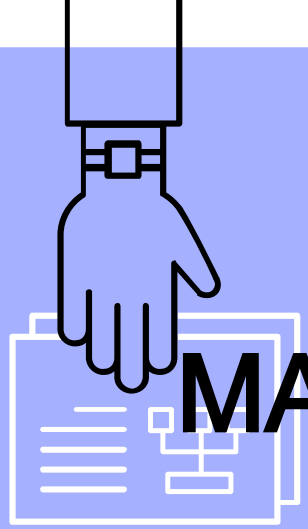

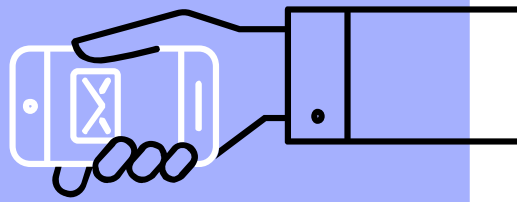

MATLAB Graphics Structure

Image Display

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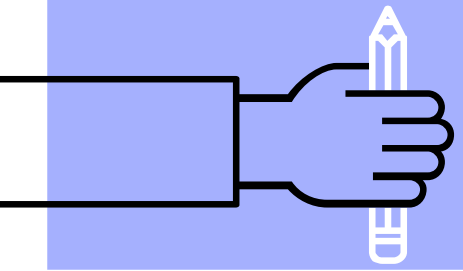
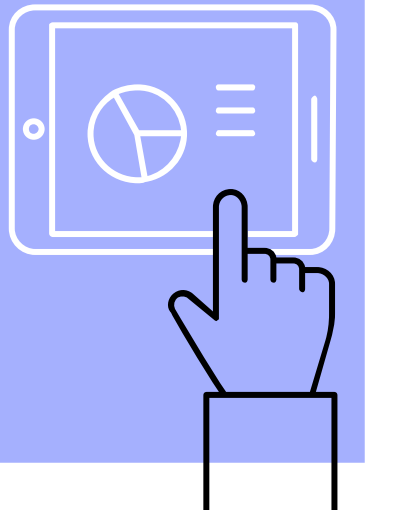




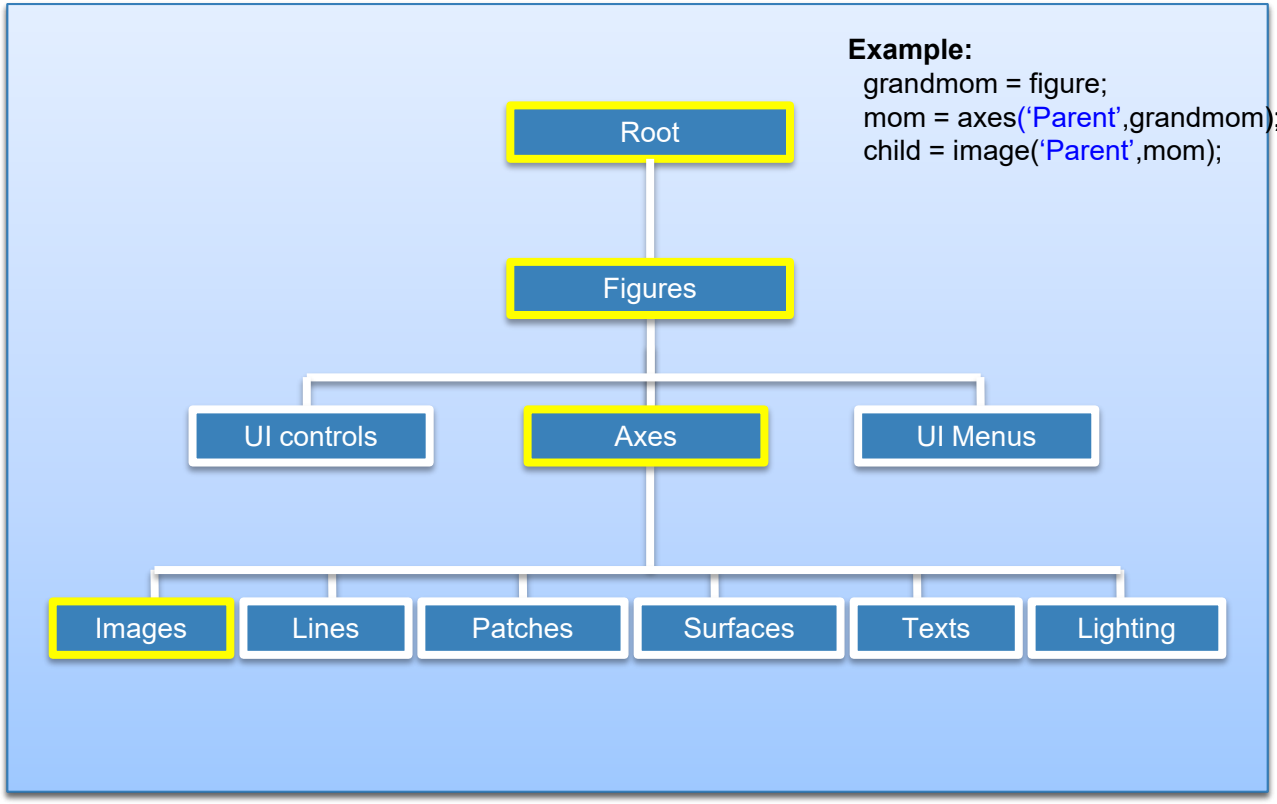
Contents

- Image display and color map

Please download the handout and materials from (Week 11-2)

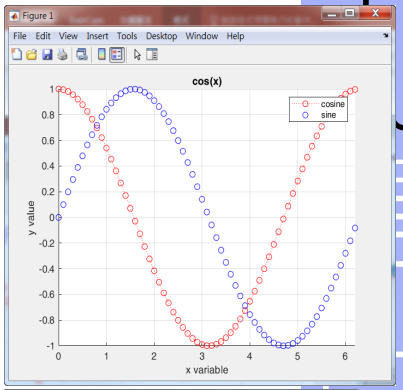
http://cflu.lab.nycu.edu.tw/CFLu_course_matlabimage.html

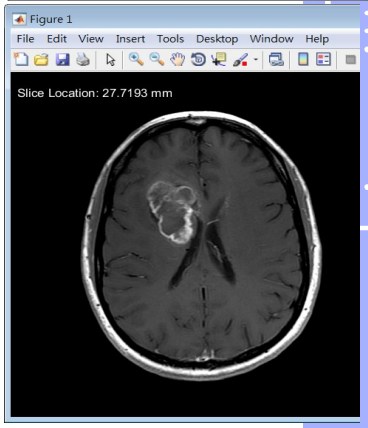
Hierarchical Relations of Objects



Example:

```
grandmom = figure;
mom = axes('Parent',grandmom);
child = image('Parent',mom);
```

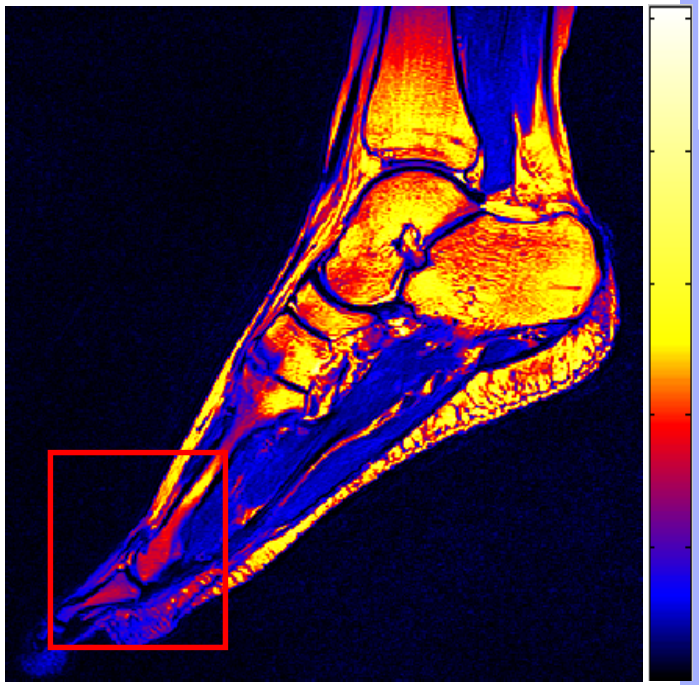




Concept of image intensity

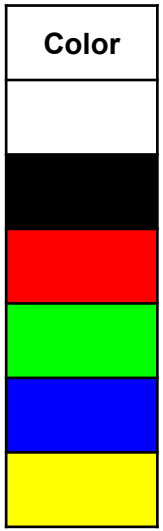
- Pixel value and gray level

	3	4	5	6	7	8	9	10	11	12	13	14	15	16
13	17	20	18	19	18	17	19	19	19	20	20	19	15	
14	17	19	18	19	17	18	18	18	19	21	20	22	20	2
15	17	17	17	19	18	18	20	20	19	22	23	22	116	4
16	19	19	21	20	20	20	23	22	22	24	21	56	322	3
17	18	21	19	20	19	21	20	22	24	27	24	223	429	4
18	19	18	20	18	20	23	21	24	25	14	158	284	376	5
19	17	17	18	18	19	20	21	21	22	60	331	214	183	5
20	16	16	17	16	18	21	21	26	0	321	419	337	386	4
21	17	16	15	17	20	22	22	17	83	582	242	329	654	6
22	16	15	17	19	21	20	24	4	339	353	165	344	308	2
23	15	17	18	19	19	21	10	135	495	130	262	144	164	1
24	16	17	17	18	18	21	11	424	203	299	167	132	157	1
25	17	17	18	18	20	3	189	444	300	332	153	150	116	1
26	16	17	18	19	20	9	395	383	424	108	191	206	145	1
27	18	16	18	17	15	142	370	347	139	95	197	252	126	2
28	17	18	19	12	59	145	384	298	97	128	111	146	397	5
29	19	19	15	85	205	324	429	178	91	142	201	513	507	
30	18	15	76	236	260	228	158	69	253	366	476	297	25	
31	21	70	180	295	287	136	176	331	326	219	95	2	21	
32	67	129	134	180	218	220	313	199	46	7	11	24	26	
33	76	57	67	84	162	202	176	47	12	20	20	21	21	
34	111	75	17	10	31	35	10	15	20	21	18	19	20	
35	62	26	16	16	13	13	17	20	18	18	18	18	24	



RGB Color Style

- Each color is composed of 3 numbers as a 1 x 3 vector



⇔

Color	RED	GREEN	BLUE
	1	1	1
	0	0	0
	1	0	0
	0	1	0
	0	0	1
	1	1	0

the value must between 0 and 1!!

- uisetcolor (can help you determine the color vector)

Intensity vs. Colormap

3

R G B

```
cmap = [0  0  0;
        1  0  0;
        0  1  0;
           .    ;
           .    ;
           .    ;
        1  1  1];
```

n

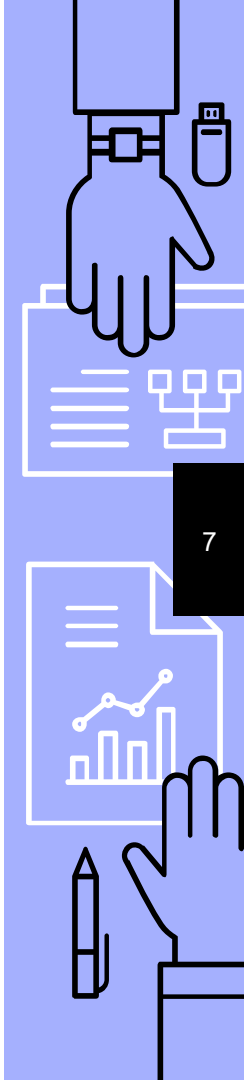
← corresponding color for intensity of 1

← corresponding color for intensity of 2

← corresponding color for intensity of n

Image Display Function

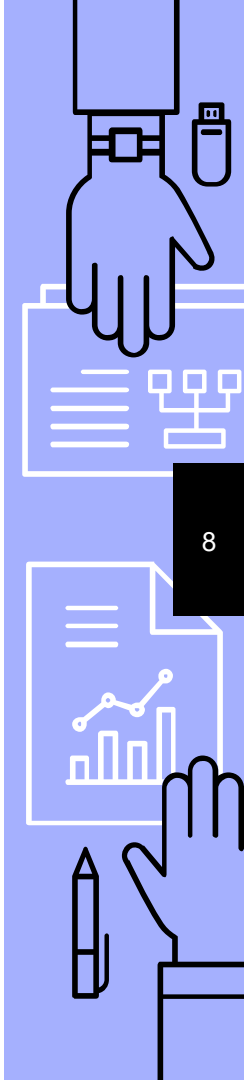
- **imshow**
  - Display image (with **gray** colormap in default).
  - Intensity between 0 and 1
- **image**
  - Display image (with **parula** colormap in default).
  - More suitable for color image



help image

image Display image from array

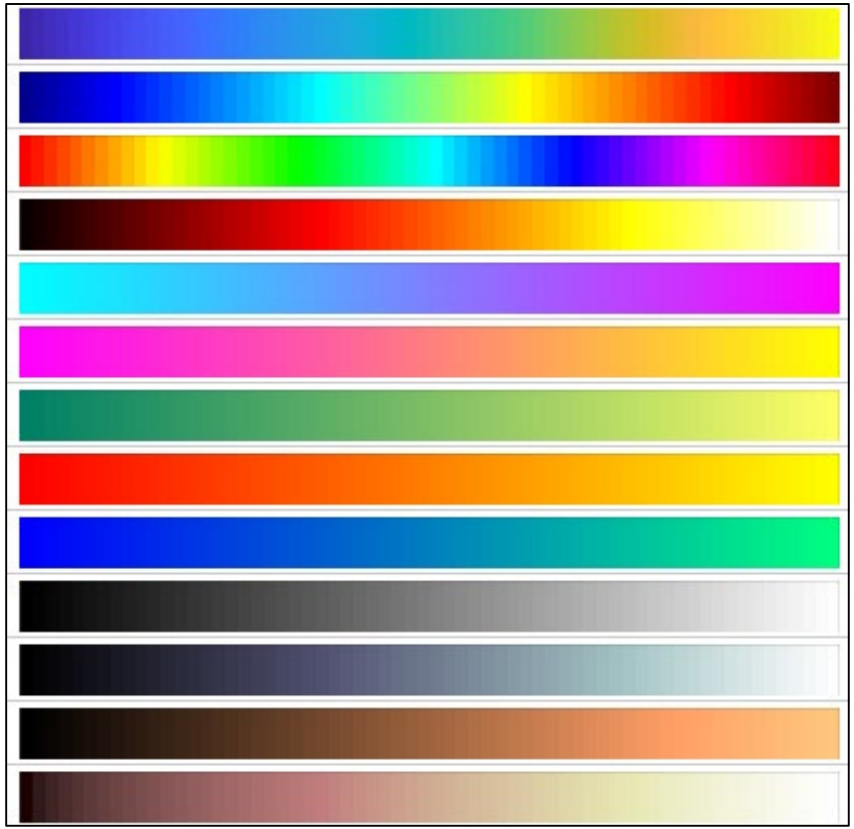
- image(C) displays the data in array C as an image. Each element of C specifies the color for 1 pixel of the image. The resulting image is an **m-by-n** grid of pixels where m is the number of columns and n is the number of rows in C.



Intensity vs. Color

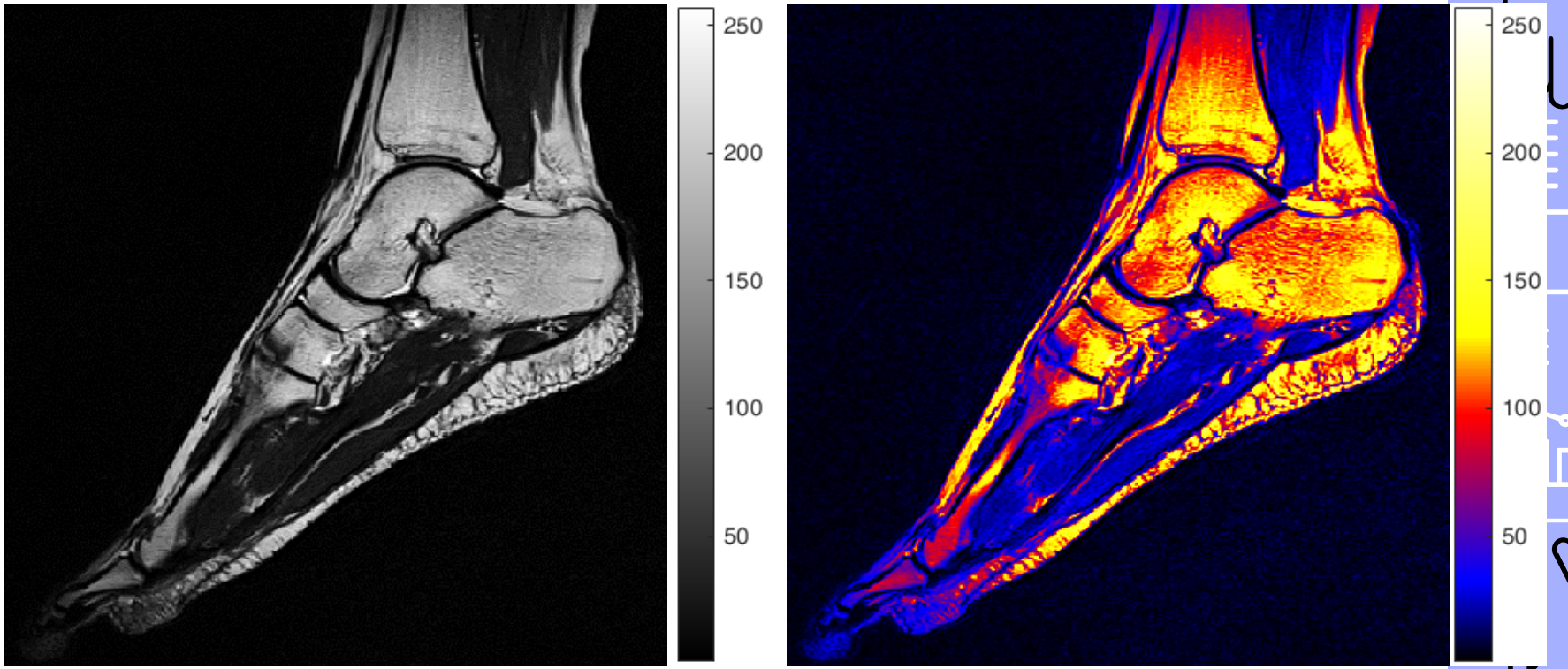
```
X=[4 5 6; 3 1 2];
image(X);
cmap=[1 0 0;0 1 0;0 0 1;1 1 0;0 1 1;1 0 1];
colormap(cmap)
```

Predefined colormaps



ex:
colormap(gray(256))
or
colormap(hot(256))

Customized colormap



Please open and run MImaterials_L11_2\ImageEx11_2.m

Customized colormap

```
6   %% load image
7   load('footimg.mat')
8
9   img=(img-min(img(:)))/(max(img(:))-min(img(:)));
10  img=img*255;
11
12  %% image colormap
13  figure,
14  image(img), axis off
15  colormap(gray(256)), colorbar
16
17  figure,
18  image(img), axis off
19  cmap=[zeros(32,2) linspace(0,1,32)';...                % black -> blue
20        linspace(0,1,64)' zeros(64,1) linspace(1,0,64)';... % blue -> red
21        ones(32,1) linspace(0,1,32)' zeros(32,1);...     % red -> yellow
22        ones(128,2) linspace(0,1,128)'];                 % yellow -> white
23  colormap(cmap), colorbar
```

img=img*255+1;

32 64 32 128

Black → blue → red → yellow → white

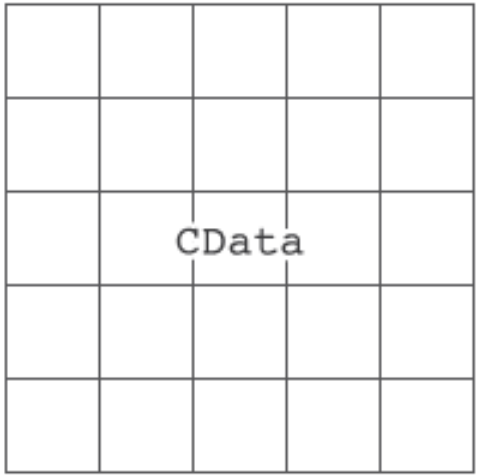
help image

image Display image from array

- When C is a 2-dimensional **m-by-n** matrix, the elements of C are used as indices into the current **COLORMAP** to determine the color.
- When C is a 3-dimensional **m-by-n-by-3** matrix, the elements in C(:,:,1) are interpreted as red intensities, in C(:,:,2) as green intensities, and in C(:,:,3) as blue intensities.

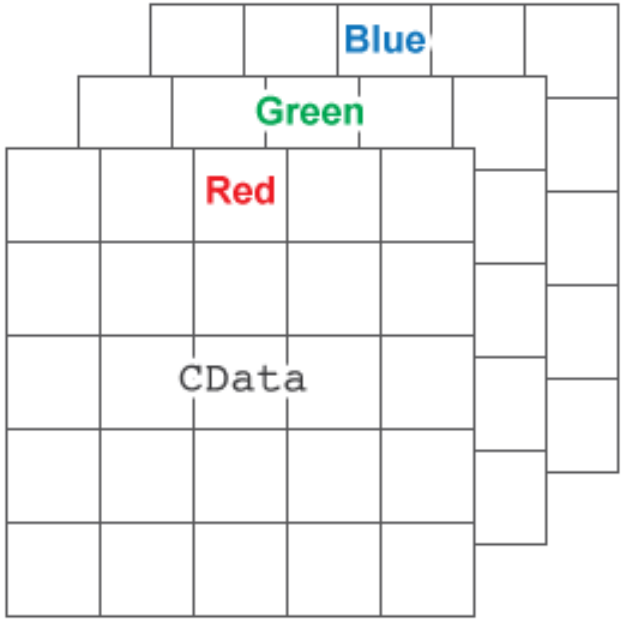
Color modes

Indexed Colors



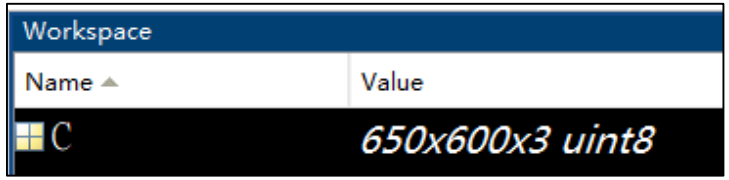
Display color is determined by the colormap.

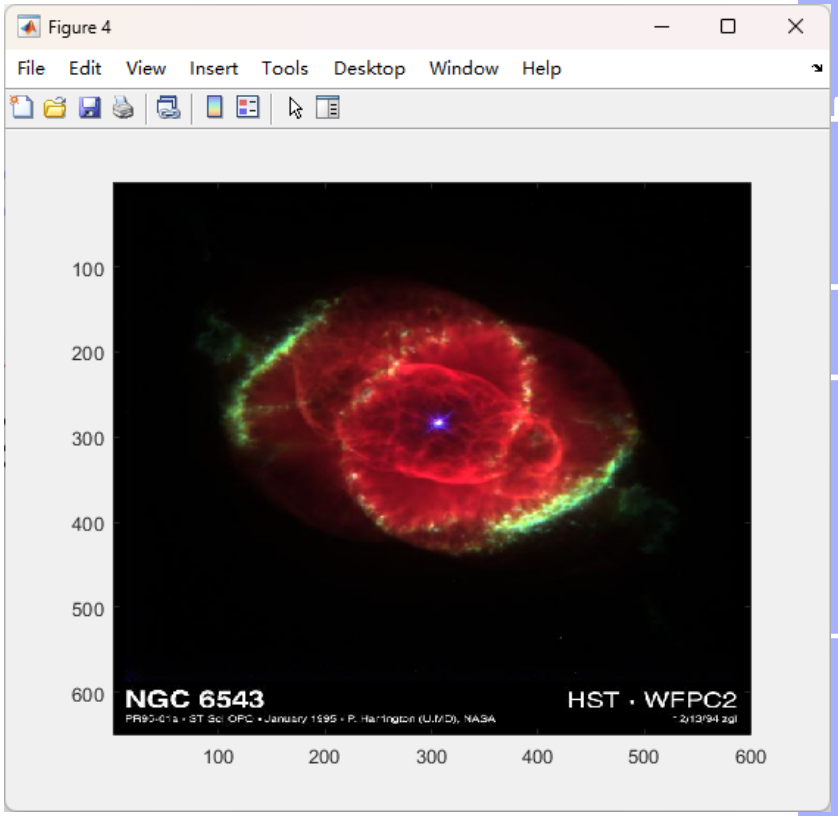
True Colors



True Colors

```
C = imread('ngc6543a.jpg');
figure, image(C)
```





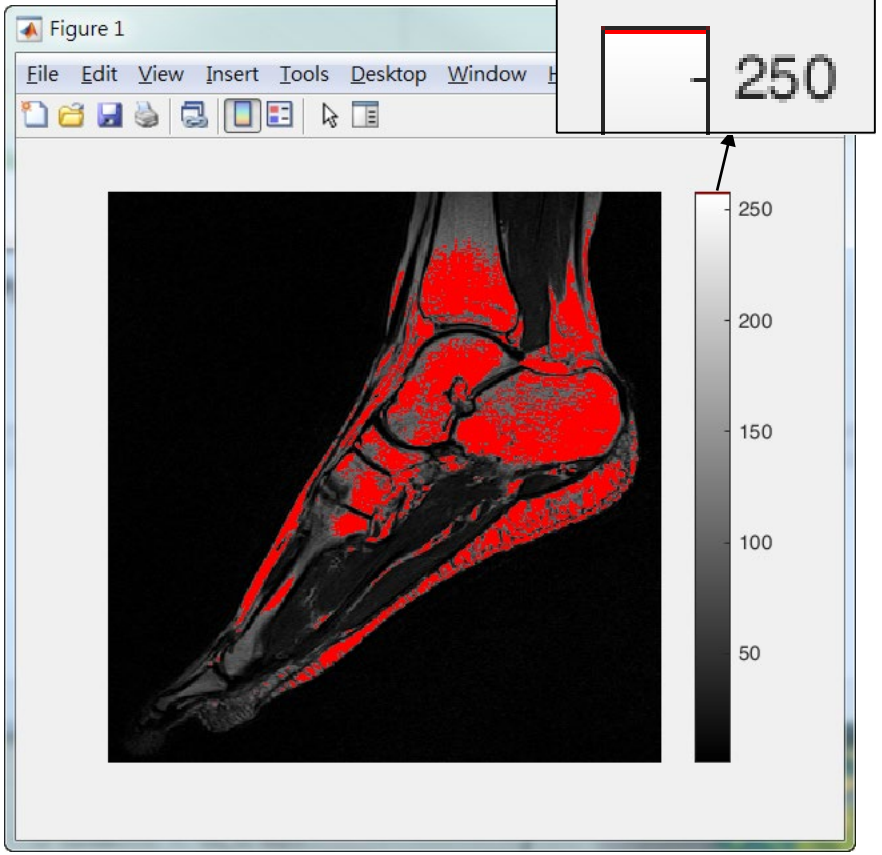
https://en.wikipedia.org/wiki/Cat%27s_Eye_Nebula

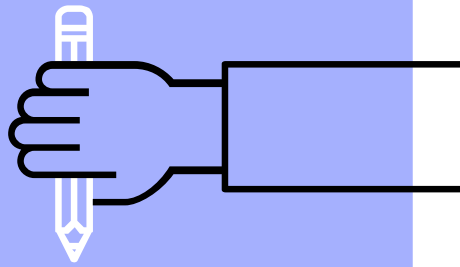
Homework…

- Please display the foot image with the red-labeled region for the high-intensity area (intensity > 600).
- 1. **find** the indices of pixels with intensity > 600.
- 2. rescale img intensity to 1~255.

  (overall 255 gray levels)
- 3. assign the intensity of indices (found in step 1) to 256.

colormap([gray(255);1,0,0])





THE END

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