OPENCV
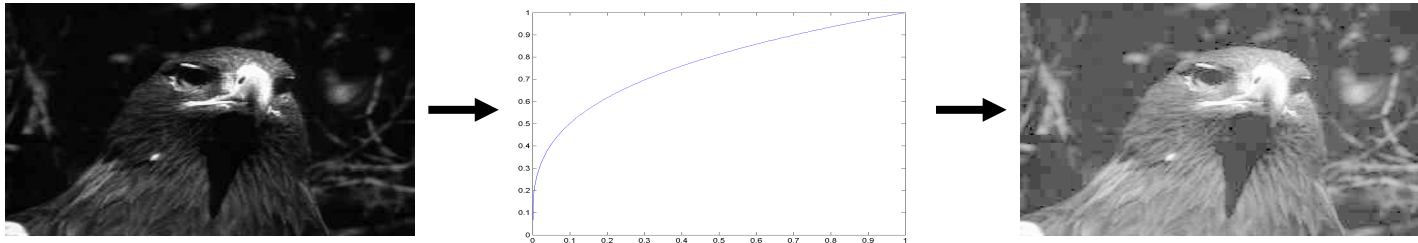# Session 2

Example 1. Smoothing

Example 2. Dilatation -Erosion
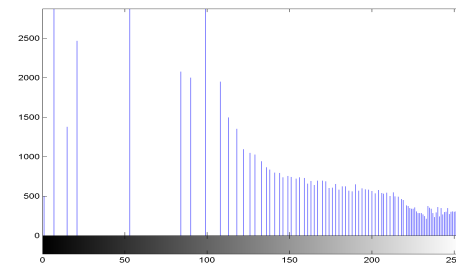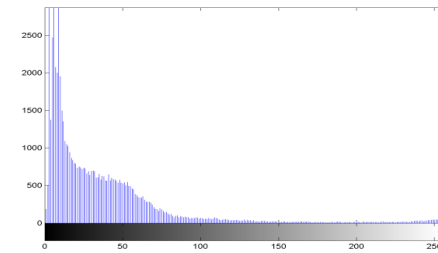
Example 3 . Histogram equalization

$$s = Cr^{\gamma}$$

$$S_k = T(r_k) = \sum_{j=1}^{k} \frac{n_j}{n}$$
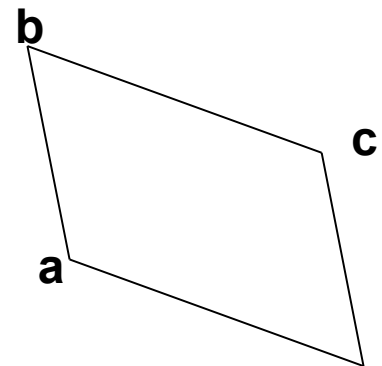
Example 4 . Affine transformations

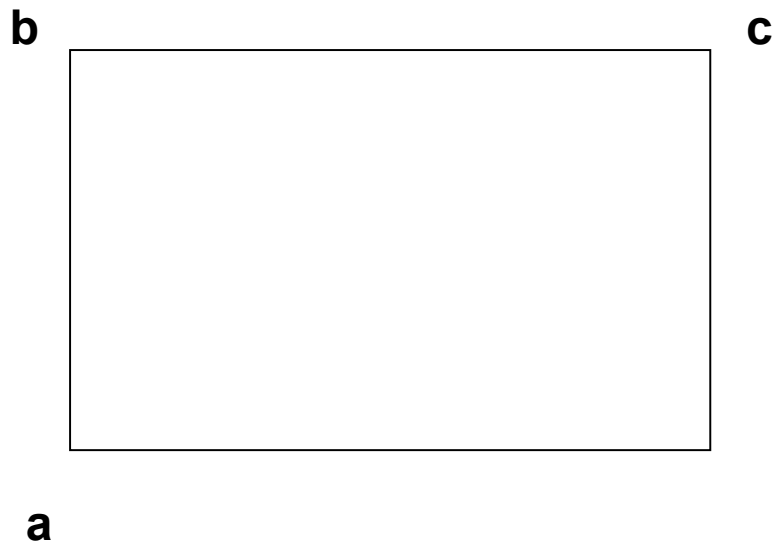Keep parallel lines

$$y \leftarrow \mathbf{A}x + \mathbf{b}$$

In OpenCV

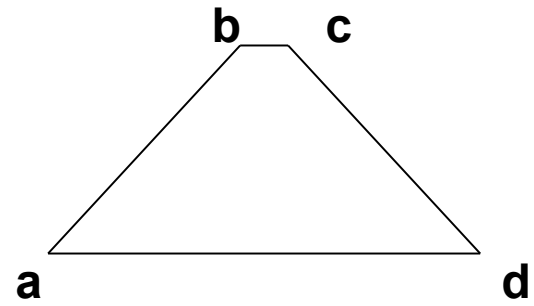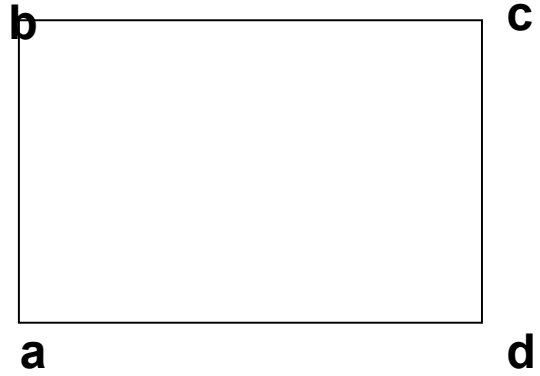$$T = \begin{bmatrix} \mathbf{A} & \mathbf{b} \end{bmatrix} = \begin{bmatrix} a_{00} & a_{01} & b_0 \\ a_{10} & a_{11} & b_1 \end{bmatrix}$$

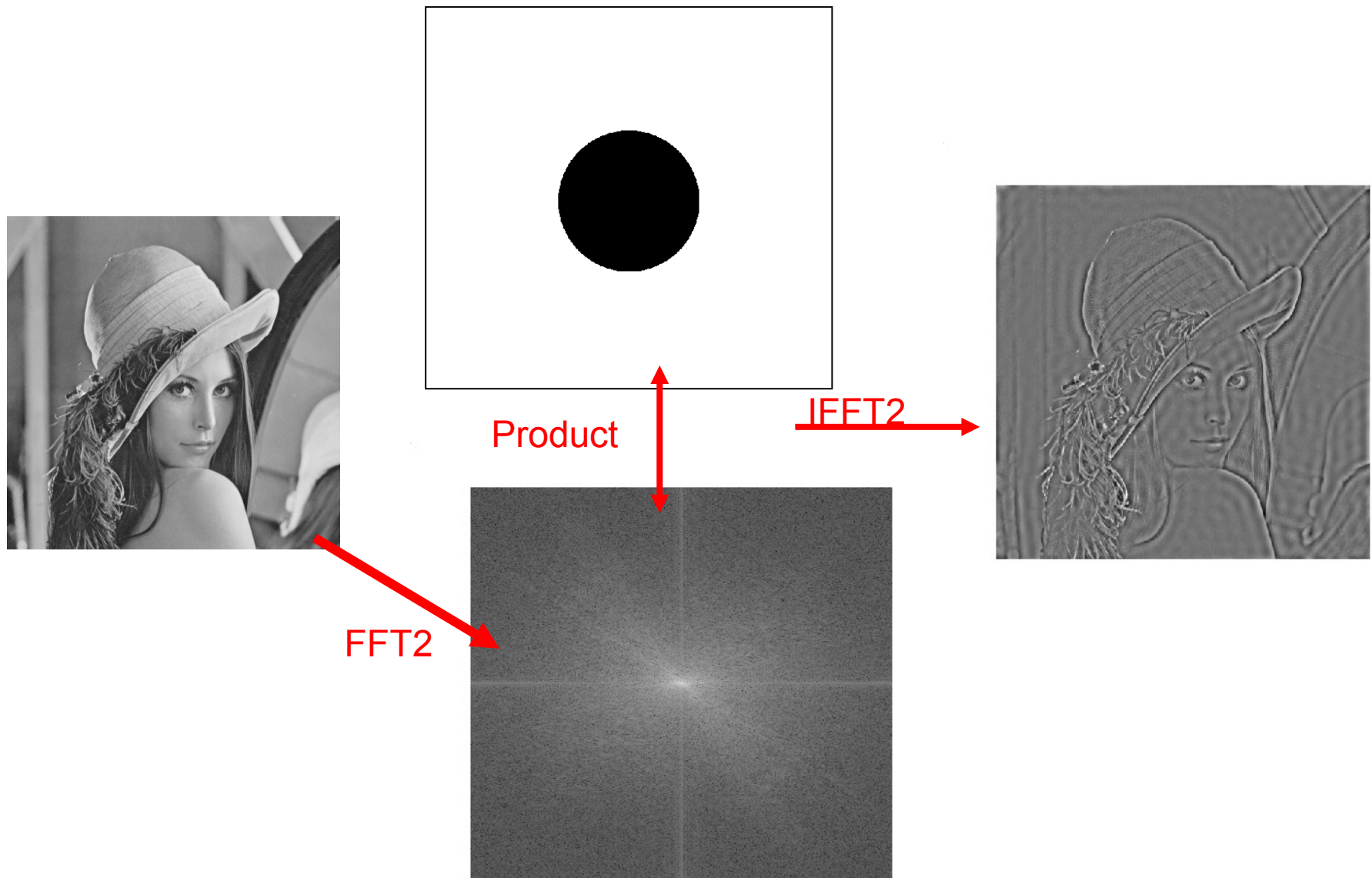# Example 5 . Get Affine transformations

b   c

a

Example 6 . Get Perspective Transformation

Example 7,8 9,10 . 2D DFT

Product

FFT2

IFFT2

Example 11 . 2D DCT

Input → **DCT** → → **IDCT** → Output
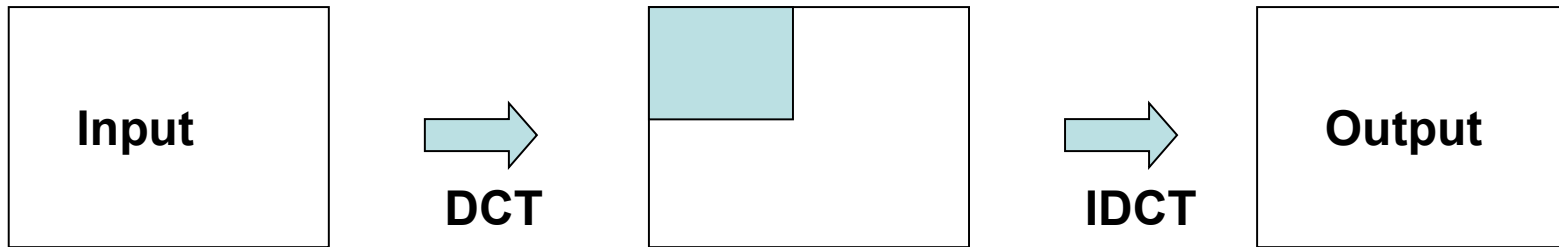
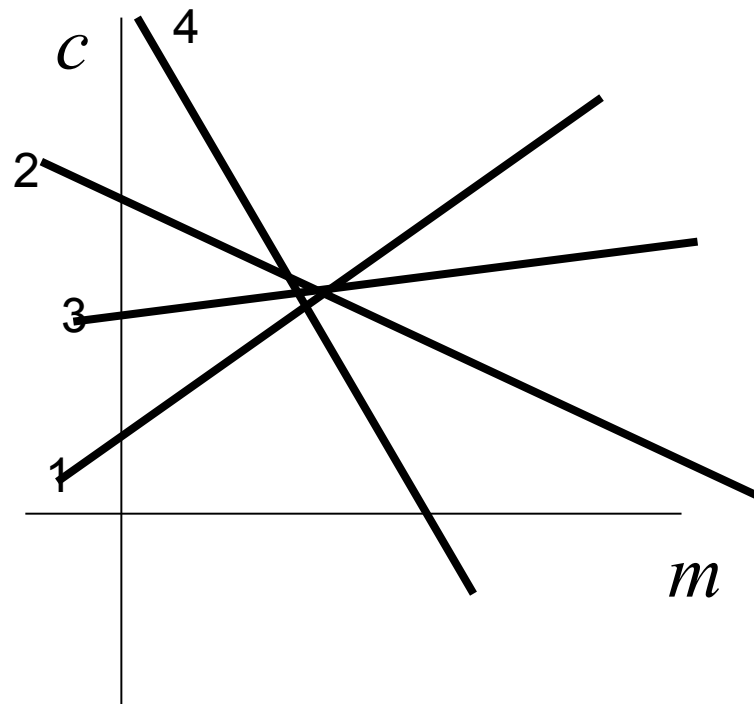Example 12,13 .Feature extraction
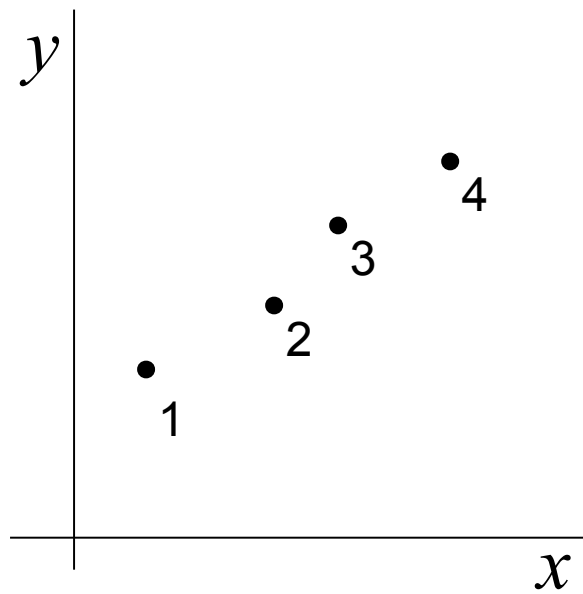
Line equation

$$y = mx + c$$

$$c = y - mx$$

Example 12. Hough Transform, polar form for line detection

$$x \cos\theta + y sen\theta = \rho$$
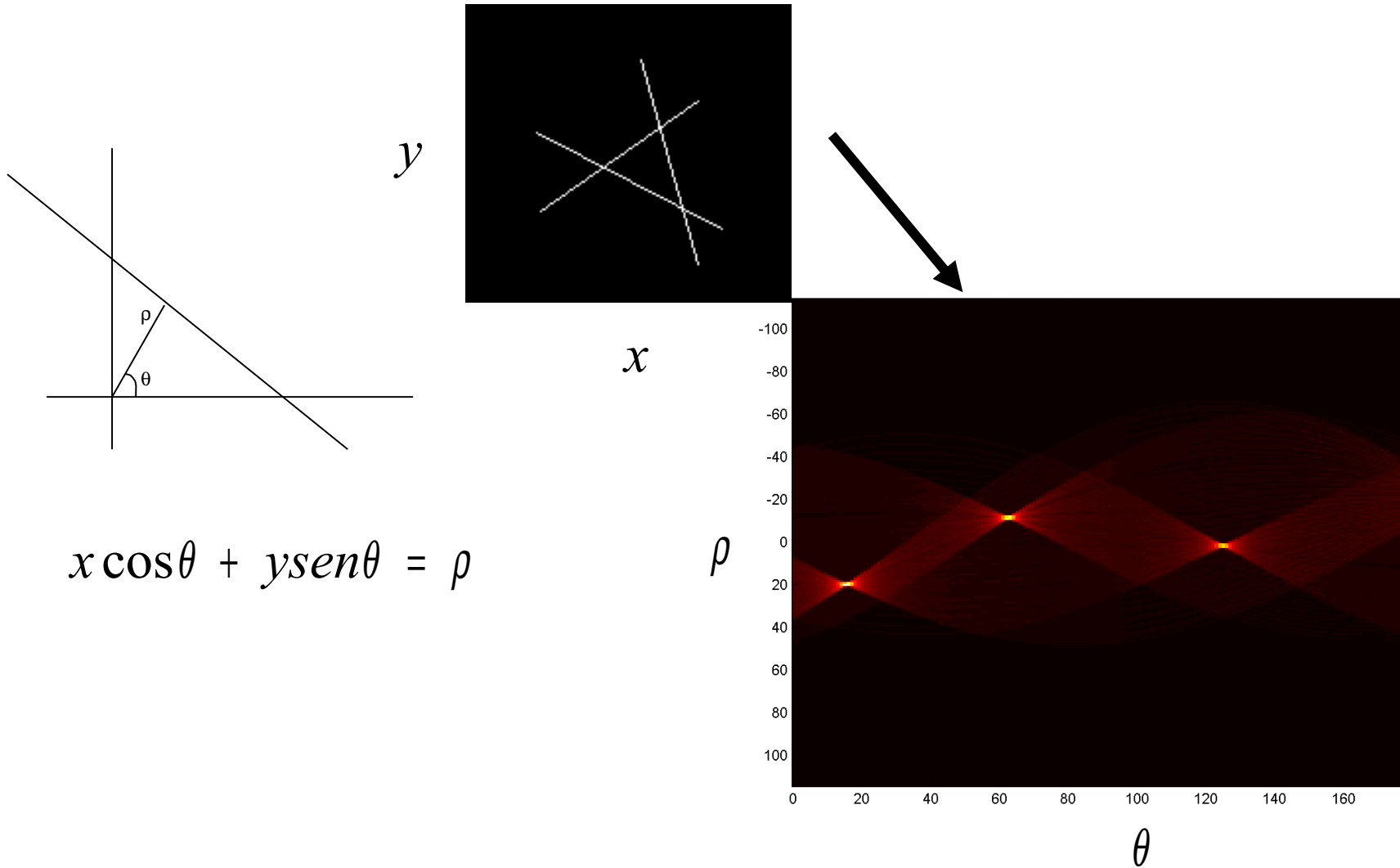
Example 13. Hough Transform, for circle detection
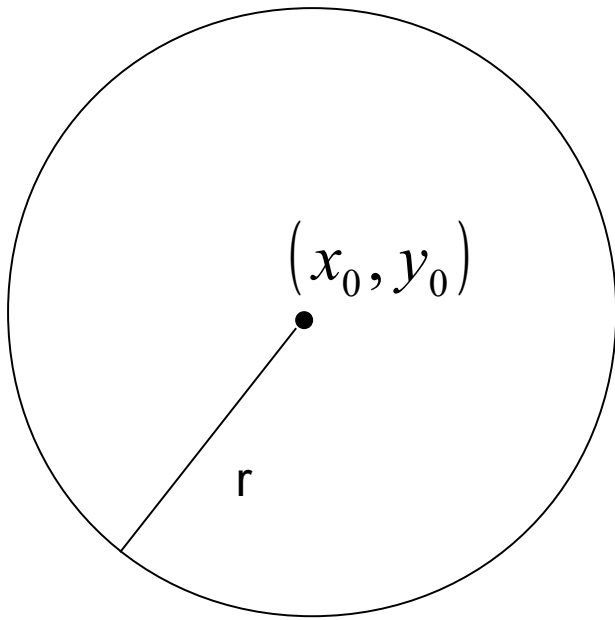
$$(x - x_0)^2 + (y - y_0)^2 = r^2$$
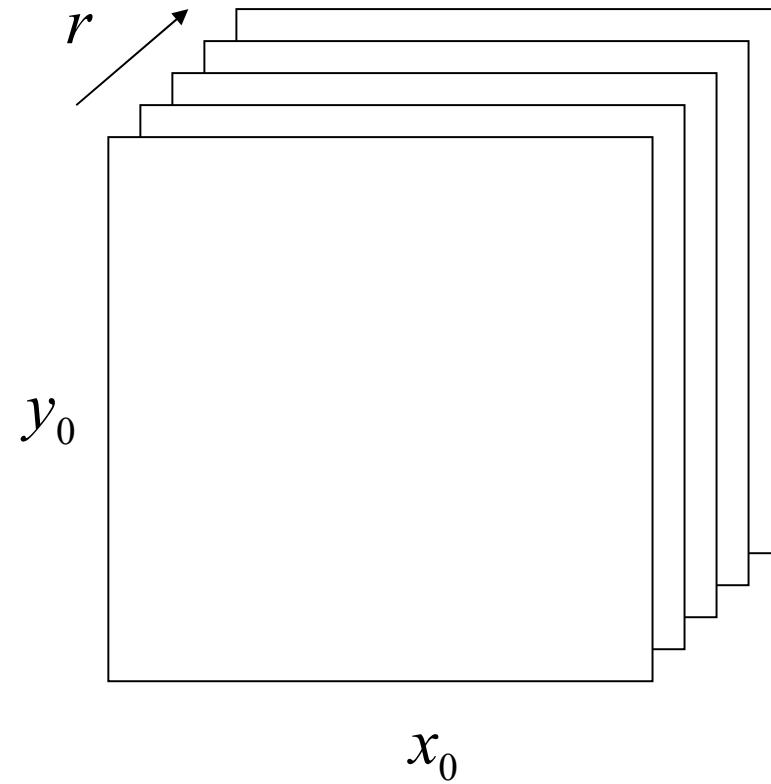
Example 14. Template Matching
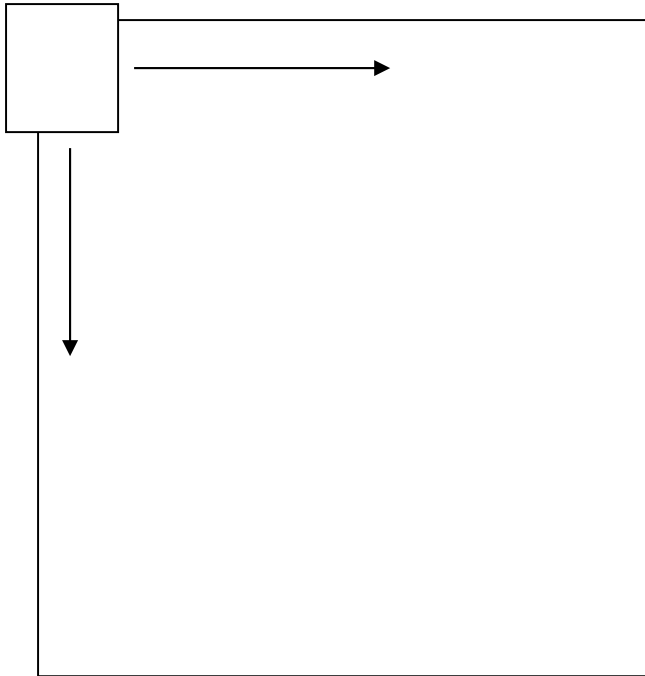
- Square of the difference (look for the minimum)
- Correlation (look for the maximum)

Example 15. Contour detection

Example 16. Ellipse Fitting
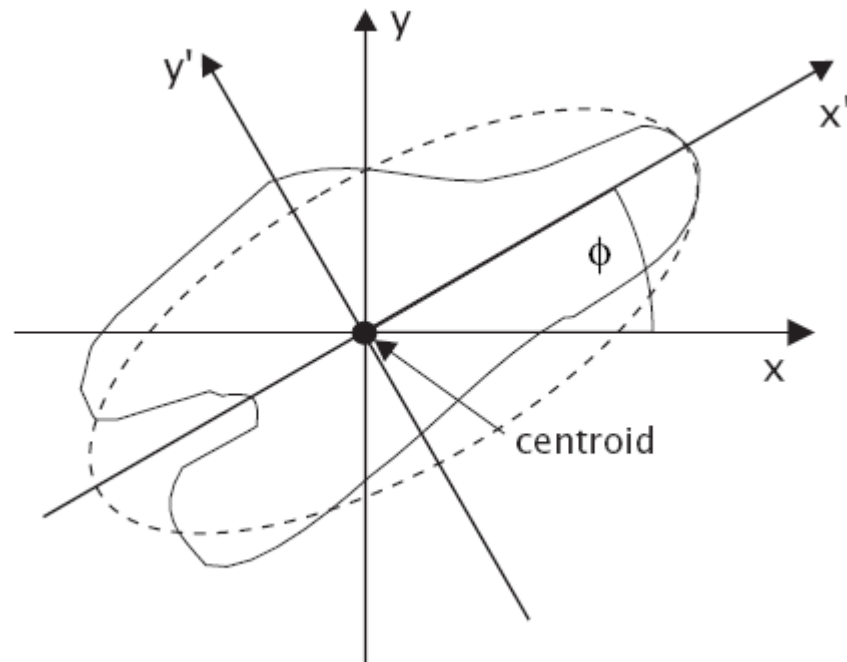
Example 17. Minimum enclosing rectangle

Example 18. Moments

$$m_{pq} = \sum_x \sum_y x^p y^q I(x, y)$$

$$m_{00} = \sum_x \sum_y I(x, y)$$

$$m_{10} = \sum_x \sum_y x I(x, y)$$

$$m_{01} = \sum_x \sum_y y I(x, y)$$

Central Moments

$$\mu_{10} = \frac{m_{10}}{m_{00}} \qquad \mu_{01} = \frac{m_{01}}{m_{00}}$$

$$\mu_{pq} = \sum_x \sum_y \left(x - \mu_{10}\right)^p \left(y - \mu_{01}\right)^q I(x,y)$$

Normalized central moments

$$\eta_{p,q} = \frac{\mu_{p,q}}{m_{0,0}^{\frac{(p+q)}{2}+1}}$$

Example 19. Hu Moments

$$I_1 = \eta_{20} + \eta_{02}$$

$$I_2 = (\eta_{20} - \eta_{02})^2 + (2\eta_{11})^2$$

$$I_3 = (\eta_{30} - 3\eta_{12})^2 + (3\eta_{21} - \eta_{03})^2$$

$$I_4 = (\eta_{30} + \eta_{12})^2 + (\eta_{21} + \eta_{03})^2$$

$$I_5 = (\eta_{30} - 3\eta_{12})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] +$$
$$(3\eta_{21} - \eta_{03})(\eta_{21} + \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2]$$

$$I_6 = (\eta_{20} - \eta_{02})[(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2] + 4\eta_{11}(\eta_{30} + \eta_{12})(\eta_{21} + \eta_{03})$$

$$I_7 = (3\eta_{21} - \eta_{03})(\eta_{30} + \eta_{12})[(\eta_{30} + \eta_{12})^2 - 3(\eta_{21} + \eta_{03})^2] -$$
$$(\eta_{30} - 3\eta_{12})(\eta_{21} + \eta_{03})[3(\eta_{30} + \eta_{12})^2 - (\eta_{21} + \eta_{03})^2].$$

```
cvGetHuMoments( CvMoments* moments, CvHuMoments* hu_moments );
```

from: http://en.wikipedia.org/wiki/Image_moment.