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Answer3)

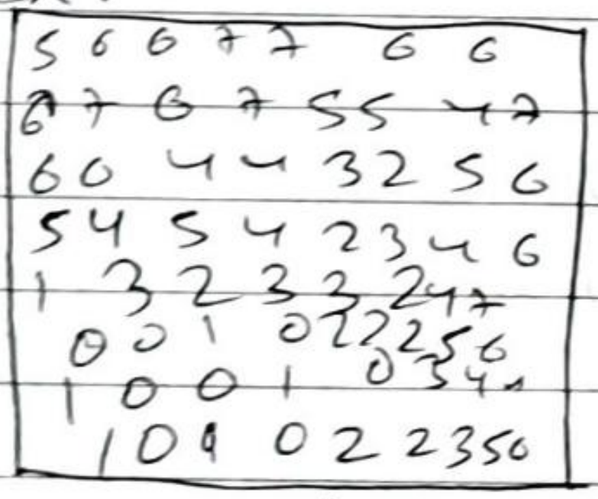
There are four Region-Based segmentation

(i) Region growing
(ii) Region Splitting
(iii) Region merging
(iv) Region split and merge

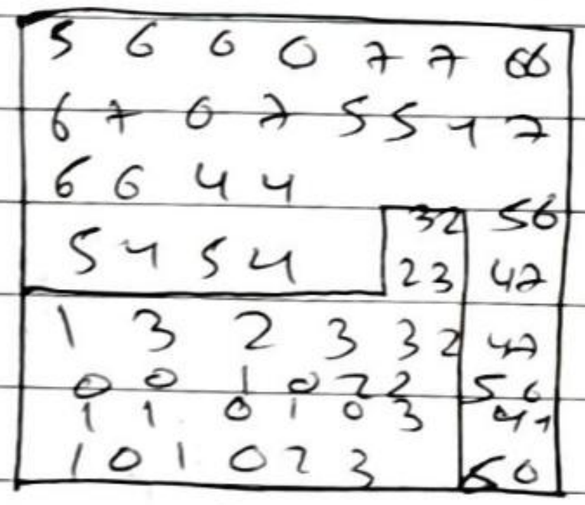
⇒ Region Growing

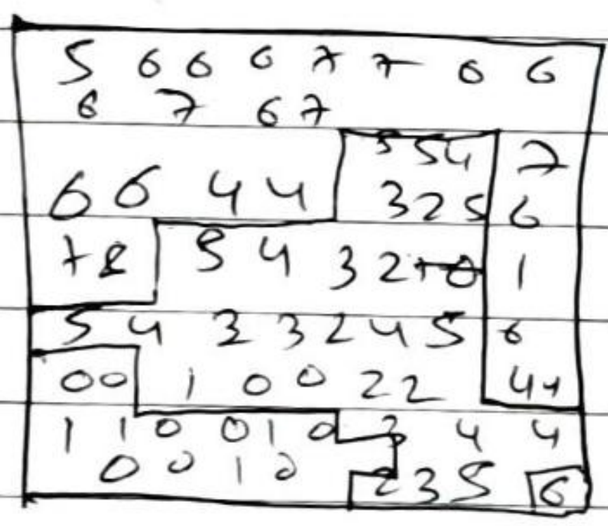
- It starts with a set of "seed" points
- growing by appending to each seed those neighbors that have similar properties such as specific ranges of gray level, texture, color and shape.
- Better than edges based techniques in noisy images where edges are difficult to dect.

Ex!-



original image





Segmented image

Seed points are encircled in respective images and threshold is slected as th=3.

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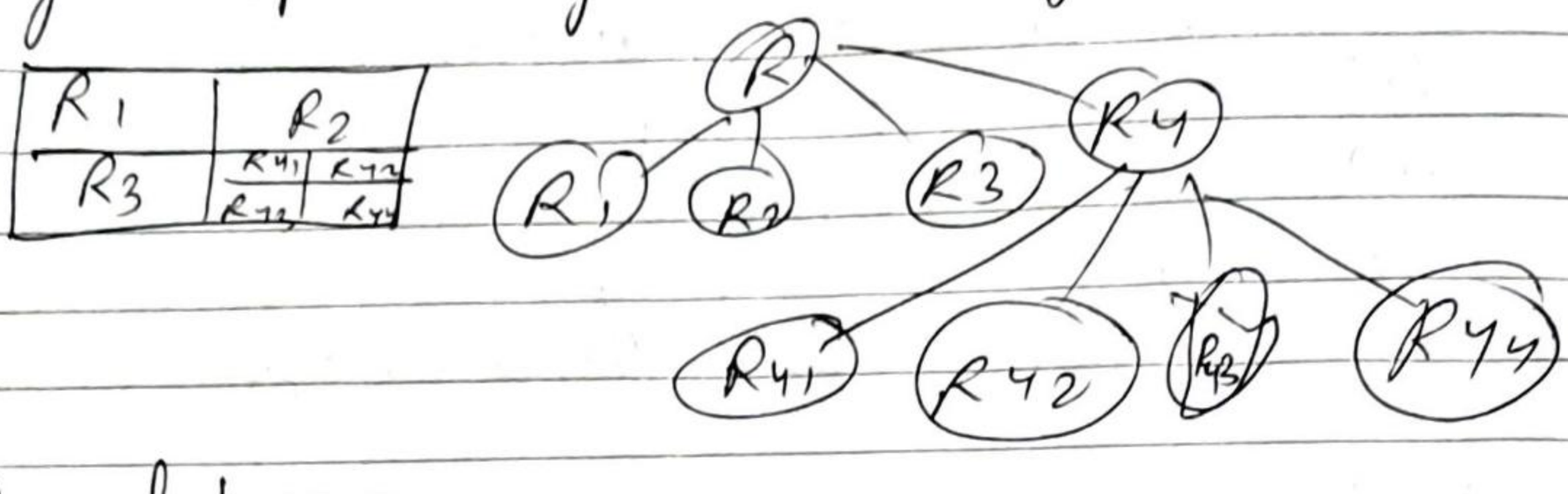
Region Splitting and merging



Quadtree

① Split into 4 disjoint quadrants any region Ri for which P(Ri) = false

② Merge any adjacent regions Ri and Rk for when P(Ri ∪ Rn) = True

③ Stop when no future merging or splitting is possible.

→ Region growing starts from set of seed points.

→ An alternative is to start with the whole image as a signal region and subdivide the regions that do not satisfy a condition of homogeneity.

→ Region merging is the opposite of region splitting Start with small region (e.g. 2x1 or 4x4 regions) and merge the regions that have similar characters.

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-> Typically splitting and merging approach are used iteratively.

Ex 1-

Region Splitting

original image

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

ing after splitting

Regions merging

original image

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

- Start from the pixel level and Consider each of them as homogeneous region.
- At any level of merging check if four adjacent homogenous regions arranged in 2×2 fashion satisfys the homogeneity property.
- Region merging with threshold th = 3.

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(B) Dilation operation in the context of image morphology:

Let A and B are sets in Z^2 then dilation of A and B is denoted as:

$$A \oplus B = \{ z \mid (\hat{B})_z \cap A \neq \phi \} \quad \text{—(1)}$$

It is the set of all displacements B(cap) an amount z such that B(cap) and A overlap at least one element.

Then the eqn(1) is reduced to

$$A \oplus B = \{ z \mid [(\hat{B})_z \cap A] \subseteq A \} \quad \text{—(2)}$$

Set is referred as the structuring element of dilation, as well as in other morphological operations.

$$A \oplus B = \{ w \in Z^2 \mid w = a + b, \text{ for some } a \in A \text{ and } b \in B \} \quad \text{—(3)}$$

$$A \oplus B = \bigcup_{b \in B} (A)_b \quad \text{—(4)}$$

This expression in (4) is also known as Minkowsky addition of two sets.

Eq (1) and (2) are more is more Convenient if the structing element B is a convolution Mask.

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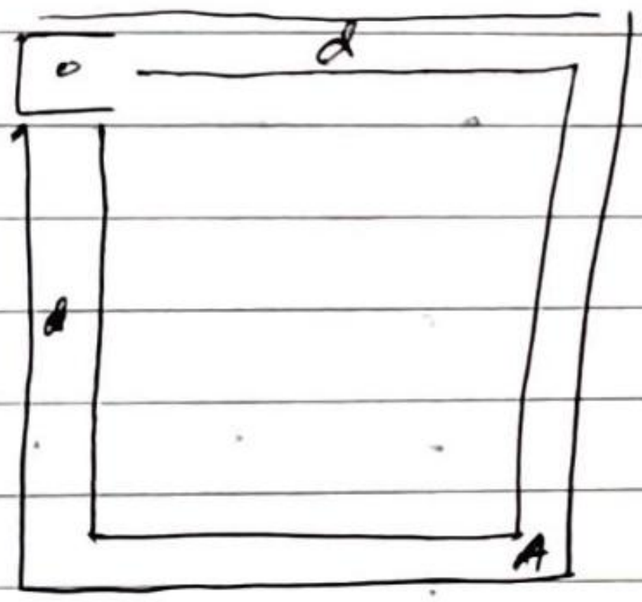
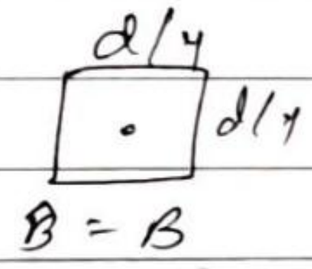
If the B is a convolution mask then the Dilation process is.

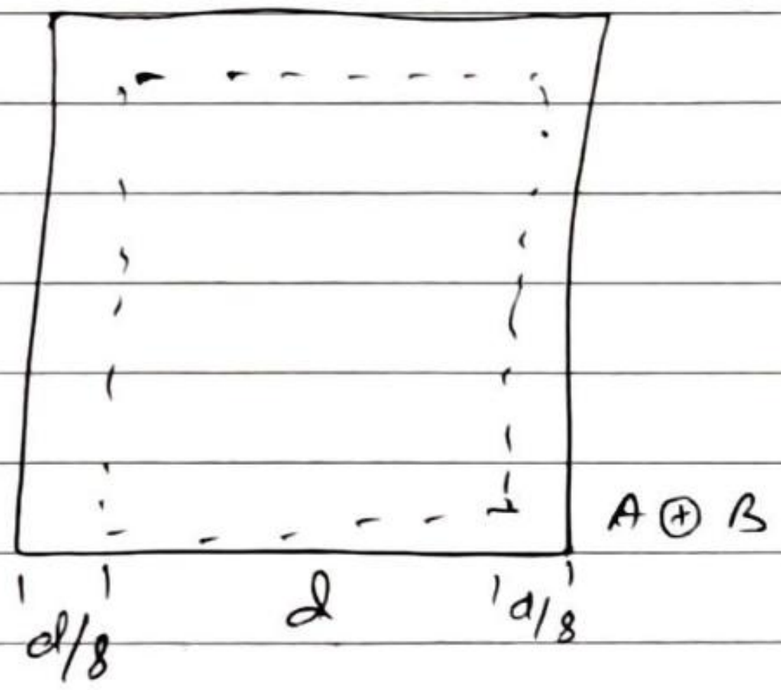
- flip the B about the origin and then successively displacing it so that it slides over the set (image) A. This process is the convolution process.
- Although Dilation is a set operation and Convolution is an arithmetic operation for a convolution mask the dilation is a convolution process.

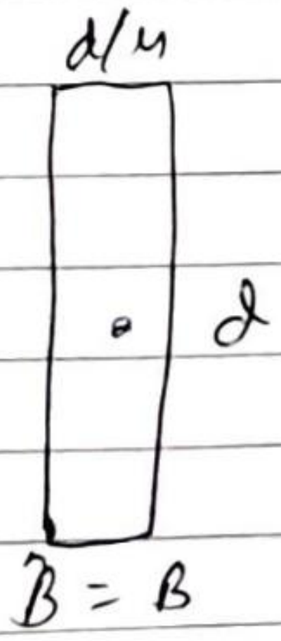
- Dilation is a non-linear operation where as convolution is a linear operation

Example :-









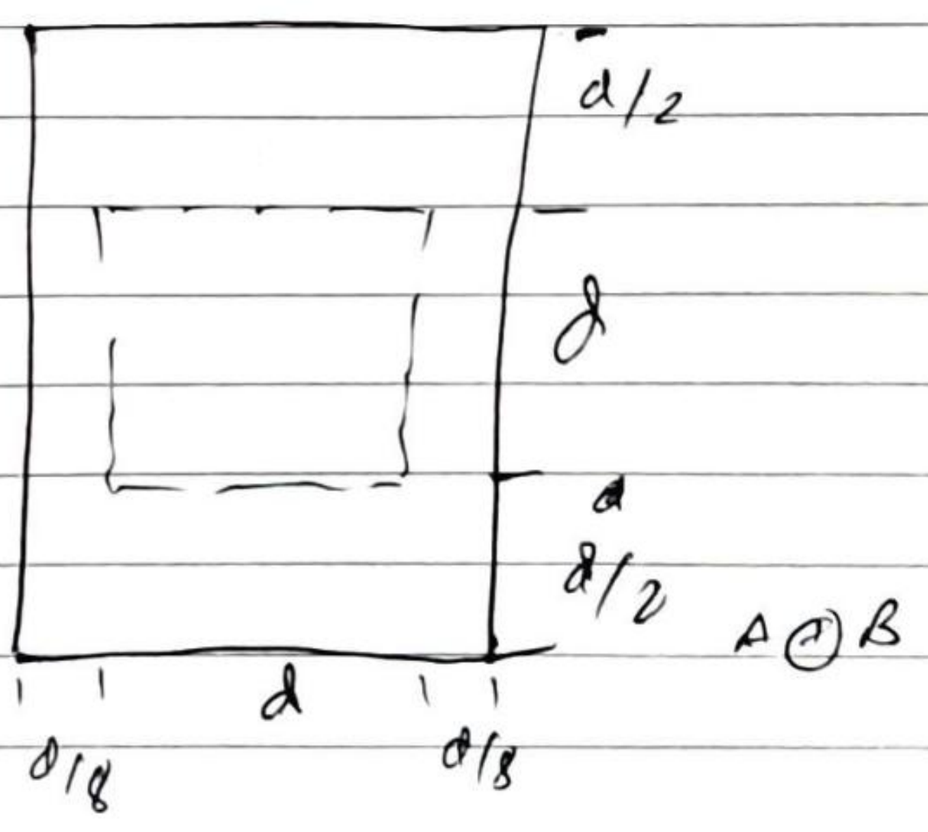


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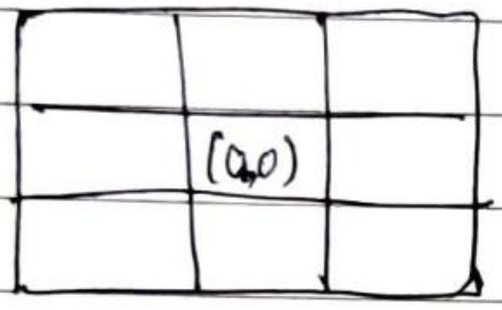
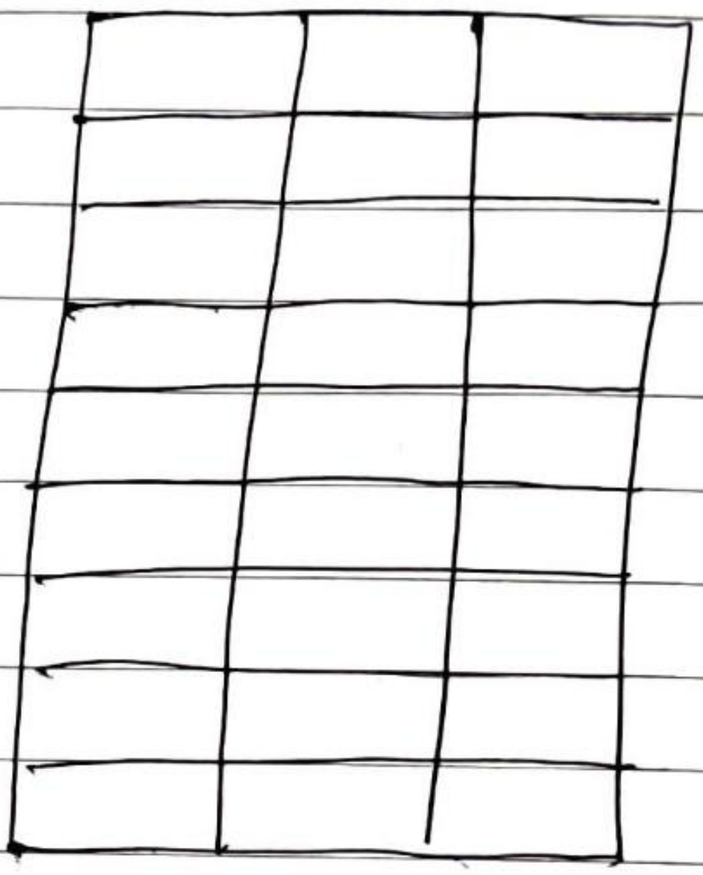
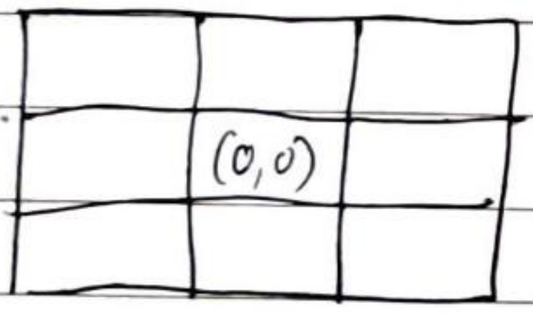
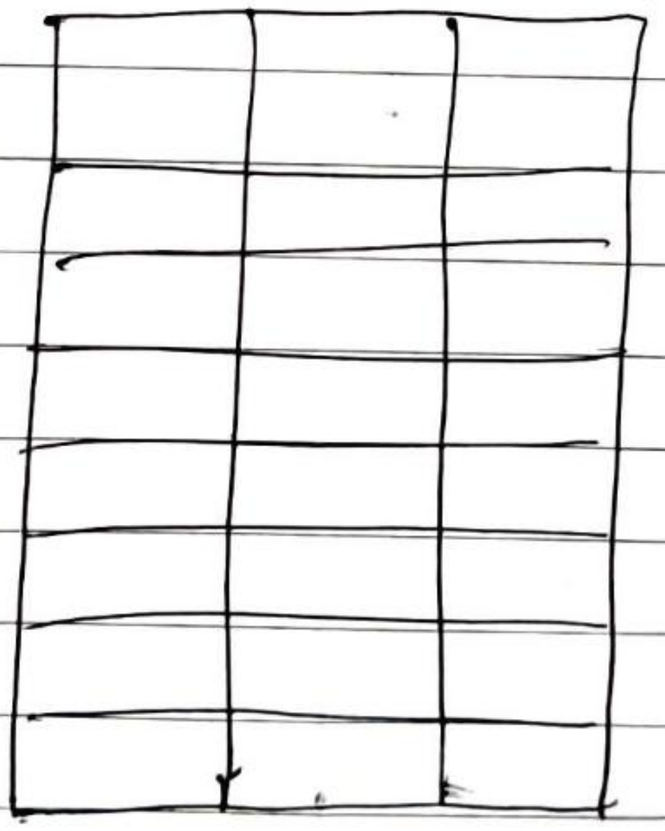
fig :-
(a) Set A
(b) Square structing element (dot is the center)
(c) Dilation of A by B, shown shaded
(d) Elongated structuring element.
(e) Dilation of A using this element.









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Application

- Bridging gaps
- Advantage over a lowpass filter.
- Morphological operation directly results in a binary image whose as lowpass filter produced a grayscale image from a binary image and needs a threshold to convert it back into binary image.
- Dilation thickens an object in a binary image.

~~Bridging gaps~~

* Morphological dilation maks objects more visible and fills in small holes in objects.