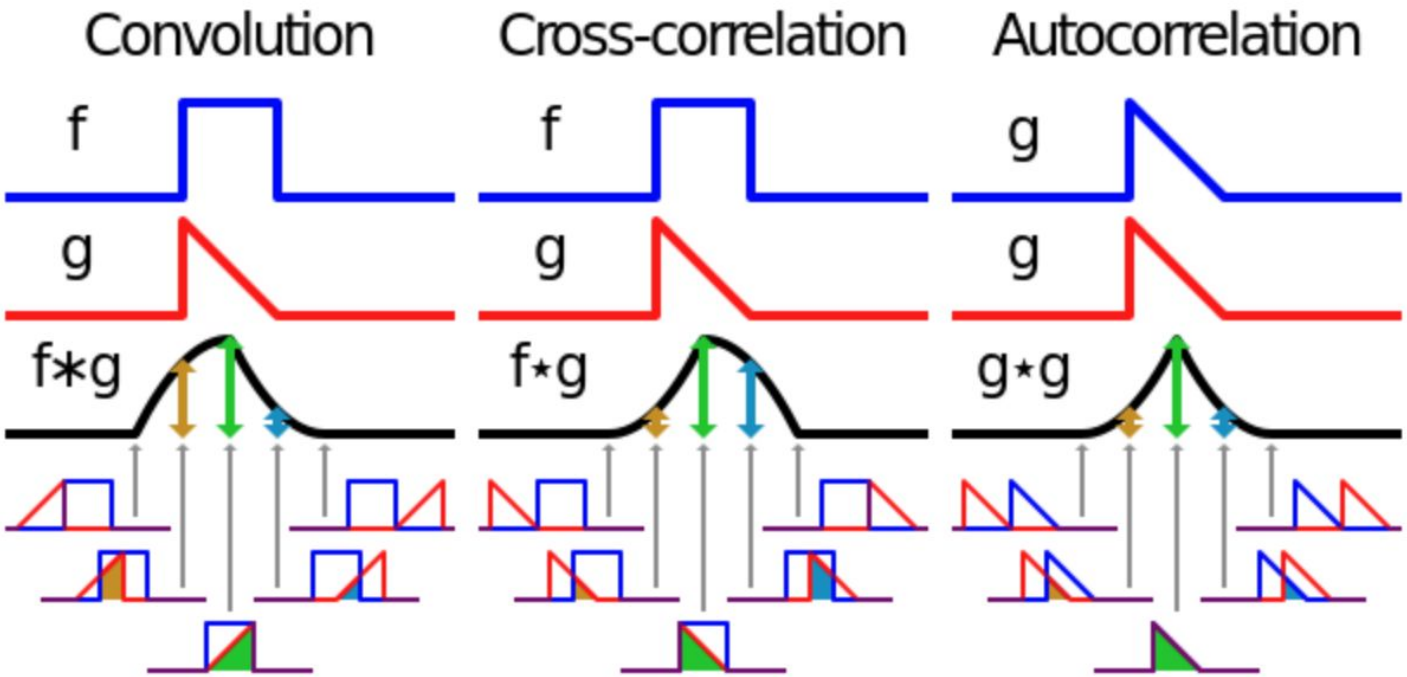
Computer Vision Tutorial 3 - Hough Transform

Manuel Heurich - Biorobotics Lab

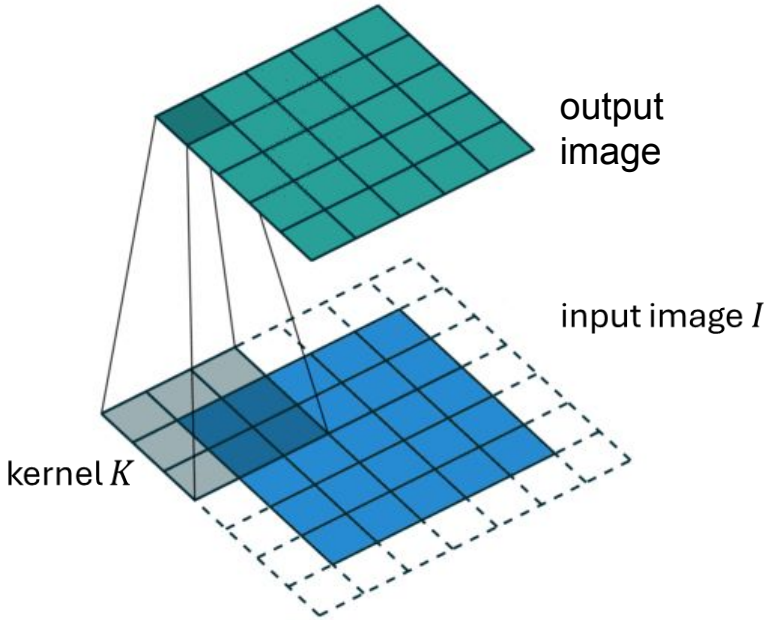
12.11.24


Convolution
Cross-correlation
Autocorrelation
f
g
f∗g
f
g
f⋆g
g
g
g⋆g

Computer Vision 101: Convolution

$$(I * K)_{x,y} = \sum_{-W}^{W} \sum_{-H}^{H} I_{x-w,y-h} K_{w,h}$$

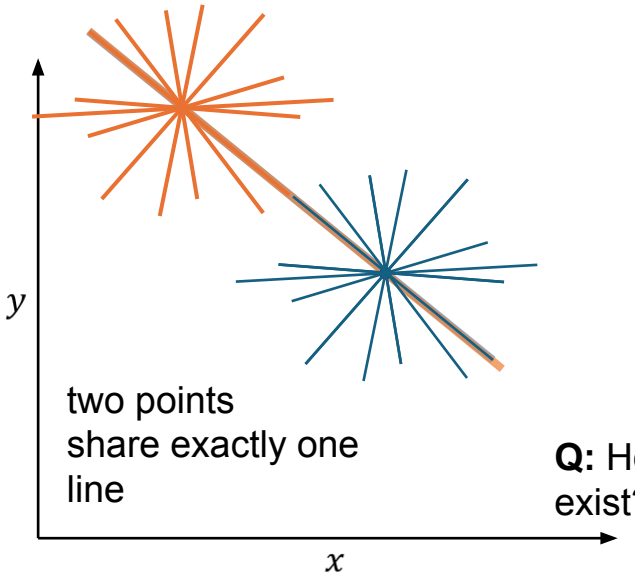
$$= I^{T}_{N(x,y)} K$$



Notion 1: weighted sum

https://towardsdatascience.com/a-comprehensive-introduction-to-different-types-of-convolutions-in-deep-learning-669281e58215

Image

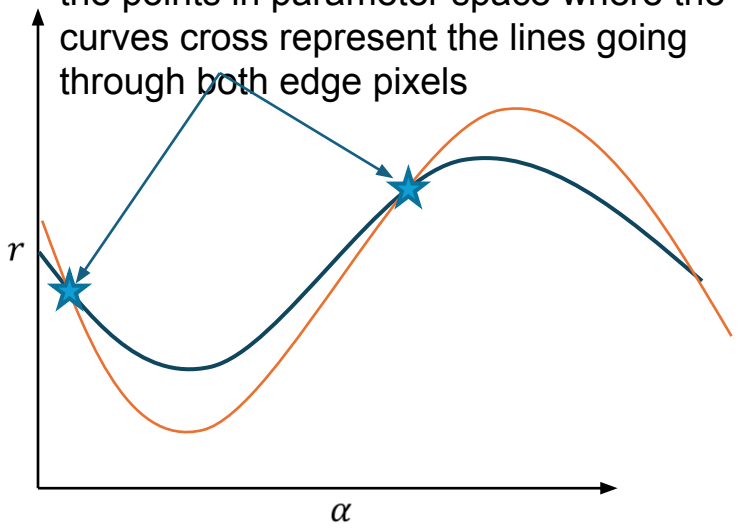


two points
share exactly one
line

Q: How many solutions exist?

Parameter space

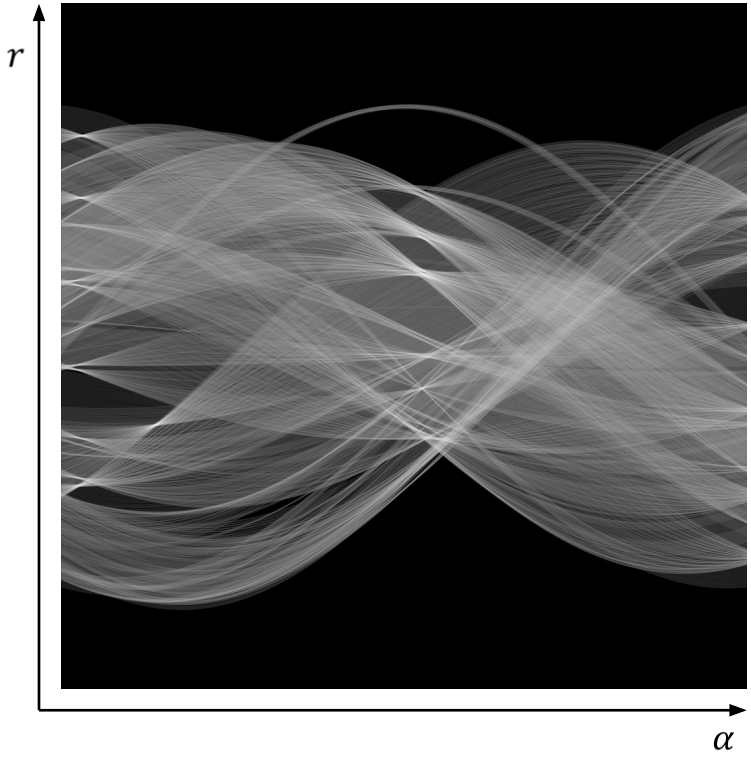
the points in parameter space where the curves cross represent the lines going through both edge pixels



The „accumulator“

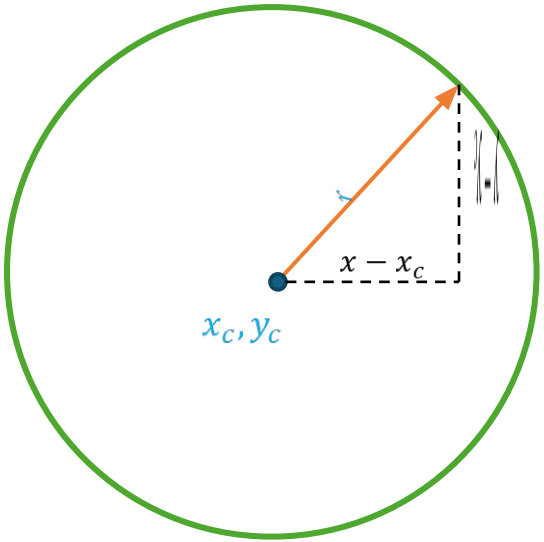
```
for each edge pixel at x,y
    for a = 0 : pi
        r = x * cos(a) + y * sin(a)
        A(a,r)++
```

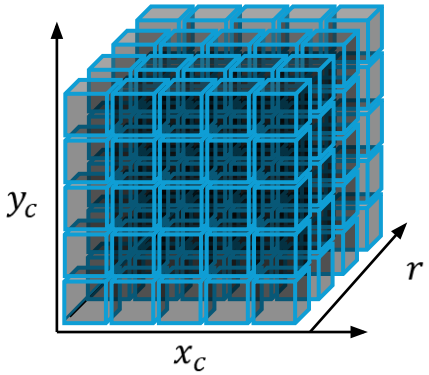
- find indices of local maxima in A

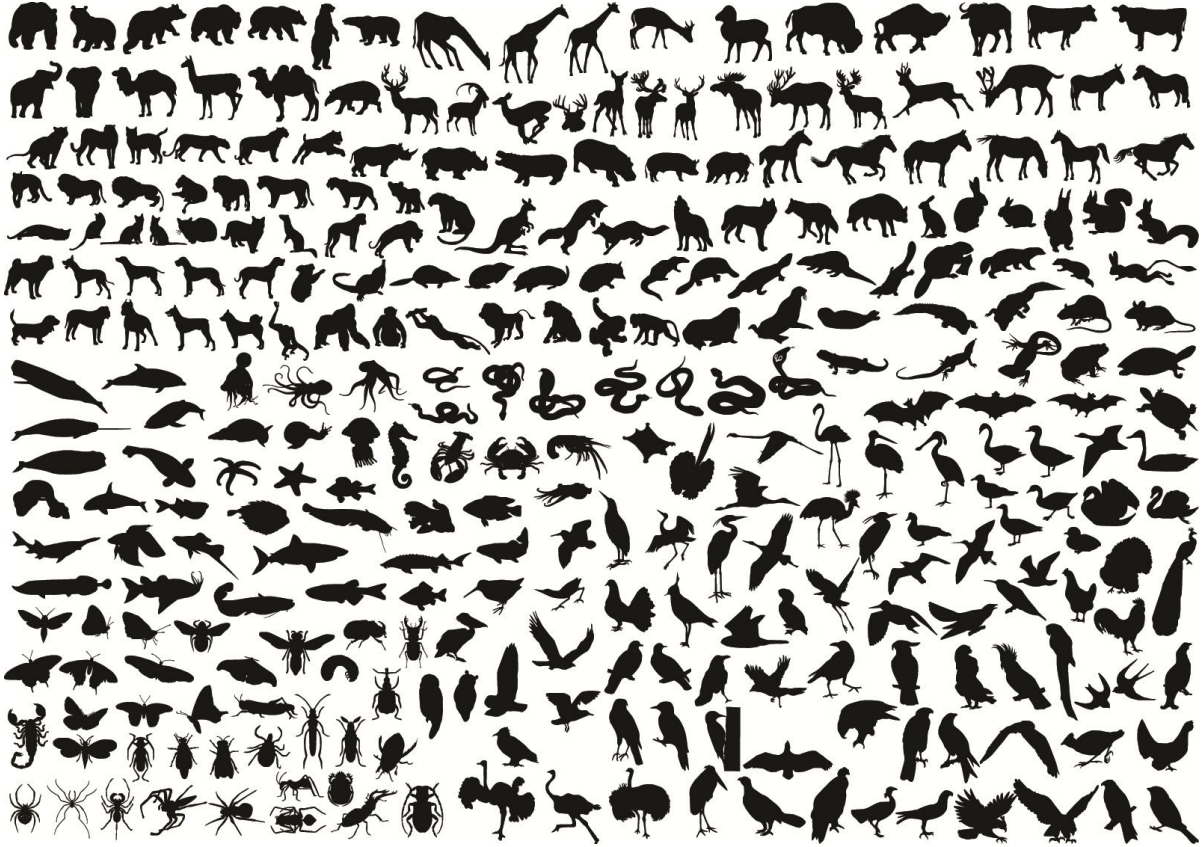


Circle equation:

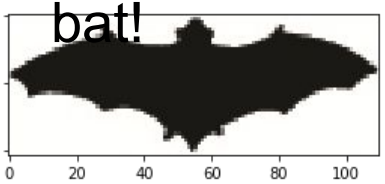
$$(x - x_c)^2 + (y - y_c)^2 = r^2$$







Find the bat!

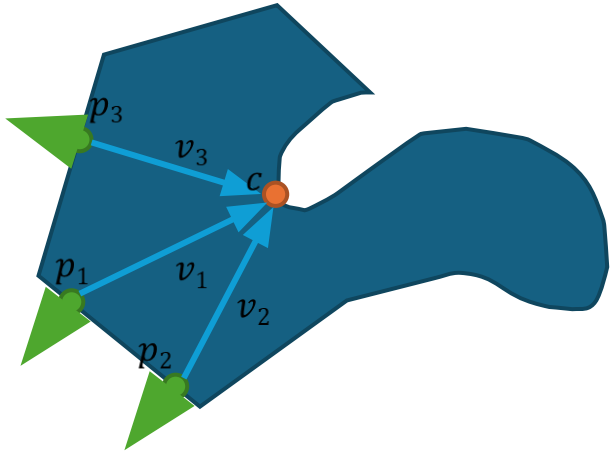


template

haystack

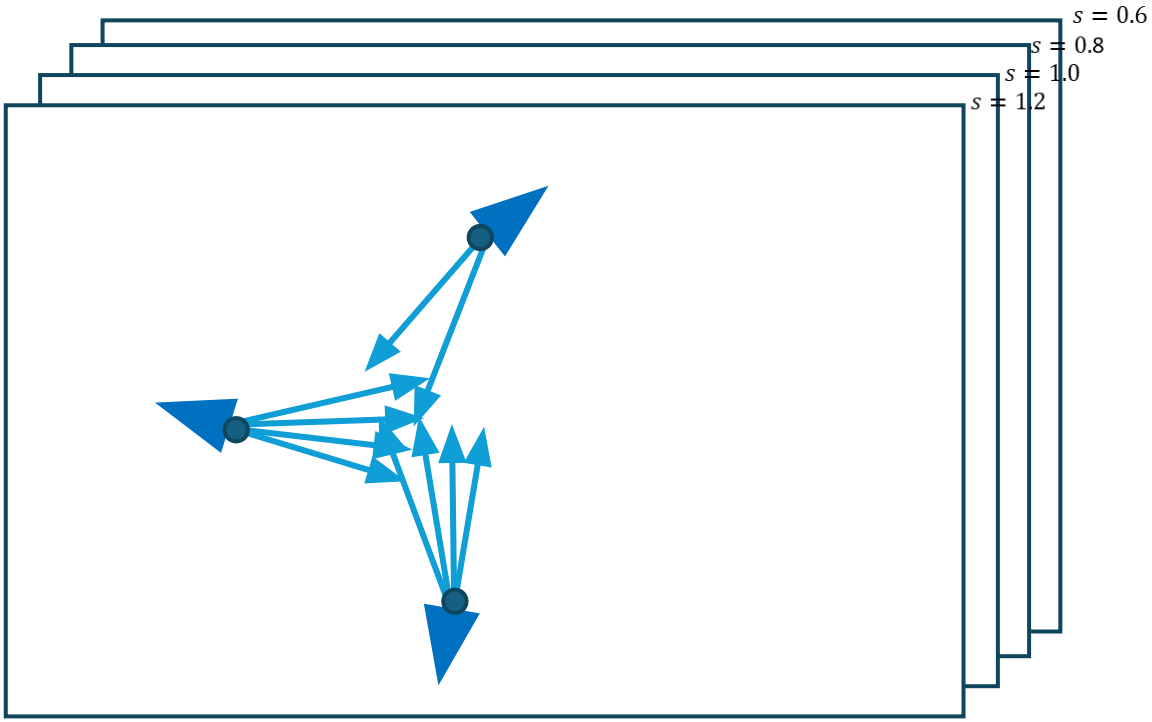
R-Table

0°	
20°	
40°	
60°	
80°	



For all edge pixels p_i in the template: append v_i to $R(\theta_i)$!

Adding scale-invariance



Accumulator is now 3-D!

Adding rotation-invariance

80°	
90°	
100°	
…	
160°	
170°	
180°	
190°	

assuming 0° object rotation

assuming -80° object rotation