a powerful, high level language and a technical computing environment which provides core mathematics and advanced graphical tools for data analysis, visualization, algorithm and application development.

- In MATLAB everything is a matrix
- Matrix operations are programmed so that Element-wise operations are more efficient than loops.

MATLAB - Basics



MATLAB - Basics

To create a matrix you can type its values directly:

```
>> x = [ 1 2 3 4 5 6 7 8 9 10 ];
```

Which is equivalent to:

```
>> x = 1:10;
```

It is possible to define the initial and final value and increment in the following way:

```
>> z = 0 : 0.1 :20;
```

Note that this would be different from:

```
>> y = [1;2;3;4;5;6;7;8;9;10];
>> y = [1:10]';
```

MATLAB - Basics

The product x*y would yield the inner product of the vectors, a single value, y*x would yield the outer product, a 10 x 10 matrix:

```
>> x*y
ans =
     385
>> x*x
??? Error using ==> *
Inner matrix dimensions must agree.
>> y*x
>> x.*x
```

MATLAB - Basics

The Matrix:

$$mat = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 3 & 4 & 5 \\ 3 & 4 & 5 & 6 \\ 4 & 5 & 6 & 7 \end{bmatrix}$$

can be obtained by typing:

```
>> mat = [1 2 3 4;2 3 4 5;3 4 5 6;4 5 6 7];
```

Any individual value of the matrix can be read by typing:

```
>> mat(2,2)
>> mat(2:4,1:2)
>> mat(4,:)
```

MATLAB - Basics

Mathematical functions can be used over the defined matrices, for example:

```
>> s1 = sin (z);
```

A column or line of a matrix can be obtained from another one:

```
>> s2(1,:) = -s1/2;
>> s2(2,:) = s1;
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MATLAB - Basics

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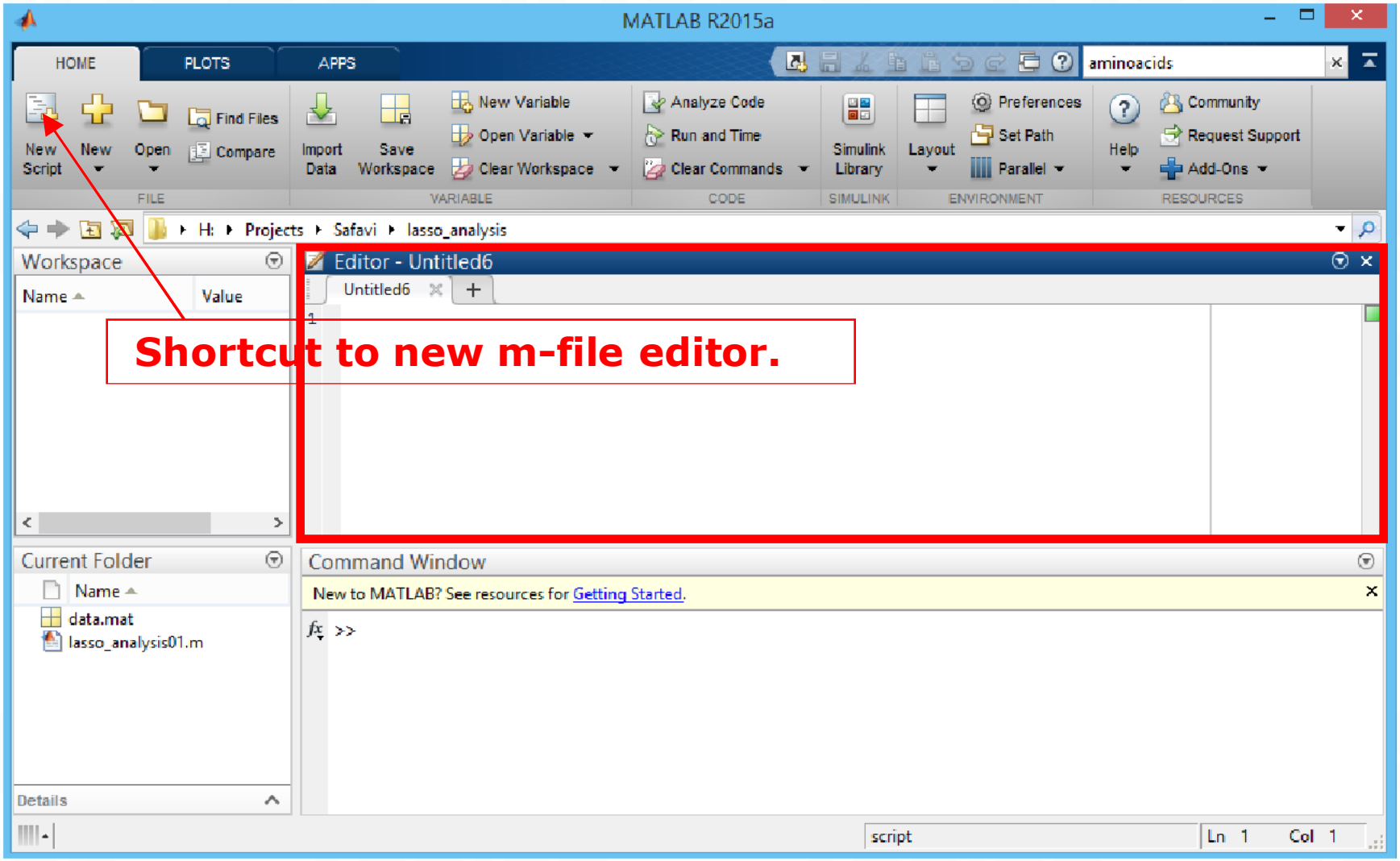
MATLAB - Basics



MATLAB – Image Processing Toolbox

Terms	Definitions
Binary image	An image containing only black and white pixels. In MATLAB, a binary image is represented as a logical array of 0's and 1's (which usually represent black and white, respectively).
Indexed image	An image whose pixel values are direct indices into an RGB colormap. The colormap is always an m-by-3 array of class double
Intensity image	An image consisting of intensity (grayscale) values
RGB image	Each pixel is specified by three values--one each for the red, green, and blue components of the pixel's color. In MATLAB, an RGB image is represented by an m-by-n-by-3 array

MATLAB – Image Basics

imread

Read image from graphics file an creation an array with the image:

```
A = imread(filename)
```

```
>> clear
>> close all
>> im1 = imread ('rice.png');
>> im2 = imread ('cameraman.tif');
>> im1(85,35)
>> whos
```

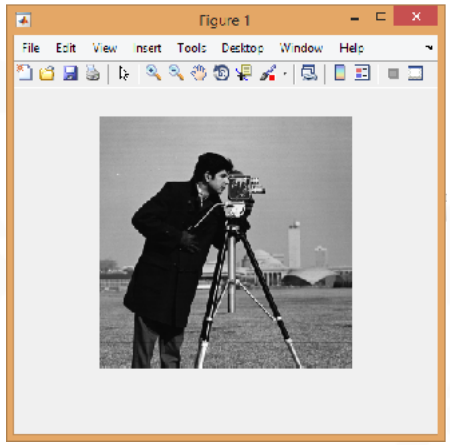
MATLAB – Image Basics

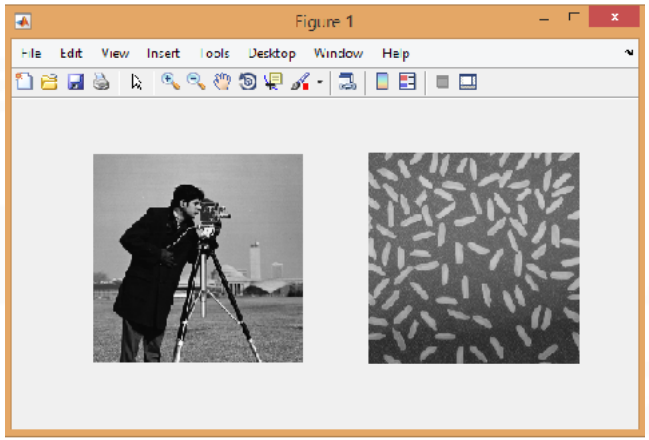
imshow

Display the image read

A = imshow(filename)

```
>> figure(1); imshow(im1);
>> figure(2);
>> subplot(1,2,1); imshow(im1);
>> subplot(1,2,2); imshow('rice.png');
```





MATLAB – Image Basics

imfinfo

returns a structure whose fields contain information about an image in a graphics file, filename.

```
info = imfinfo(filename)
```

```
>> info = imfinfo('rice.png')
info =
    Filename: 'C:\Program Fi…
    FileSize: 44607
    Format: 'png'
    FormatVersion: []
    Width: 256
    Height: 256
    BitDepth: 8
    ColorType: 'grayscale'
    FormatSignature: [137 80 78 71 13 10 26 10]
```

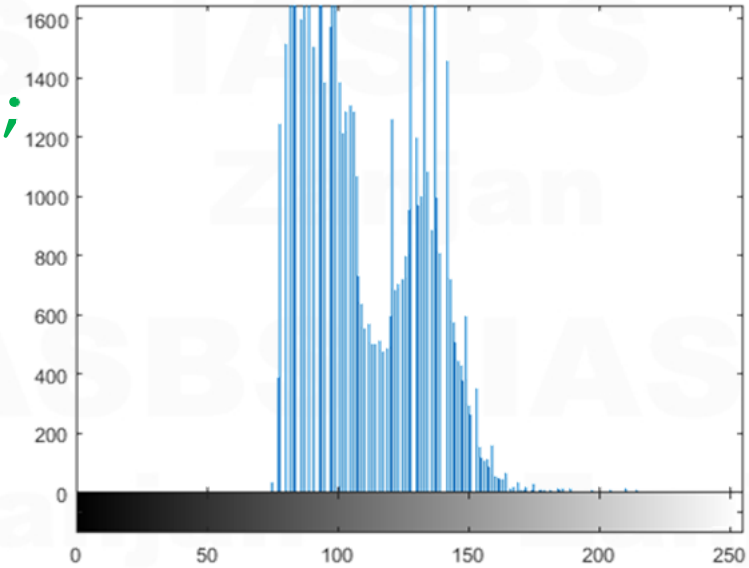
MATLAB – Image Basics

imhist

calculates the histogram for the intensity image I and displays a plot of the histogram. The number of bins in the histogram is determined by the image type:

```
imhist(I)
[counts,binloc]=imhist(I,n)
```

```
>> I=imread('pout.tif');
>> imhist(I)
```

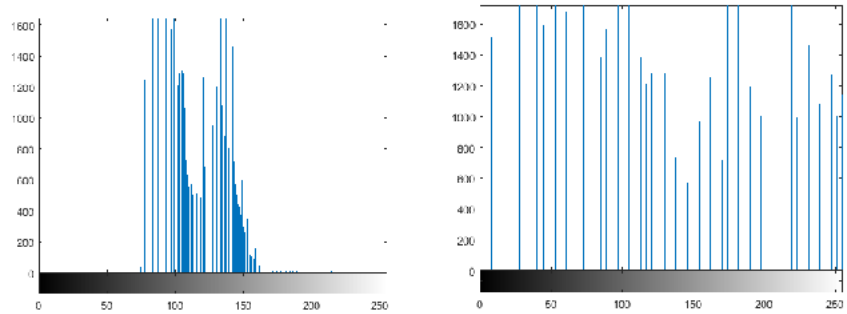


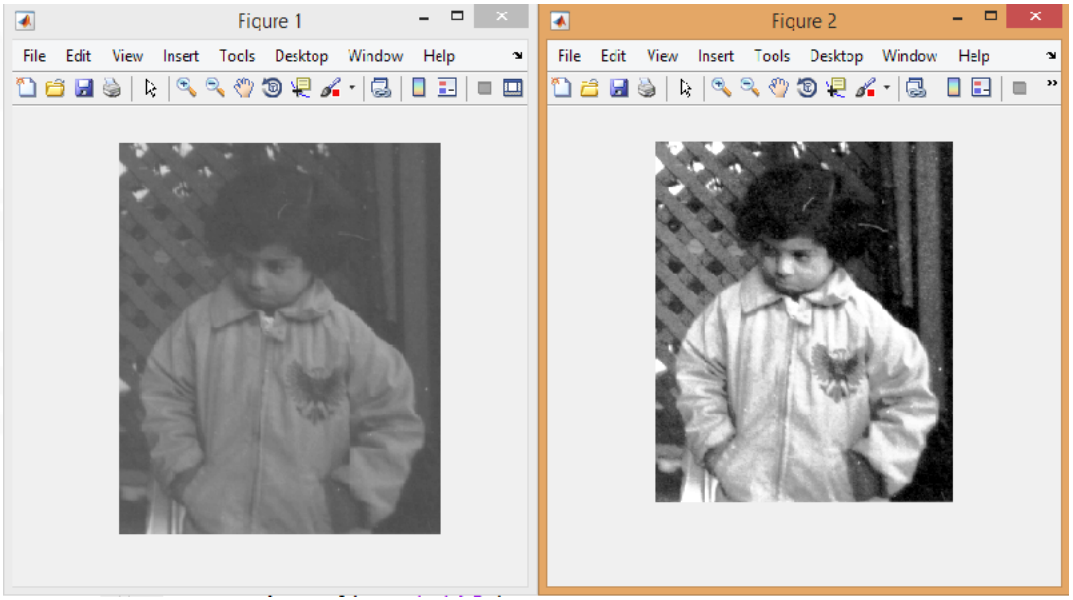
MATLAB – Image Basics

histeq

Enhance contrast using histogram equalization

```
I = imread('tire.tif')
J = histeq(I);
figure(1);imshow(I)
Figure(2);imshow(J)
```





MATLAB – Image Basics

histeq

Enhance contrast using histogram equalization

Example: (a 64x64 image, 8 gray levels)

$x_i = i$	n_i	$h[i] = n_i/N$	$y' = H[i]$	y_1	h_1	H_1
0	790	0.19	0.19	$0.19 \times 7 \approx 1$	0.19	0.19
1	1023	0.25	0.44	$0.44 \times 7 \approx 3$	0.25	0.44
2	850	0.21	0.65	$0.65 \times 7 \approx 5$	0.21	0.65
3	656	0.16	0.81	$0.81 \times 7 \approx 6$		
4	329	0.08	0.89	$0.89 \times 7 \approx 6$	0.24	0.89
5	245	0.06	0.95	$0.95 \times 7 \approx 7$		
6	122	0.03	0.98	$0.98 \times 7 \approx 7$		
7	81	0.02	1.00	$1.00 \times 7 = 7$	0.11	1.00

MATLAB – Image Basics

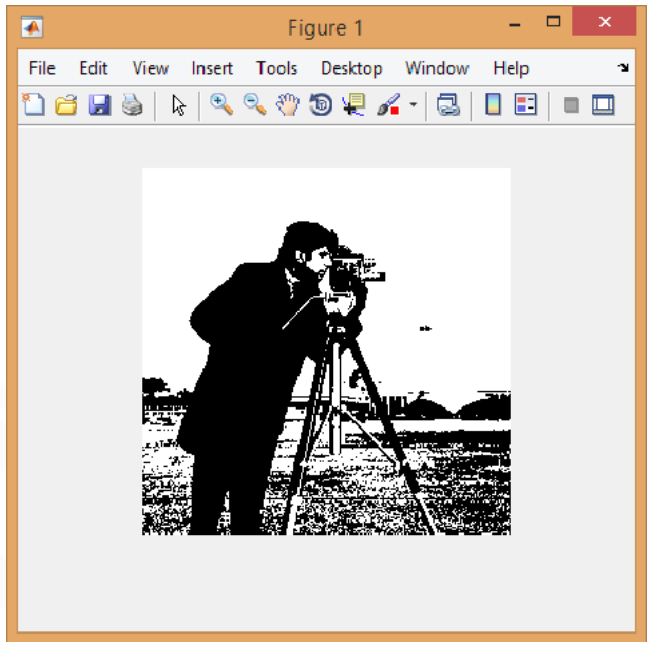
bitget

Get bit at specified position

```
b = bitget(A,bit)
```

```
>> bitget(4,2)
>> bitget(7,4)
```

```
>> I = imread('cameraman.tif')
>> B = bitget(I,8);
>> imshow(B,[0 1]);
```



MATLAB – Image Basics

Bit plan 6

Bit plan 7

Bit plan 8