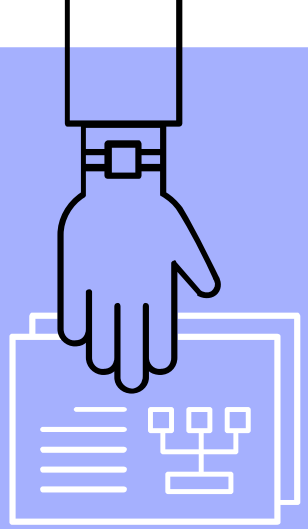

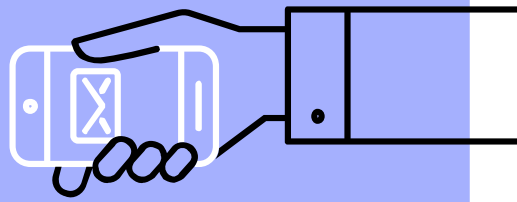

MATLAB Function

Image Smoothing and Edge Detection

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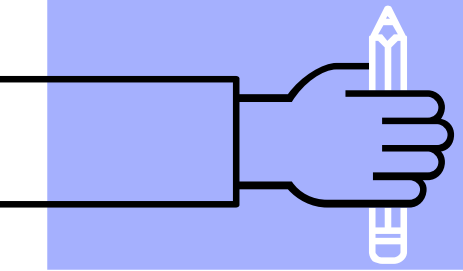
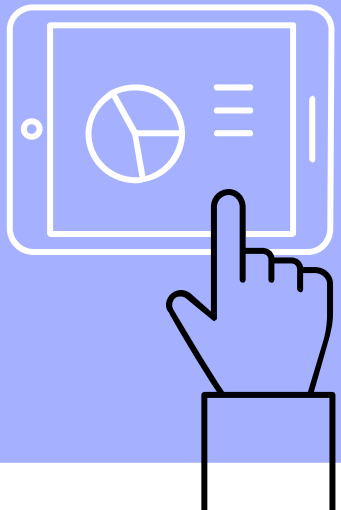


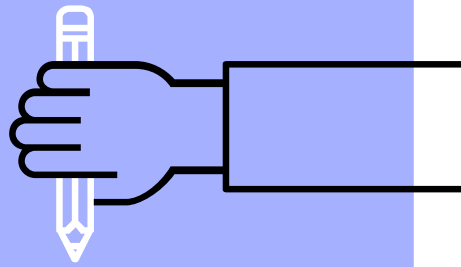


Contents

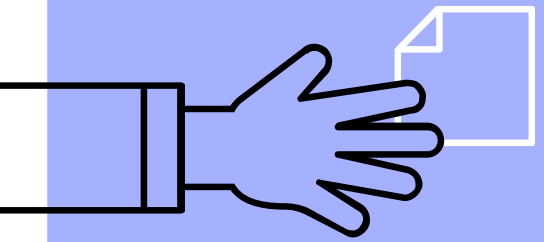
- Function declaration and usage
- Image smoothing and edge detection

Please download the handout and materials from

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

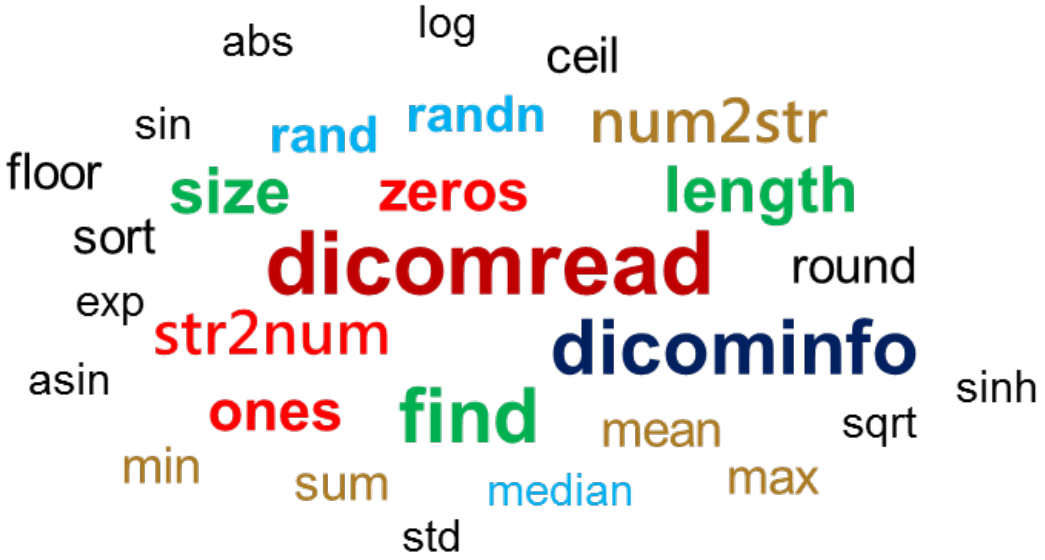


Function Declaration & usage



Useful Functions

- A function is a group of statements that together perform a task.



You have learned several MATLAB functions

Basic Format

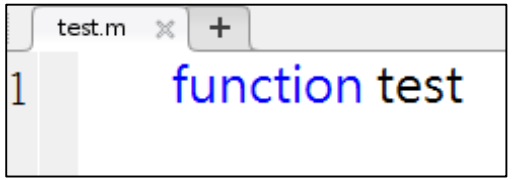
- Start with **function**
- Function name = file name
- <Optional> **Input**: right-hand side, within parentheses
- <Optional> **Output**: left-hand side, within brackets

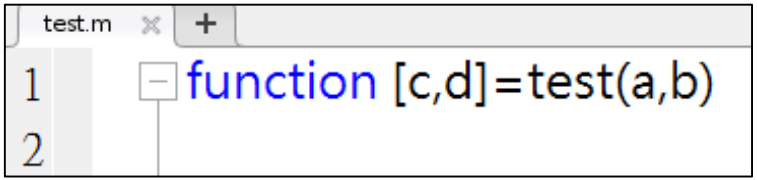
corr.m

```
1  function [coef, pval] = corr(x, varargin)
2  %CORR Linear or rank correlation.
3  %   RHO = CORR(X) returns a P-by-P matrix c
4  %   correlation coefficient between each pair
5  %   matrix X.
```

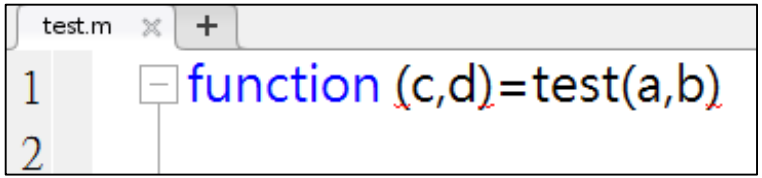
Common Errors

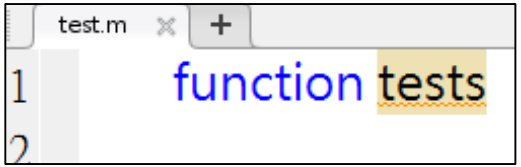
- Correct

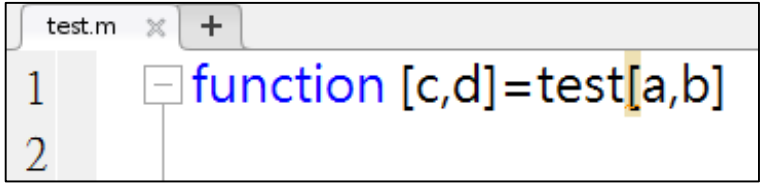




- Errors…







Basic Format

- **Function declaration**
  - Function name
  - Input and output variables
- Function instruction
  - Brief description
  - Introduction of variables
  - Examples
  - Author
- **Function content**
  - Remember to call all inputs
  - Remember to set all outputs

testfun.m

```
1   function [c,d]=testfun(a,b)
2   % This is a test function.
3   %   Lu, Chia-Feng 2014.10.2
4
5   c=a+b;
6   d=a-b;
```

Try to create a test function!

Calling a Function

- Change "current directory"
- Set path to include the folder of function

```
Command Window
>> [c,d]=testfun(1,2)
Undefined function 'testfun'
for input arguments of type
'double'.
```

Calling a Function

- Incorrect usages…

testfun.m

```
1  function [c,d]=testfun(a,b)
2  % This is a test function.
3  %   Lu, Chia-Feng 2014.10.2
4
5  c=a+b;
6  d=a-b;
```

Forget to set input variables first!

```
>> [c,d]=testfun(a,b)
Undefined function or variable
'a'.
```

Forget to set path first!

```
>> [c,d]=testfun(1,2)
Undefined function 'testfun'
for input arguments of type
'double'.
```

```
>> [c,d]=testfun(1)
Error using testfun (line 5)
Not enough input arguments.
```

```
>> [c,d,e]=testfun(1,2)
Error using testfun
Too many output arguments.
```

```
>> [c,d]=testfun(1,2,3)
Error using testfun
Too many input arguments.
```

Instruction of Functions

- help
  - Display help text in Command Window.

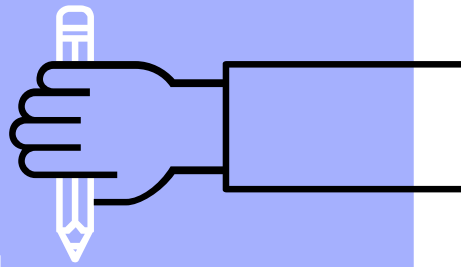
testfun.m

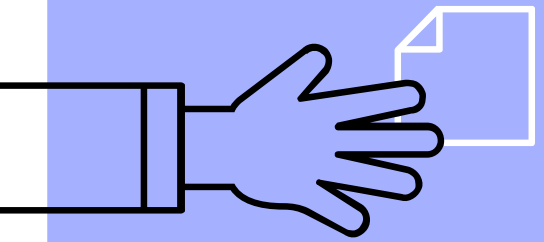
```
1   function [c,d]=testfun(a,b)
2   % This is a test function.
3   %   Lu, Chia-Feng 2014.10.2
4
5   c=a+b;
6   d=a-b;
```

consecutive notation lines

- open
  - Open files by extension.
  - .m file　open program file in MATLAB Editor.

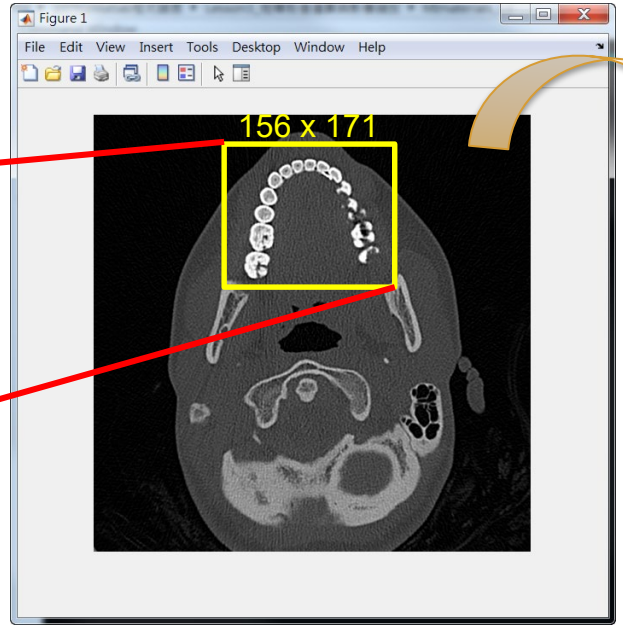
Image smoothing and edge detection



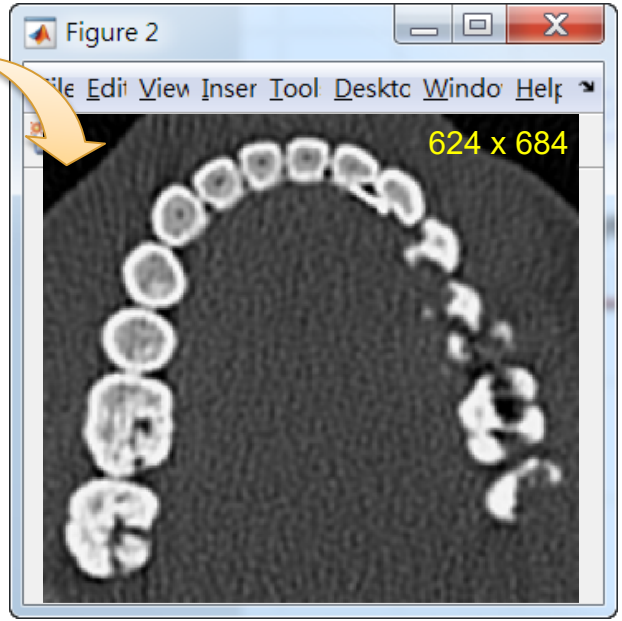


Step 1 – Import, Region, and Interpolation

```
img=dicomread('IM-0001-0081.dcm');
```



Interpolated image (by a factor of 4)



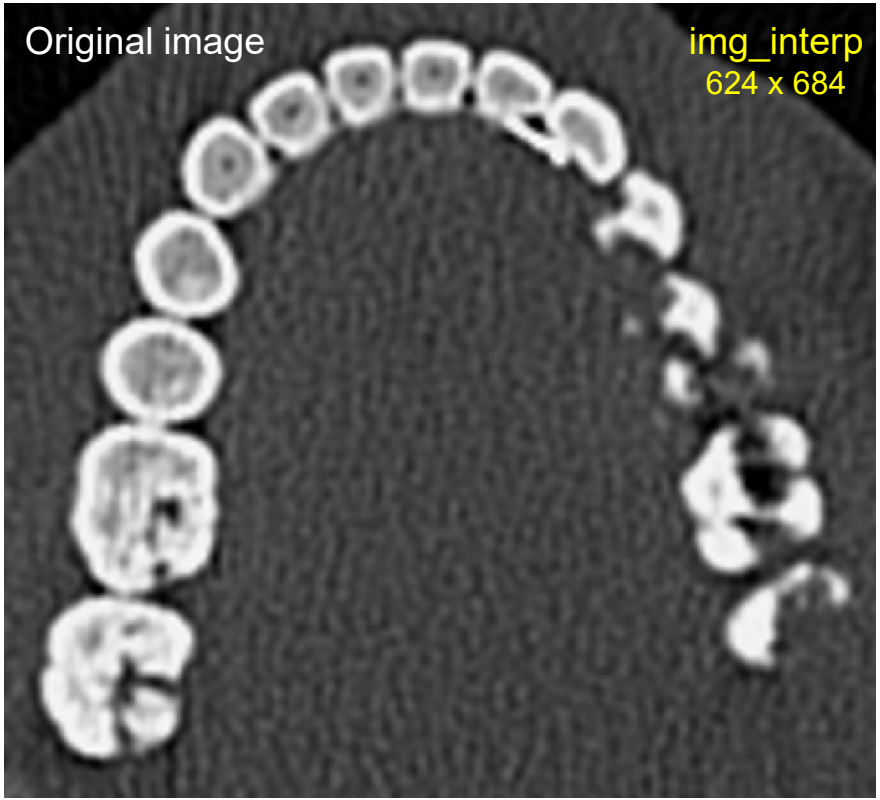
Please save as a Script File (*.m)~

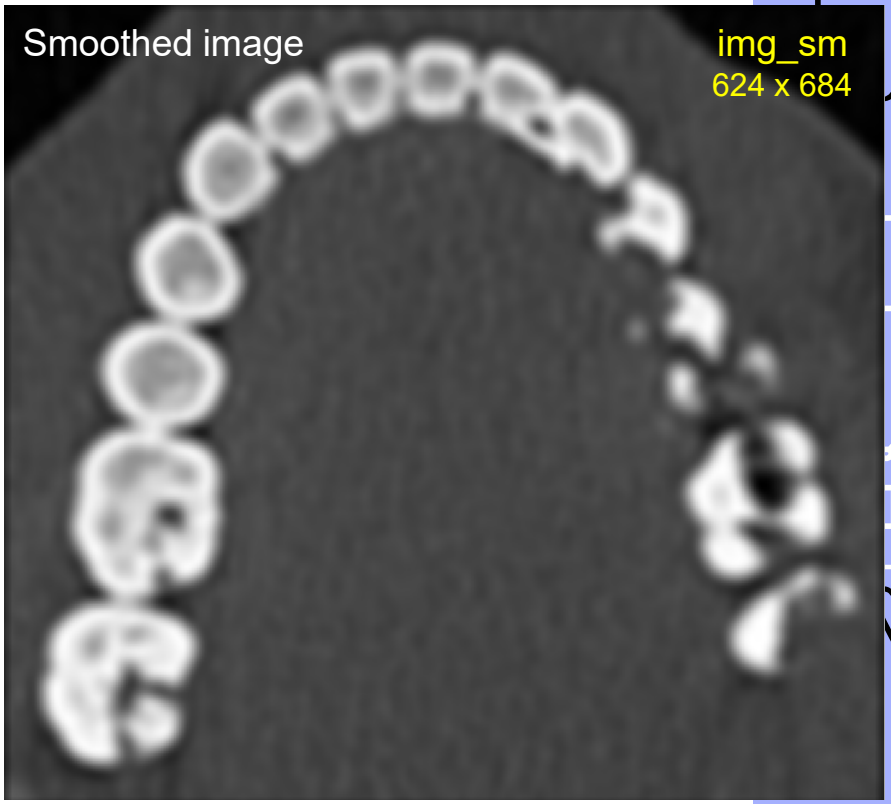
Step 1 – Import, Region, and Interpolation

ImageEx01.m

```
1   %% Perform Image Interpolation on local image region us
2   clear, close all
3
4   % get the image data of a DICOM file
5   img=dicomread('IM-0001-0081.dcm');
6
7   % extract a local region, perform interpolation and display
8   img_local=img(45:200,170:340);
9   img_interp=imresize(img_local,4);
10  figure, imshow(img_interp,[],'border','tight')
```

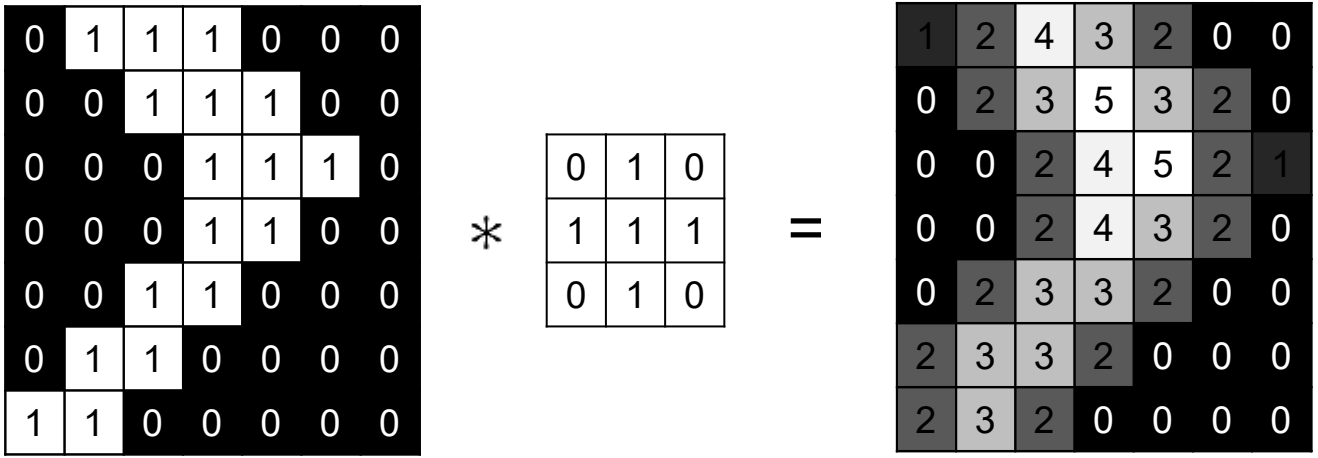
Step 2 – Image Smoothing





Step 2 – Image Smoothing

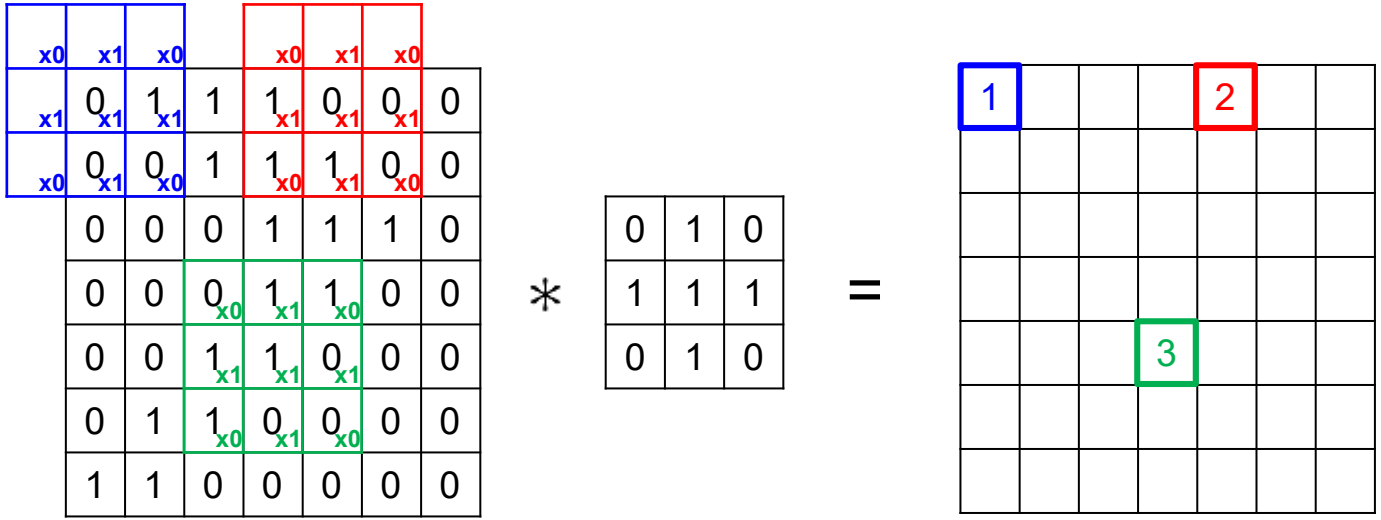
- 2D convolution



Original image | Kernel | Smoothed Image

Step 2 – Image Smoothing

- 2D convolution



Original image Kernel Smoothed Image

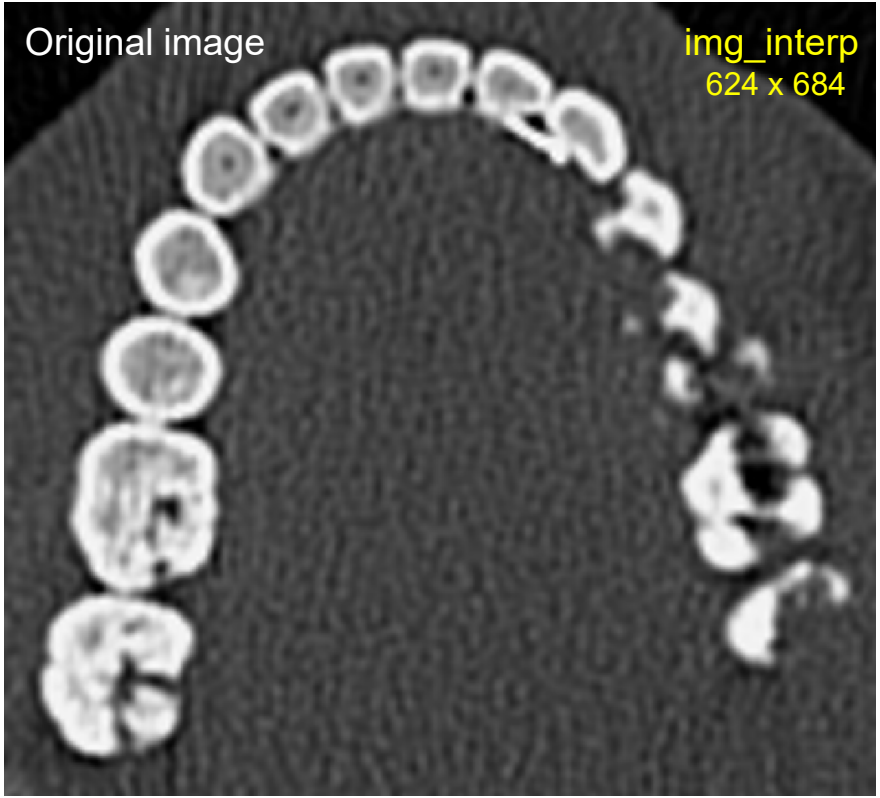
Step 2 – Image Smoothing

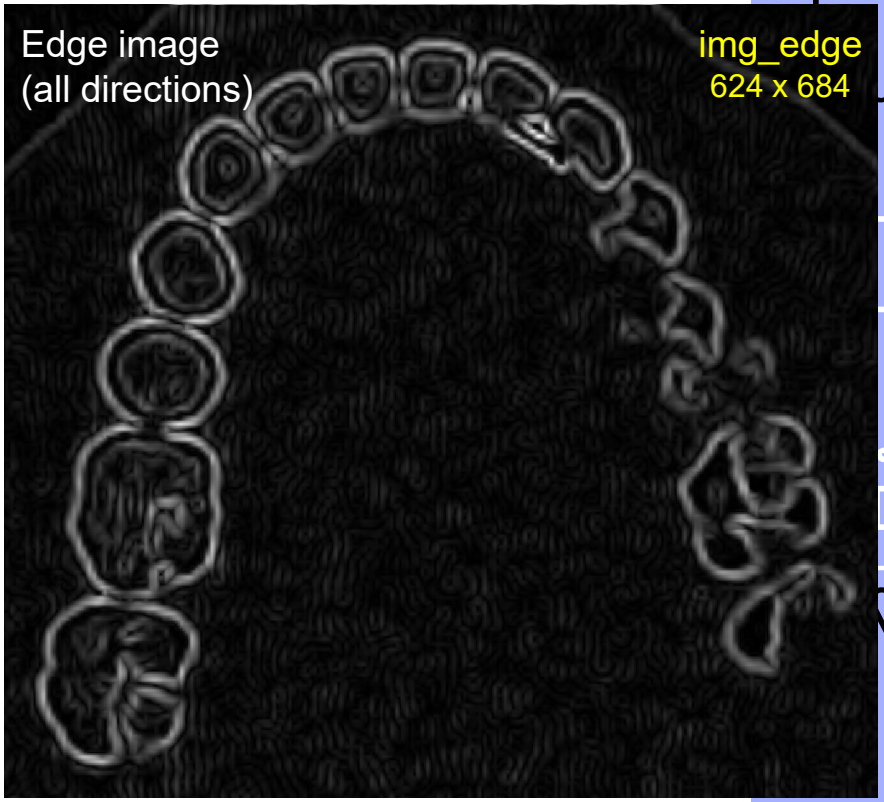
conv2 Two dimensional convolution.

- **img_new=conv2(img,kernel**,'same');

```
12      %% perform image smoothing
13 -    kernal_sm=ones(15,15);
14 -    img_sm=conv2(double(img_interp),kernal_sm,'same');
15
16 -    figure, imshow(img_sm,[],'border','tight')
17
```

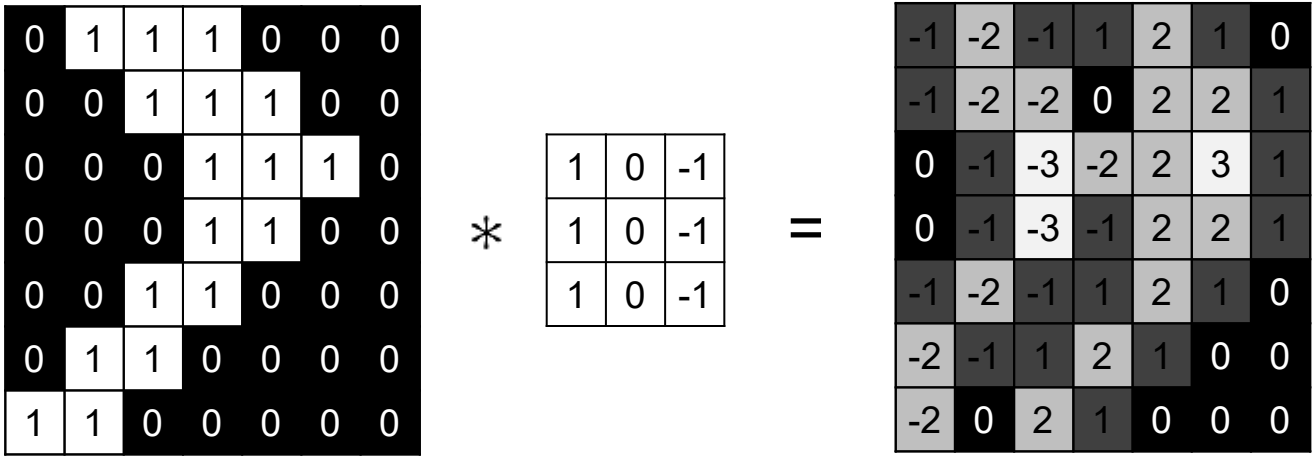
Step 3 – Edge Detection





Step 3 – Edge Detection

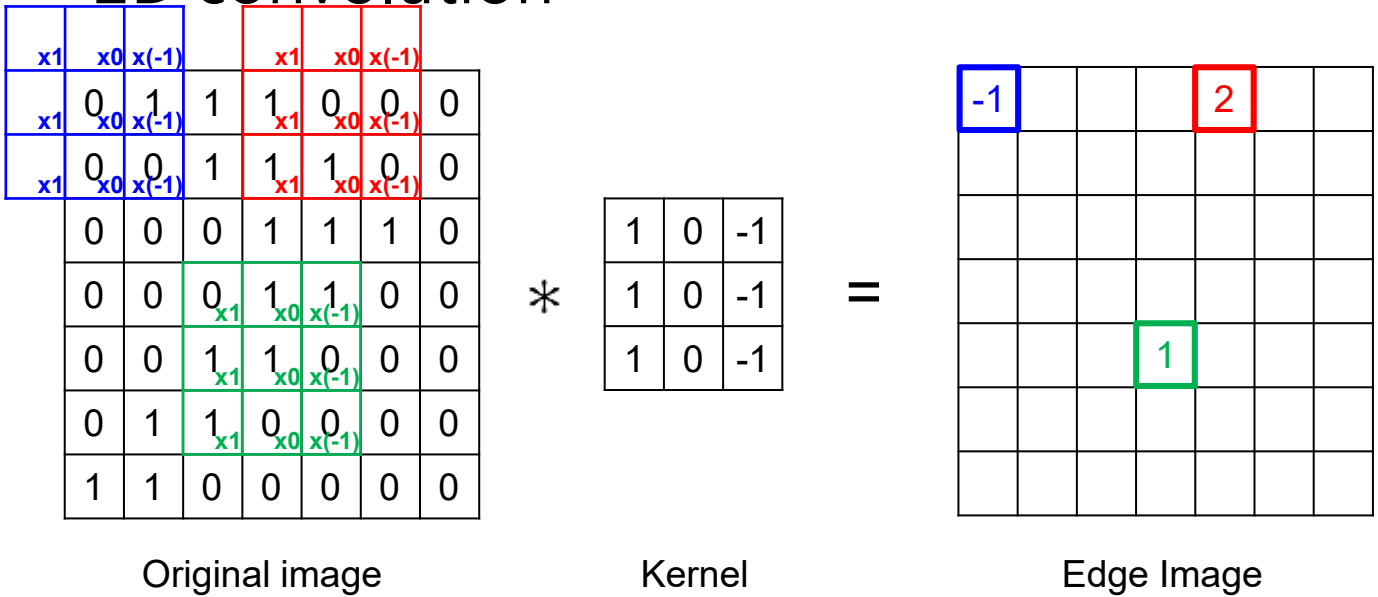
- 2D convolution



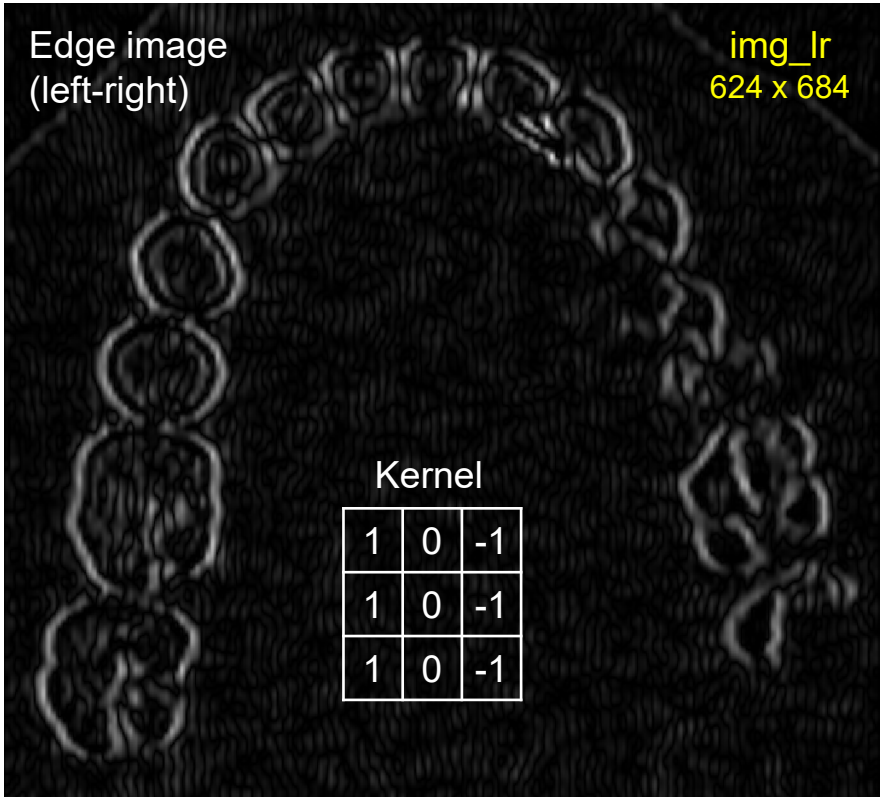
Original image Kernel Edge Image

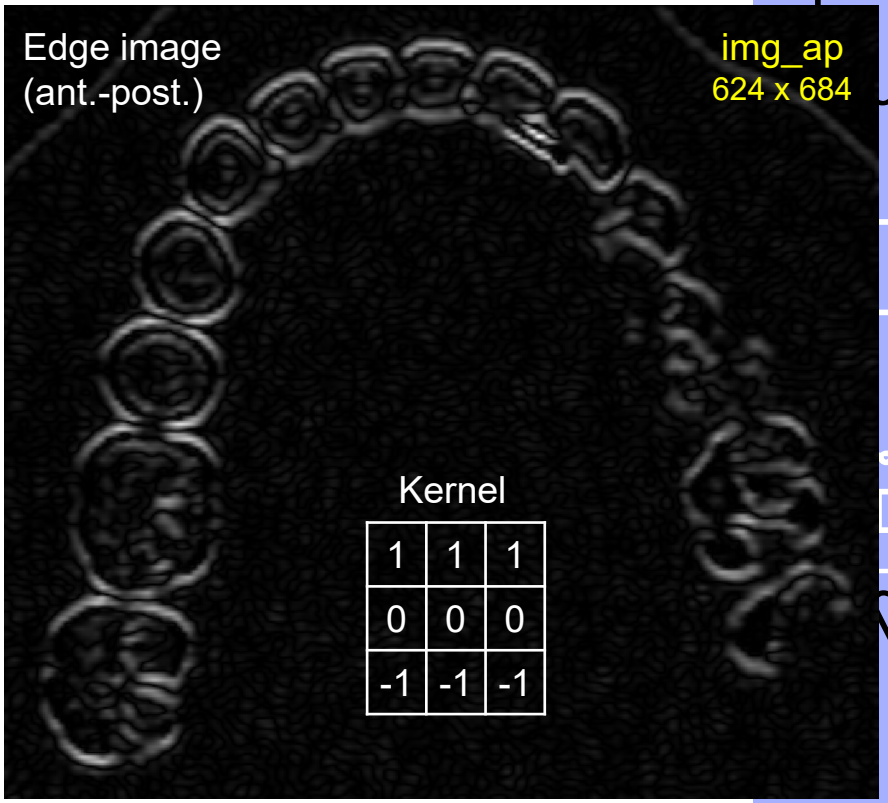
Step 3 – Edge Detection

- 2D convolution



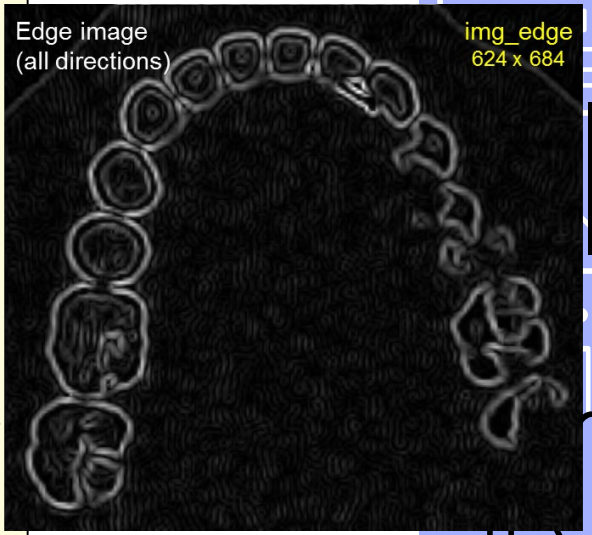
Step 3 – Edge Detection





Step 3 – Edge Detection

```
18      %% perform edge detection
19 -    kernal_lr=[1 0 -1;1 0 -1;1 0 -1];
20 -    img_lr=conv2(double(img_interp),kernal_lr,'same');
21 -    figure, imshow(abs(img_lr),[],'border','tight')
22
23 -    kernal_ap=[1 1 1;0 0 0;-1 -1 -1];
24 -    img_ap=conv2(double(img_interp),kernal_ap,'same');
25 -    figure, imshow(abs(img_ap),[],'border','tight')
26
27 -    img_edge=max(abs(img_lr),abs(img_ap));
28 -    figure, imshow(img_edge,[],'border','tight')
```

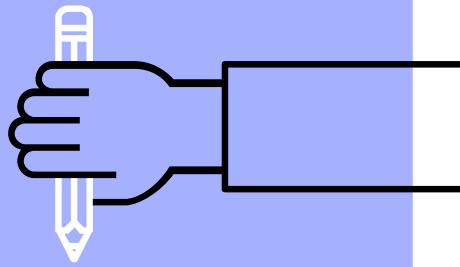


Homework

- Create a function that can…
  - extract local image (based on rowrange and colrange),
  - perform interpolation (by a factor of 4),
  - image smoothing (15 pixels),
  - edge detection (3 pixels, L/R & A/P)

- [img_sm,img_edge]=**imgprocess**(img,rowrange,colrange);

  - Modify from **ImageEx04.m**
  - Do not load image within the function (~~dicomread~~)!
  - Do not display any image within the function (~~imshow~~)!



THE END

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