REGION-BASED SEGMENTATION

- Includes 3 methods:

  Region Growing

  Region Merging

  Region Split and Merge

REGION GROWING

- It is a procedure that groups pixels or sub regions into larger regions based on predefined criteria for growth.
- Basic approach is to start with a set of seed point and

from this grow regions by appending to each seed those neighboring pixels that have predefined properties similar to the seed.

- Suppose v is the current point in the region and u is the pixel point in its neighbourhood to be compared; than criteria for the given image function f is defined as follows:-

$$S = \begin{cases} 1, & \text{if } |f(u) - f(v)| < T \\ 0, & \text{if } |f(u) - f(v)| \geq T \end{cases}$$

where T-> pre assigned threshold

- When S = 1, u and v are similar and are put in the same region; otherwise, u and v belong to different regions.

- <u>Advantages</u>

  Very simple concept

  Can separate the regions that have the same properties we define.

- <u>Disadvantages</u>

  Descriptors can yield misleading results if connectivity properties are not used in region growing process.

  Region growing is the formulation of a stopping rule. Region growth should stop when no more pixels satisfy the criteria for inclusion in that region.

Seed point must be specified correctly as different seed point will give different results.

Algorithm 4.6: The region-growing method

For the given image $f(i,j): 0 \le i \le m-1, 0 \le j \le n-1$

Preassign a seed pixel v_0 and a threshold τ;

Initialize the current region $R := \{v_0\}$; The set of candidate seeds $C := \{v_0\}$;

While ($C \neq \varnothing$) do

{

select a seed pixel v from C;

$C := C \setminus \{v\}$; // delete the seed pixel v from the candidate seed set;

$N(v)$:= the set containing 4-neighbouring pixels of v;

For each $u \in N(v)$: if ($u \notin R$) and ($s = 1$) // From Equation 4.13

{

$R := R \cup \{u\}$;

$C := C \cup \{u\}$ // u is added to the region and is a candidate seed

}

}

End-Algorithm

REGION MERGING

- It partitions the image into small regions followed by combination of similar adjacent regions into bigger region according to a given principle.

- This process is repeated until no more neighboring regions satisfy the homogeneity principle.

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                (i, j) belongs to the region which u belongs to;
            case (f(u) = f(i, j)) and (u is unmarked):
                (i, j) and u belong to the same region R_k;
                k: = k + 1; mark u;
            case (f(u) ≠ f(i, j)):
                (i, j) belongs to the region R_k; k: = k + 1;
        end-for;
}}
n_merge = 0; // tag of merges;
Repeat
{ For all region R_s, compute r_s = the mean grey level of R_s;
      For each region R_s, compare R_s with its neighbour region R_t:
                if |r_s − r_t| < T then
                      combine R_s, R_t to form a new region;
                      n_merge = n_merge + 1;
                endif
} until (n_merge: = 0)
End-Algorithm
```

Algorithm 4.7: Region merging

REGION SPLIT AND MERGE

- Let R represent the entire image region and select a predicate Q.
- To segment R, we subdivide it successively into smaller and smaller quadrant regions so that for any

region R_i, $Q(R_i)$=TRUE.

- We start with the entire region. If Q(R) =FALSE, we divide the image into quadrants.
- If Q is false for any quadrant, we subdivide that quadrant into sub quadrants and so on.
- This can be represented by a quad trees, that is, trees in which each node has exactly four descents as shown in figure below.

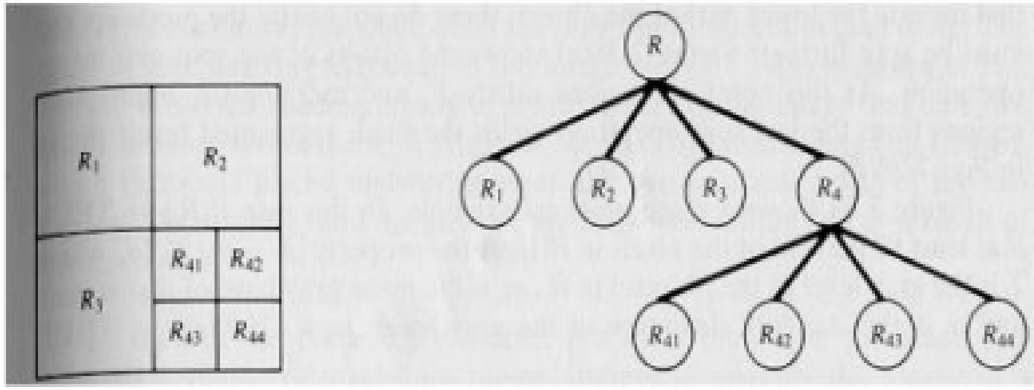
- Root of the tree corresponds to the entire image and each node corresponds to the subdivision of a node into four descendent nodes.
- In the figure R4 is subdivided further.

- <u>Procedure</u>

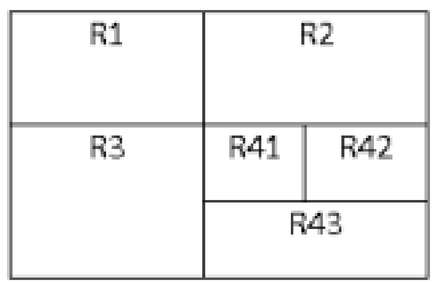
1) Split into four disjoint quadrants any region R_i for which $Q(R_i)$=FALSE.

2) When no further splitting is possible merge any adjacent regions R_j and R_k for which $Q(R_j \cup R_k)$=TRUE.

3) Stop when no further merging is possible.



Partitioned Image and quadtree R represents the entire image region.



Merged Regions