

Computer Vision-IT813

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Image Segmentation

- Region-based segmentation is a technique for determining the region directly.
- Region growing is a simple region-based image segmentation method. It is also classified as a pixel-based image segmentation method since it involves the selection of initial seed points.

- Applications-Finding tumors ,veins etc in medical images , finding targets in satellite/aerial images , finding people in surveillance images , summarizing video etc
- Methods- Thresholding , k-means clustering etc

- Region growing is a procedure that groups pixels or sub regions into larger regions.
- The simplest of these approaches is pixel aggregation, which starts with a set of seed points and from these grows regions by appending to each seed points those neighboring pixels that have similar properties (such as gray level, texture, color, shape).
- Region growing based techniques are better than the edge-based techniques in noisy images where edges are difficult to detect

- Region growing methods can correctly separate the regions that have the same properties we define.
- Region growing methods can provide the original images which have clear edges with good segmentation results.
- The concept is simple. We only need a small number of seed points to represent the property we want, then grow the region.

- Computationally expensive
- It is a local method with no global view of the problem.
- Sensitive to noise.
- Unless the image has had a threshold function applied to it, a continuous path of points related to color may exist which connects any two points in the image.

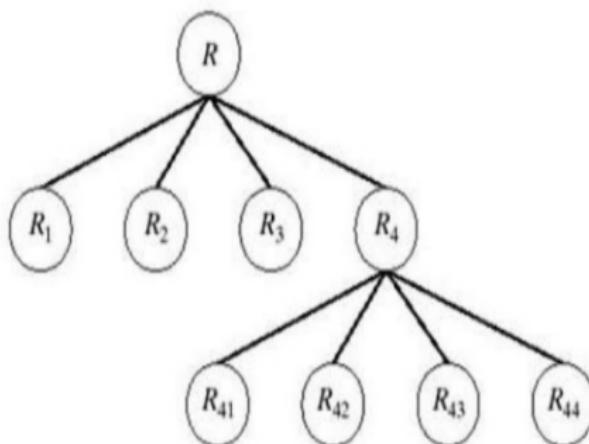
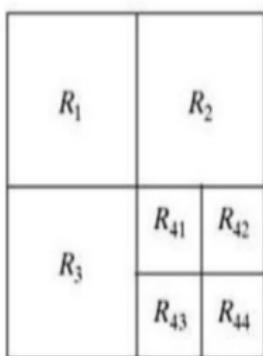
REGION SPLITTING

- Region growing starts from a set of seed points.
- An alternative is to start with the whole image as a single region and subdivide the regions that do not satisfy a condition of homogeneity.

REGION MERGING

- Region merging is the opposite of region splitting.
- Start with small regions (e.g. 2x2 or 4x4 regions) and merge the regions that have similar characteristics (such as gray level, variance).
- Typically, splitting and merging approaches are used iteratively

REGION SPLITTING AND MERGING



Region growing

2	3	F	5	3	3	3
5	N	2	3	7	2	F A
5	6	6	7	7	6	P
6	7	6	7	5	5	4
6	6	F	4	4	3	2
5	4	5	4	2	3	4
0	3	2	3	2	5	6
0	0	0	0	2	2	5
1	1	0	1	0	3	4
1	0	1	0	2	3	5
						4

Region growing

threshold ≤ 3

5	6	6	7	a	7	a	6	a
6	7	6	7	a	a	7	a	a
9	7	6	7	a	a	7	a	a
6	7	6	7	a	a	7	a	a
6	6	4	4	a	3	2	5	6
a	a	a	a	a	2	3	a	a
5	5	5	5	5	5	5	4	6
0	3	2	3	3	2	3	5	a
0	0	0	0	2	2	5	a	a
1	1	0	1	0	3	4	4	a
0	1	0	2	3	5	a	5	4

5	6	6	7	7	7	6	6
6	7	6	7	5	5	4	7
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
0	3	2	3	3	2	7	7
0	0	0	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	4

$$\begin{array}{r} a/a \\ \hline 566 \\ 6a \quad 6 \\ 6a \quad 6 \\ 6a \quad 6 \\ 5a \quad a \\ \hline 0 \end{array} \quad \begin{array}{r} a/a \\ \hline 777 \\ 5a \quad 5a \\ 5a \quad 5a \\ 5a \quad 5a \\ 23a \quad 4 \\ \hline 32 \end{array} \quad \begin{array}{r} a/a \\ \hline 66 \\ 5a \quad 5a \\ 5a \quad 5a \\ 4a \quad 4 \\ \hline 4 \end{array}$$

Handwritten annotations:

- A circled '7' is written above the first column of the first row.
- A circled '4' is written above the second column of the third row.
- A circled '0' is written above the second column of the fifth row.
- A circled '1' is written above the first column of the sixth row.
- A circled '1' is written above the second column of the sixth row.

Below the first two columns of the first row, there is a small square containing '0 0 0 0'. Below the first two columns of the fifth row, there is a small square containing '2 3'. Below the first two columns of the sixth row, there is a small square containing '1 0'.

Region split & merge.

5	6	6	6	7	7	6	6
6	7	6	7	5	5	4	7
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
0	3	2	3	3	2	4	7
0	0	0	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	4

Region split & merge.

$$7 - 4 = 3$$

Interest ≤ 3

5

5	6	6	6	7	7	6	6
6	7	6	7	5	5	4	7
6	6	4	4	3	2	5	6
5	4	5	4	2	3	4	6
0	3	2	3	3	2	4	7
0	0	0	0	2	2	5	6
1	1	0	1	0	3	4	4
1	0	1	0	2	3	5	4

Region split & merge.

$$7 - 4 = 3$$

$$\text{unrest} \leq 3$$

5

5	6	6	6	1	7	7	6	6
6	7	6	7	5	5	5	6	7
6	6	4	4	3	2	5	6	7
5	4	5	4	2	3	7	6	7
0	3	2	(3)	3	2	4	7	7
0	0	0	0	2	2	5	6	7
1	1	0	1	0	3	4	4	
1	0	1	0	2	3	5	4	

morphology

Set theory.

4	0	0	0	0
3	0	1	1	1
2	0	0	1	1
0	0	0	0	0

$$V = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1)\}$$

New concepts

1) Reflection

Reflection of v

$$\hat{V} = \{ \omega | \omega = -v \text{ for } v \in V \}$$

e.g.

$$\hat{V} = \{ (-1, -3), (-1, -1), (-2, -2), (-2, -3), (-3, -3), (-3, -1) \}$$

					0 0 0 0
				0	1 1
				0 0 1	1
				0 1 0	1
-4	-3	-2	-1	0 0 0 0	0
0 0 0 0	0 1 2 3				
0 1 0 1	-1				
0 1 1 0	-2				
0 1 1 1	-3				
0 0 0 0	-4				

$$V = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1)\}$$

Translation. $L_2 = \{z_1, z_2\}$

$$(V)_2 = \{ c | c = v + z, \text{ for } v \in V \}$$

$$\text{eg. } z = \{1, 1\}$$

$$(V)_2 = \{(2,4), (2,2), (3,3), (3,4), (4,4), (4,3), (4,2)\}$$

	0	0	1	1	1
4	0	0	1	1	1
3	0	0	0	1	1
2	0	0	1	0	1
1	0	0	0	0	0
0	0	0	0	0	0
	0	1	2	3	4

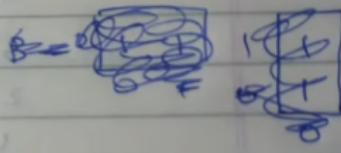
Dilated Dilation

- ① $X \oplus B = \{ p \in \mathbb{Z}^2 \mid p = x + b, x \in X, b \in B \}$
- ② $X \oplus B = \{ p \mid (\hat{B})_p \cap X \neq \emptyset \}$

eg.

Let

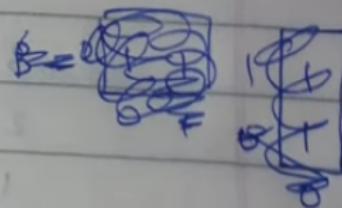
$$X = \begin{matrix} & \begin{matrix} 0 & 0 & 0 & 10 \end{matrix} \\ \begin{matrix} 3 \\ 2 \\ 1 \\ 0 \end{matrix} & \left| \begin{matrix} 0 & 1 & 11 & 1 \\ 0 & 0 & 11 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{matrix} \right| \end{matrix}$$



$$B = \begin{matrix} & \begin{matrix} 1 & 1 \\ 0 & 1 \end{matrix} \\ \left| \begin{matrix} 0 & \\ & \end{matrix} \right. & \end{matrix}$$

let

$x = 4$	0	0	0	0
3	0	1	1	1
2	0	0	1	1
1	0	1	0	1
0	0	0	0	0
	0	1	2	3



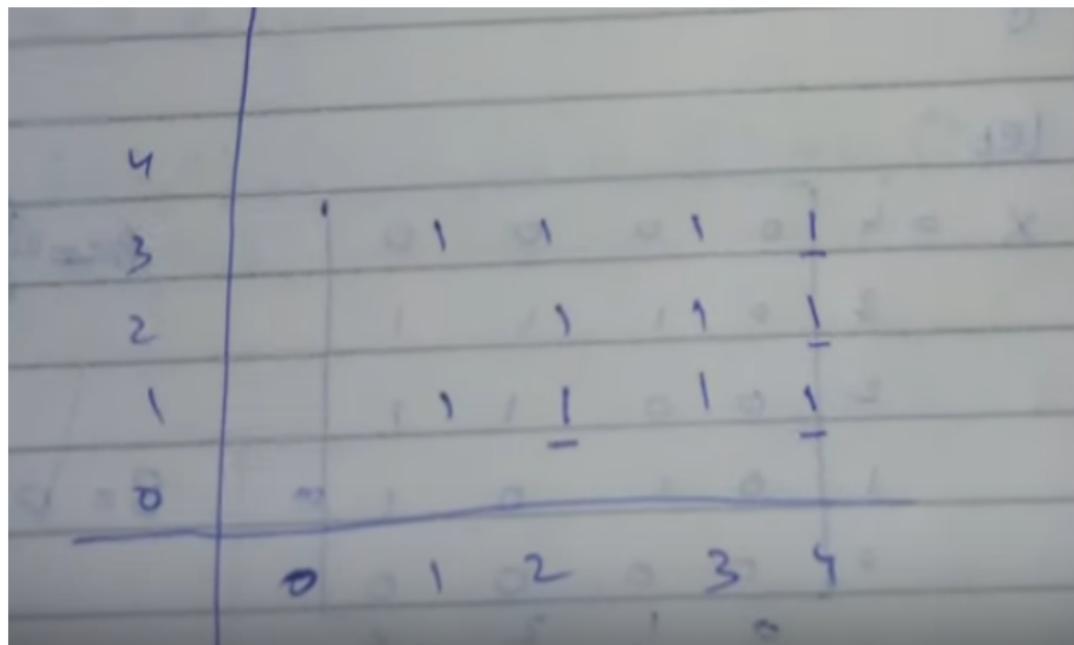
$$B = \{ \begin{pmatrix} 0 & 1 \\ 1 & 1 \end{pmatrix}, \begin{pmatrix} 0 & 1 \\ 0 & 1 \end{pmatrix} \}$$

$$X = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1)\}$$

$$B = \{(0,0), (1,0)\}$$

$$X = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2)\} \\ B = \{(0,0), (1,0)\}$$

$$X \oplus B = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1), (2,3), (2,1), (3,2), (3,3), (4,3), (4,2), (4,1)\}$$



Erosion.

$$x \ominus B = \{ p \mid (B)p \subseteq x \}$$

$$x \ominus B = \{ p \in \mathbb{Z}^2 \mid p + b \in x \text{ for every } b \in B \}$$

$$x = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

$$B = \begin{bmatrix} 0 & 1 \\ 1 & 1 \\ 0 & 1 \end{bmatrix}$$

$$X = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1)\}$$

~~X ⊕ B ⊂ X~~

$$\text{B} = \{(0,0), (1,0)\}$$

$$X \ominus B = \{(1,3), (2,3), (2,2)\}$$

