



**Homework** = The Image Filtering in Matlab by Doing 2D Convolution

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### Matlab Code:

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```
function T = convolve(img, kernel)
[p, q] = size(img);
[r, s] = size(kernel);
v = rot90(kernel, 2);
center = floor((size(v)+1)/2);
left = center(2) - 1;
right = s - center(2);
top = center(1) - 1;
bottom = r - center(1);
Rep = zeros(p + top + bottom, q + left + right);
for x = 1 + top : p + top
    for y = 1 + left : q + left
        Rep(x,y) = img(x - top, y - left);
    end
end
T = zeros(p , q);
for x = 1 : p
    for y = 1 : q
        for i = 1 : r
            for j = 1 : s
                q = x - 1;
                w = y - 1;

                T(x, y) = T(x, y) + (Rep(i + q, j + w) * v(i,
j));
            end
        end
    end
end
```

---

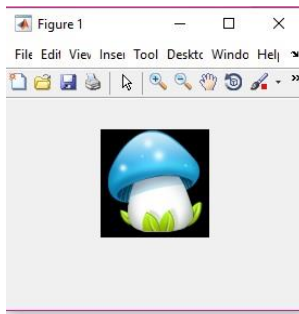
### At the Command Window:

```
>> Image=imread('img.png')
```

```
Image=
```

```
(It wrote 100*100 matrices)
```

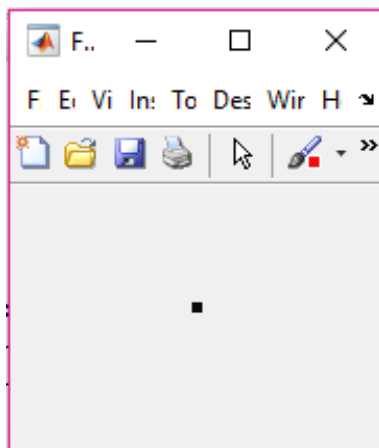
```
>>imshow(Image)
```



```
>>kernel=fspecial('gaussian',5,5)
kernel =
```

```
0.0369  0.0392  0.0400  0.0392  0.0369
0.0392  0.0416  0.0424  0.0416  0.0392
0.0400  0.0424  0.0433  0.0424  0.0400
0.0392  0.0416  0.0424  0.0416  0.0392
0.0369  0.0392  0.0400  0.0392  0.0369
```

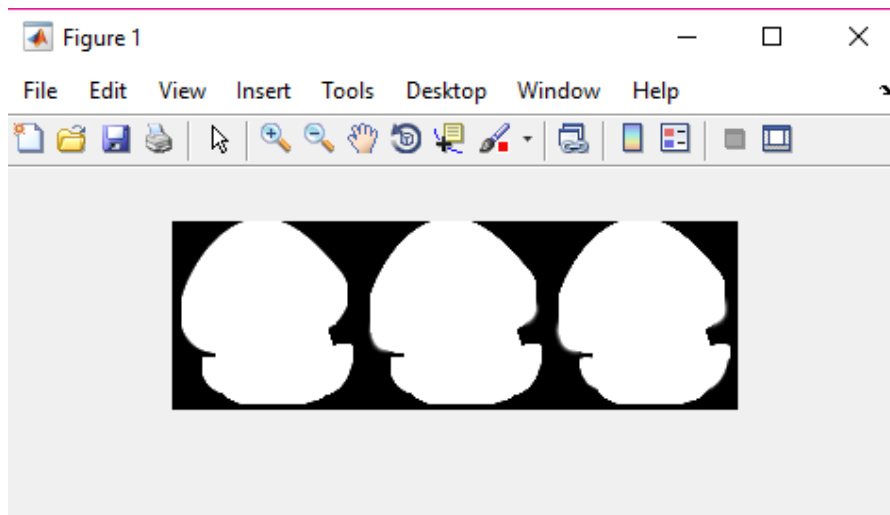
```
>>imshow(kernel)
```



```
>>first = convolve(Image,kernel)
```

```
first = ..... long matrices again
```

```
>>imshow(first)
```



```
>>clc
```

```
>> kernel = fspecial('laplacian',0.5)
```

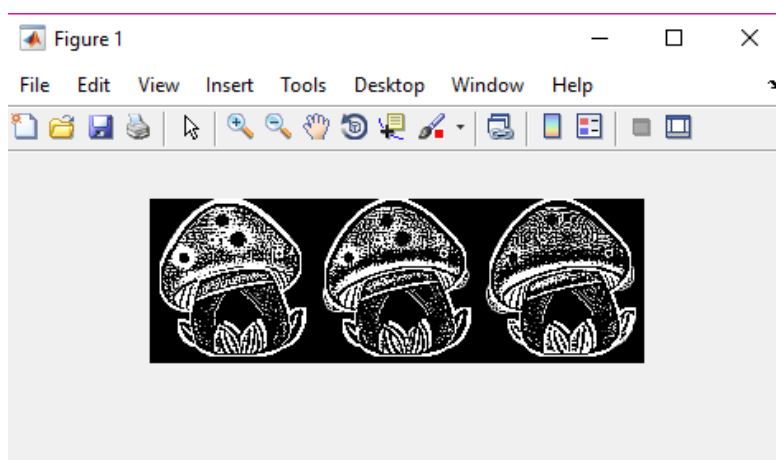
```
kernel=
```

```
0.3333 0.3333 0.3333
0.3333 -2.6667 0.3333
0.3333 0.3333 0.3333
```

```
>>second = convolve (Image, kernel)
```

```
second = a long matrices with 300 columns
```

```
>>imshow(second)
```



```
>>clc
```

```
>>kernel = [97 75 50; 20 32 15; 47 50 12]
```

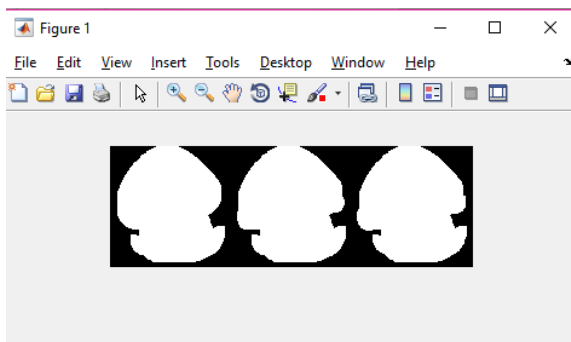
```
kernel =
```

```
    97    75    50  
    20    32    15  
    47    50    12
```

```
>>third = convolve(Image, kernel)
```

```
third= long matrices
```

```
>>imshow(third)
```



In code we used help with some calculations like below;

$$O(i, j) = \sum_{k=1}^m \sum_{l=1}^n I(i+k-1, j+l-1) K(k, l)$$

[1]

[1] Convolution, Bob Fisher, 22<sup>th</sup> April 2017.

<http://homepages.inf.ed.ac.uk/rbf/HIPR2/convolve.htm>