DIGITAL IMAGE PROCESSING MATLAB NOTES

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Digital Image Processing MATLAB Notes, First Edition

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More content available at: www.Akshansh.weebly.com

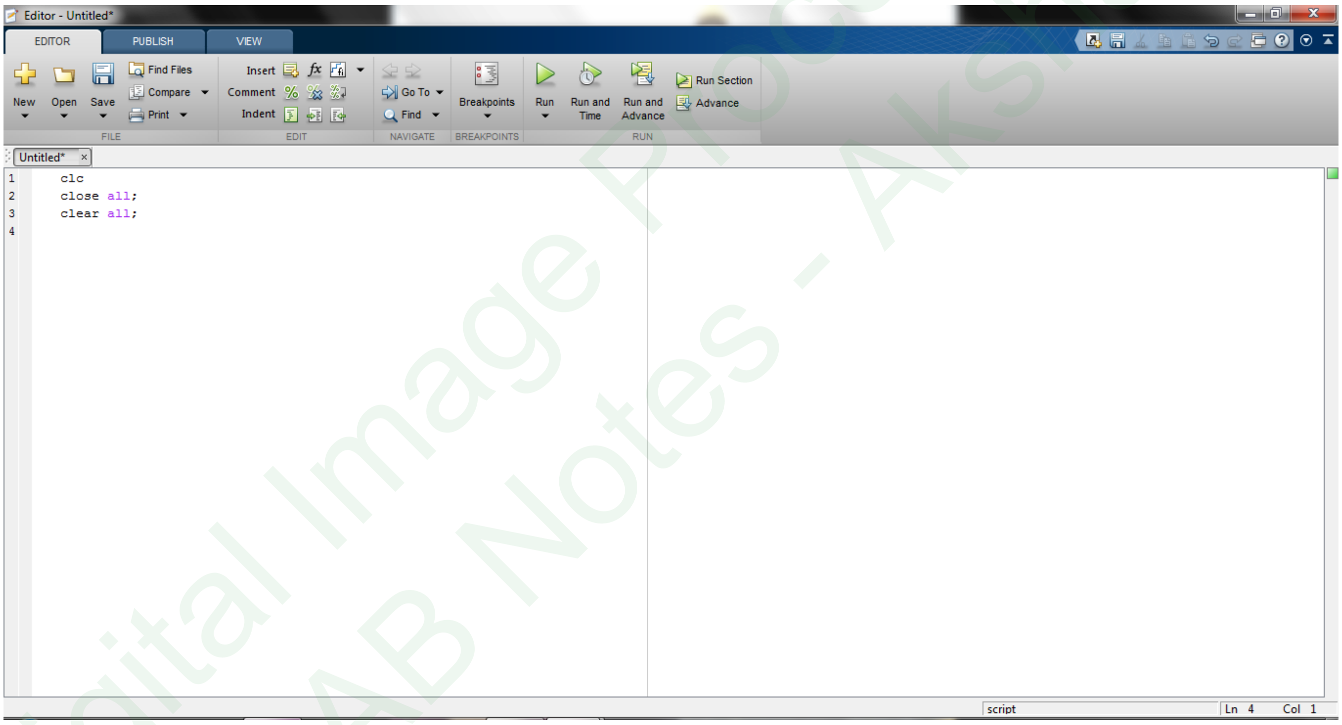
Editing Images in MATLAB Programming Approach

Create an m file.

Use of an editor.
Ctrl+N

A new window opens.
This window is basically the area where all the commands will be written and all changes to the image will be done here.

Now, start typing commands.



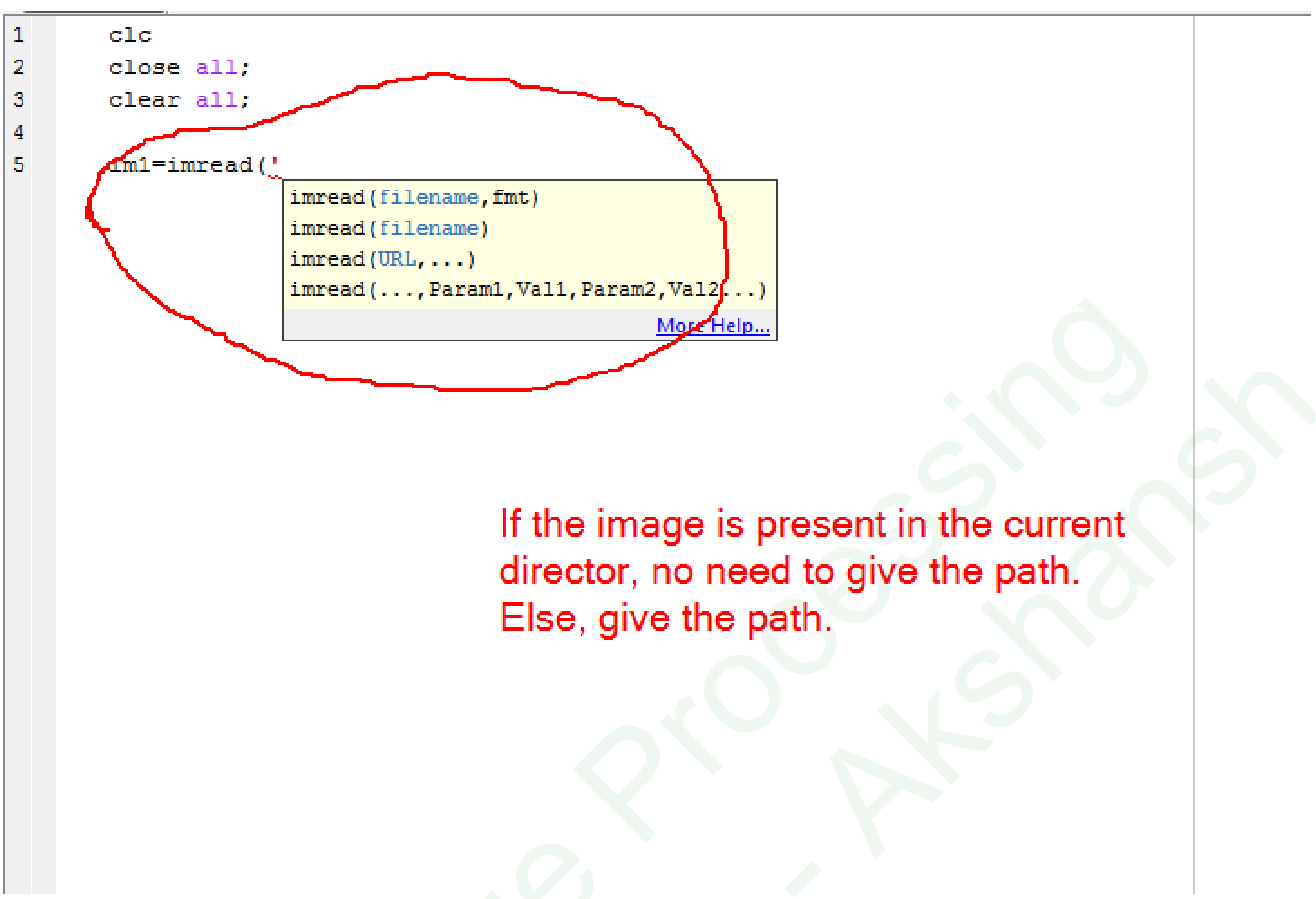
```
clc
close all;
clear all;
```

"CLC, CLOSE ALL, CLEAR ALL" - Are used to remove all the previous commands used and files made.

Now, starting to use main commands:

IMREAD

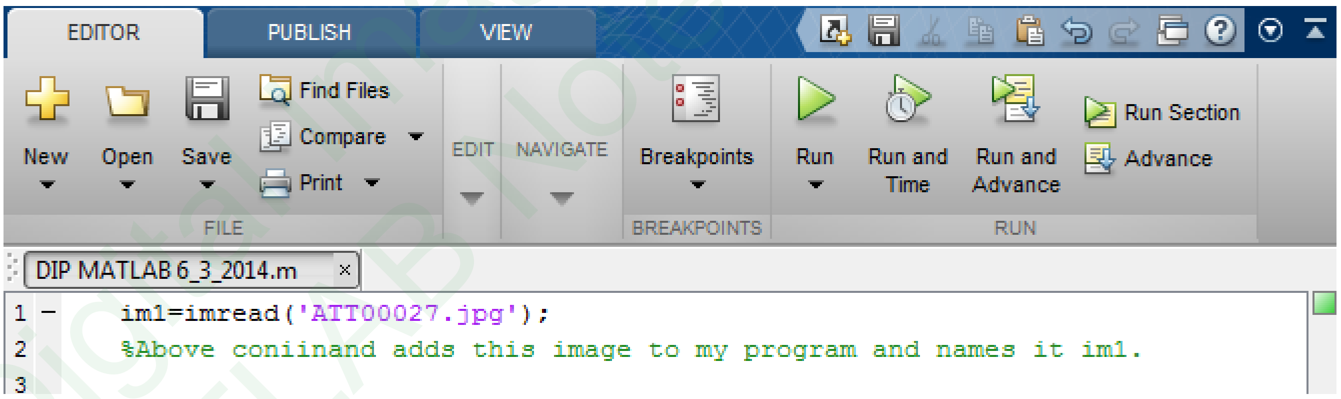
Syntax:
x=imread('filename')
Where x is the name of the image that we are uploading
Note: All the images (or anything) will be accessed from the main MATLAB Directory.
(Default directory is C:\Users\Akshansh\Documents\MATLAB)



```
clc
close all;
clear all;

im1=imread('
```

```
imread(filename,fmt)
imread(filename)
imread(URL,...)
imread(...,Param1,Val1,Param2,Val2,...)
```

If the image is present in the current director, no need to give the path. Else, give the path.



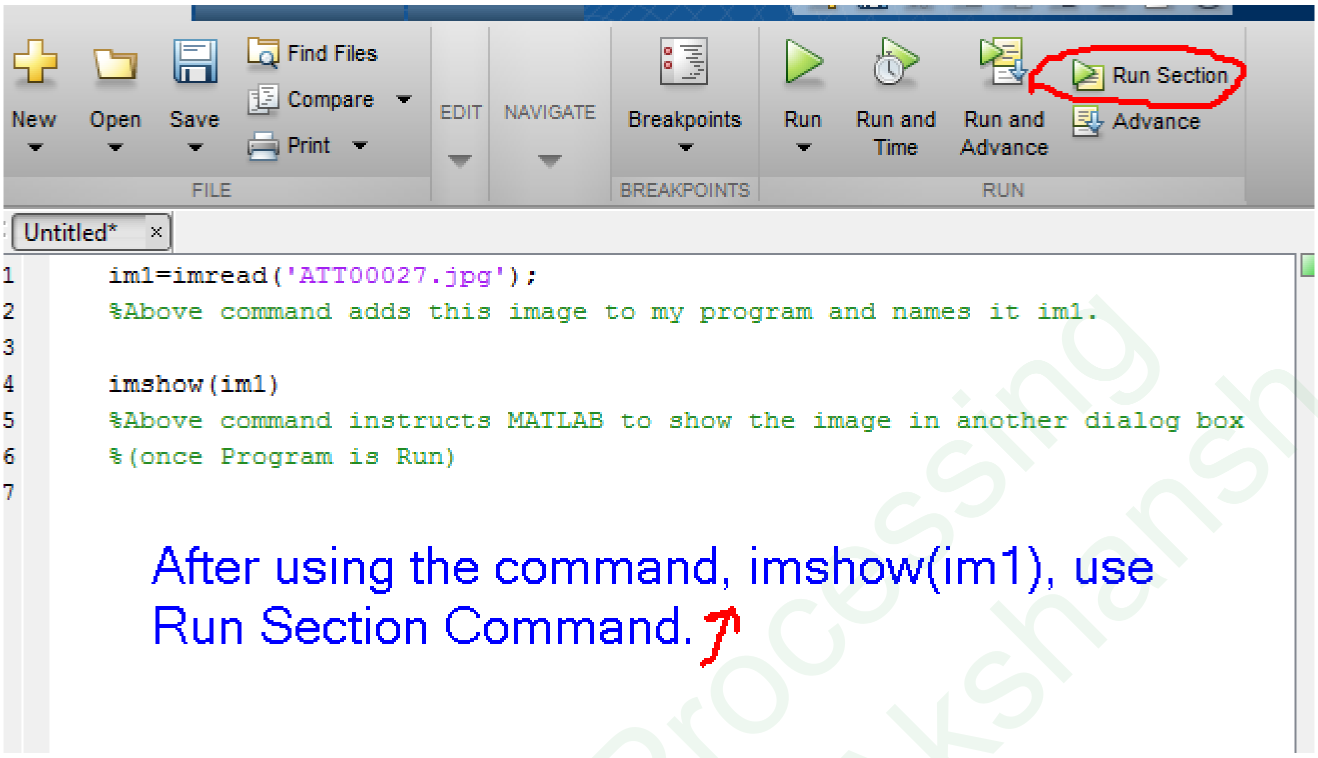
```
im1=imread('ATT00027.jpg');
%Above coniinand adds this image to my program and names it im1.
```

Save your program.

Note: % is used to comment anything (as shown above, with green color)

IMSHOW

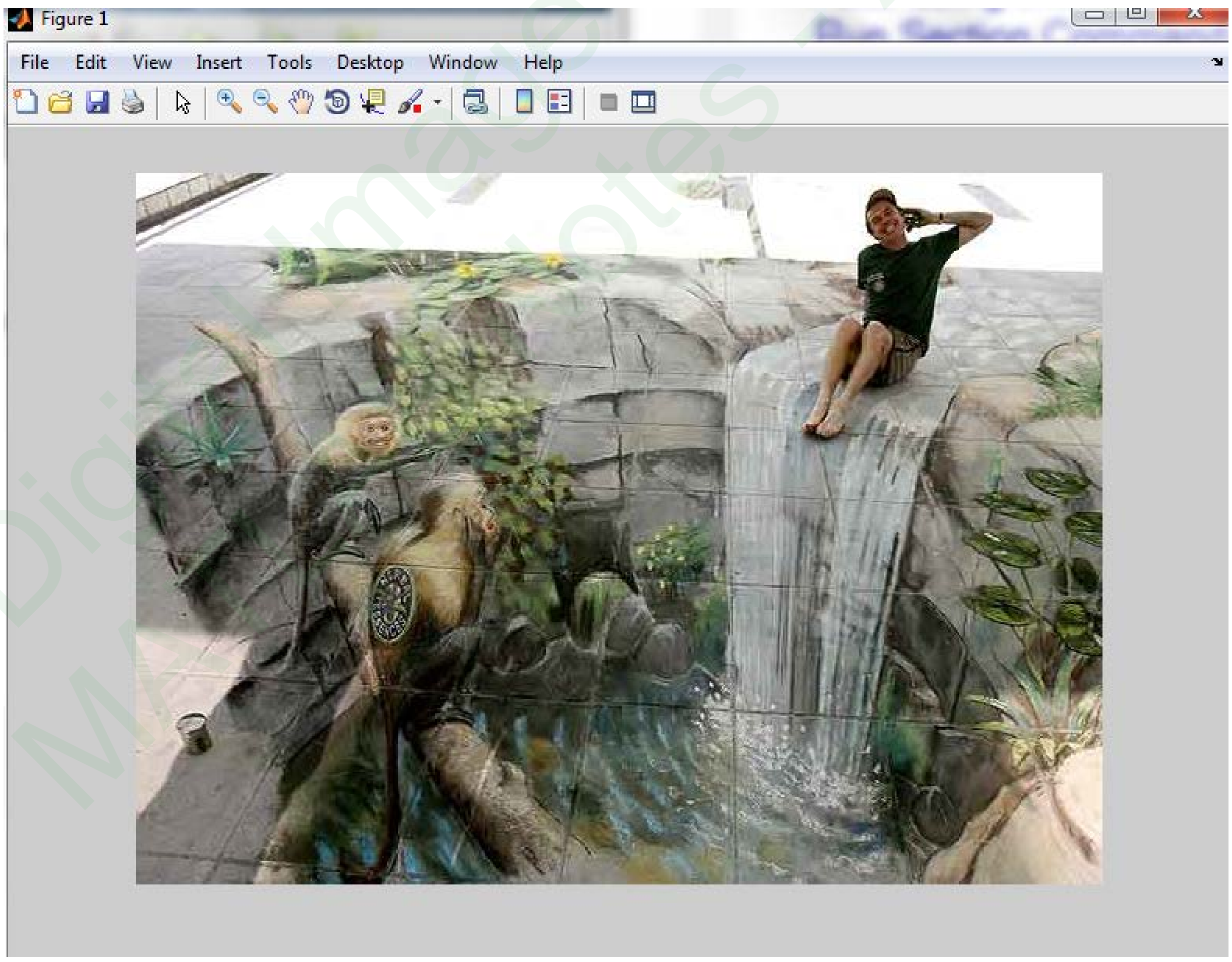
Syntax:
imshow(im1)



```
im1=imread('ATT00027.jpg');
%Above command adds this image to my program and names it im1.

imshow(im1)
%Above command instructs MATLAB to show the image in another dialog box
%(once Program is Run)
```

After using the command, imshow(im1), use Run Section Command.

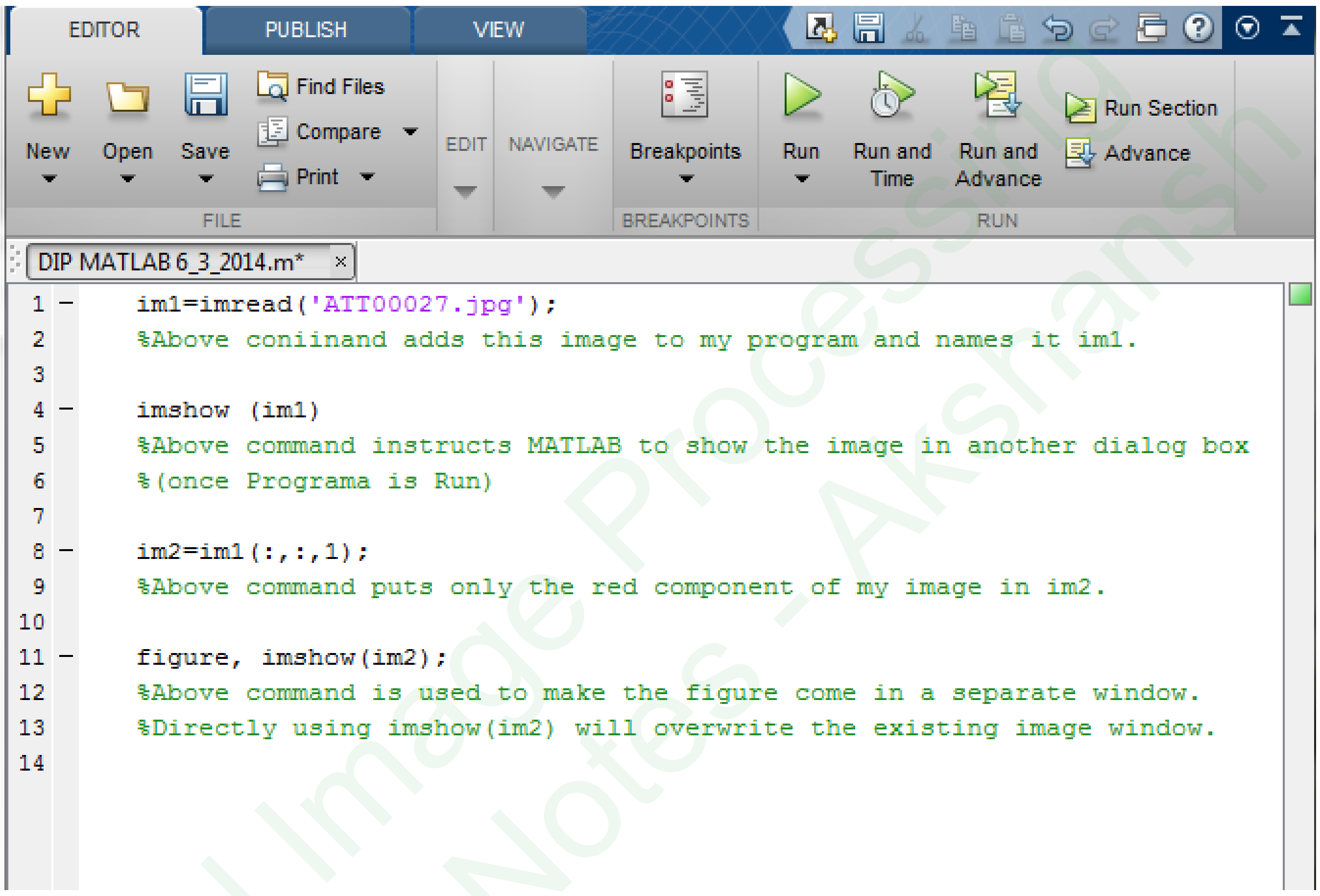
The image opens, as shown.



Component Separation

Once the image is there, let's try separating the components of the image.
We know that an RGB image has 3 components, Red, Green and Blue.

Seeing only the red component:



```
im1=imread('ATT00027.jpg');
%Above coniinand adds this image to my program and names it im1.

imshow (im1)
%Above command instructs MATLAB to show the image in another dialog box
%(once Programa is Run)

im2=im1(:,:,1);
%Above command puts only the red component of my image in im2.

figure, imshow(im2);
%Above command is used to make the figure come in a separate window.
%Directly using imshow(im2) will overwrite the existing image window.
```

Click on Run Section.
A dialog box opens in a separate window.

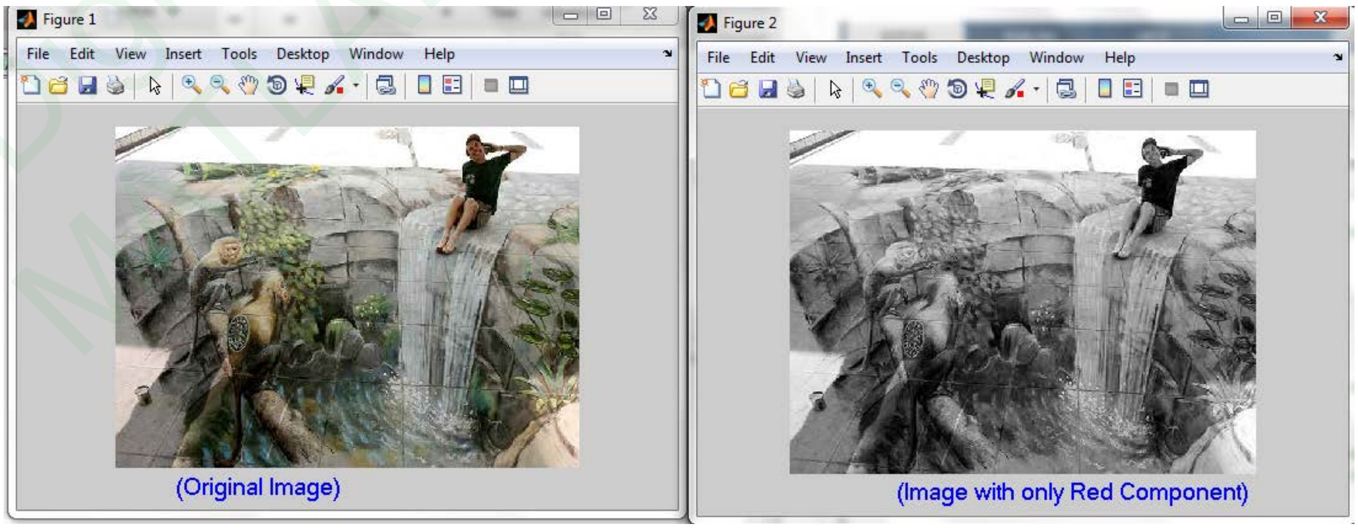
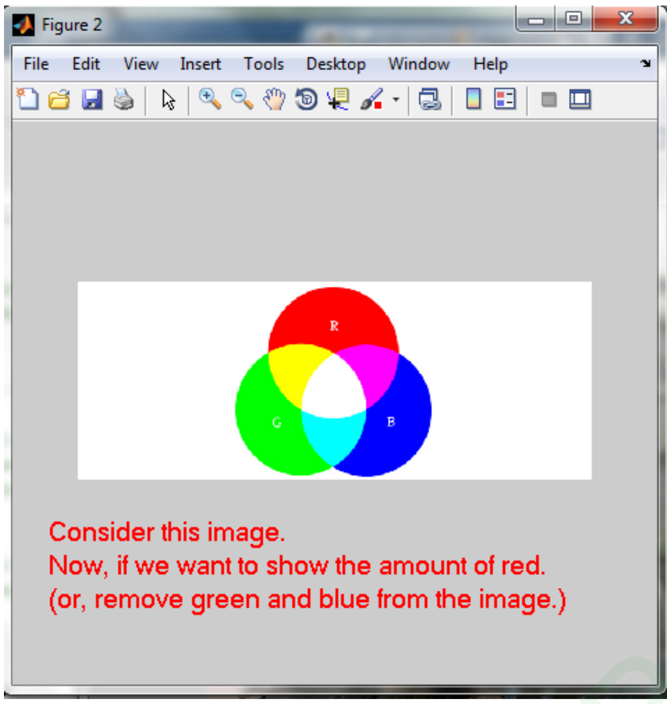
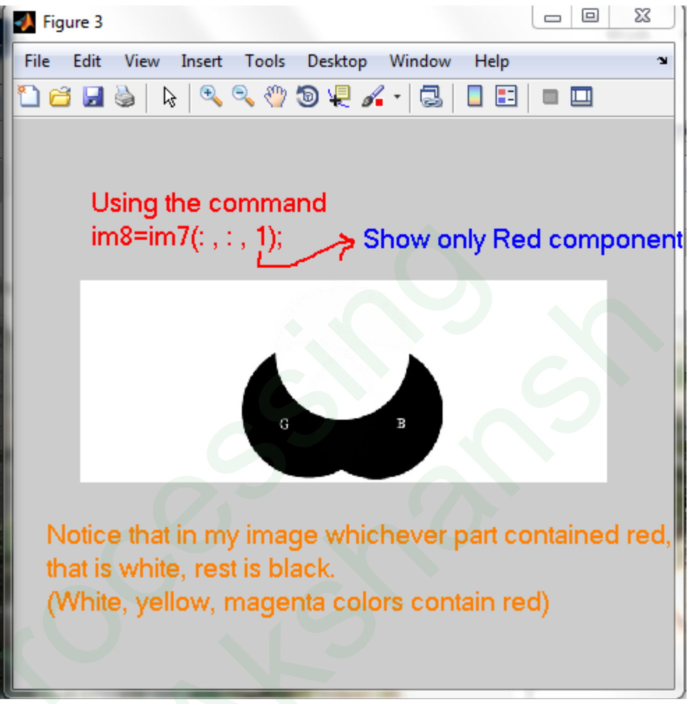


Figure 1
Figure 2
File Edit View Insert Tools Desktop Window Help
(Original Image)
(Image with only Red Component)

Observation:



Consider this image.
Now, if we want to show the amount of red.
(or, remove green and blue from the image.)

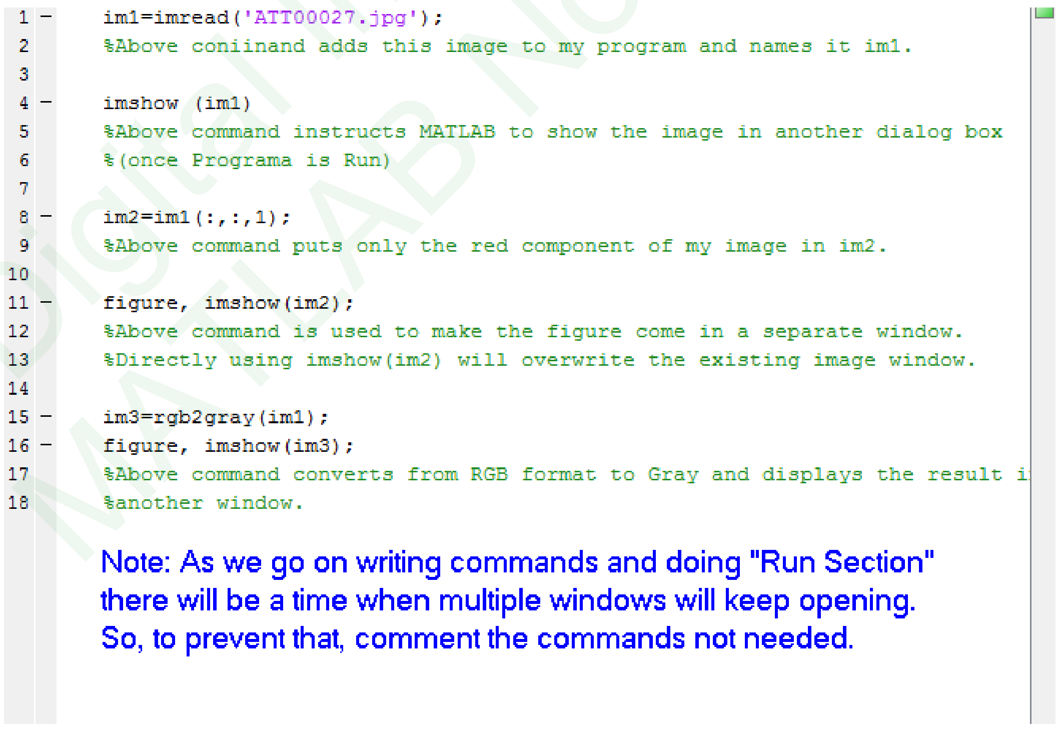


Using the command
im8=im7(: , : , 1); Show only Red component

Notice that in my image whichever part contained red,
that is white, rest is black.
(White, yellow, magenta colors contain red)

RGB2GRAY

Now, if we want to convert our image from RBG format (colored) to Gray (Grayscale), we can use this command.
Syntax:
im3=rgb2gray(im1);
This indicates that I want to see im1 in grayscale.



```
im1=imread('ATT00027.jpg');
%Above coniinand adds this image to my program and names it im1.

imshow (im1)
%Above command instructs MATLAB to show the image in another dialog box
%(once Programa is Run)

im2=im1(:,:,1);
%Above command puts only the red component of my image in im2.

figure, imshow(im2);
%Above command is used to make the figure come in a separate window.
%Directly using imshow(im2) will overwrite the existing image window.

im3=rgb2gray(im1);
figure, imshow(im3);
%Above command converts from RGB format to Gray and displays the result i
%another window.
```

Note: As we go on writing commands and doing "Run Section" there will be a time when multiple windows will keep opening.
So, to prevent that, comment the commands not needed.

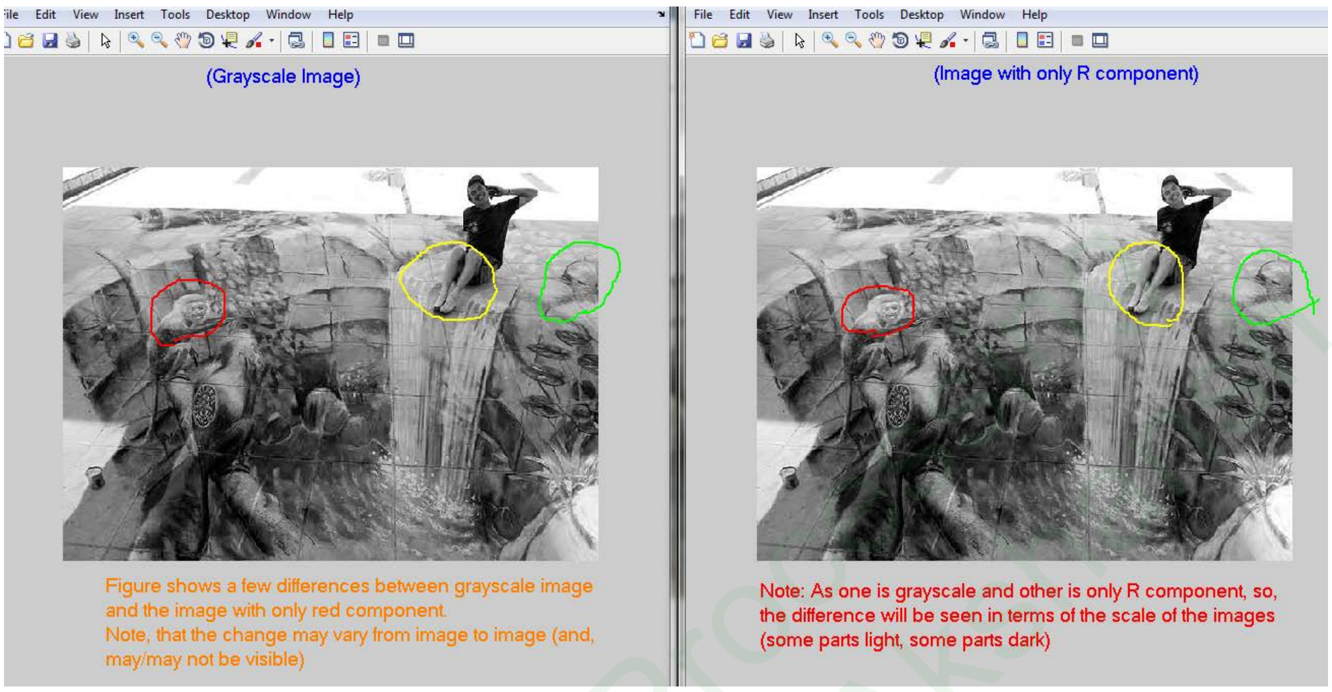

File Edit View Insert Tools Desktop Window Help
(Grayscale Image)
(Image with only R component)

Figure shows a few differences between grayscale image and the image with only red component.
Note, that the change may vary from image to image (and, may/may not be visible)

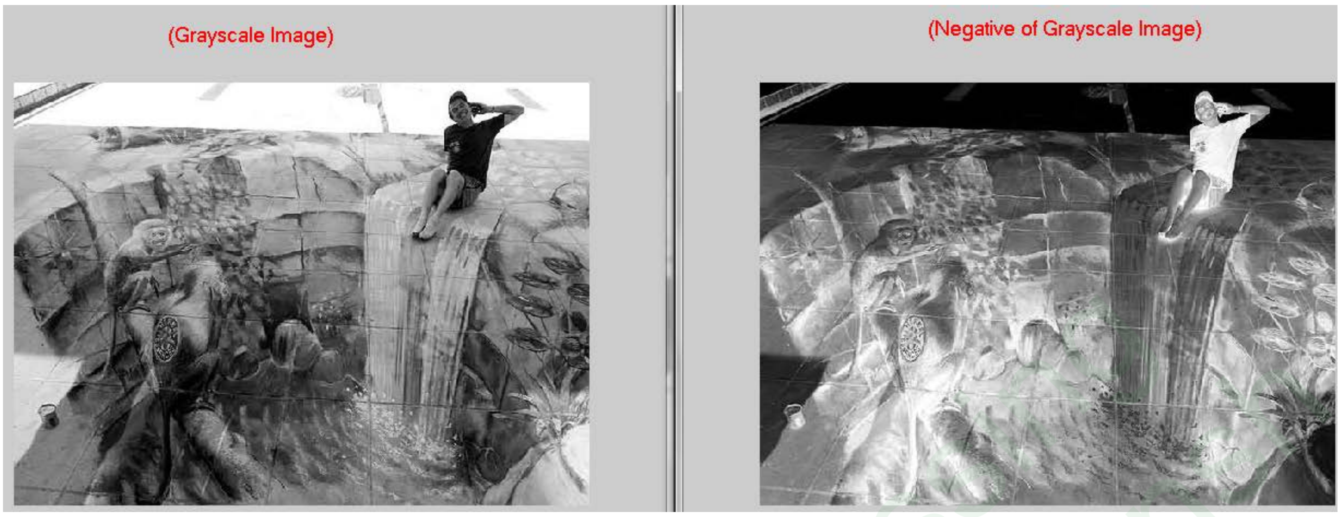
Note: As one is grayscale and other is only R component, so, the difference will be seen in terms of the scale of the images (some parts light, some parts dark)

Negative of Image

We are making negative of the image.
Idea: 255-(Image)=Negative

Note:
RGB Format is used only for display purpose and to view the image, no processing is done.
To process the image, it is converted to HIS Format.
(HIS - Hue, Intensity and Saturation format)

```
im3=rgb2gray(im1);
figure, imshow(im3);
%Above command converts from RGB format to Gray and displays the result in
%another window.

im4=255-im3;
figure, imshow(im4);
%Above command gives a negative of the image im3.
```

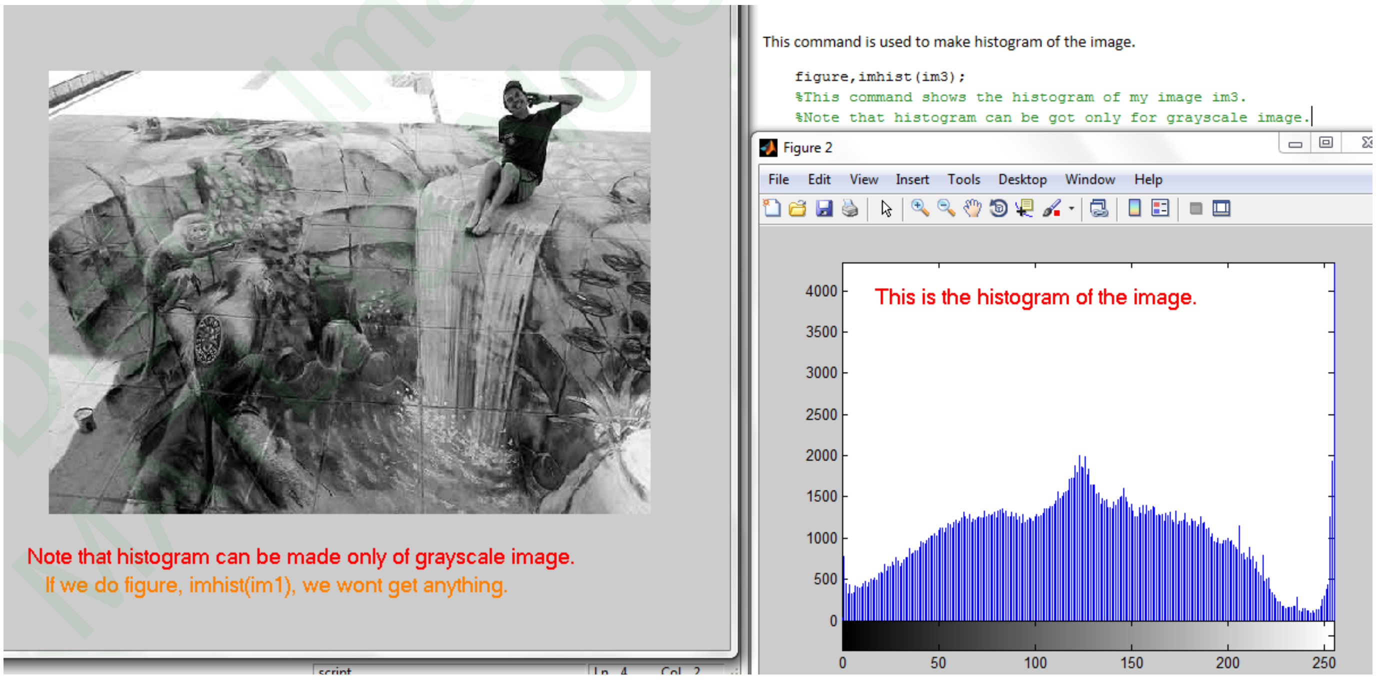


Note: We can also do negative of an RGB image.

IMHIST

This command is used to make histogram of the image.

```
figure,imhist(im3);
%This command shows the histogram of my image im3.
%Note that histogram can be got only for grayscale image.
```



Note that histogram can be made only of grayscale image.
If we do figure, imhist(im1), we wont get anything.

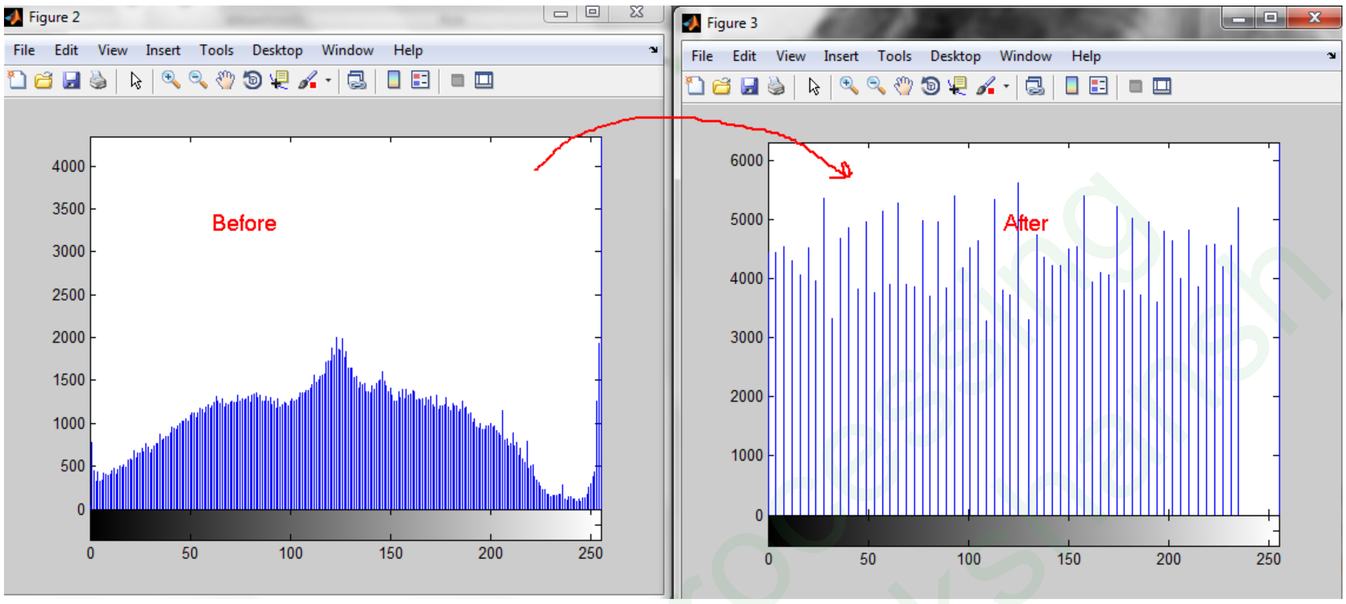
This command is used to make histogram of the image.

```
figure,imhist(im3);
%This command shows the histogram of my image im3.
%Note that histogram can be got only for grayscale image.
```

This is the histogram of the image.

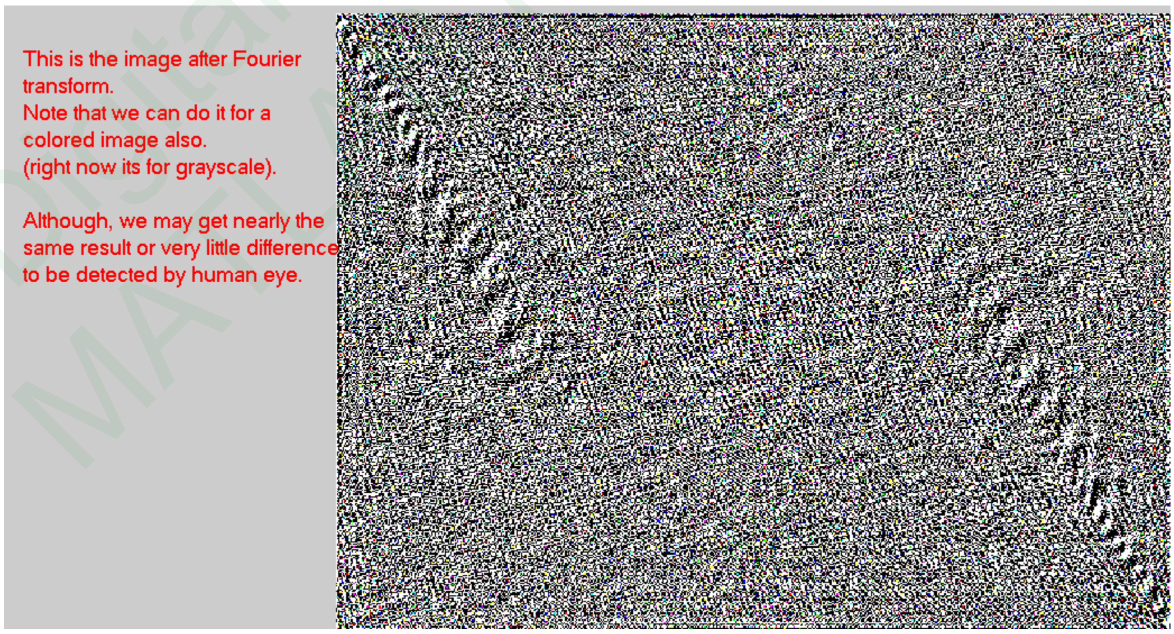
HISTEQ

Doing histogram equalization of the image.

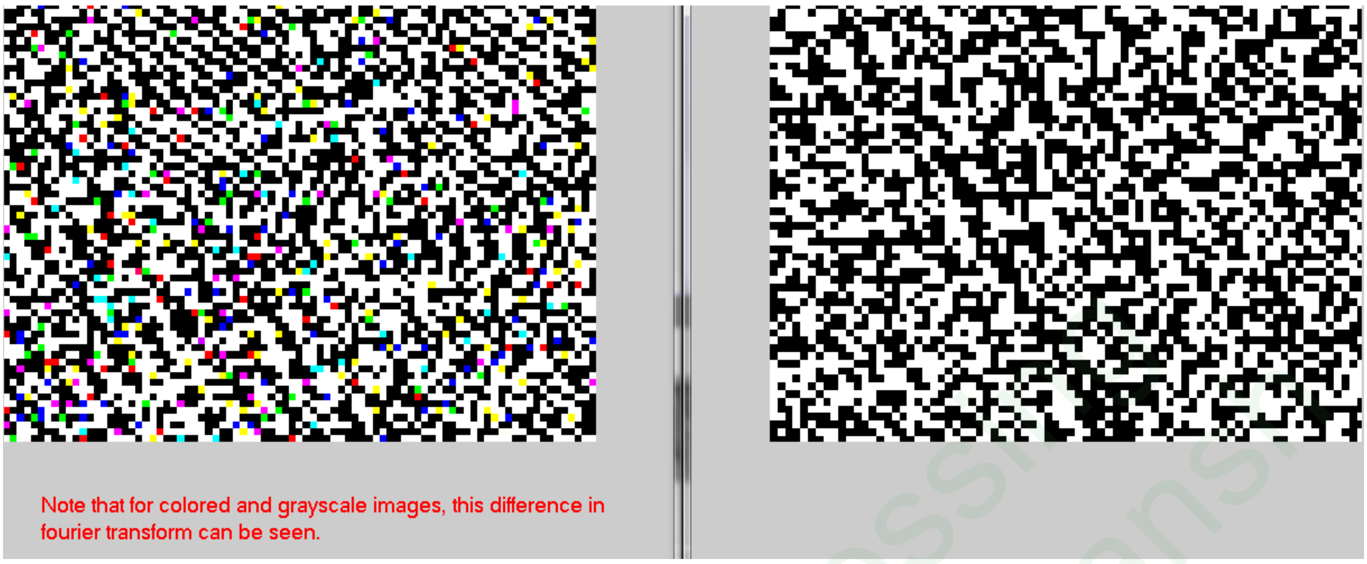


FFT2

```
ft2=fft2(im3);
figure, imshow(ft2);
%This function does fourier transform of the grayscale image (im3)
```


This is the image after Fourier transform.
Note that we can do it for a colored image also.
(right now its for grayscale).

Although, we may get nearly the same result or very little difference to be detected by human eye.

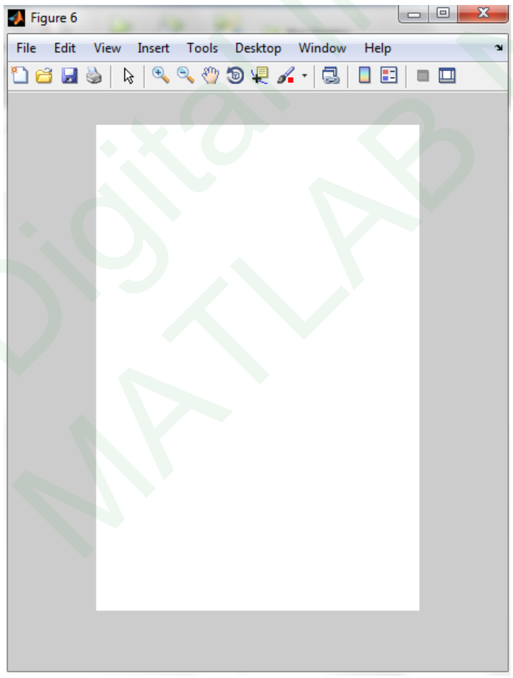

Note that for colored and grayscale images, this difference in fourier transform can be seen.

Note that the image has complex values. For taking real values, use abs command.

ABS

Using abs command, the function tries to adjust the intensity to zero or full intensity. So, the output is white or black COMPLETELY.

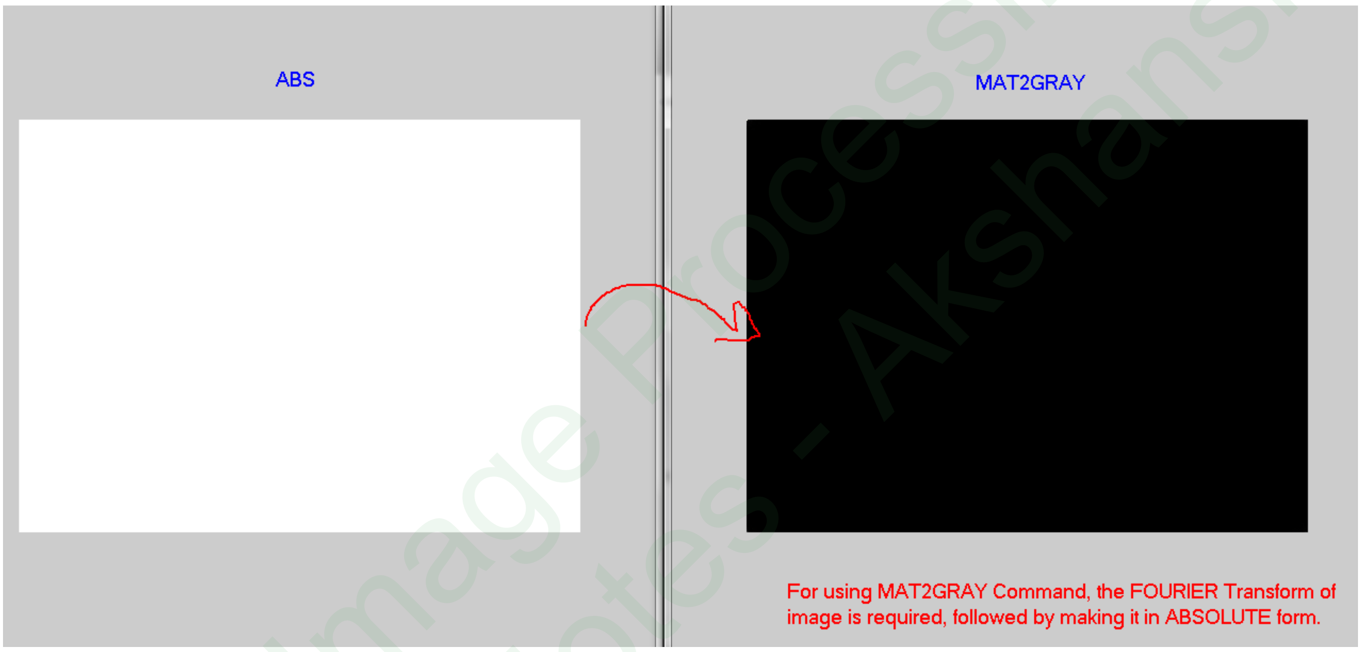
```
ft3=abs(ft2);
figure, imshow(ft3);
%This function shows absolute value of the Fourier transform.
```



MAT2GRAY

Converts Matrix to Grayscale image.

```
ft1=fft2(im1);
ft2=abs(ft1);
figure,imshow(ft2);
ft3=mat2gray(ft2);
figure, imshow(ft3);
```



For using MAT2GRAY Command, the FOURIER Transform of image is required, followed by making it in ABSOLUTE form.

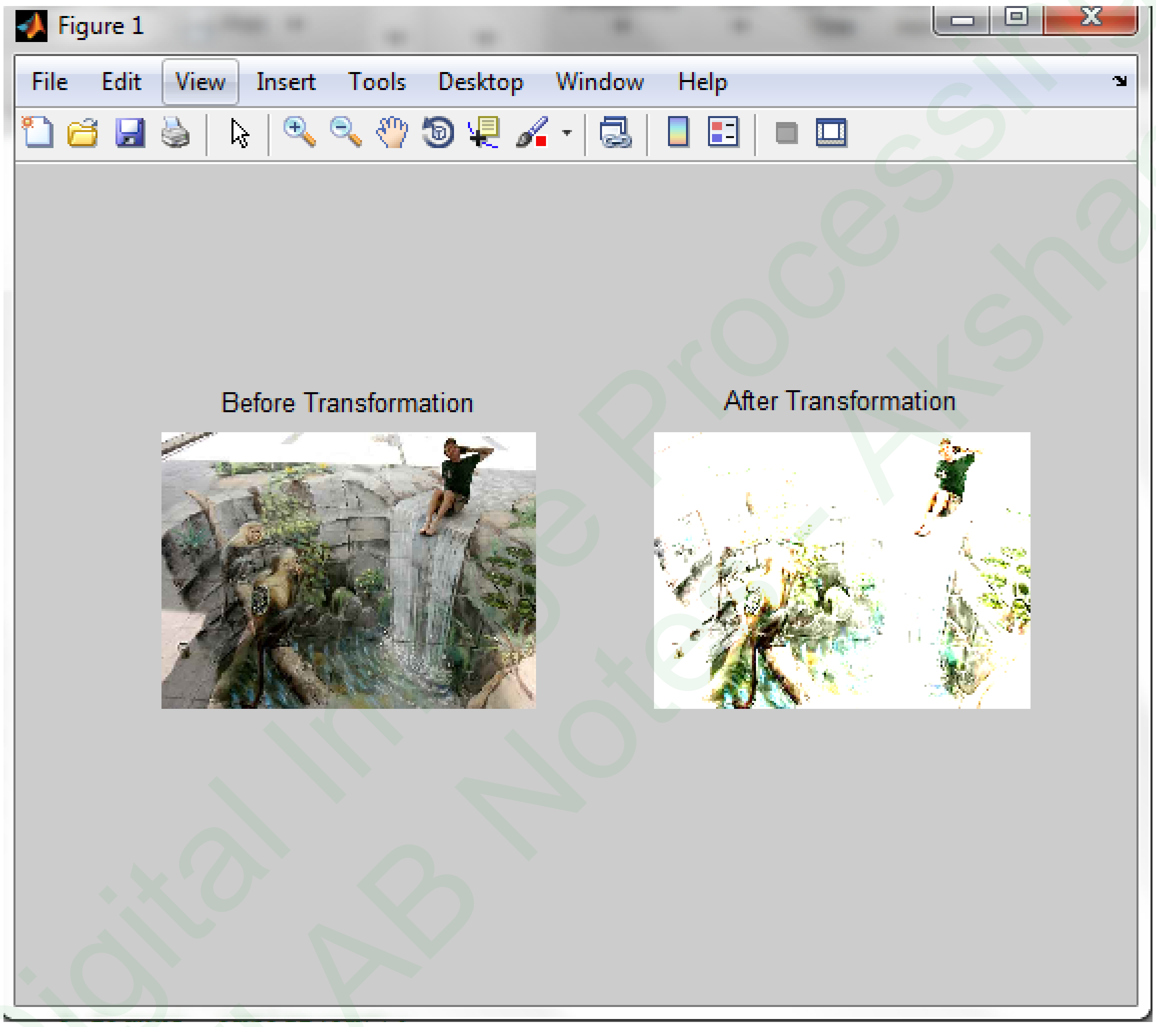
LOG

Note:
We saw that the frequency domain transform gave the results as black and white of my image. So, we use logarithmic transform.
Applying log transformation to an image will expand its low valued pixels to a higher level and has little effect on higher valued pixels so in other words it enhances image in such a way that it highlights minor details of an image.

Commands:

```
a=imread('ATT00027.jpg');
a=im2double(a);
x=a;
[r,c]=size(a);
C=4;
for i=1:r
for j=1:c
```

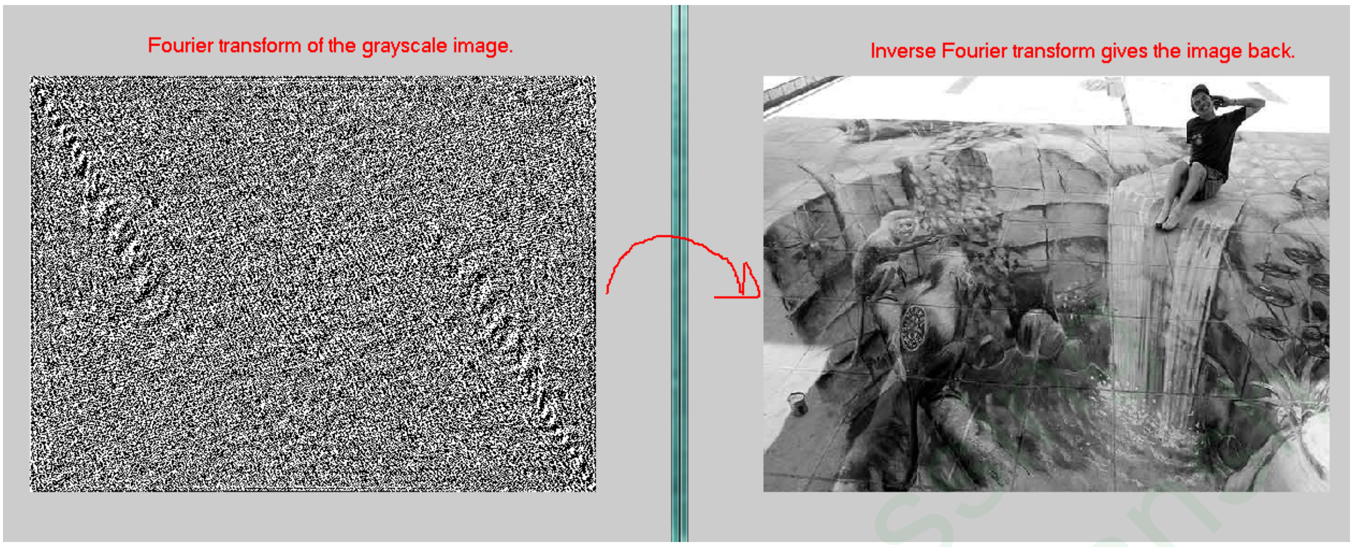
x(i,j)=C*log(1+a(i,j));
end
end
subplot(1,2,1)
imshow(a);
title('Before Transformation');
subplot(1,2,2);
imshow(x);
title('After Transformation');



IFFT2, UINT8

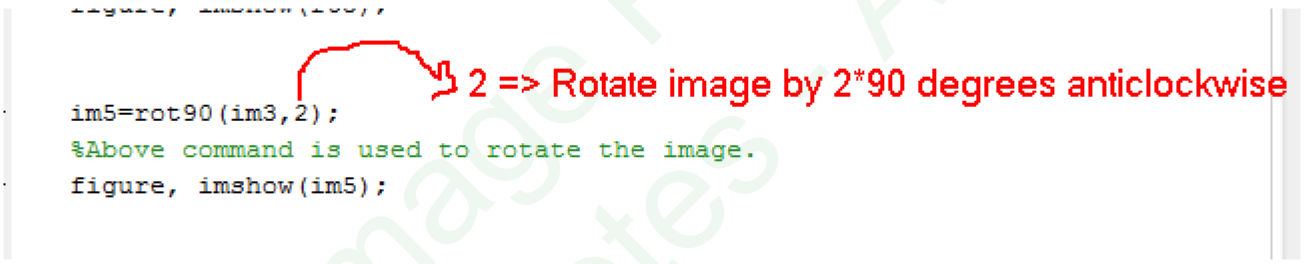
IFFT2 command is used to do the inverse Fourier transform of the image.
UINT8 command is used to convert the image to an 8 bit signed integer.

```
ft2=fft2(im3);
% ft2=abs(ft2);
figure,imshow(ft2);
ft3=ifft2(ft2);
ft3=uint8(ft3);
figure, imshow(ft3);
```

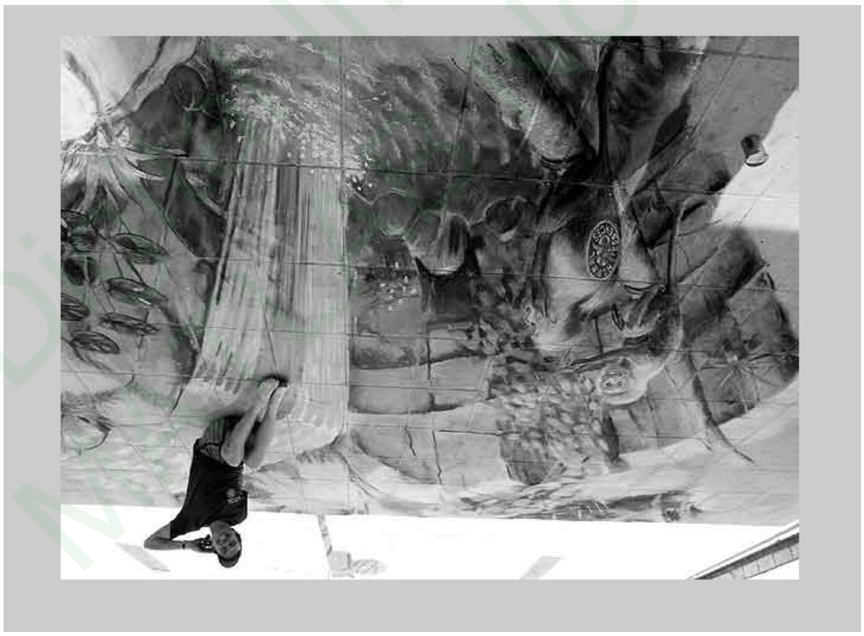

Fourier transform of the grayscale image.
Inverse Fourier transform gives the image back.

ROT90

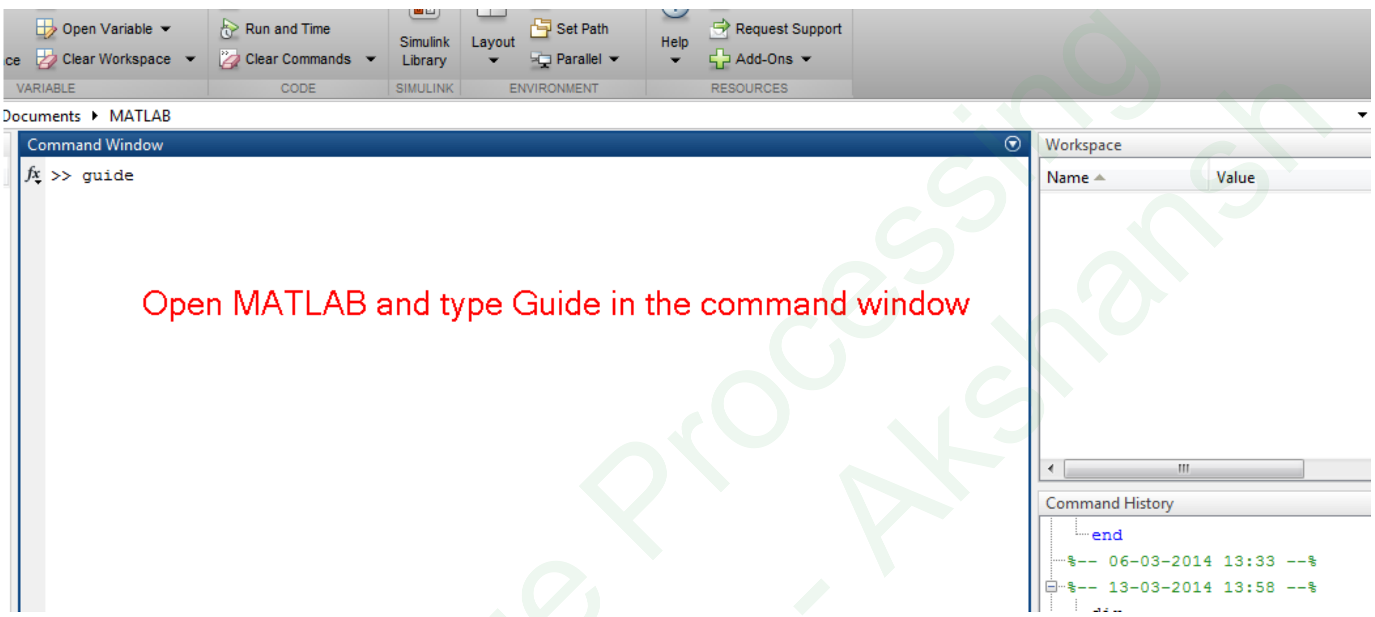
Note: Image rotation can only be done to 2D image.
That is, we can use it only for grayscale images.



```
im5=rot90(im3,2);
%Above command is used to rotate the image.
figure, imshow(im5);
```



Creating a basic GUI and reading images from directory

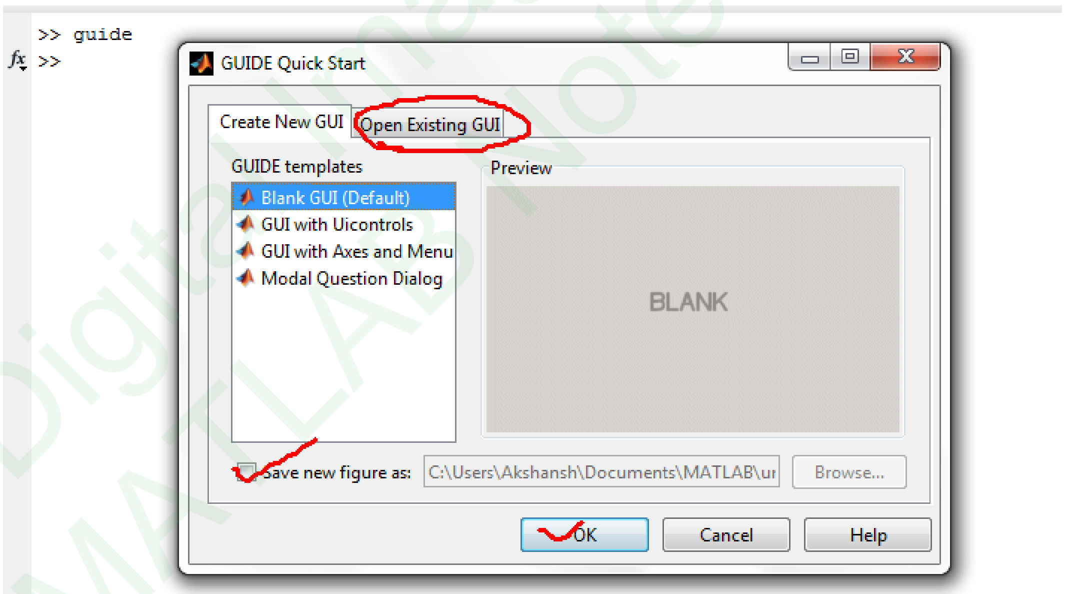


```
>> guide
```

```
end
%-- 06-03-2014 13:33 --%
%-- 13-03-2014 13:58 --%
```

Open MATLAB and type Guide in the command window

Dialog box opens

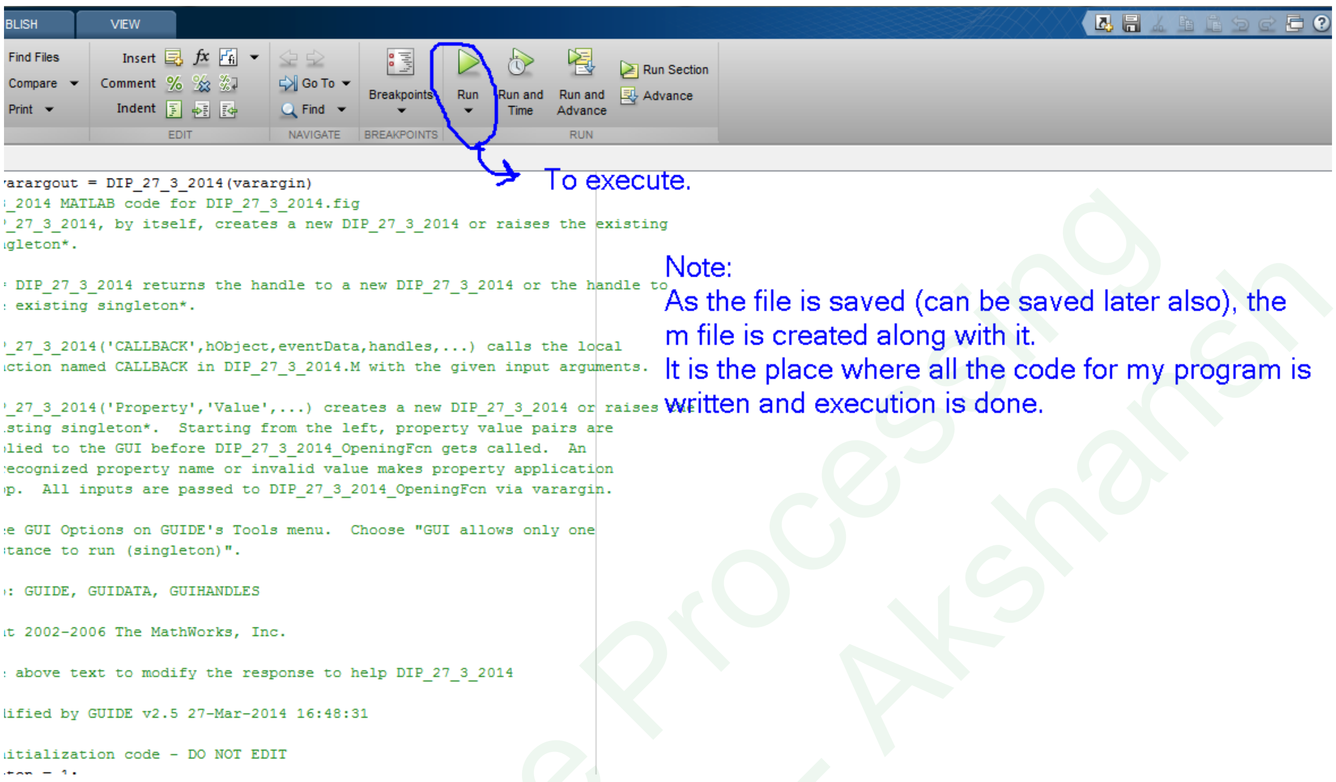


```
>> guide
>>
```

Save new figure as: C:\Users\Akshansh\Documents\MATLAB\ur

Select Blank GUI (Default) option if creating a new one,
or, Open Existing GUI.
Tick the Check Box to save the figure.

Note: "GUIDE - Graphical User Interface Development Environment"

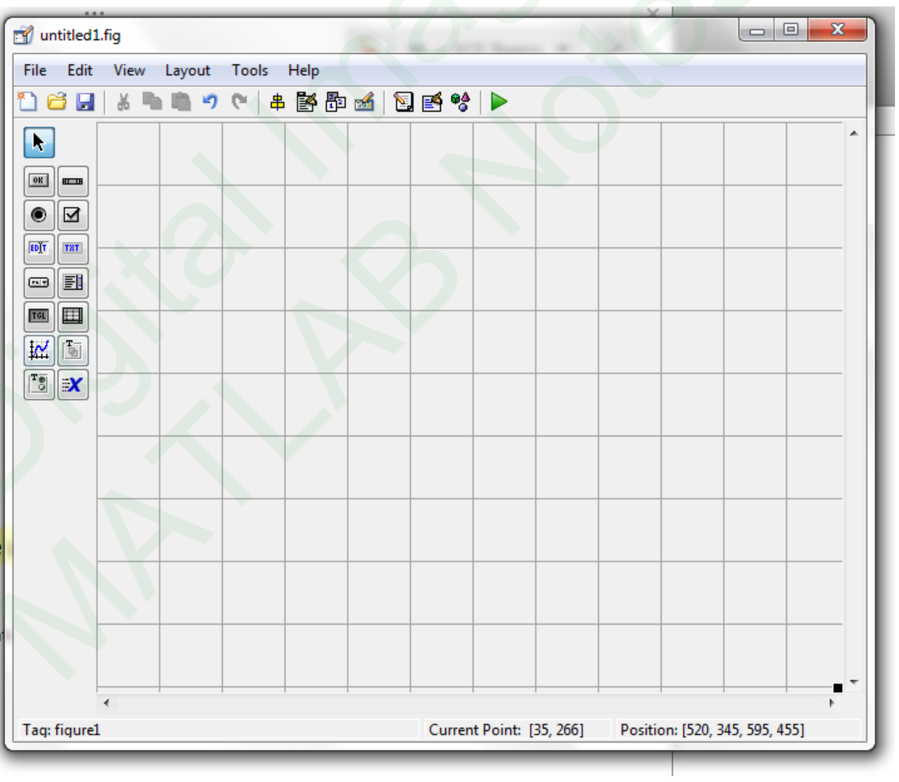


To execute.

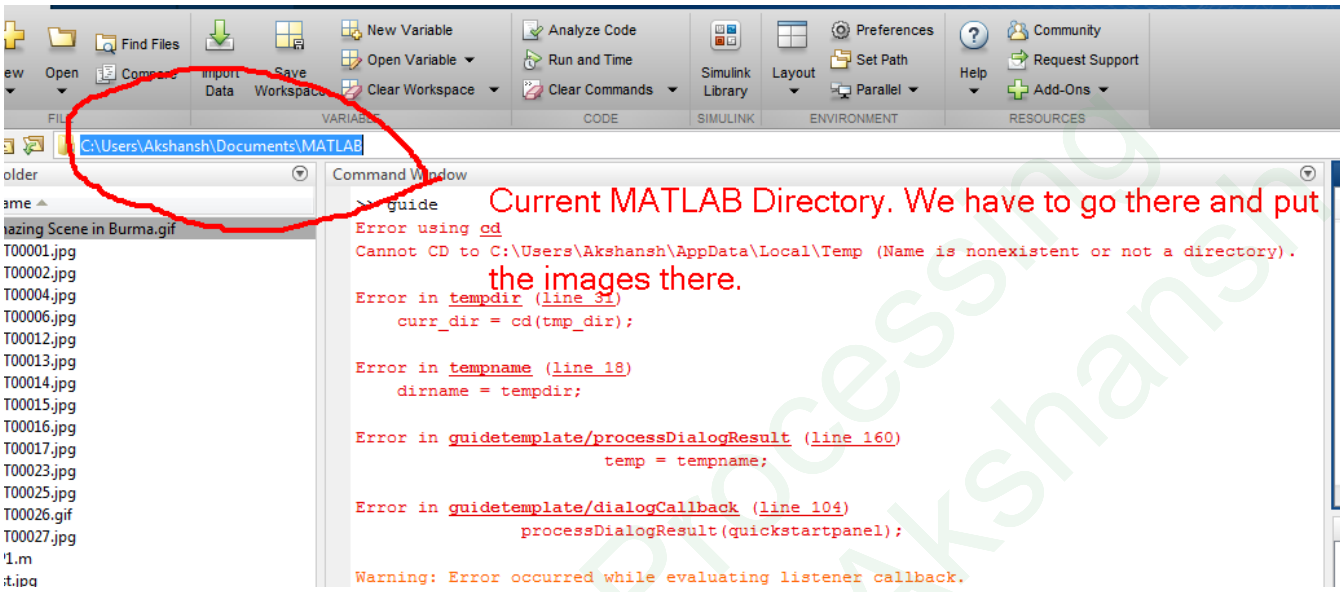
```
'arargout = DIP_27_3_2014(varargin)
_2014 MATLAB code for DIP_27_3_2014.fig
'_27_3_2014, by itself, creates a new DIP_27_3_2014 or raises the existing
.gleton*.

 DIP_27_3_2014 returns the handle to a new DIP_27_3_2014 or the handle to
 existing singleton*.

'_27_3_2014('CALLBACK',hObject,eventData,handles,...) calls the local
.ction named CALLBACK in DIP_27_3_2014.M with the given input arguments.

'_27_3_2014('Property','Value',...) creates a new DIP_27_3_2014 or raises the
.sting singleton*.  Starting from the left, property value pairs are
.lied to the GUI before DIP_27_3_2014_OpeningFcn gets called.  An
'ecognized property name or invalid value makes property application
.p.  All inputs are passed to DIP_27_3_2014_OpeningFcn via varargin.

.e GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
.tance to run (singleton)".

: GUIDE, GUIDATA, GUIHANDLES

.t 2002-2006 The MathWorks, Inc.

 above text to modify the response to help DIP_27_3_2014

.ified by GUIDE v2.5 27-Mar-2014 16:48:31

.itialization code - DO NOT EDIT
```

Note:
As the file is saved (can be saved later also), the m file is created along with it.
It is the place where all the code for my program is written and execution is done.

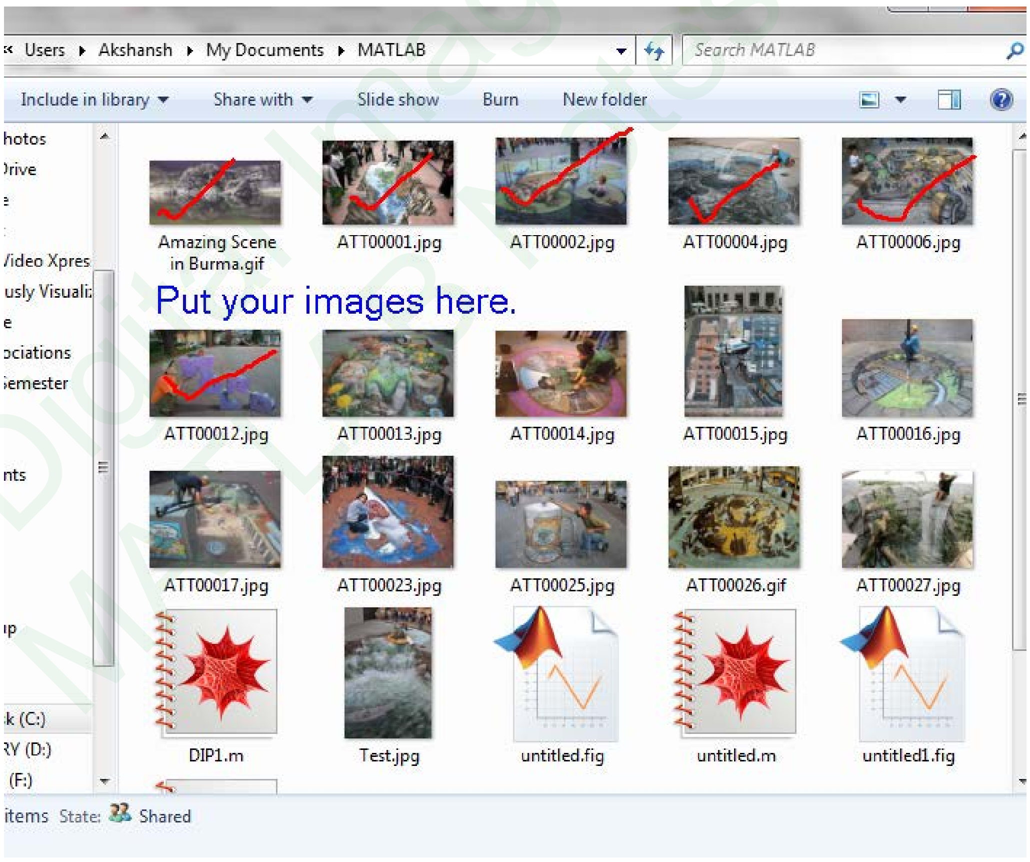
This opens a new GUI dialog box as shown -



Let's say we make a List Box.
As I aim to load the image, I have to put the images in the MATLAB Directory so that the images can be accessed from there directly while coding is done.

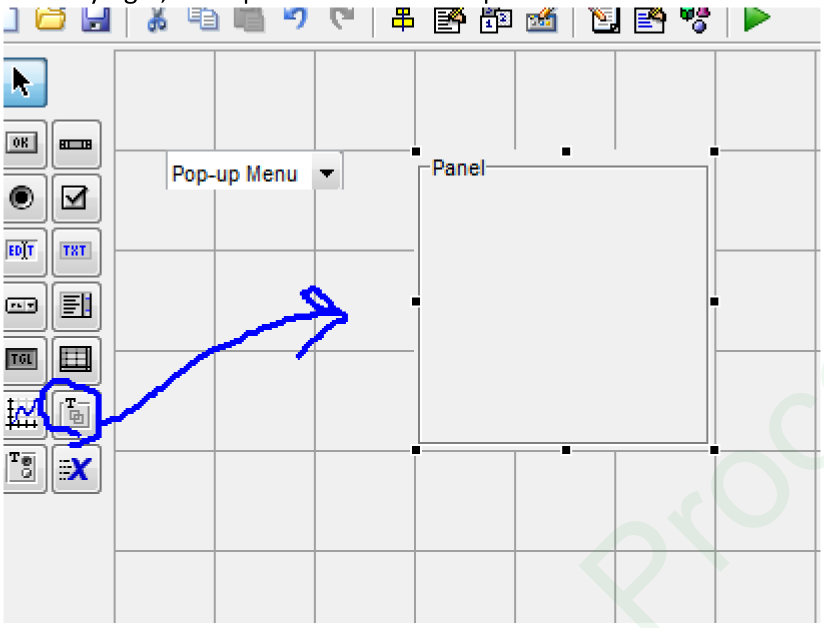

C:\Users\Akshansh\Documents\MATLAB
Current MATLAB Directory. We have to go there and put the images there.
Command Window

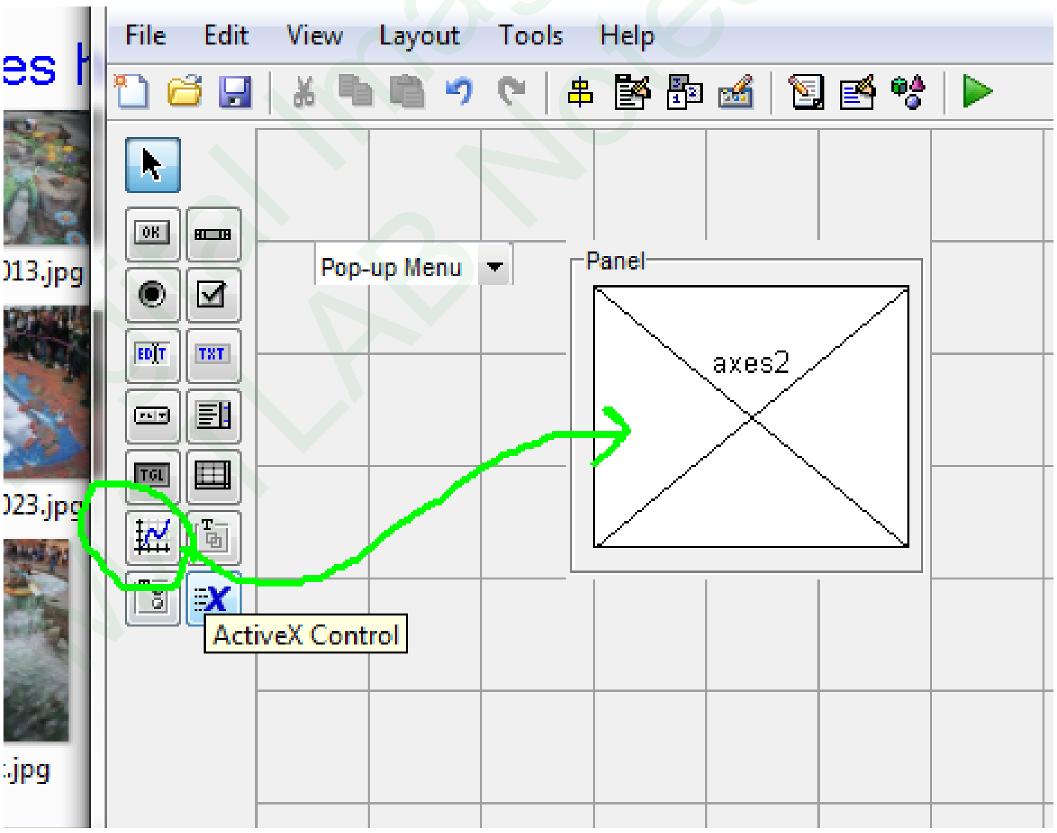
```
>> guide
Error using cd
Cannot CD to C:\Users\Akshansh\AppData\Local\Temp (Name is nonexistent or not a directory).

Error in tempdir (line 31)
    curr_dir = cd(tmp_dir);

Error in tempname (line 18)
    dirname = tempdir;

Error in guidetemplate/processDialogResult (line 160)
                temp = tempname;

Error in guidetemplate/dialogCallback (line 104)
            processDialogResult(quickstartpanel);

Warning: Error occurred while evaluating listener callback.
```



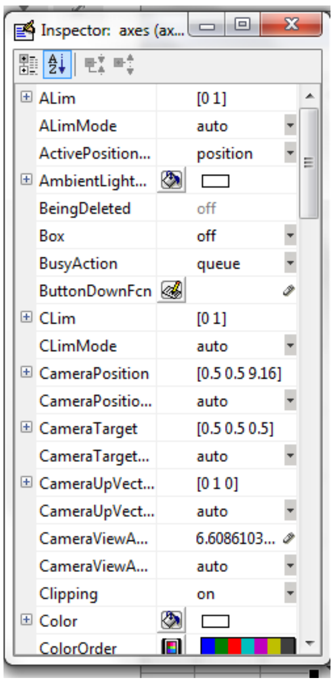
In the GUI window, there is an AXES option.
Let's make two AXIS. One for the original image and other for the changed image.

Beautifying it, Put a panel first and then put Axes over it as shown.

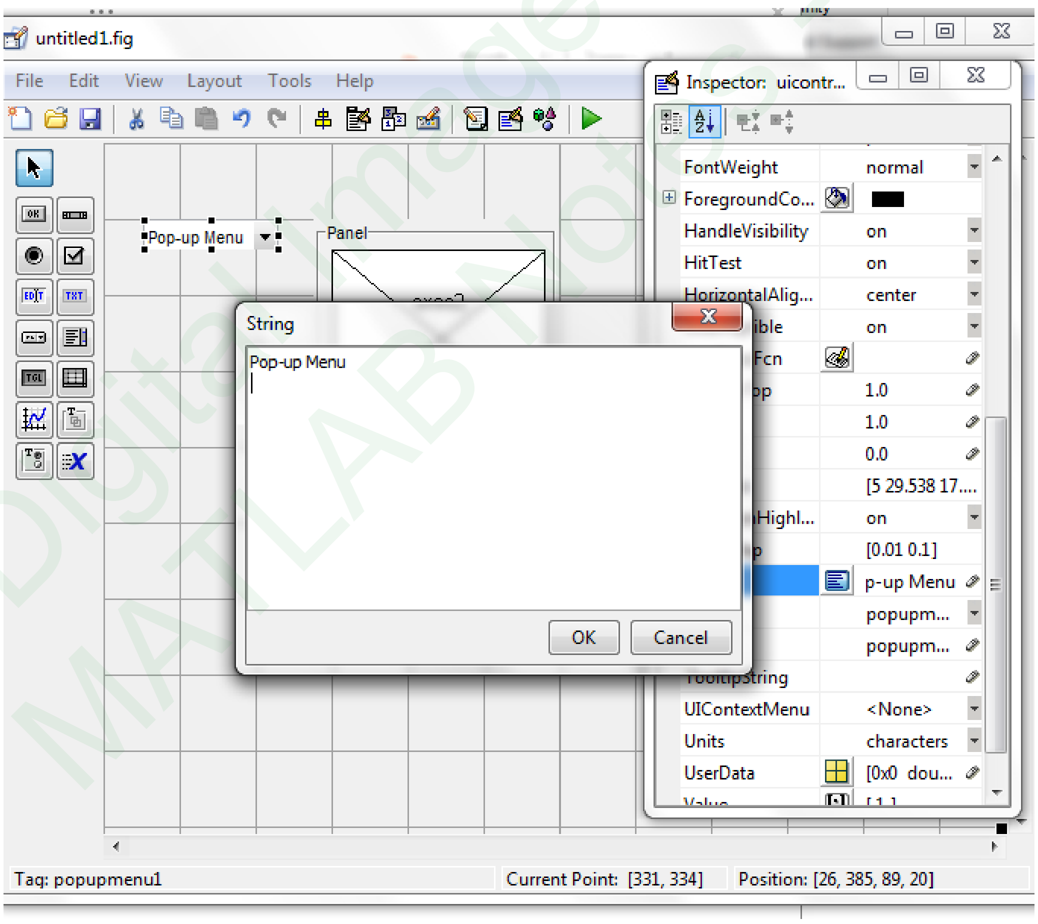




Double click on Pop up menu opens Property Inspector window.


Inspector: axes (ax...

ALim	[0 1]
ALimMode	auto
ActivePosition...	position
AmbientLight...	
BeingDeleted	off
Box	off
BusyAction	queue
ButtonDownFcn	
CLim	[0 1]
CLimMode	auto
CameraPosition	[0.5 0.5 9.16]
CameraPositio...	auto
CameraTarget	[0.5 0.5 0.5]
CameraTarget...	auto
CameraUpVect...	[0 1 0]
CameraUpVect...	auto
CameraViewA...	6.6086103...
CameraViewA...	auto
Clipping	on
Color	
ColorOrder	



String: Pop-up Menu

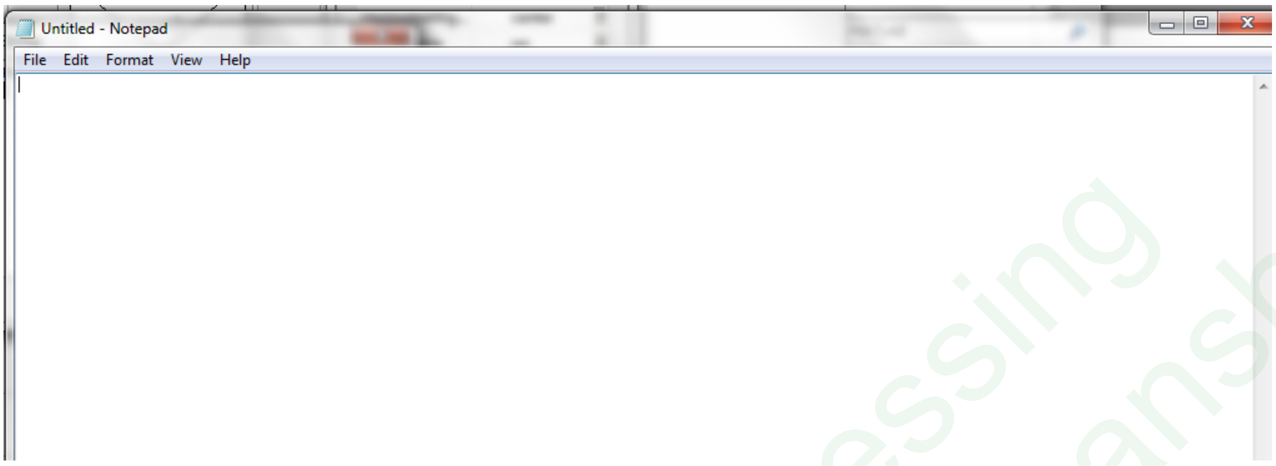
Inspector: uicontr...

FontWeight	normal
ForegroundCo...	■
HandleVisibility	on
HitTest	on
HorizontalAlig...	center
...ible	on
...Fcn	
...p	1.0
	1.0
	0.0
	[5 29.538 17....
...Highl...	on
...p	[0.01 0.1]
	p-up Menu
	popupm...
	popupm...
TooltipString	
UIContextMenu	<None>
Units	characters
UserData	[0x0 dou...
Value	[1 1

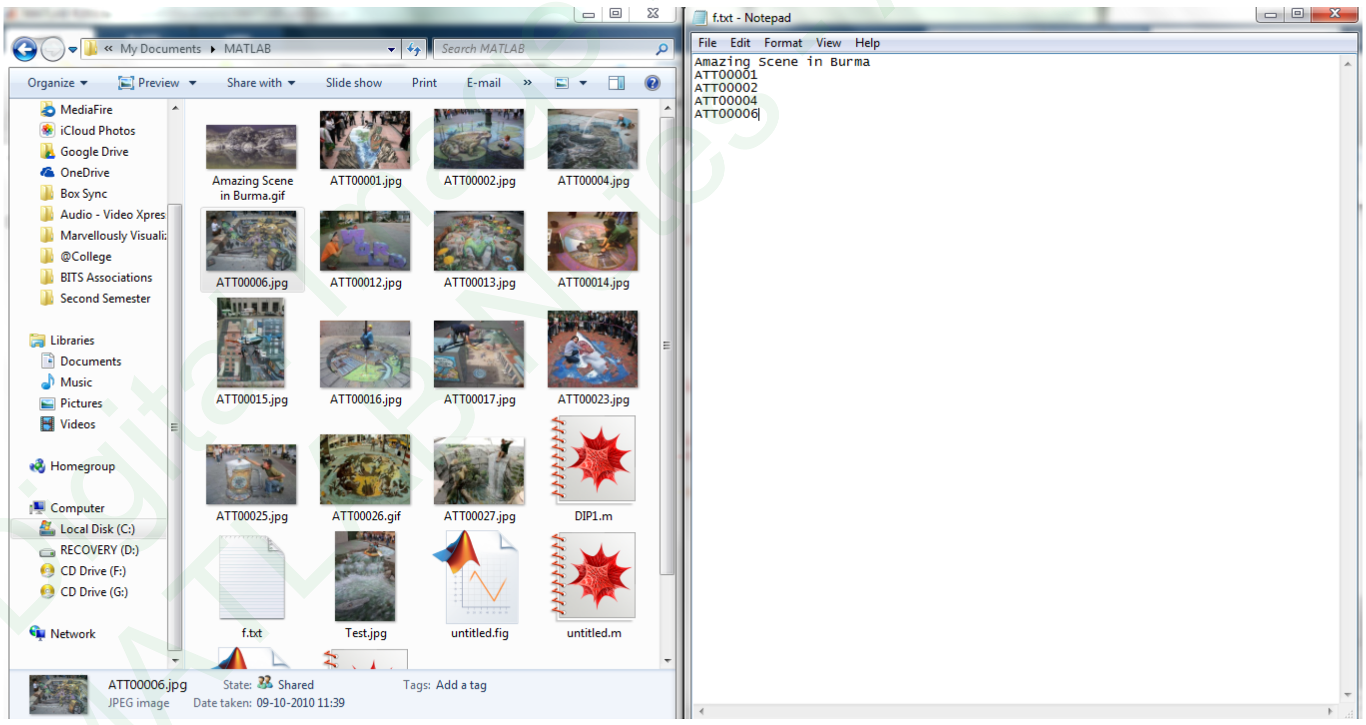
Tag: popupmenu1 Current Point: [331, 334] Position: [26, 385, 89, 20]

Creating a text file -

Open Notepad and write the names of all the file names in your current directory.

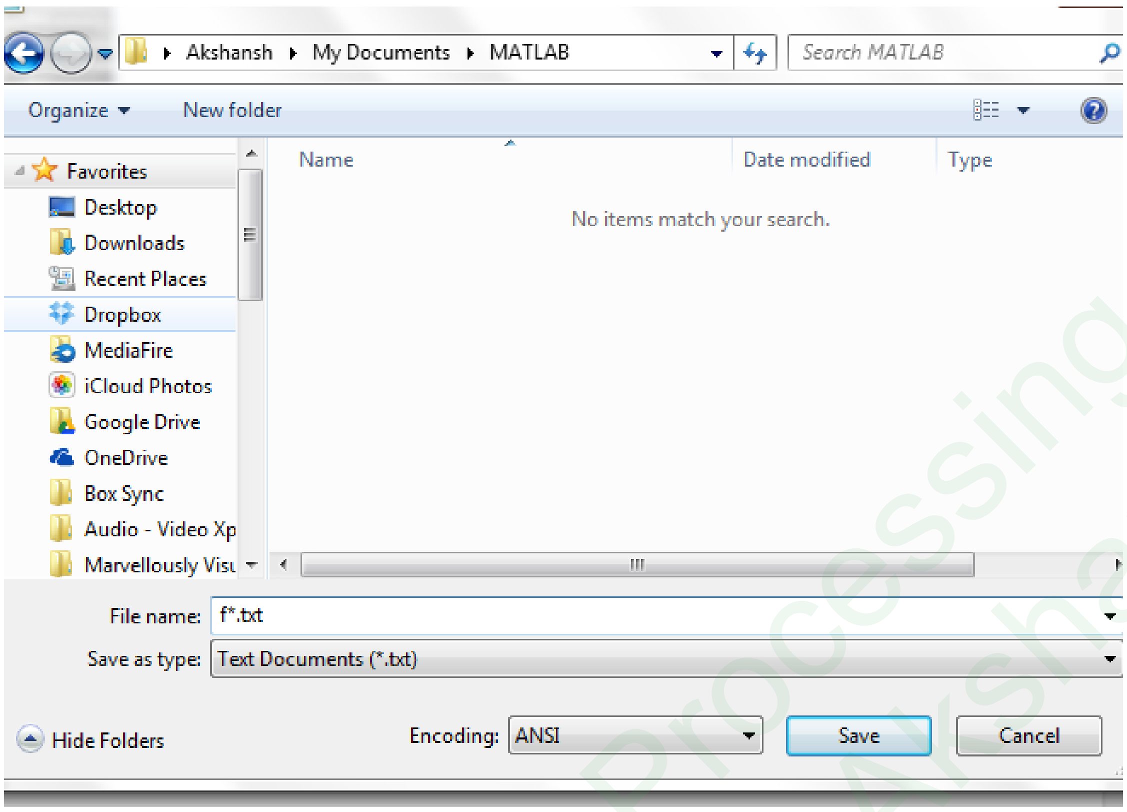


See that the names in the current directory (without the extension like .jpeg) are being copy pasted in the Notepad.



```
Amazing Scene in Burma
ATT00001
ATT00002
ATT00004
ATT00006
```

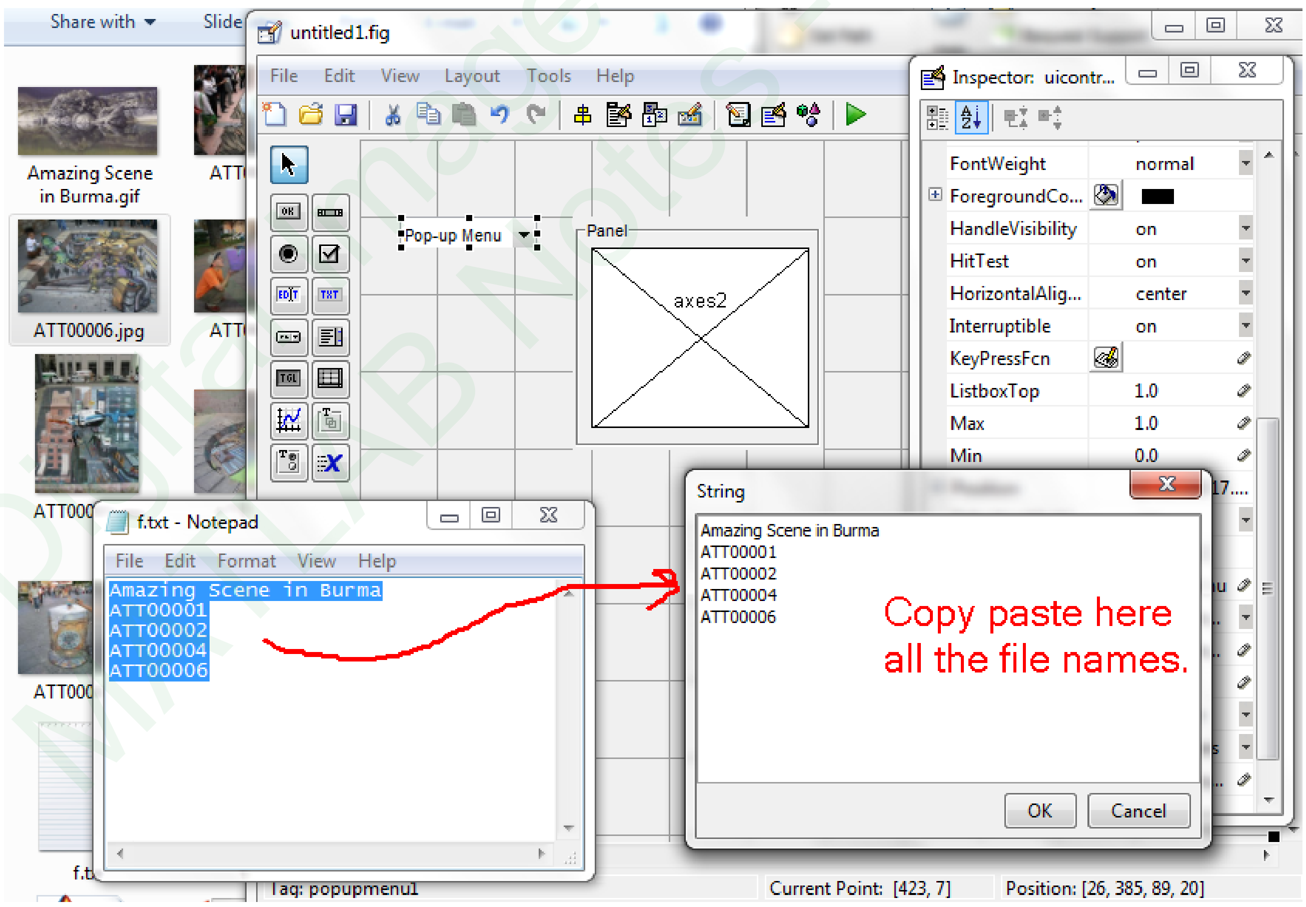
Then, save the notepad file in the same MATLAB Directory
(By default, its C:\Users\Akshansh\Documents\MATLAB)



File name: f*.txt

Save as type: Text Documents (*.txt)

Encoding: ANSI



FontWeight	normal
ForegroundCo...	■
HandleVisibility	on
HitTest	on
HorizontalAlig...	center
Interruptible	on
KeyPressFcn	
ListboxTop	1.0
Max	1.0
Min	0.0

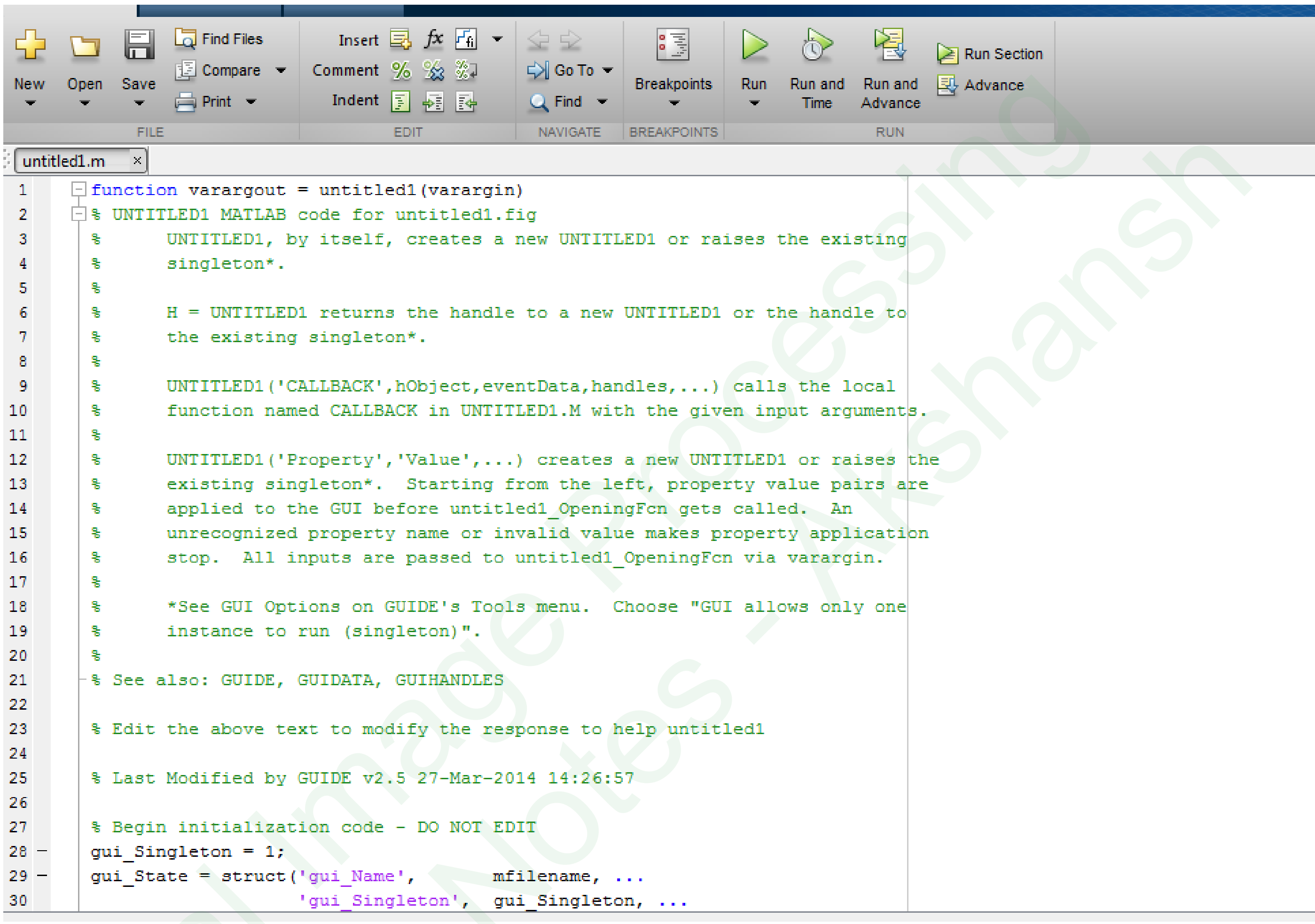
```
Amazing Scene in Burma
ATT00001
ATT00002
ATT00004
ATT00006
```

Copy paste here all the file names.

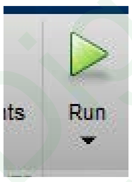
Tag: popupmenu1 Current Point: [423, 7] Position: [26, 385, 89, 20]

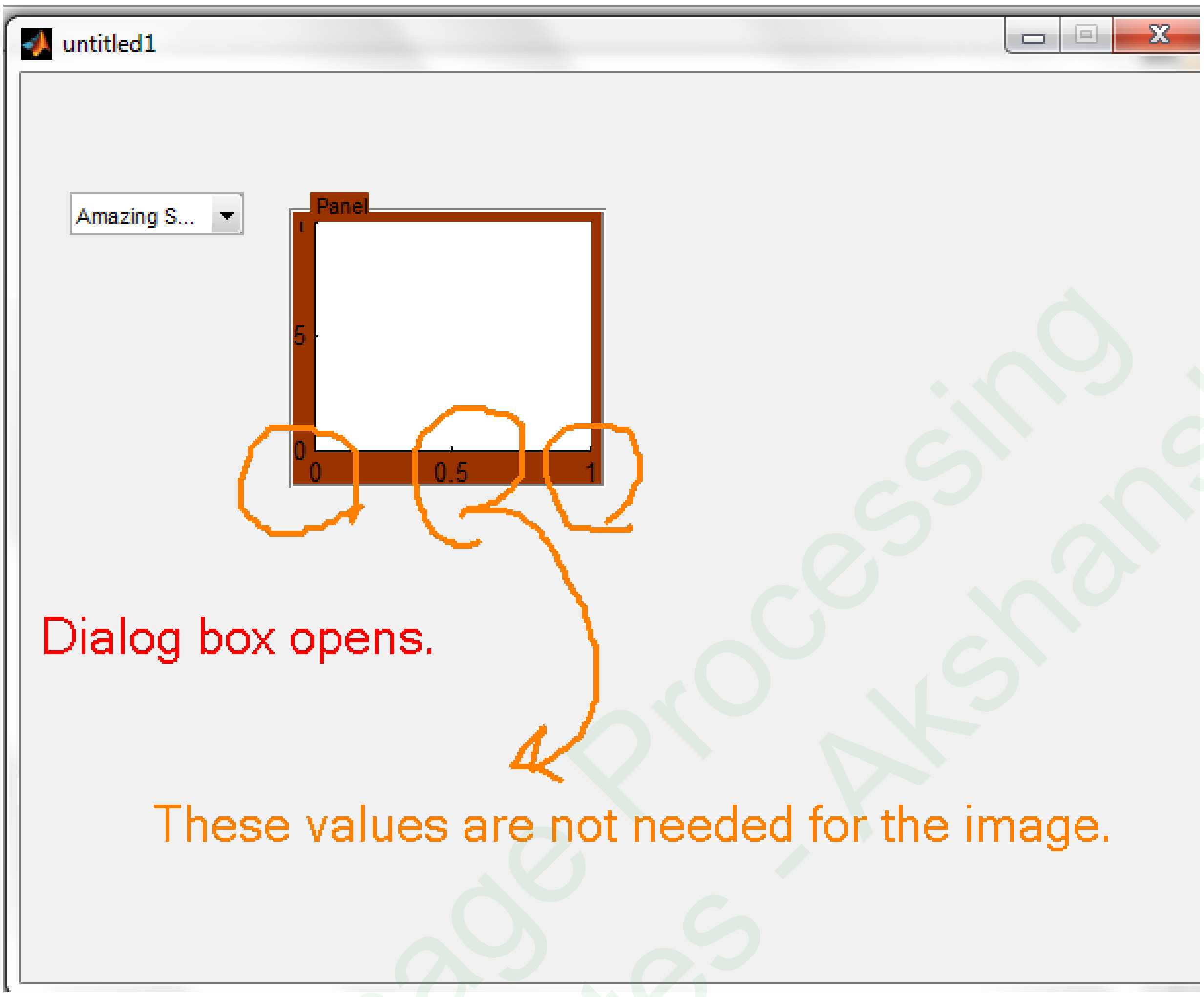
Now,
We can also click on the properties and change the colors of the background and its title, etc.

As we save this program, it creates an m file.



```
function varargout = untitled1(varargin)
% UNTITLED1 MATLAB code for untitled1.fig
%      UNTITLED1, by itself, creates a new UNTITLED1 or raises the existing
%      singleton*.
%
%      H = UNTITLED1 returns the handle to a new UNTITLED1 or the handle to
%      the existing singleton*.
%
%      UNTITLED1('CALLBACK',hObject,eventData,handles,...) calls the local
%      function named CALLBACK in UNTITLED1.M with the given input arguments.
%
%      UNTITLED1('Property','Value',...) creates a new UNTITLED1 or raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before untitled1_OpeningFcn gets called.  An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to untitled1_OpeningFcn via varargin.
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help untitled1

% Last Modified by GUIDE v2.5 27-Mar-2014 14:26:57

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
```

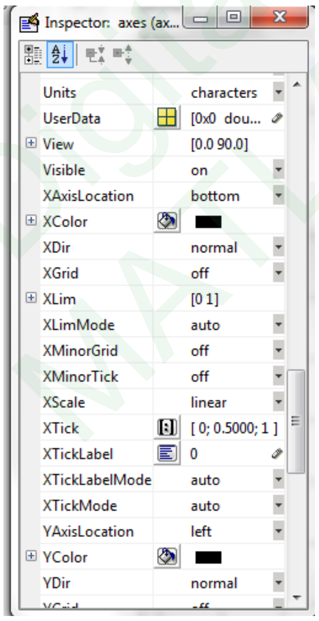




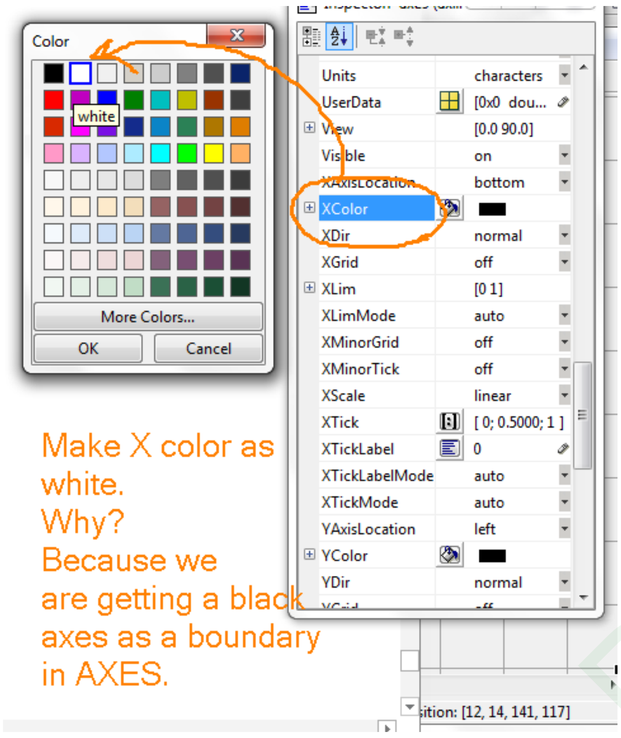
Dialog box opens.

These values are not needed for the image.

We need to remove the values
Go back to figure window.
Double click on AXES. A dialog box opens.



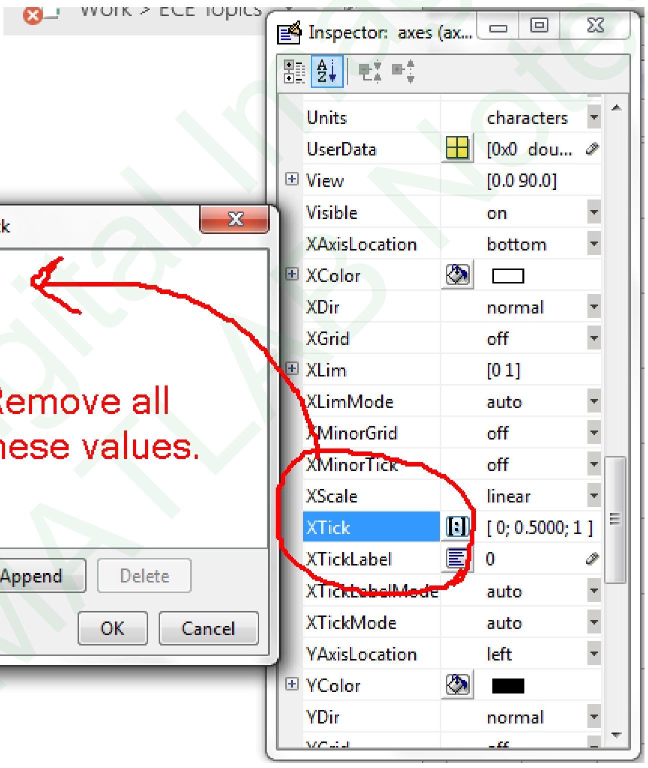
Units	characters
UserData	[0x0 dou...
View	[0.0 90.0]
Visible	on
XAxisLocation	bottom
XColor	■
XDir	normal
XGrid	off
XLim	[0 1]
XLimMode	auto
XMinorGrid	off
XMinorTick	off
XScale	linear
XTick	[0; 0.5000; 1]
XTickLabel	0
XTickLabelMode	auto
XTickMode	auto
YAxisLocation	left
YColor	■
YDir	normal



Units	characters
UserData	[0x0 dou...
View	[0.0 90.0]
Visible	on
XAxisLocation	bottom
XColor	⬛
XDir	normal
XGrid	off
XLim	[0 1]
XLimMode	auto
XMinorGrid	off
XMinorTick	off
XScale	linear
XTick	[0; 0.5000; 1]
XTickLabel	0
XTickLabelMode	auto
XTickMode	auto
YAxisLocation	left
YColor	⬛
YDir	normal

Make X color as white.
Why?
Because we are getting a black axes as a boundary in AXES.

ition: [12, 14, 141, 117]

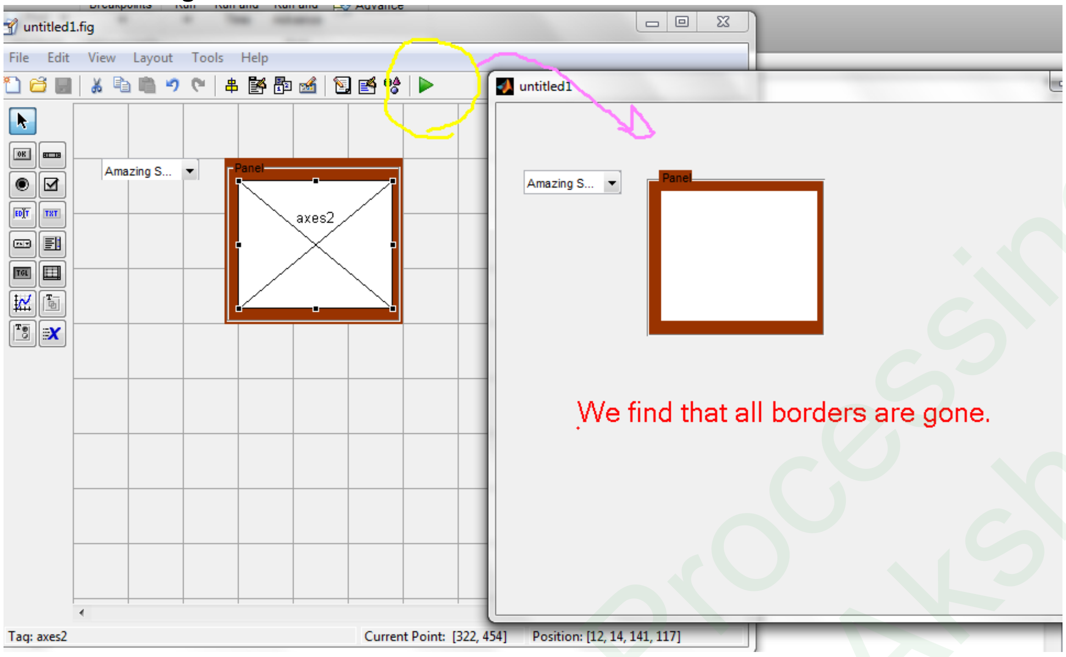


```
0.0
0.5
1.0
```

Remove all these values.

Units	characters
UserData	[0x0 dou...
View	[0.0 90.0]
Visible	on
XAxisLocation	bottom
XColor	⬜
XDir	normal
XGrid	off
XLim	[0 1]
XLimMode	auto
XMinorGrid	off
XMinorTick	off
XScale	linear
XTick	[0; 0.5000; 1]
XTickLabel	0
XTickLabelMode	auto
XTickMode	auto
YAxisLocation	left
YColor	⬛
YDir	normal

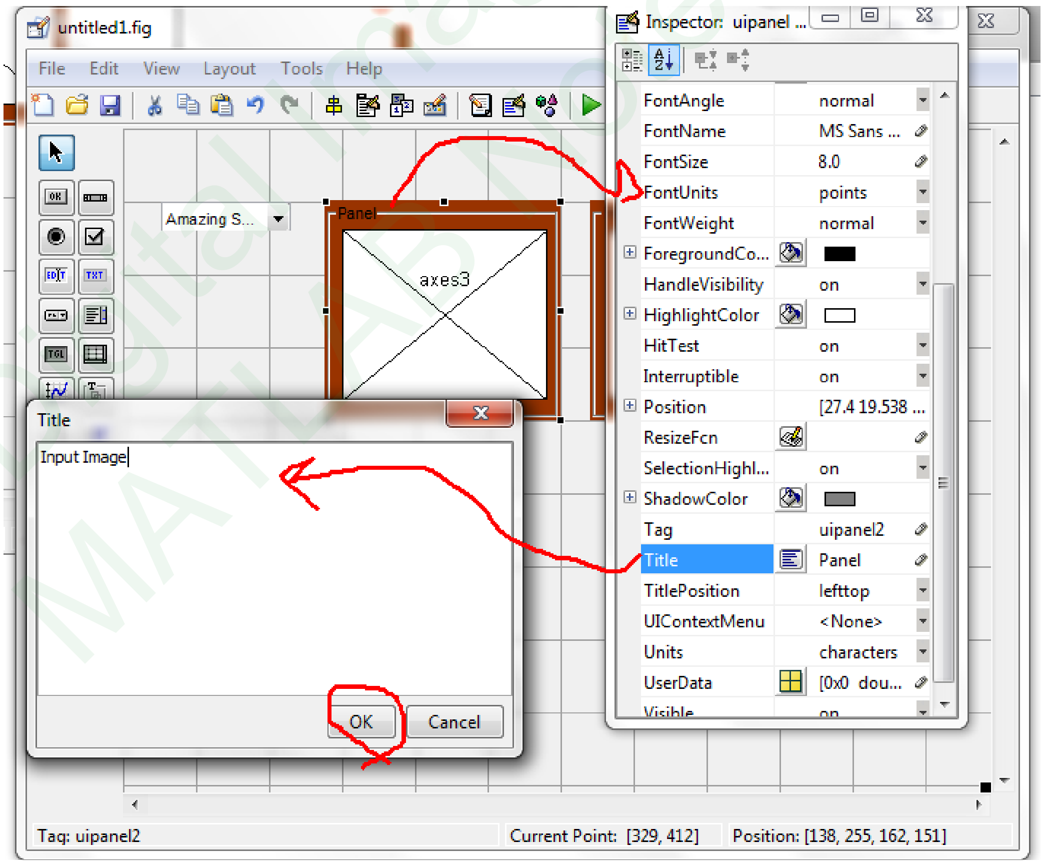
Similarly do for Y axes.
Save the GUI and open m file
Run it.
All boundaries gone.



We find that all borders are gone.

Tag: axes2 Current Point: [322, 454] Position: [12, 14, 141, 117]

Now, make a duplicate of the (Axes+Panel).
One will be input, other will be output.

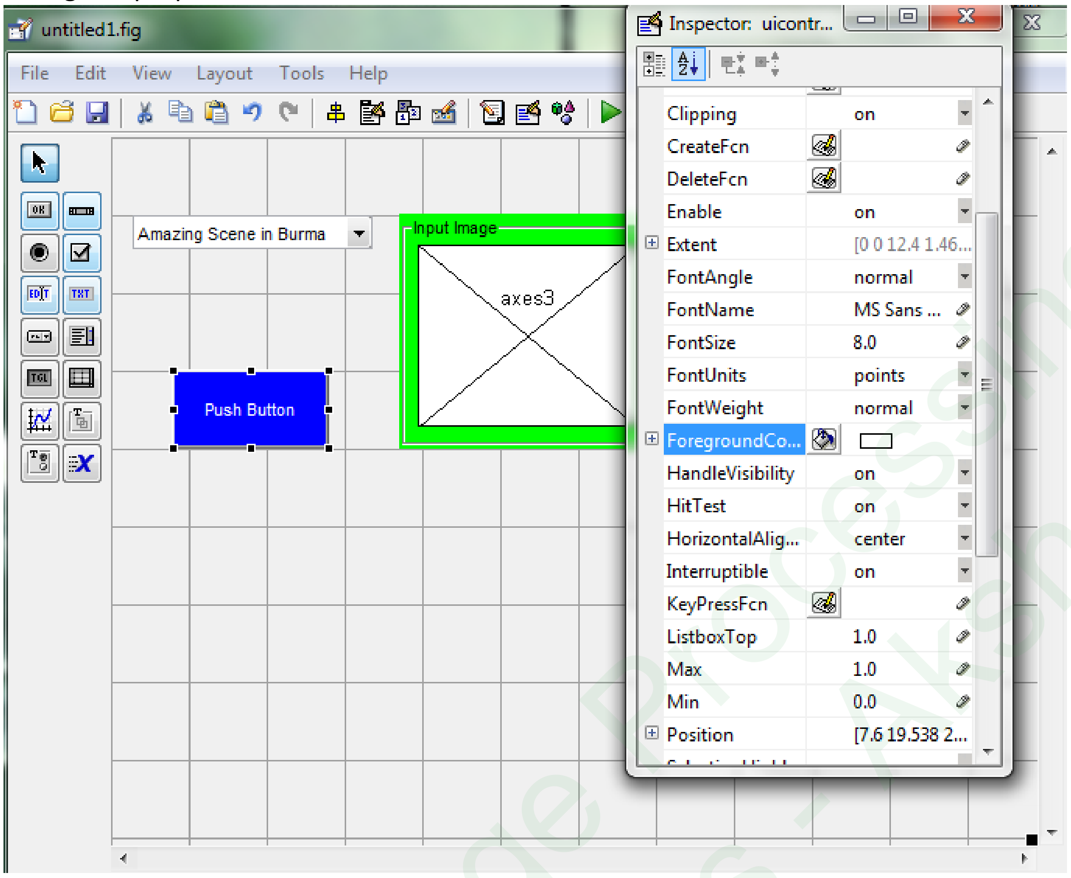


Input Image

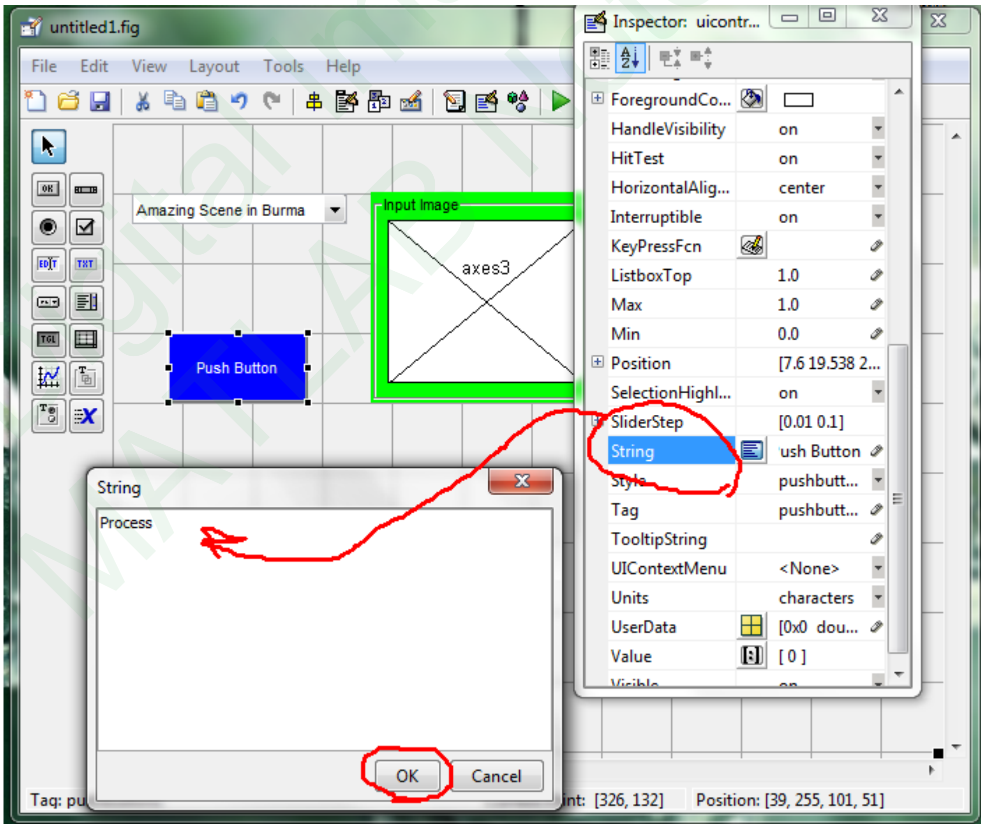
FontAngle	normal
FontName	MS Sans ...
FontSize	8.0
FontUnits	points
FontWeight	normal
ForegroundCo...	■
HandleVisibility	on
HighlightColor	□
HitTest	on
Interruptible	on
Position	[27.4 19.538 ...
ResizeFcn	
SelectionHighl...	on
ShadowColor	■
Tag	uipanel2
Title	Panel
TitlePosition	lefttop
UIContextMenu	<None>
Units	characters
UserData	[0x0 dou...
Visible	on

Tag: uipanel2 Current Point: [329, 412] Position: [138, 255, 162, 151]

Add a push button
Change its properties if needed.



Clipping	on
CreateFcn	
DeleteFcn	
Enable	on
Extent	[0 0 12.4 1.46...
FontAngle	normal
FontName	MS Sans ...
FontSize	8.0
FontUnits	points
FontWeight	normal
ForegroundCo...	
HandleVisibility	on
HitTest	on
HorizontalAlig...	center
Interruptible	on
KeyPressFcn	
ListboxTop	1.0
Max	1.0
Min	0.0
Position	[7.6 19.538 2...

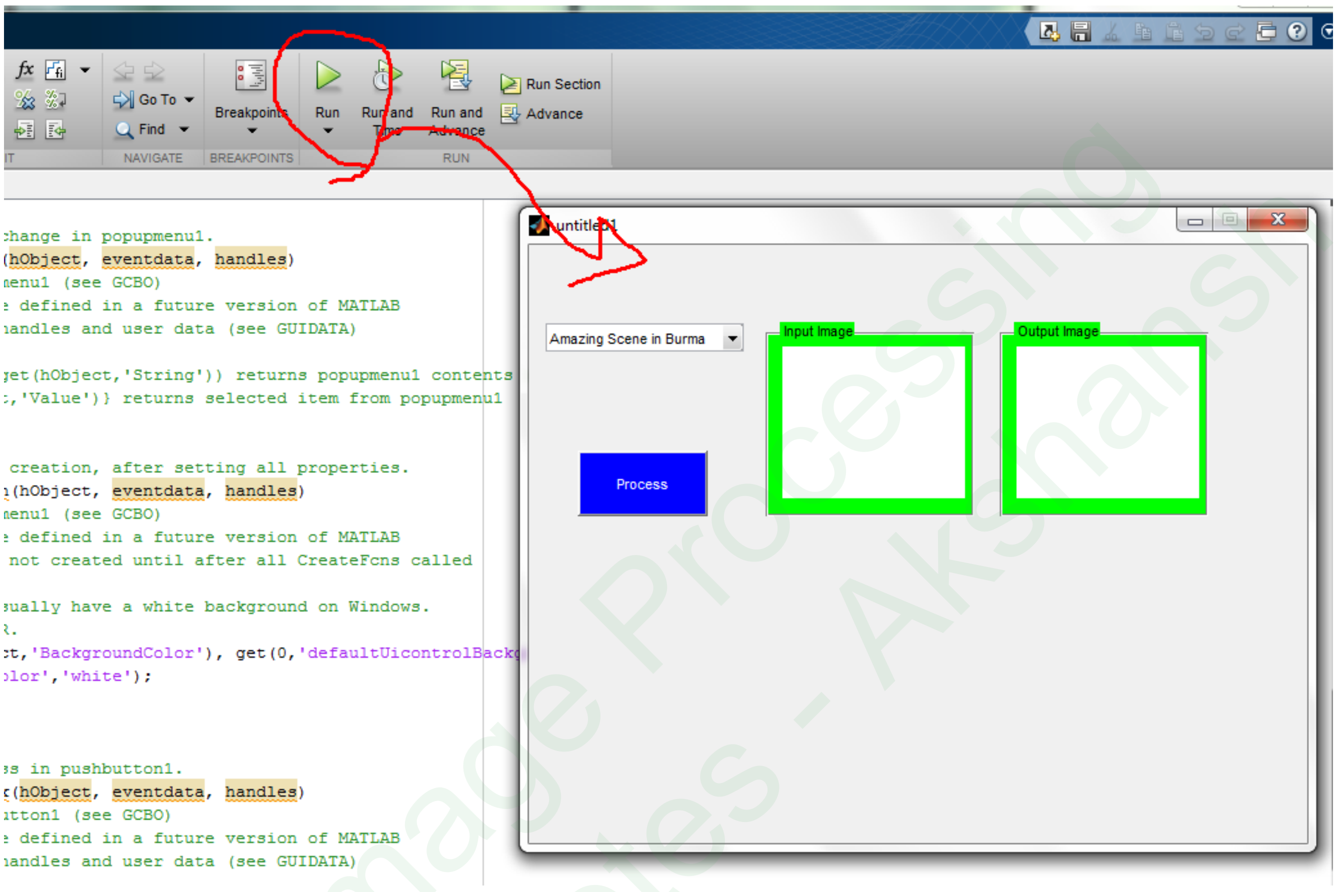


ForegroundCo...	
HandleVisibility	on
HitTest	on
HorizontalAlig...	center
Interruptible	on
KeyPressFcn	
ListboxTop	1.0
Max	1.0
Min	0.0
Position	[7.6 19.538 2...
SelectionHighl...	on
SliderStep	[0.01 0.1]
String	ush Button
Style	pushbutt...
Tag	pushbutt...
TooltipString	
UIContextMenu	<None>
Units	characters
UserData	[0x0 dou...
Value	[0]

Process

Tag: pu nt: [326, 132] Position: [39, 255, 101, 51]

Save it and Run it.



```
hange in popupmenu1.
(hObject, eventdata, handles)
enu1 (see GCBO)
 defined in a future version of MATLAB
andles and user data (see GUIDATA)

et(hObject,'String')) returns popupmenu1 contents
,'Value')} returns selected item from popupmenu1


 creation, after setting all properties.
(hObject, eventdata, handles)
enu1 (see GCBO)
 defined in a future version of MATLAB
 not created until after all CreateFcns called

ually have a white background on Windows.
.
t,'BackgroundColor'), get(0,'defaultUicontrolBack
lor','white');



s in pushbutton1.
(hObject, eventdata, handles)
tton1 (see GCBO)
 defined in a future version of MATLAB
andles and user data (see GUIDATA)
```

Select image and press process.
Nothing happens, as, there is no code written for my GUI.

BITS PILANI DUBAI CAMPUS

MATLAB ASSIGNMENT QUESTIONS FOR DIGITAL IMAGE PROCESSING AND IMAGE PROCESSING

Note: ANY FIVE out of six questions have to be implemented in MATLAB.
Hand written sheets of program codes have to be submitted (not the soft copy).

Question 1.
Write a MATLAB based GUI program, to illustrate the power law transformation

Question 2.
Write a MATLAB based GUI program, to illustrate intensity level slicing and bit level slicing

Question 3.
Write a MATLAB based GUI program to illustrate Steganography.

Question 4.
Write a GUI based MATLAB program to detect the boundary of the object using Hough transform.

Question 5.
Write a MATLAB based GUI program to illustrate removal of periodic noise from an image using a Notch Filter (Band Stop Filter).

Question 6.
Write a MATLAB based GUI program to illustrate the effect of Atmospheric Turbulence on an image and how the image can be retrieved from the noise.

Lecture Notes

DIP (EEE F435)
MATLAB Assignment Program

1 Power Law Transformation

```
unction varargout = Gamma_Transform(varargin)
% GAMMA_TRANSFORM MATLAB code for Gamma_Transform.fig
%      GAMMA_TRANSFORM, by itself, creates a new GAMMA_TRANSFORM or raises
the existing
%      singleton*.
%
%      H = GAMMA_TRANSFORM returns the handle to a new GAMMA_TRANSFORM or the
handle to
%      the existing singleton*.
%
%      GAMMA_TRANSFORM('CALLBACK',hObject,eventData,handles,...) calls the
local
%      function named CALLBACK in GAMMA_TRANSFORM.M with the given input
arguments.
%
%      GAMMA_TRANSFORM('Property','Value',...) creates a new GAMMA_TRANSFORM
or raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before Gamma_Transform_OpeningFcn gets called.  An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to Gamma_Transform_OpeningFcn via
varargin.
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help Gamma_Transform

% Last Modified by GUIDE v2.5 14-May-2014 22:44:13

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @Gamma_Transform_OpeningFcn, ...
                   'gui_OutputFcn',  @Gamma_Transform_OutputFcn, ...
                   'gui_LayoutFcn',  [] , ...
                   'gui_Callback',   []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
```

```
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT


% --- Executes just before Gamma_Transform is made visible.
function Gamma_Transform_OpeningFcn(hObject, eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Gamma_Transform (see VARARGIN)

% Choose default command line output for Gamma_Transform
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes Gamma_Transform wait for user response (see UIRESUME)
% uiwait(handles.figure1);


% --- Outputs from this function are returned to the command line.
function varargout = Gamma_Transform_OutputFcn(hObject, eventdata, handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;


% --- Executes on selection change in listbox1.
function listbox1_Callback(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: contents = cellstr(get(hObject,'String')) returns listbox1 contents
as cell array
%        contents{get(hObject,'Value')} returns selected item from listbox1


global im;
contents = cellstr(get(hObject,'String'));
im=contents{get(hObject,'Value')};
im=strcat(im,'.jpg');
im=imread(im);
axes(handles.axes1);
imshow(im);
```

```
% --- Executes during object creation, after setting all properties.
function listbox1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: listbox controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end



function edit1_Callback(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit1 as text
%        str2double(get(hObject,'String')) returns contents of edit1 as a
double


global cval;
% cval=get(hObject,'String');
cval=str2double(get(hObject,'String'));




% --- Executes during object creation, after setting all properties.
function edit1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end


% --- Executes on button press in pushbutton1.
function pushbutton1_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
```

```
global im;
global im2;
im=rgb2gray(im);
im2=im2double(im);
axes(handles.axes1);
imshow(im);






function edit2_Callback(hObject, eventdata, handles)
% hObject    handle to edit2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit2 as text
%        str2double(get(hObject,'String')) returns contents of edit2 as a
double


global gval;
% gval=get(hObject,'Value')
gval=str2double(get(hObject,'String'));


% --- Executes during object creation, after setting all properties.
function edit2_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end


% --- Executes on button press in pushbutton3.
function pushbutton3_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

global im2;
global im3;
global cval;
global gval;

[m,n]=size(im2);
for i=1:m
```

```
    for j=1:n
        im3(i,j)=cval*((im2(i,j)/255).^gval);
    end
end

axes(handles.axes2);
imshow(im3);
```

2

2.1 Intensity Level Slicing

```
function varargout = Intensity_Level_Slicing(varargin)
% INTENSITY_LEVEL_SLICING MATLAB code for Intensity_Level_Slicing.fig
%      INTENSITY_LEVEL_SLICING, by itself, creates a new
INTENSITY_LEVEL_SLICING or raises the existing
%      singleton*.
%
%      H = INTENSITY_LEVEL_SLICING returns the handle to a new
INTENSITY_LEVEL_SLICING or the handle to
%      the existing singleton*.
%
%      INTENSITY_LEVEL_SLICING('CALLBACK',hObject,eventData,handles,...)
calls the local
%      function named CALLBACK in INTENSITY_LEVEL_SLICING.M with the given
input arguments.
%
%      INTENSITY_LEVEL_SLICING('Property','Value',...) creates a new
INTENSITY_LEVEL_SLICING or raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before Intensity_Level_Slicing_OpeningFcn gets
called.  An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to Intensity_Level_Slicing_OpeningFcn via
varargin.
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help Intensity_Level_Slicing

% Last Modified by GUIDE v2.5 10-May-2014 15:59:34

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
```

```
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @Intensity_Level_Slicing_OpeningFcn, ...
                   'gui_OutputFcn',  @Intensity_Level_Slicing_OutputFcn, ...
                   'gui_LayoutFcn',  [] , ...
                   'gui_Callback',   []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT


% --- Executes just before Intensity_Level_Slicing is made visible.
function Intensity_Level_Slicing_OpeningFcn(hObject, eventdata, handles,
varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Intensity_Level_Slicing (see VARARGIN)

% Choose default command line output for Intensity_Level_Slicing
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes Intensity_Level_Slicing wait for user response (see UIRESUME)
% uiwait(handles.figure1);


% --- Outputs from this function are returned to the command line.
function varargout = Intensity_Level_Slicing_OutputFcn(hObject, eventdata,
handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;


% --- Executes on selection change in listbox1.
function listbox1_Callback(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% Hints: contents = cellstr(get(hObject,'String')) returns listbox1 contents
as cell array
%        contents{get(hObject,'Value')} returns selected item from listbox1


global im1;
global im2;
global con;
con = cellstr(get(hObject,'String'));
im1=con{get(hObject,'Value')};
im1=strcat(im1, '.jpg');
im1=imread(im1);
im2=im1;
axes(handles.axes1);
imshow(im1);

% --- Executes during object creation, after setting all properties.
function listbox1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: listbox controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end


% --- Executes on button press in pushbutton1.
function pushbutton1_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

global im1;
global im2;
im2=rgb2gray(im1);
axes(handles.axes1);
imshow(im2);


% --- Executes on slider movement.
function slider1_Callback(hObject, eventdata, handles)
% hObject    handle to slider1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'Value') returns position of slider
%        get(hObject,'Min') and get(hObject,'Max') to determine range of
slider
```

```
global minval;
global maxval;
global tval;
tval=get(hObject,'Value');
if (tval>maxval || tval<minval)
    msgbox(sprintf('Please choose Threshold value between Maximum and
Minimum'),'Error','Error');
    return
end
data1 = strcat(num2str(tval));
set(handles.text1,'String',data1);

% --- Executes during object creation, after setting all properties.
function slider1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to slider1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: slider controls usually have a light gray background.
if isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor',[.9 .9 .9]);
end



% --- Executes on slider movement.
function slider2_Callback(hObject, eventdata, handles)
% hObject    handle to slider2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'Value') returns position of slider
%        get(hObject,'Min') and get(hObject,'Max') to determine range of
slider
% --- Executes during object creation, after setting all properties.
global maxval;
global minval;
minval=get(hObject,'Value');
if (minval>maxval)
    msgbox(sprintf('Please choose Min. Value < Max Value'),'Error','Error');
    return
end

data2 = strcat(num2str(minval));
set(handles.text2,'String',data2);


function slider2_CreateFcn(hObject, eventdata, handles)
% hObject    handle to slider2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: slider controls usually have a light gray background.
if isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
```

```
    set(hObject,'BackgroundColor',[.9 .9 .9]);
end



% --- Executes on slider movement.
function slider3_Callback(hObject, eventdata, handles)
% hObject    handle to slider3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'Value') returns position of slider
%        get(hObject,'Min') and get(hObject,'Max') to determine range of
slider



% --- Executes during object creation, after setting all properties.
global minval;
global maxval;
maxval=get(hObject,'Value');
if (maxval<minval)
    msgbox(sprintf('Please choose Max Value > Min Value'),'Error','Error');
    return
end

data3 = strcat(num2str(maxval));
set(handles.text3,'String',data3);

function slider3_CreateFcn(hObject, eventdata, handles)
% hObject    handle to slider3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: slider controls usually have a light gray background.
if isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor',[.9 .9 .9]);
end



% --- Executes on button press in pushbutton2.
function pushbutton2_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

global tval;
global minval;
global maxval;
global im2;
[M,N]=size(im2);
if (minval<maxval)
    for i=1:M
        for  j=1:N
            if (im2(i,j)>tval)
                im2(i,j)=maxval;
            else
                im2(i,j)=minval;
            end
        end
    end
end
axes(handles.axes2);
imshow(im2);
```

2.2 Bit Plane Slicing

```
function varargout = Bit_Plane_Slicing(varargin)
% BIT_PLANE_SLICING MATLAB code for Bit_Plane_Slicing.fig
%      BIT_PLANE_SLICING, by itself, creates a new BIT_PLANE_SLICING or
raises the existing
%      singleton*.
%
%      H = BIT_PLANE_SLICING returns the handle to a new BIT_PLANE_SLICING or
the handle to
%      the existing singleton*.
%
%      BIT_PLANE_SLICING('CALLBACK',hObject,eventData,handles,...) calls the
local
%      function named CALLBACK in BIT_PLANE_SLICING.M with the given input
arguments.
%
%      BIT_PLANE_SLICING('Property','Value',...) creates a new
BIT_PLANE_SLICING or raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before Bit_Plane_Slicing_OpeningFcn gets called.
An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to Bit_Plane_Slicing_OpeningFcn via
varargin.
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help Bit_Plane_Slicing

% Last Modified by GUIDE v2.5 17-May-2014 20:02:42

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @Bit_Plane_Slicing_OpeningFcn, ...
                   'gui_OutputFcn',  @Bit_Plane_Slicing_OutputFcn, ...
                   'gui_LayoutFcn',  [] , ...
                   'gui_Callback',   []);
if nargin && ischar(varargin{1})
```

```
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
% End initialization code - DO NOT EDIT


% --- Executes just before Bit_Plane_Slicing is made visible.
function Bit_Plane_Slicing_OpeningFcn(hObject, eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Bit_Plane_Slicing (see VARARGIN)

% Choose default command line output for Bit_Plane_Slicing
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes Bit_Plane_Slicing wait for user response (see UIRESUME)
% uiwait(handles.figure1);


% --- Outputs from this function are returned to the command line.
function varargout = Bit_Plane_Slicing_OutputFcn(hObject, eventdata, handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;


% --- Executes on selection change in listbox1.
function listbox1_Callback(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: contents = cellstr(get(hObject,'String')) returns listbox1 contents
as cell array
%        contents{get(hObject,'Value')} returns selected item from listbox1

global im1;
contents = cellstr(get(hObject,'String'));
im1= contents{get(hObject,'Value')};
im1=strcat(im1,'.jpg');
```

```
im1=imread(im1);
axes(handles.axes1);
imshow(im1);

% --- Executes during object creation, after setting all properties.
function listbox1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: listbox controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end



% --- Executes on button press in pushbutton1.
function pushbutton1_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
global im1;
global im2;

im2=rgb2gray(im1);
axes(handles.axes1);
imshow(im2);

% --- Executes on button press in pushbutton2.
function pushbutton2_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton2 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

global im4;
global im2;
global bp1;
global bp2;
global bp3;
global bp4;
global bp5;
global bp6;
global bp7;
global bp8;

[m, n]=size(im2);

for i=1:m
    for j=1:n
        for k=1:8
            if k==1
            bp1(i,j)=bitget(im2(i,j),k);
            else if k==2
```

```
                    bp2(i,j)=bitget(im2(i,j),k);
                else if k==3
                        bp3(i,j)=bitget(im2(i,j),k);
                    else if k==4
                           bp4(i,j)=bitget(im2(i,j),k);
                        else if k==5
                             bp5(i,j)=bitget(im2(i,j),k);
                            else if k==6
                                    bp6(i,j)=bitget(im2(i,j),k);
                                else if k==7
                                        bp7(i,j)=bitget(im2(i,j),k);
                                    else
                                            bp8(i,j)=bitget(im2(i,j),k);
                                    end
                                end
                            end
                        end
                    end
                end
            end

        end
    end
end



axes(handles.axes18);
imshow(bp1);
axes(handles.axes17);
imshow(bp2);
axes(handles.axes16);
imshow(bp3);
axes(handles.axes15);
imshow(bp4);
axes(handles.axes14);
imshow(bp5);
axes(handles.axes13);
imshow(bp6);
axes(handles.axes12);
imshow(bp7);
axes(handles.axes11);
imshow(bp8);



for i=1:m
    for j=1:n

im4(i,j)=bp1(i,j)/200+bp2(i,j)/200*2+bp3(i,j)/200*4+bp4(i,j)/200*8+bp5(i,j)/2
00*16+bp6(i,j)/200*32+bp7(i,j)/200*64+bp8(i,j)/200*128;

    end
end
```

```
axes(handles.axes19);
imshow(im4);
```

3 STEGANOGRAPHY

```
function varargout = Steganography(varargin)
% STEGANOGRAPHY MATLAB code for Steganography.fig
%      STEGANOGRAPHY, by itself, creates a new STEGANOGRAPHY or raises the
existing
%      singleton*.
%
%      H = STEGANOGRAPHY returns the handle to a new STEGANOGRAPHY or the
handle to
%      the existing singleton*.
%
%      STEGANOGRAPHY('CALLBACK',hObject,eventData,handles,...) calls the
local
%      function named CALLBACK in STEGANOGRAPHY.M with the given input
arguments.
%
%      STEGANOGRAPHY('Property','Value',...) creates a new STEGANOGRAPHY or
raises the
%      existing singleton*.  Starting from the left, property value pairs are
%      applied to the GUI before Steganography_OpeningFcn gets called.  An
%      unrecognized property name or invalid value makes property application
%      stop.  All inputs are passed to Steganography_OpeningFcn via varargin.
%
%      *See GUI Options on GUIDE's Tools menu.  Choose "GUI allows only one
%      instance to run (singleton)".
%
% See also: GUIDE, GUIDATA, GUIHANDLES

% Edit the above text to modify the response to help Steganography

% Last Modified by GUIDE v2.5 15-May-2014 16:20:37

% Begin initialization code - DO NOT EDIT
gui_Singleton = 1;
gui_State = struct('gui_Name',       mfilename, ...
                   'gui_Singleton',  gui_Singleton, ...
                   'gui_OpeningFcn', @Steganography_OpeningFcn, ...
                   'gui_OutputFcn',  @Steganography_OutputFcn, ...
                   'gui_LayoutFcn',  [] , ...
                   'gui_Callback',   []);
if nargin && ischar(varargin{1})
    gui_State.gui_Callback = str2func(varargin{1});
end

if nargout
    [varargout{1:nargout}] = gui_mainfcn(gui_State, varargin{:});
else
    gui_mainfcn(gui_State, varargin{:});
end
```

```
% End initialization code - DO NOT EDIT


% --- Executes just before Steganography is made visible.
function Steganography_OpeningFcn(hObject, eventdata, handles, varargin)
% This function has no output args, see OutputFcn.
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)
% varargin   command line arguments to Steganography (see VARARGIN)

% Choose default command line output for Steganography
handles.output = hObject;

% Update handles structure
guidata(hObject, handles);

% UIWAIT makes Steganography wait for user response (see UIRESUME)
% uiwait(handles.figure1);



% --- Outputs from this function are returned to the command line.
function varargout = Steganography_OutputFcn(hObject, eventdata, handles)
% varargout  cell array for returning output args (see VARARGOUT);
% hObject    handle to figure
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Get default command line output from handles structure
varargout{1} = handles.output;



% --- Executes on selection change in listbox1.
function listbox1_Callback(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: contents = cellstr(get(hObject,'String')) returns listbox1 contents
as cell array
%        contents{get(hObject,'Value')} returns selected item from listbox1

global im;
contents = cellstr(get(hObject,'String'));
im=contents{get(hObject,'Value')};
im=strcat(im,'.jpg');
im=imread(im);
axes(handles.axes1);
imshow(im);



% --- Executes during object creation, after setting all properties.
function listbox1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to listbox1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: listbox controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end



% --- Executes on button press in pushbutton1.
function pushbutton1_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

global im;
im=rgb2gray(im);
axes(handles.axes1);
imshow(im);



function edit1_Callback(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)

% Hints: get(hObject,'String') returns contents of edit1 as text
%        str2double(get(hObject,'String')) returns contents of edit1 as a
double

global txt;
global t2;
txt=get(hObject, 'String')

t2=de2bi(uint16(char(txt)))



% --- Executes during object creation, after setting all properties.
function edit1_CreateFcn(hObject, eventdata, handles)
% hObject    handle to edit1 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    empty - handles not created until after all CreateFcns called

% Hint: edit controls usually have a white background on Windows.
%       See ISPC and COMPUTER.
if ispc && isequal(get(hObject,'BackgroundColor'),
get(0,'defaultUicontrolBackgroundColor'))
    set(hObject,'BackgroundColor','white');
end



% --- Executes on button press in pushbutton3.
```

```
function pushbutton3_Callback(hObject, eventdata, handles)
% hObject    handle to pushbutton3 (see GCBO)
% eventdata  reserved - to be defined in a future version of MATLAB
% handles    structure with handles and user data (see GUIDATA)


global im;
global im2;
global bp1;
global t5;
global t6;
global t2;
global imx;
im2=im;
[m, n]=size(im2);


global n1;
global n2;
% n2=0;

for i=1:m
    for j=1:n
            bp1(i,j)=bitget(im2(i,j),1);
    end
end


[t5, t6]=size(t2);

imx=zeros(t5,t6,8);

for i=1:t5
    for j=1:t6
        imx(i,j,1)=t2(i,j);
    end
end

for i=1:t5
    for j=1:t6
        im2(i,j)=im2(i,j)-bp1(i,j)/200+bi2de(imx(i,j));
    end
end



axes(handles.axes4);
imshow(im2);
```

4 HOUGH TRANSFORM

```
%David Raedy
%Introduction to Computer vision and modeling
%Final Project -- Shape detection with Hough Transforms
%
%Hough transform is used to automatically detect
%features from an image that has has an edge detection
%algorithm applied.
%
%I have implemented two types of feature extraction:
%lines and circles, both of which involve transforming
%the image from "feature space" into "parameter space".
%The methods for extracting line and circle features
%are different enough to warrant separate explanations.
%
%Circle Extraction
%The more intuitive of the methods is circle extraction.
%It is more intuitive to me because the matrix representing
%the parameter space has the same dimensions as the original,
%and the method involves projecting circles using cartesian
%coordinates. Simply stated, each pixel in the edge-detected
%image serves as the centerpoint for a circle of a given radius.
%Circles are projected around the centerpoint, and for each point
%on the circle, the corresponding cell in the accumulator array
%is incremented by one.
%
%The result of projecting these circles of fixed array in the
%hough parameter space is that the centerpoints of circles in
%feature space is revealed:  in parameter space those centerpoints
%will accumulate relatively large values, since the centerpoint
%will appear on the edge of all of the circles formed in
%parameter space by the edges of the actual circle in feature space.
%
%The drawback of this technique is that it is computationally
%complex, and requires separate passes for any give radius.
%It's also rigid, and only reveals nearly perfect circles.
%
%Line Extraction
%Line extraction operates in a similar vein, but is somewhat more
%abstract -- which is to say, you can view the accumulator matrix
%(parameter space) from circle extraction, and see pretty clearly
%how the process works, including being able to see vestiges of the
%original image.  With line extraction, there is no such correlation:
%parameter space inhabits a different-sized matrix for one, and the
%axes represent minimum distance from the origin for a given line on
%the one hand, and angle of the line on the other.
%
%So the first thing to understand about parameter space for line
%extraction is that there is no one-to-one relationship between
%pixels in the image and cells in the parameter space matrix.
%Rather, each cell in parameter space represents a line that spans
%across the entire image.
%
%The transformation between feature space and parameter space is
%the following:
```

```
%Project a line through each edge pixel at every possible angle
%(you can also increment the angles at steps).  For each line,
%calculate the minimum distance between the line and the origin.
%Increment the appropriate parameter space accumulator by one.
%The x-axis of parameter space ranges from 1 to the square root of
%the sum of the squares of rows and columns from feature space.
%(This number corresponds to the furthest possible minimum distance
%from the origin to a line passing through the image.
%The y-axis represents the angle of the line.
%Obviously the axes could be switched...
%
%Similarly to the process of circle extraction, the larger the number
%in any given cell of the accumulator matrix, the larger the likelihood
%that a line exists at that angle and distance from the origin.
%
%Transforming from parameter space back to feature space is slightly
%more trouble for lines than circles -- the method I employ involves
%the risk of divide-by-zero for one.  Also, each line pixel is checked
%to see if there is a pixel in edge space, and marked accordingly.
%
%An extra step which I didn't employ would be to add a step of hysterisis
%to attempt to discover the line segments more definitively.
%
%The main trouble with both methods was finding an appropriate
%threshhold for determining what constitutes a feature.  The image
%processing toolkit apparently has a local maximum detector, which
%would have been very helpful.  I relied on a more blunt measure,
%which was a threshold as a percentage of the maximum accumulator
%value.
%

%----------------------------------------------
%canny edge detector section
%
%img=imread('parallelo.jpg');
img=imread('Amazing Scene in Burma.jpg');
%img=imread('scene_shapes_a.png');

F=(rgb2gray(img));

%display original image in grayscale
figure(1);
imagesc(F);
colormap(gray);
axis image;

% compute Gaussian
sig = 1.5;
x = floor(-3*sig):ceil(3*sig);
GAUSS = exp(-0.5*x.^2/sig^2);
GAUSS = GAUSS/sum(GAUSS);
dGAUSS = -x.*GAUSS/sig^2;

% convolute the image with kernel
Kx = GAUSS'*dGAUSS;
Ky = Kx';
```

```
Ix=conv2(F, Kx, 'same');
Iy=conv2(F, Ky, 'same');

%determine a range and scale for tossing out noise later
%(only look at relatively strong edges)
maxIx = max(max(Ix));
minIx = min(min(Ix));
scaleIx = (maxIx-minIx)/10.0;

maxIy = max(max(Iy));
minIy = min(min(Iy));
scaleIy = (maxIy-minIy)/10.0;

%threshhold is a little arbitrary
strThresh = (0.5*scaleIx)^2 + (0.5*scaleIy)^2;

%initialize matrices for edge image and edge strengths
[rows,cols] = size(F);
Edges = zeros(rows,cols);

%edges binary records 1 for edge pixel and 0 otherwise
%used in hough transform
EdgesBinary = zeros(rows,cols);
Strength = zeros(rows,cols);

%calculate edge strengths
Strength = Ix.^2 + Iy.^2;

%define thresholds for arctan results
% of Iy/Ix (to determine orientation)
pi = 22.0/7.0;
pi8 = pi/8;
pi2 = 4.0*pi8;
threepi8 = 3.0 * pi8;

%value holds arctan orientation value temporarily for each pixel
value = 0;

%skip outermost pixel to avoid out of bounds errors
for x = 2:rows-1
   for y = 2:cols-1

      %set the edge image pixels to white
      Edges(x,y) = 255;

      %only proceed with orientation and edge strength if the result will be
defined
        %and if edge strength is above threshhold
      if( abs(Ix(x,y)) > 0.001  & Strength(x,y) > strThresh )

         %get orientation
         value = atan( Iy(x,y) / Ix(x,y) );
         %horizontal orientation
        if (value <= pi8 & value >= -1.0*pi8)
            if Strength(x,y) > Strength(x,y-1) & Strength(x,y) >
Strength(x,y+1)
               Edges(x,y) = 0;
               EdgesBinary(x,y) = 1;
            end

            %negative slope orientation
        elseif value < threepi8 & value > 0.0
            if Strength(x,y) > Strength(x-1, y-1) & Strength(x,y) >
Strength(x+1, y+1)
               Edges(x,y) = 0;
               EdgesBinary(x,y) = 1;
            end

            %positive slope orientation
        elseif value > -1.0*threepi8 & value < 0.0
            if Strength(x,y) > Strength(x-1, y+1) & Strength(x,y) >
Strength(x+1, y-1)
                Edges(x,y) = 0;
                   EdgesBinary(x,y) = 1;
                end
         else
            %vertical orientation
            if Strength(x,y) > Strength(x-1,y) & Strength(x,y) >
Strength(x+1,y)
               Edges(x,y) = 0;
               EdgesBinary(x,y) = 1;
            end
        end
    end
   end
end

%this figure will display the canny edge results
figure(2);
image(Edges);
colormap(gray);
axis image;

%-----------------------------------------------
%begin hough transform stage, starting with lines
%
%variables controlling granularity of line search
dist_step = 1;
angle_incr = 2;

%set up Accumulator matrix based on size of image
[rows, cols] = size(EdgesBinary);
p = 1 : dist_step : sqrt(rows^2 + cols^2);
theta_deg = 0 : angle_incr : 360-angle_incr;
Accumulator = zeros(length(p), length(theta_deg));

%get indices of all edge pixels
[y_ind x_ind] = find(EdgesBinary > 0);
```

```
%iterate through each pixel
for i = 1 : size(x_ind)

    theta_ind = 0;

   %iterate through each angle through pixel
   for theta_rad = theta_deg*pi/180

    theta_ind = theta_ind+1;

      %determine min distance to line calculated from origin
      roi = x_ind(i)*cos(theta_rad) + y_ind(i)*sin(theta_rad);

      if roi >= 1 & roi <= p(end)
        temp = abs(roi-p);
         mintemp = min(temp);
         rad_ind = find(temp == mintemp);
         rad_ind = rad_ind(1);

         %add 1 to accumulator for this point at this angle
         %the result is a matrix of numbers of lines,
         %described by angle, and the point at which the
         %line is a minimum distance from the origin
         %naturally this is not a 1 to 1 relationship
         %between line segments in the original image
         %and lines described in hough parameter space
         Accumulator(rad_ind,theta_ind) = Accumulator(rad_ind,theta_ind)+1;
      end
   end
end

%set threshold as percentage of max
thresh = 0.5 *(max(max(Accumulator(:))));
% get indices of lines (in parameter space) above threshold
[radius angle] = find(Accumulator > thresh);

temp_acc = Accumulator - thresh;
hough_rad = [];
hough_angle = [];

%take indices of instances where Accumulator > thresh
%and create vectors of distances from origin and angle
%from origin of line normal
for i = 1:length(radius)
    if temp_acc(radius(i), angle(i)) >= 0
        hough_rad = [hough_rad; radius(i)];
        hough_angle = [hough_angle; angle(i)];
    end
end

%adjust distance and angle to account for quantization level
%(steps/increments) in searching for lines
hough_rad = hough_rad * dist_step;
hough_angle = (hough_angle * angle_incr) - angle_incr;
```

```
%-------------------------------------------------------

%visualize the parameter space for lines
%x-axis is distance from origin in feature space
%y-axis is angle of line
figure(3);
image(Accumulator);
colormap(gray);
axis image;

%this figure will display the lines and circles
figure(4);
image(Edges);
colormap(gray);
axis image;
hold on;

[rows,cols] = size(Edges);

%need to convert degrees to radians again!!
hough_angle = hough_angle*pi/180;

for z = 1 : size(hough_rad)

   for y = 1 : rows

      %handle divide by zero situations
      %(sin 0) = 0
      if hough_angle(z) == 0
         x = hough_rad(z);

         if Edges(y,round(x)) == 0
            plot(round(x),y,'b+');
            else
            plot(x,y,'c-');
         end
      else
         x = ( hough_rad(z) / cos( hough_angle(z) )) - ( y *
sin( hough_angle(z) )) / cos( hough_angle(z));

         %make sure y is within image matrix dimensions
         %so that it can be plotted (for example y=0.34
         %will give an error
         if round(x) > 0 & round(x) < cols
            %plot a blue '+' where line intersects edge
            if Edges(y,round(x)) == 0
               plot(round(x),y,'b+');
            else
               plot(round(x),y,'g+');
            end
         end
      end
   end

   %handle divide by zero (cos 90)=0
```

```
    for x = 1 : cols
       if hough_angle(z) == 90
          y = hough_rad(z);

          %plot a blue '+' where line intersects edge
          if Edges(y,round(x)) == 0
             plot(x,round(y),'b+');
             else
             plot(x,round(y),'c-');
          end
       end
    end
 end

 %-----------------------------------------------------
 %now go after circles
 %rad describes the radius of the circle being matched
 %(the radius of the template being imposed on the image)
 for rad = 50:75

    %avoid hundreds of duplicate calculations
    rad_sq = rad^2;

    %accumulator for circles
    AccCircles = zeros(size(EdgesBinary));

    %grab indices of edge points in image
    [yIndex xIndex] = find(EdgesBinary > 0);

    for i = 1 : length(xIndex)
       left = xIndex(i)-rad;
       right = xIndex(i)+rad;

       %allow for circles off the edge
       if (left<1)
          left=1;
       end

       %and the other edge
       if (right > size(EdgesBinary,2) )
          right = size(EdgesBinary,2);
       end

       %by projecting a circle around the edge points
       %for each edge point, and adding one to the
       %accumulator for each calculated point on that circle
       %the effect is that the center point of any circle
       %will have a relatively large value in the accumulator
       %
       %here the circle formula is applied, where
       %x_offset iterates over the center+- radius
       %and y_offset is calculated:
       %y_offset = center_y +- sqrt( radius^2 - (center_x - x_offset)^2
       for x_circ = left : right
          rhs = sqrt(rad_sq - ( xIndex(i)-x_circ )^2 );
```

```
      y_circ_a = yIndex(i) - rhs;
      y_circ_b = yIndex(i) + rhs;
      y_circ_a = round(y_circ_a);
      y_circ_b = round(y_circ_b);

      if y_circ_a < size(EdgesBinary,1) & y_circ_a >= 1
         AccCircles(y_circ_a, x_circ) = AccCircles(y_circ_a, x_circ)+1;
      end
      if y_circ_b < size(EdgesBinary,1) & y_circ_b >= 1
         AccCircles(y_circ_b, x_circ) = AccCircles(y_circ_b, x_circ)+1;
      end
   end
end

%set threshold, arbitrarily
thresh = 0.9 * max(max(AccCircles(:)));

% get centers of circles above threshold
xcoord = [];
ycoord = [];
[y_center x_center] = find(AccCircles > thresh);

temp_acc = AccCircles - thresh;
%and add to x and y coordinate value arrays
for i = 1:length(x_center)
   if temp_acc(y_center(i), x_center(i)) >= 0
      xcoord = [xcoord; x_center(i)];
      ycoord = [ycoord; y_center(i)];
   end
end
%-------------------------------

theta = [0:1:2*pi+1];

[xsize,ysize] = size(xcoord);

%reconstruct circles from centerpoints
for n_circ = 1:xsize

   plot(xcoord(n_circ), ycoord(n_circ), '*');

   x = rad * sin(theta);
   y = rad * cos(theta);

   %do this to initialize xoff/yoff to right size...
   xoff = x;
   yoff = y;

   %reset values to correct offset
   xoff(:) = xcoord(n_circ);
   yoff(:) = ycoord(n_circ);

   plot(x+xoff, y+yoff, 'c');
   end

end

%finally visualize parameter space of circles
figure(5);
image(AccCircles);
colormap(gray);
axis image;
```

5 Periodic Noise Removal: Notch Filter

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
 %%  im: input image
 %%  FT: Fourier transform of original image
 %%  mask : mask used for band reject filtering
 %%  FT2 : Band pass filtered spectrum
 %%  output : Denoised image
 %%
 %%  Author: Krishna Kumar
 %%  Date: 25 Mar 2014
 %%
 %%One of the applications of band reject filtering is for noise removal
 %%in applications where the general location of the noise component in
 %%the frequency domain is approximately known.
 %%
 %% This program denoise an image corrupted by periodic noise that can be
 %% approximated as two-dimensional sinusoidal functions using a band
 %% reject filters.
 %%You can adjust the radius of the filter mask to apply for a different
 %%image.
 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
clc;
clear all;
close all;
im = imread('imagename.extension');
figure,imshow(im);
FT = fft2(double(im));
FT1 = fftshift(FT);%finding spectrum
imtool(abs(FT1),[]);
m = size(im,1);
n = size(im,2);

t = 0:pi/20:2*pi;
xc=(m+150)/2; % point around which we filter image
yc=(n-150)/2;
r=200;   %Radium of circular region of interest(for BRF)
r1 = 40;
xcc = r*cos(t)+xc;
ycc =  r*sin(t)+yc;

xcc1 = r1*cos(t)+xc;
```

```
ycc1 =  r1*sin(t)+yc;

mask = poly2mask(double(xcc),double(ycc), m,n);
mask1 = poly2mask(double(xcc1),double(ycc1), m,n);%generating mask for
filtering

mask(mask1)=0;

FT2=FT1;
FT2(mask)=0;%cropping area or bandreject filtering

imtool(abs(FT2),[]);
output = ifft2(ifftshift(FT2));
imtool(output,[]);
```