Finding Shapes

i. thresholding - useless - needs shape.

ii. template matching.

$$accum_{x,y} = \sum_{m}\sum_{m}(P=T)$$

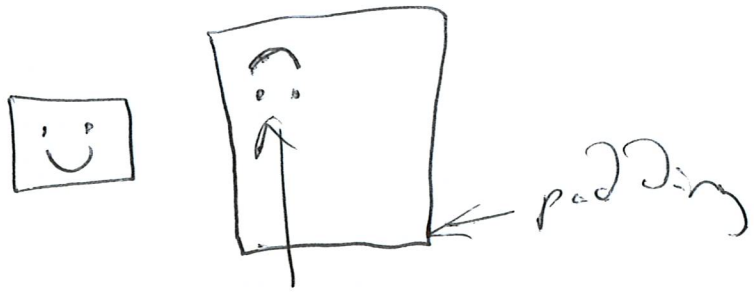
template points

template image accumulator

templates are often large, ⇒ use Fourier.

operations	spatial	frequency
convolution	invert template	$F^{-1}(F(P) \cdot F(T))$
correlation/matching	no inversion	$F^{-1}(F(P) \cdot F(-T))$

inverted template & padded.



inversion.

position invariant Template Match.

rotate - scale template as necessary.

iii/. Hough transform.

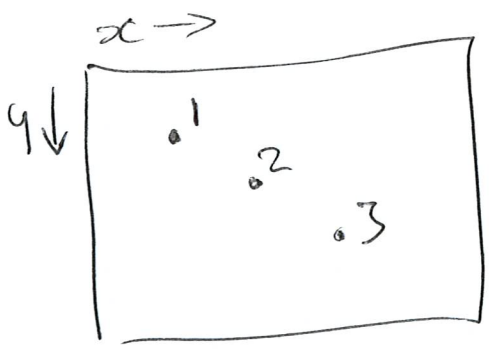
a/. lines

$$y = mx + c$$

points x, y gradient m intercept c

$$c = -xm + y$$

points (m, c) gradient $-x$ " y.



image

accumulator
contains lies of 1 ~~vote~~ vote.

pseudo code

$\forall x, y$
IF edge $(x, y) >$ threshold
{ $\forall m \in m_{min}, m_{max}$
{ $c = -xm + y$
accumulator (m, c) PLUS 1 }}

afterwards argmax(accumulator) gives the shape

problem $m \to \infty$

iv). change the equation

use polar

$x\cos\theta + y\sin\theta = \rho$

test of normal parameterisation

$$\left.\begin{array}{l} -90 < \theta < 90 \\ 0 < \rho < \sqrt{2} \end{array}\right\} \text{ so no problems with } \infty$$

v). speed?

template matching (spatial) $= O(N^2 \times m^2)$

Hough transform $= O(\text{no. of edge points})$

speed Hough >> template matching.

but properties are the same