Step 1 – Convolution

Step 1 - Convolution

$$(f * g)(t) \stackrel{\text{def}}{=} \int_{-\infty}^{\infty} f(\tau)\, g(t-\tau)\, d\tau$$

Step 1 - Convolution

Additional Reading:

Introduction to Convolutional Neural Networks

By Jianxin Wu (2017)

$$\begin{aligned}\frac{\partial z}{\partial(\mathrm{vec}(\boldsymbol{y})^T)}(F^T \otimes I) &= \left((F \otimes I)\frac{\partial z}{\partial \mathrm{vec}(\boldsymbol{y})}\right)^T \\ &= \left((F \otimes I)\,\mathrm{vec}\left(\frac{\partial z}{\partial Y}\right)\right)^T \\ &= \mathrm{vec}\left(I\frac{\partial z}{\partial Y}F^T\right)^T \\ &= \mathrm{vec}\left(\frac{\partial z}{\partial Y}F^T\right)^T,\end{aligned}$$

Link:

http://cs.nju.edu.cn/wujx/paper/CNN.pdf

Step 1 - Convolution

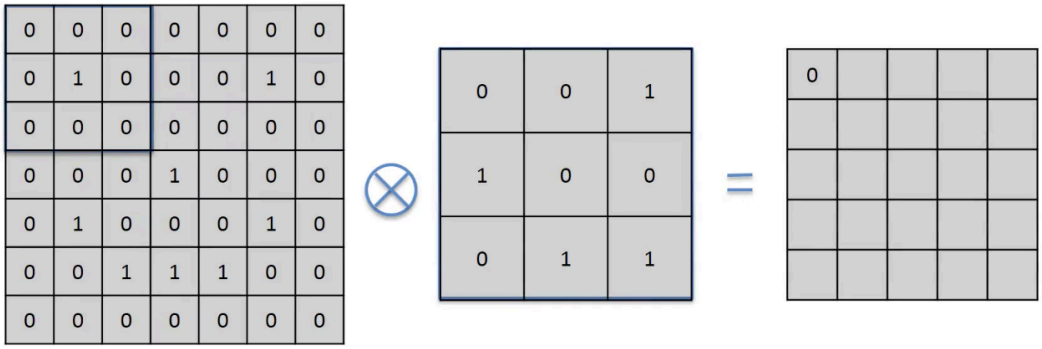
0	0	0	0	0	0	0
0	1	0	0	0	1	0
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	1	0	0	0	1	0
0	0	1	1	1	0	0
0	0	0	0	0	0	0

Input Image

0	0	1
1	0	0
0	1	1

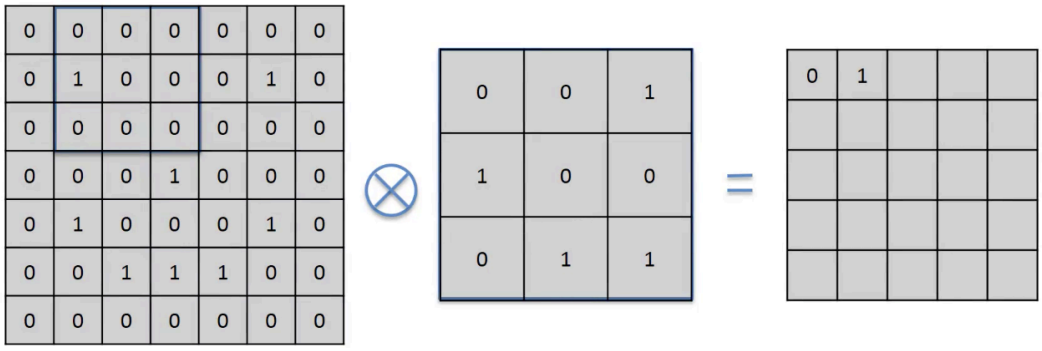
Feature Detector

Step 1 - Convolution



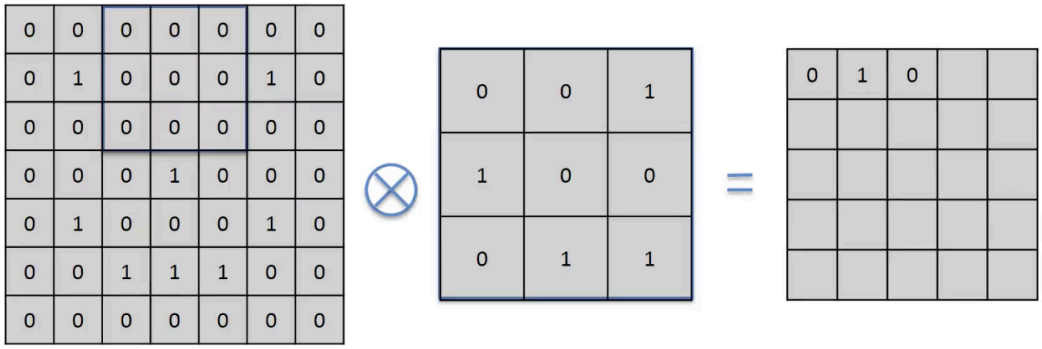
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



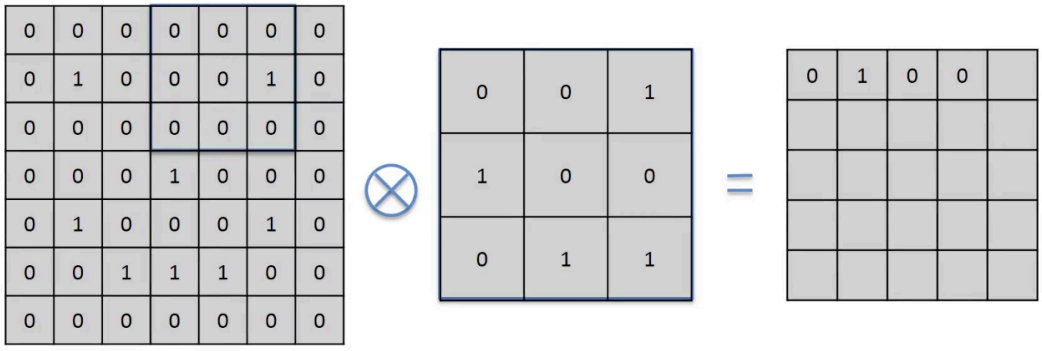
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



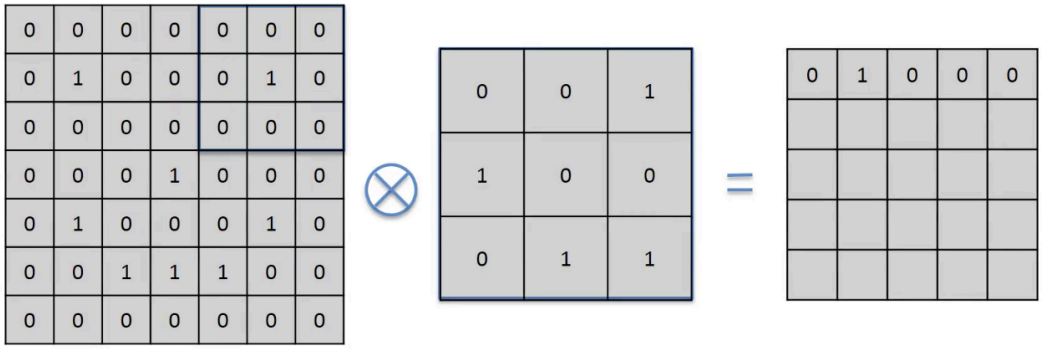
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



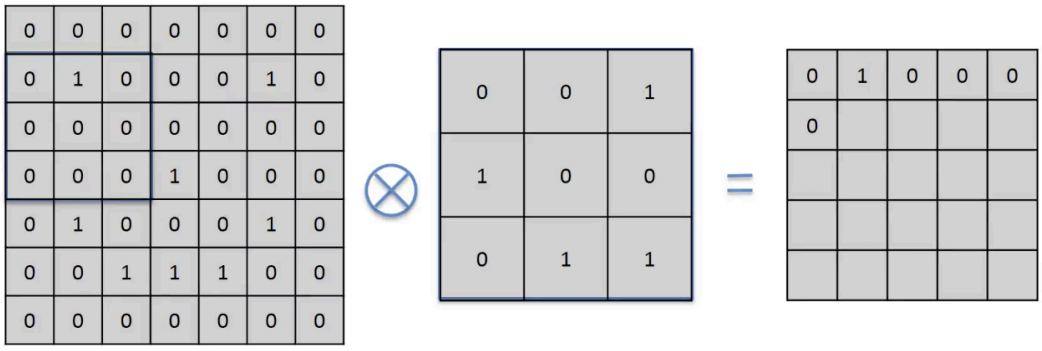
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



Input Image | Feature Detector | Feature Map

Step 1 - Convolution



Input Image | Feature Detector | Feature Map

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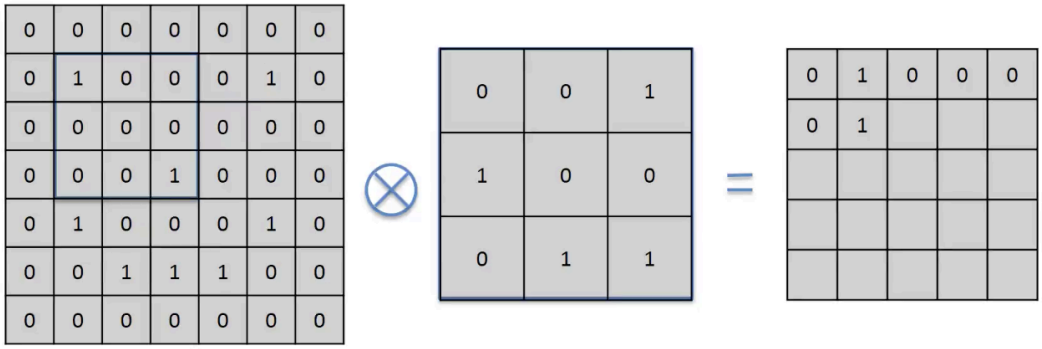
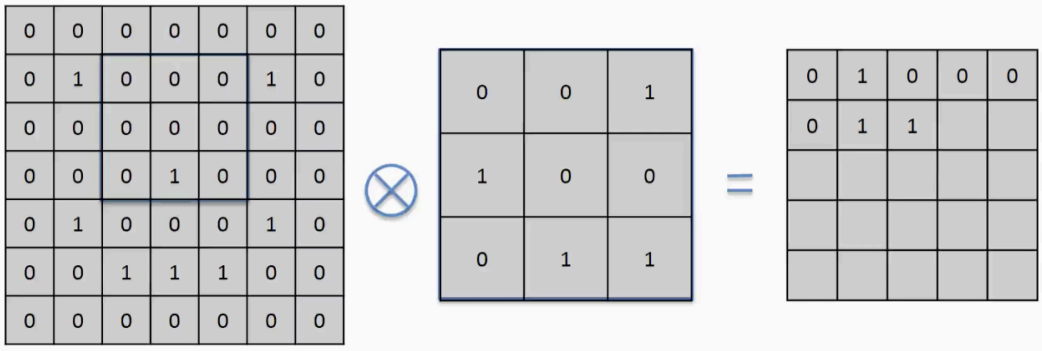
Step 1 - Convolution



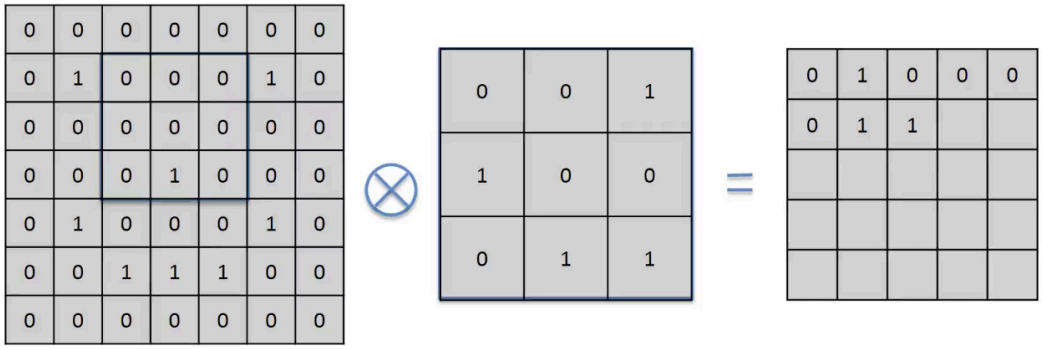
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



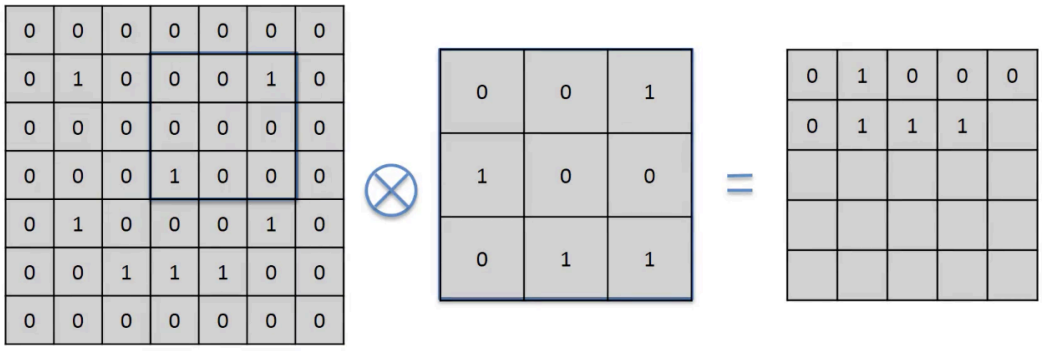
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



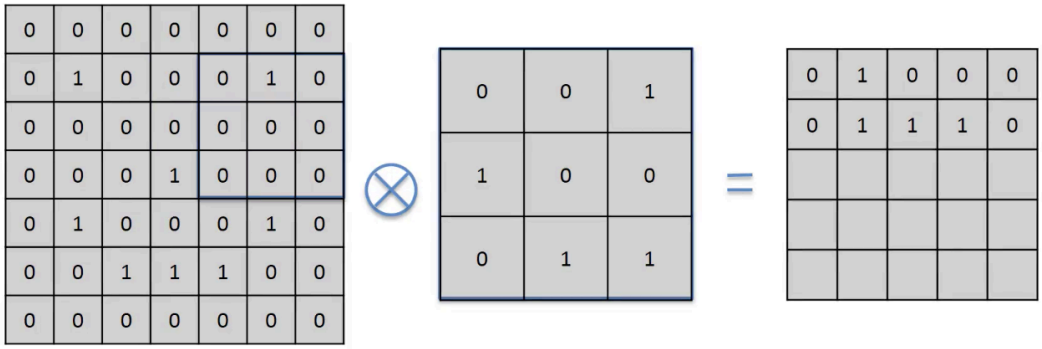
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



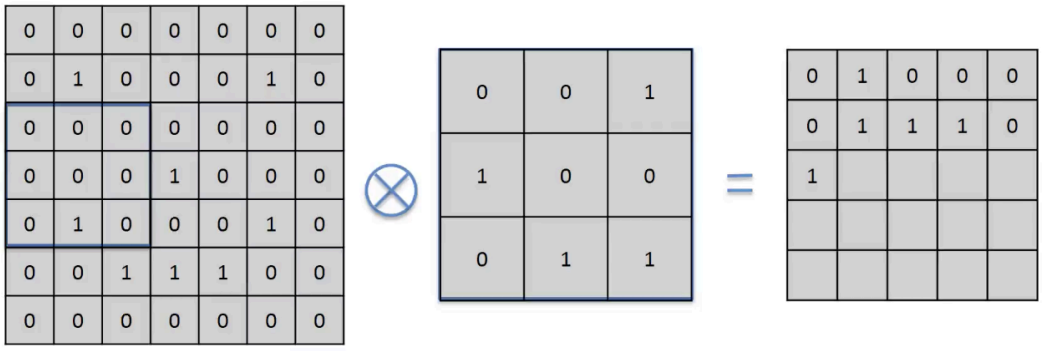
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



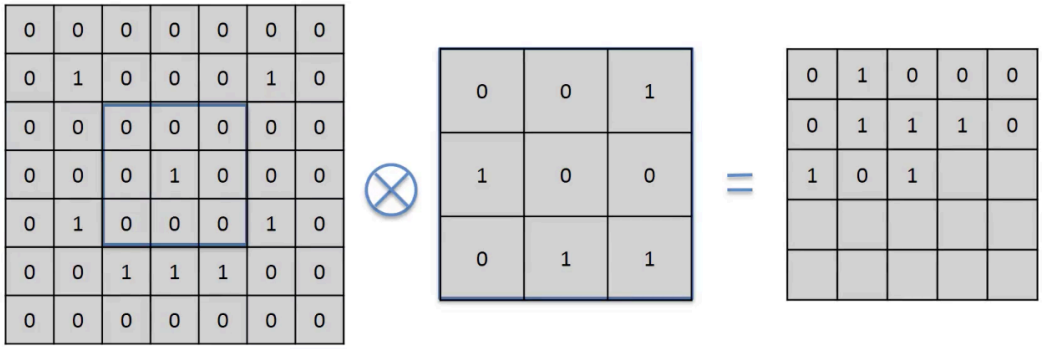
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



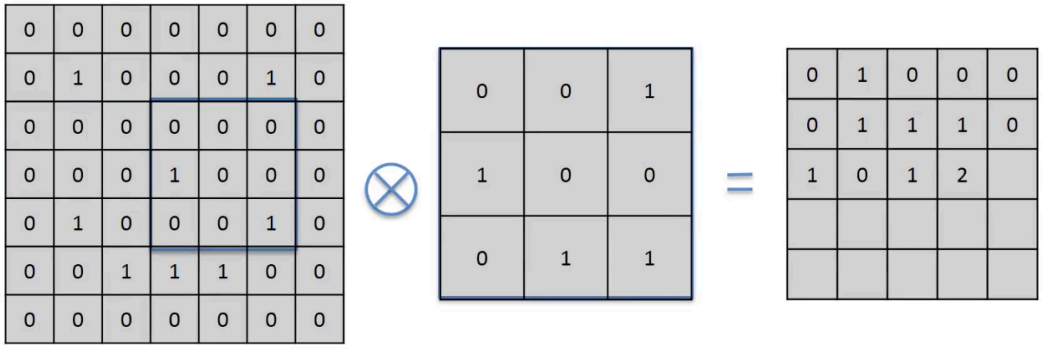
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



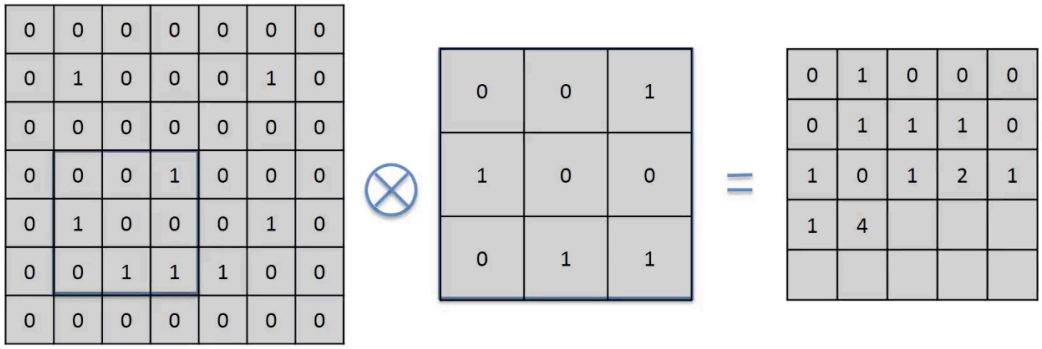
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



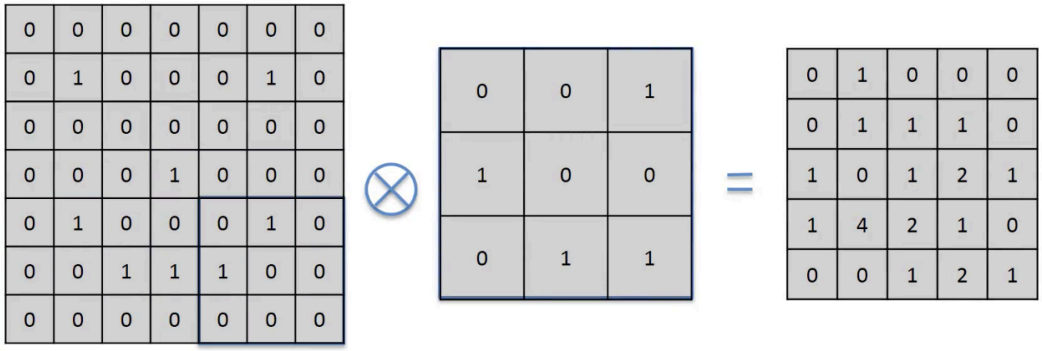
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



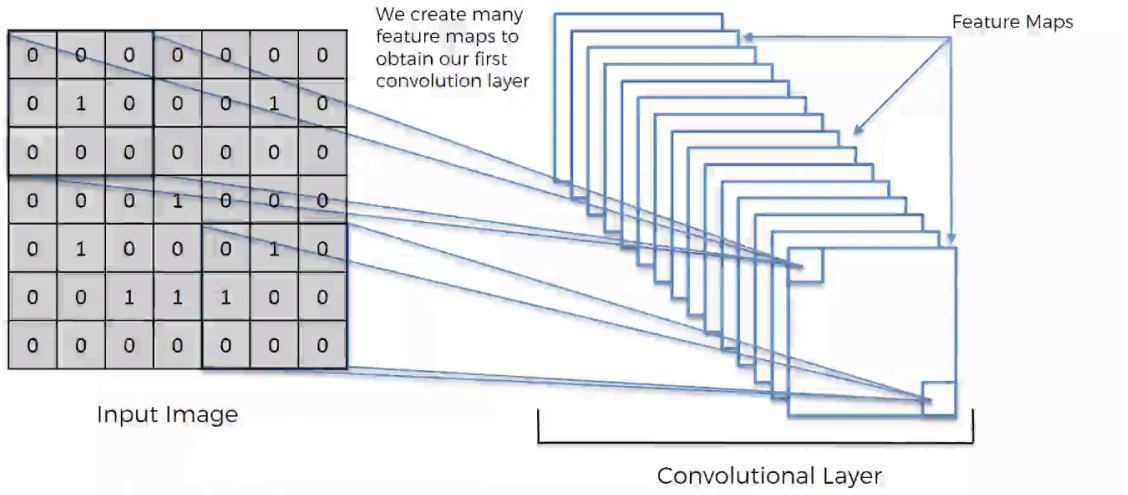
Input Image | Feature Detector | Feature Map

Step 1 - Convolution



Input Image | Feature Detector | Feature Map

Step 1 - Convolution



The reason we create multiple feature maps is because we want to try different filters on them to preserve more information in order to use it in different application.

Step 1 - Convolution

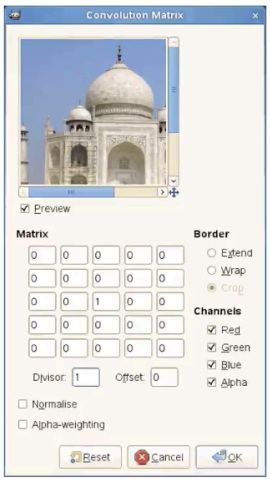


Image Source: docs.gimp.org/en/plug-in-convmatrix.html

Step 1 - Convolution

Sharpen:

0	0	0	0	0
0	0	-1	0	0
0	-1	5	-1	0
0	0	-1	0	0
0	0	0	0	0

Image Source: docs.gimp.org/en/plug-in-convmatrix.html

Step 1 - Convolution

Sharpen:

0	0	0	0	0
0	0	-1	0	0
0	-1	5	-1	0
0	0	-1	0	0
0	0	0	0	0

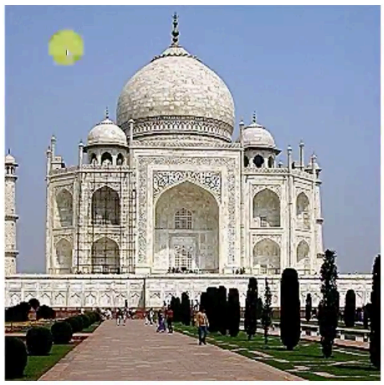


Image Source: docs.gimp.org/en/plug-in-convmatrix.html

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5 is the pixel in the middle of the filter or feature detector and -1 reduces the pixels around it.

Step 1 - Convolution

Blur:

0	0	0	0	0
0	1	1	1	0
0	1	1	1	0
0	1	1	1	0
0	0	0	0	0

Image Source: docs.gimp.org/en/plug-in-convmatrix.html

Equal significance to all pixels around the middle.

Step 1 - Convolution

Edge Enhance:

	0	0	0	
	-1	1	0	
	0	0	0	

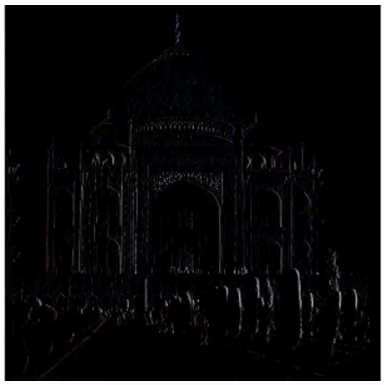

Image Source: docs.gimp.org/en/plug-in-convmatrix.html

In here we deleted all the pixels around the main one and only keep the -1 to keep the edge

Step 1 - Convolution

Edge Detect:

	0	1	0	
	1	-4	1	
	0	1	0	

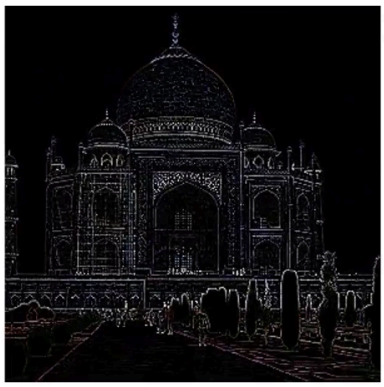

Image Source: docs.gimp.org/en/plug-in-convmatrix.html

Reduce the middle one (probably like the strength) and increase the strength of ones around them

Step 1 - Convolution

Emboss:

	-2	-1	0	
	-1	1	1	
	0	1	2	

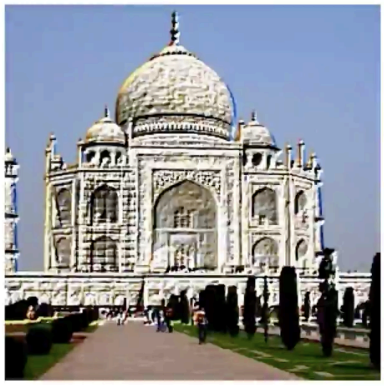

Image Source: docs.gimp.org/en/plug-in-convmatrix.html

Step 1 - Convolution

$*$

1	0	-1
2	0	-2
1	0	-1

Image Source: eonardoaraujosantos.gitbooks.io