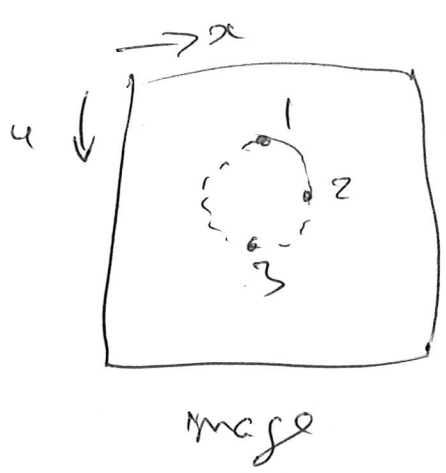


Further Shapes

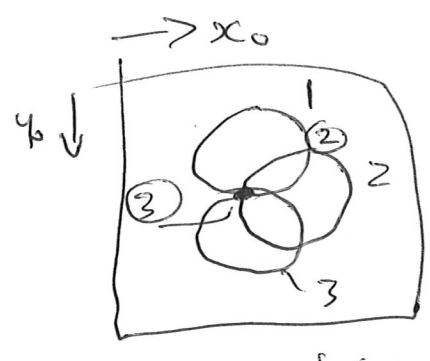
if circles?

$$(x - x_0)^2 + (y - y_0)^2 = r^2$$

points (x, y) centre (x_0, y_0) rad r
 (x_0, y_0) " (x, y) " "



image



accumulator

$\forall x, y$

if $edge(x, y) > threshold$

$\forall r = r_{min}, r_{max}$

! vary radius

$\forall \theta = 1, 360$

$$\begin{cases} x' = r \cos \theta \\ y' = r \sin \theta \end{cases}$$

$accum(x + x', y + y')$ PLUS 1

afterwards $argmax(accum)$ gives x_0, y_0

ii) ellipses

$$\frac{(x-x_0)^2}{a^2} + \frac{(y-y_0)^2}{b^2} = 1$$

4P array, + orientation SD array.
↑

e.g. 100 values for each parameter
accumulator $\leq 10^{10}$

iii) speed & accumulator size?

a) use bigger computer

b) use maths.

e.g. circle $(x-x_0)^2 + (y-y_0)^2 = r^2$

$$\frac{\partial}{\partial x} 2(x-x_0) + 2(y-y_0) \frac{\partial y}{\partial x} = 0$$

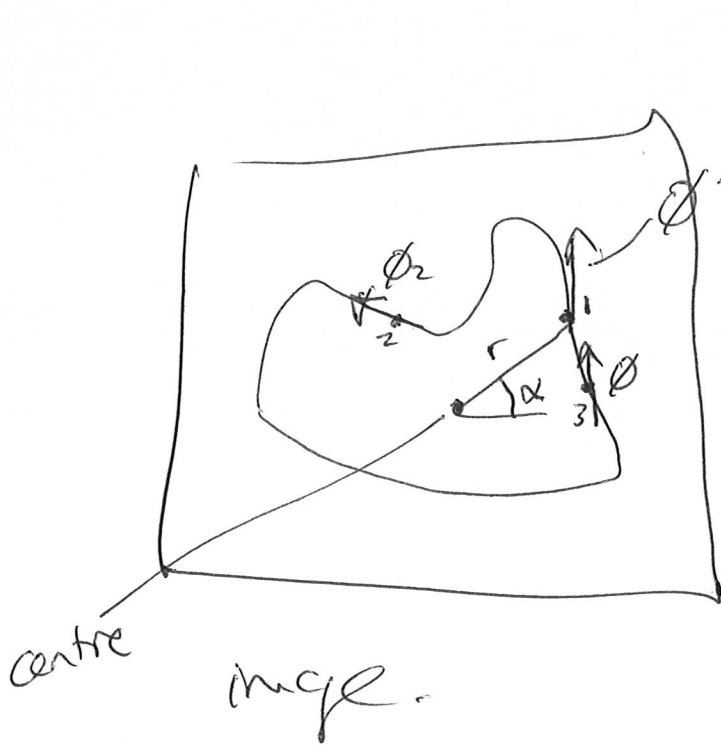
$$\frac{dy}{dx} = -\frac{(x-x_0)}{(y-y_0)} = \text{gradient direction}$$



c) use partitioned approaches,
e.g. find circle centre first.

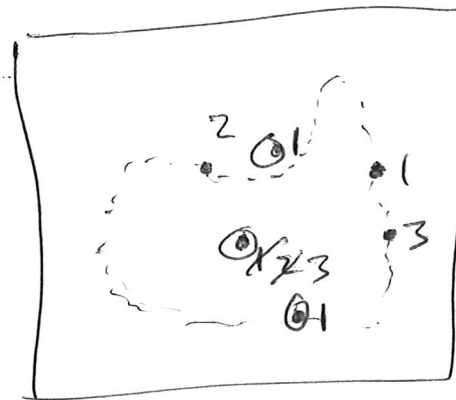
M. generalised HT for arbitrary shapes

↑
non-conic sections



$\phi_1 - (r_1, \alpha_1) (z_1, \alpha_3)$
 $\phi_2 (r_2, \alpha_2)$

↑
r-table stores the shape



use the r-table to vote

- a. find a point
- b. get edge direction
- c. look up r, α
- d. vote at ~~center~~ center
- e. noise by non-uniqueness < peak.
- f. for scale, rotation need 4D accumulator