DIP

Representation and Description.

~~Image representation and description is~~
- After the image segmentation into regions, the resulting pixels are usually represented and described in a suitable form for further computer processing.

- There are two types of Representing image
  i) By external characteristics (boundary)
  ii) By internal characteristics (pixels)

- Representation preference.

i) external representation is used when we want to focus on shape characteristics

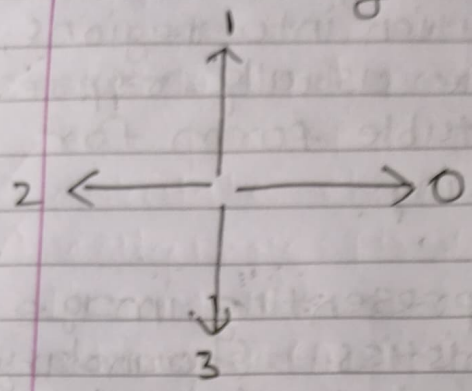
ii) Internal representation is used when focus is on regional properties like color, texture. characteristics

Some times both types of representation can be used

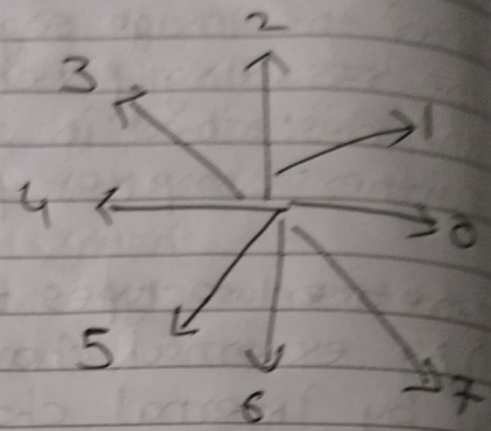
* chain code *

- The chain code is used to represent a boundry by a connected sequence of straight line of specified length and direction

- Chain code is based on 4- or 8 connection of segments. The direction of each segment is coded by number scheme



4-connectivity



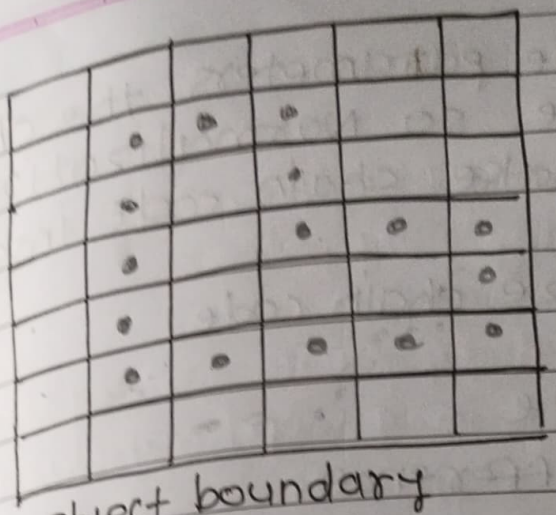
8-connectivity

- This method is generally unacceptable because of following reasons

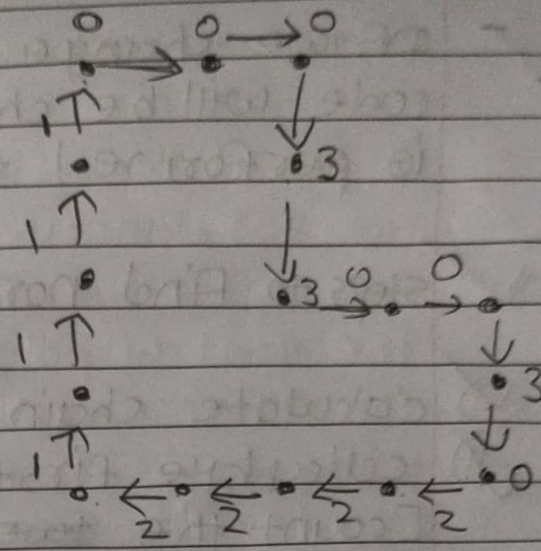
i. The resulting chain of codes can be quite long.

ii. Any small disturbance in boundry due to noise or imperfect segmentation can change the chain code.

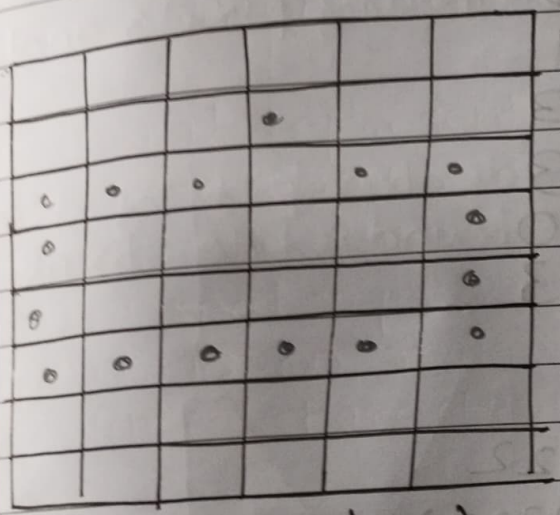
example:



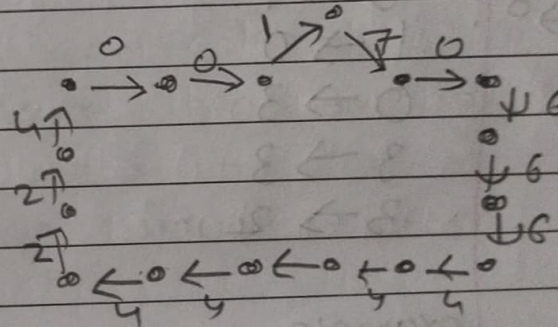
object boundary
(resampling)



4-directional
chain code.



(object boundary)



8-directional
chain code.

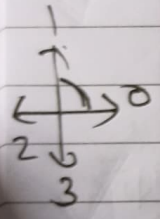
- Normalization of chain code.

- The chain code of object boundary depends upon starting point, size of object, orientation.

If we change above parameters. the chain code will be change. so Normalization is performed to make chain code invariant.

Steps to Find normalize chain code.

i) calculate chain code
ii) calculate first difference
[count the number of direction change (Anticlockwise)]



chain code	First difference
$1 \rightarrow 0$	3
$0 \rightarrow 1$	1
$1 \rightarrow 0$	3
$0 \rightarrow 3$	3
$3 \rightarrow 3$	0
$3 \rightarrow 2$	3

example
chain code = 10103322
first difference = 3133030

iii) calculate normalize chain code/shape no.
CFD = 3133030
NCFD = 0303313

- polygon approximation -

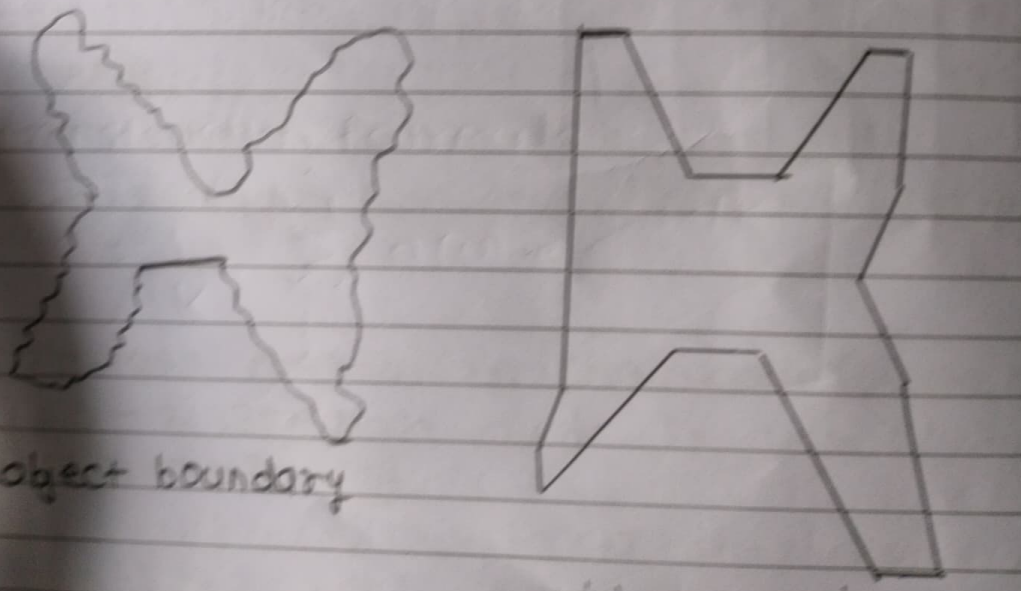
- An digital boundary can be approximated with arbitary accuracy by a polygon.

- The goal of polynomial approx. is to capture the essence of shape in given boundary using least no of segments.

- minimum perimeter polygon approximation -

- consists of line segments that minimize the distances between boundary pixels and polygon segments.

- enclose outside and inside boundary by a strip of cells and allow the boundary to shrink like rubber band.



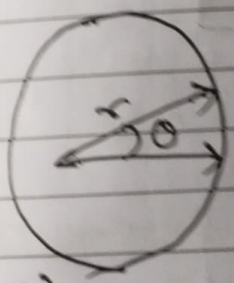
* signatures *

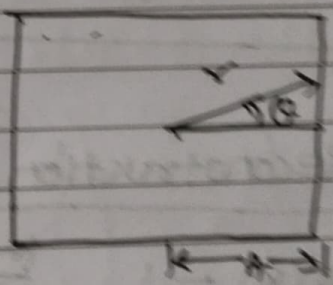
- signature give 1-D representation of the boundary.

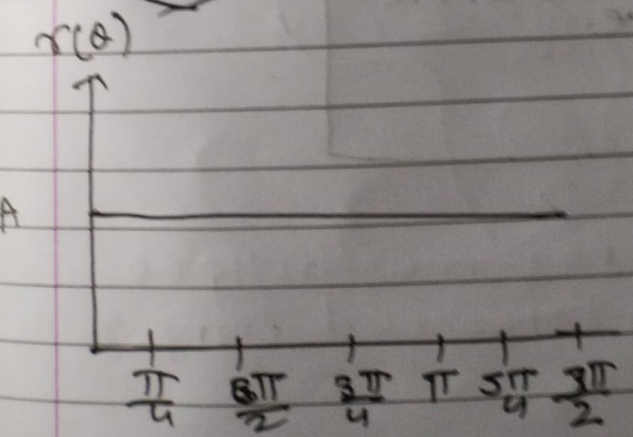
- simple signature:-
  plot the distance from centre point to ~~boundary~~ border as function of angle.

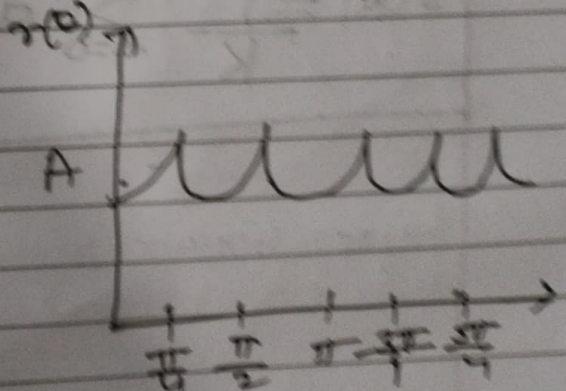
- another method is to plot the angle between the tangent at each point and reference line

eg
Representing 2d object boundary in terms of 1D function









(portation kind)

* fourier descriptor *.

- consider an N-point digital boundary in xy plane
- This forms a co-ordinate pairs $(x_0, y_0), (x_1, \ldots (x_{n-1}, y_{n-1})$
- we can consider this as two vectors
  $x(k) = xk$
  $y(k) = yk$.
- furthermore
  we could consider this is a complex number
  $s(k) = x(k) + j\,y(k)$

$$a(u) = \frac{1}{K} \sum_{k=0}^{K-1} s(k)\, e^{-2\pi u k / K}$$

Reconstruction fourmula:-

$$s(k) = \frac{1}{K} \sum_{k=0}^{K-1} a(u)\, e^{2\pi u k / K}$$

statistical moments *.

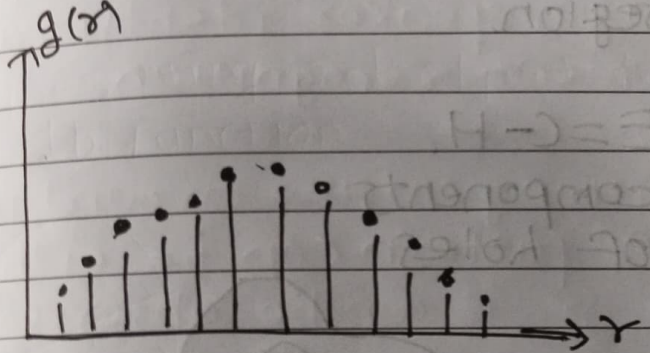
The shape of boundary segments can be described using simple statistical moments, mean, variance, higher-order moments

The n^{th} moment is given by

$$\mu_n(r) = \sum_{i=0}^{K-1} (r_i - m)^n g(r_i) \qquad m = \sum_{i=0}^{K-1} r_i g(r_i)$$

example of moment.

- The first moment = mean
- The second moment = variance
- The Third moment = symmetry w.r.t mean



- Insensitive to rotation

Regional descriptors.

- some simple regional descriptors.

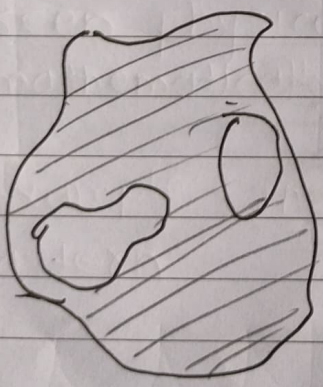
- Area of region. (no. of pixels in region
- Length of boundary (perimeter) of reg
- compactness $(= P^2(R)/A(R)$

- Topological descriptors -

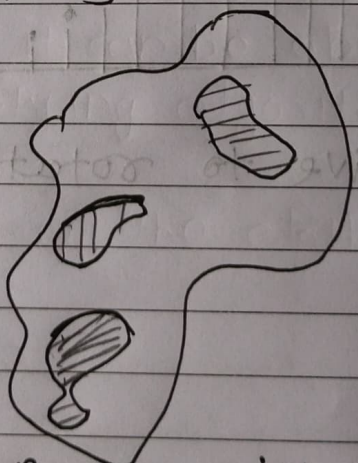
- Topology is study of properties of figu that are unaffected by any deformat

- used to describe holes and connected components of region.

- Euler number $E = C - H$.
  C = connected components
  H = Number of holes



Region with two holes



Region with three connected comp

eulers fourmula.

$V - Q + F = C - H = E$

V = no. of. vertices

Q = no. of. edges.

F = no. of. faces.

C = no. of. connected components.

H = no. of. Holes.