LAB LESSON ONE
IMAGE PROCESSING
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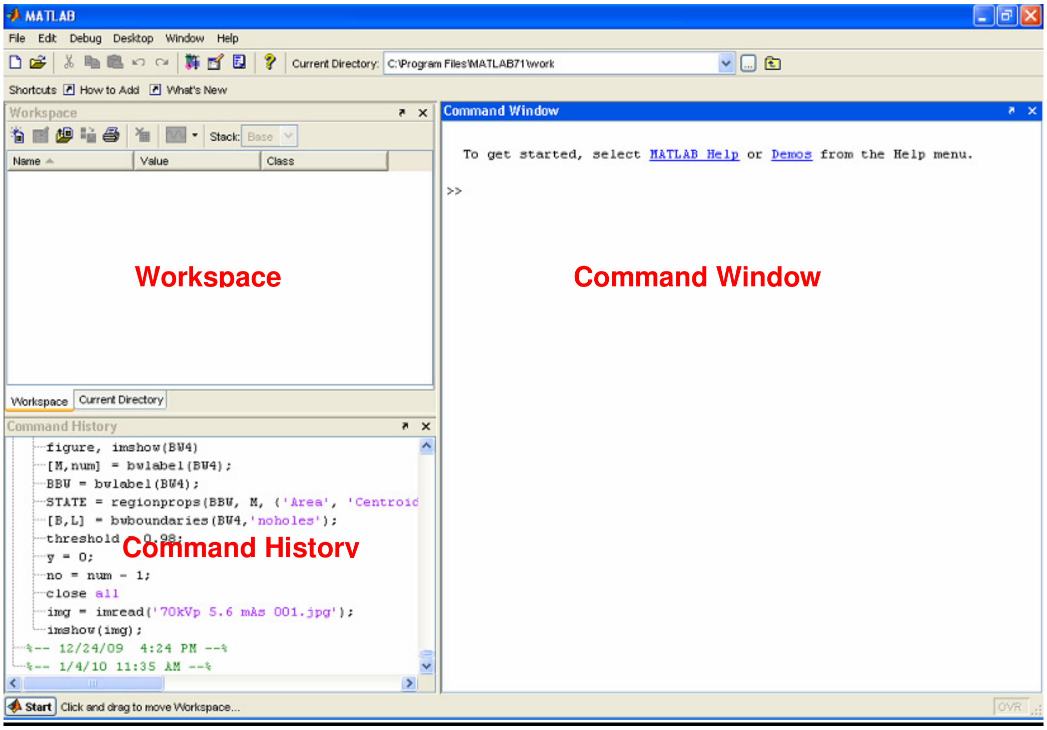
Introduction to MATLAB

MATLAB is a data analysis and visualization tool that has been design with powerful support for matrices and matrix operations. Matlab has excellent support for data visualization and its concise and expressive syntax, as well as the plethora of predefined functions, results in a powerful environment excellent for rapid prototyping with minimal overhead.

MATLAB Environment


MATLAB
File Edit Debug Desktop Window Help
Current Directory: C:\Program Files\MATLAB71\work
Shortcuts How to Add What's New
Workspace
Stack: Base
Name Value Class
Workspace
Command Window
Workspace Current Directory
Command History
Command History
Start
OVR

```
To get started, select MATLAB Help or Demos from the Help menu.

>>
```

```
figure, imshow(BW4)
[M,num] = bwlabel(BW4);
BBW = bwlabel(BW4);
STATE = regionprops(BBW, M, {'Area', 'Centroic
[B,L] = bwboundaries(BW4,'noholes');
threshold = 0.98;
y = 0;
no = num - 1;
close all
img = imread('70kVp 5.6 mAs 001.jpg');
imshow(img);
%-- 12/24/09  4:24 PM --%
%-- 1/4/10 11:35 AM --%
```

Click and drag to move Workspace...

Command Window

Matlab commands are either executed in scripts or functions, or directly at the ***Command Window*** shown above. Here are a number of command window related commands.

```
clc                     % clear the window
diary on                % record all input and
output in a file called diary
clear all               % clear all of the
current variables
close all               % close all open figures
```

Workspace

All of the current variables, as well as basic information about them, can be viewed in a convenient graphical window called the workspace. If it is not already visible, you can bring it up by typing ***workspace*** at the command prompt or by going to the desktop drop down menu.

Command History

The last typed command can be retrieved by selecting the ***Command History*** window and pressing the ***up arrow*** *key* on your keyboard. Pressing it several times scrolls you backwards through the history of typed commands. By first typing in part of the command before pressing the up arrow, only those statements that began with the typed text are displayed.

Variables

We can create named memory locations to store data, called variables, very easily in Matlab. Variable names must begin with a character and can contain up to 63 characters on most systems.

Creating Vectors and Matrices

1. To create a row vector:
   ```
   >> row = [ 1 2 3 4];
   ```

2. To create a column vector:
   ```
   >> col = [1;2];
   ```

3. To create a matrix:
   ```
   >> mat = [1 2 3; 4 5 6; 7 8 9];
   ```

4. Using colon operator
   ```
   >>  a = 1:5
   >>  b = 6:-2:0
   ```

5. Using ***ones()*** and ***zeros()*** functions

Basic Plotting

For basic data visualization, plots can be used. Type in the following commands.

```
>> x=-5:5;
>> y=x.^2;
>> plot(x,y,'-')
>> hold on
>> plot(x,25-y,’r-o’)
>> hold off
```

Subplots

To display multiple axes in the same figure.

```
>> subplot(2,2,1);
>> plot(1:10)

>> subplot(2,2,2)
>> x = 0:.1:2*pi;
>> plot(x,sin(x))

>> subplot(2,2,3)
>> x = 0:.1:2*pi;
>> plot(x,exp(-x),'r')

>> subplot(2,2,4)
>> plot(peaks)
```

Image Types

In digital image processing, a digital image is divided into three basic types: **binary, grayscale** and **color** images. The *Image Processing Toolbox* supports four basic types of images:

1.	Binary images:	{0, 1}
2.	Intensity images:	[0, 1], uint8, or uint16
3.	Indexed images:	m-by-3 color map matrix
4.	RGB images:	m-by-n-by-3 matrix

Binary Image

In a binary image, each pixel assumes one of two discrete values, zero (off) and one (on). Such images are effective in representing borders or locations of objects in images. Type in the following commands:

```
>> RGB = imread('balloons.png');
>> imshow (RGB);
>> BW=im2bw(RGB); figure; imshow(BW);
```

Intensity Image

Intensity images are grayscale images. They consist of a data matrix, I, whose values represent intensities within some range, for example [0,1] or uint8. Type in the following commands:

```
>> RGB = imread('balloons.png');
>> imshow (RGB);
>> GRAY=rgb2gray(RGB); figure; imshow(GRAY);
title('Intensity image');
```

Indexed Image

An indexed image consists of a data matrix, x, and a colormap matrix, map. The colormap matrix is an m-by-3 matrix where each row denotes a red green blue color vector. Each value in the color vector contains an intensity value ranging from zero to one, with one being a full intensity of that color, and zero being a null intensity. The first column of the color vector defines the red intensity, the second column defines the green intensity, and the third column defines the blue intensity. Type in the following commands:

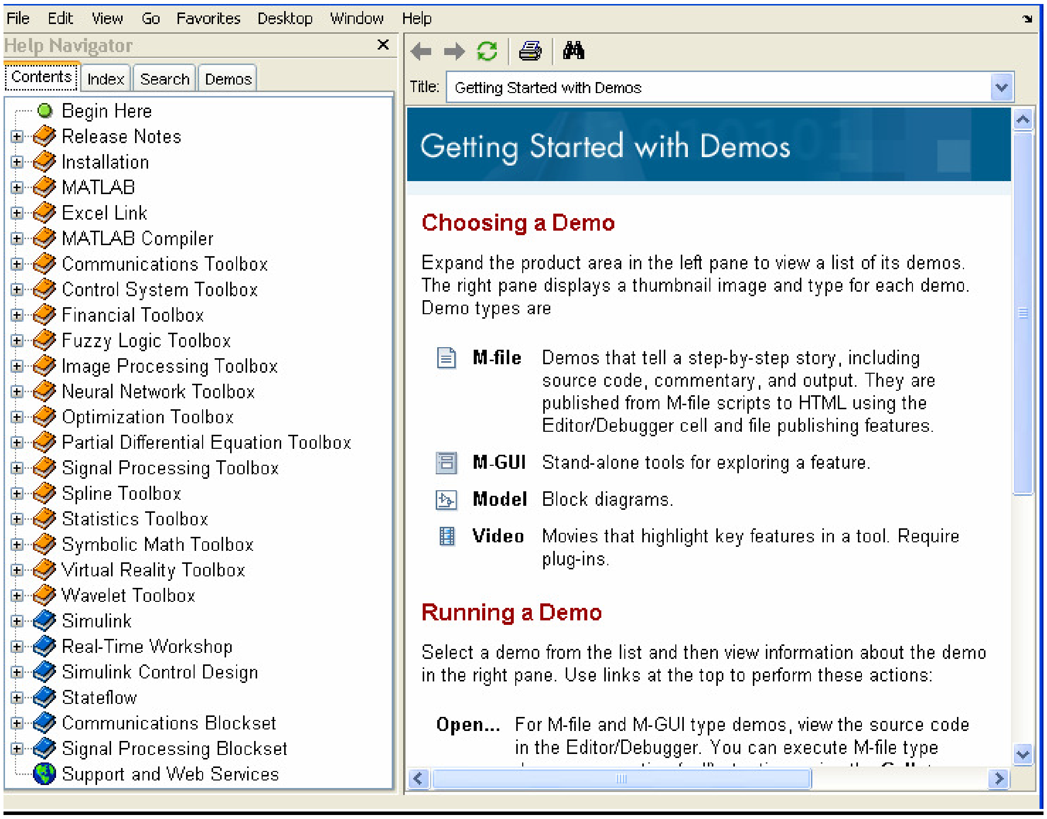
```
>> RGB = imread('balloons.png');
>> imshow (RGB);
>> [IND, map] = rgb2ind(RGB, 64);
>> figure; imshow(IND, map); title('Indexed image');
```

RGB Image

An RGB image is stored in MATLAB as an m-by-n-by-3 data, where each m-by-n page defines red, green, and blue color components for each pixel. It can be thought of as three separate intensity matrices. One for each color: red, green and blue.

Getting Help in MATLAB

MATLAB has a complete documentation online and installed with its product. To get help, click the Start Button and proceed with the choice of help that you need. The HELP window is shown below.



Title: Getting Started with Demos

Getting Started with Demos

Choosing a Demo

Expand the product area in the left pane to view a list of its demos. The right pane displays a thumbnail image and type for each demo. Demo types are

M-file Demos that tell a step-by-step story, including source code, commentary, and output. They are published from M-file scripts to HTML using the Editor/Debugger cell and file publishing features.

M-GUI Stand-alone tools for exploring a feature.

Model Block diagrams.

Video Movies that highlight key features in a tool. Require plug-ins.

Running a Demo

Select a demo from the list and then view information about the demo in the right pane. Use links at the top to perform these actions:

Open... For M-file and M-GUI type demos, view the source code in the Editor/Debugger. You can execute M-file type

Other functions

imfinfo – Returns information about the graphics file.
imwrite – Writes image to graphics file.

Exercises

1. Create a vector of 5 odd numbers starting from 11. (2 mrks)
2. Create a vector of negative numbers of -1 to -100. (3 mrks)
3. Read an RGB image and display the file information. (2 mrks)
4. Convert the RGB into grayscale and save the new image. (3 mrks)