2D Convolution

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 Slide credit: Bob Fisher

2D Convolution

Applies 2D mask to 2D image
Still weighted sum
Choice of weights determines the effect

$$Output(x,y) = \sum_{i=-N}^{N} \sum_{j=-N}^{N} weight(i,j) * input(x-i, y-j)$$

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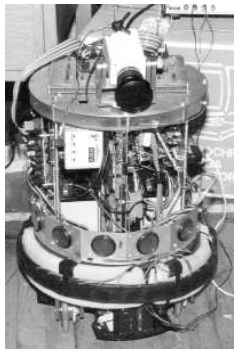
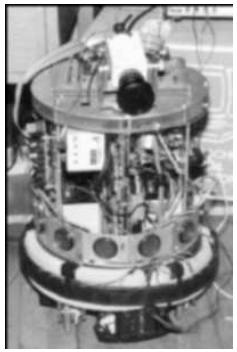
2D Convolution - Smoothing



$*$ $\frac{1}{273}$

1	4	7	4	1
4	16	26	16	4
7	26	41	26	7
4	16	26	16	4
1	4	7	4	1

$=$



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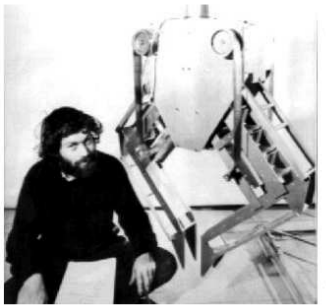
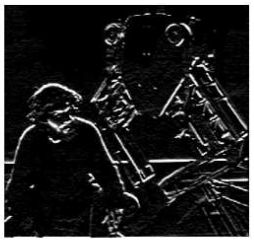
Convolution for Edge Detection



$*$

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

$=$

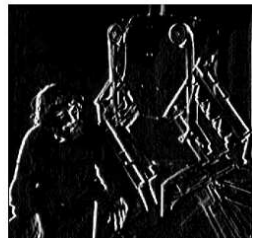


Edge detection

$*$

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

$=$



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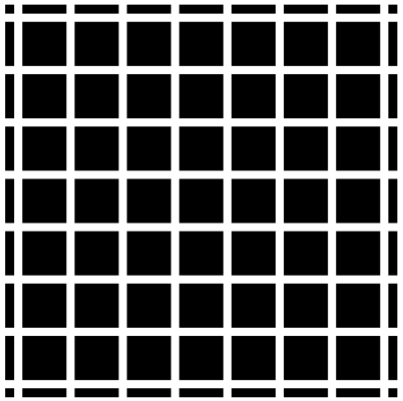
Convolution 'Explains' Illusions

Edge enhancement in human vision

Centre-surround receptors - convolved with retinal image



Hermann grid illusion – full explanation more complex

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Lecture Overview

1. Convolution extension for 2D
2. Two of many applications: smoothing and edge detection

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