The method is more suitable for a gray image. The result is usually over-segmented.

It is based on the concept that:
(1) The center of a region should have small gradient.
(2) The boundary of regions should have large gradient.

(Step 1) Determine the gradient of an image.
Perform edge detection along x-axis and y-axis and obtain gx, gy, respectively.
Then calculate
g[m, n] = (gx[m, n]^2 + gy[m, n]^2)^0.5

(Step 2) Quantize g[m, n] into several level
L[m, n] = round(g[m, n]/Q)
Q can be adjusted to obtain a better result.
(ex: Q=3)

(Step 3) For the case of L ==0, perform binary segmentation
Suppose that the output of the 2nd step is

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

We first segment it into 3 regions

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

region 1: orange; region 2: blue; region 3: red

Binary segmentation can be done by
for Matlab: R = bwlabel(L==0)
for Python: from skimage import measure
R = measure.label(L==0)

(Step 4) Increase the level by 1 (level=level + 1 or level +=1)

(Step 5) Assign the region number for the pixel that satisfies L[m, n] = level
(Step 5-1) If L[m, n] = level and it is adjacent to some existing region, then we classify it into the region.

$$L=\begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

(Step 5-2) If some pixel with L[m, n] = level is adjacent to two or more regions, we can assign the priority (For example, the order of priority can be assigned according to the difference of level. If the differences of level are the same, we can assign the prior according to the direction. In this example, the prior according to the direction is up, down, left, right).

$$L=\begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

(Step 5-3) If some pixel with L[m, n] = level has not been assigned by Steps (5-1) and (5-2), repeat Steps (5-1) and (5-2) again and again until no more pixel with L[m, n] = level can be assigned to some region.

$$L=\begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

(Step 6) After performing step (Step 5), if some pixel with L[m, n] = level can not be assigned to any region, we can treat them as new regions.

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

region 4: pink

(Step 7) Repeat Steps 4, 5, and 6 again and again. Then all the pixels in the image can be assigned to some region.

Level = 2

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

Level = 3

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

Level = 4

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$

Level = 5

$$L = \begin{bmatrix} 2 & 1 & 3 & 3 & 2 & 1 & 1 \\ 0 & 0 & 0 & 1 & 0 & 0 & 1 \\ 2 & 1 & 3 & 2 & 0 & 0 & 1 \\ 3 & 4 & 4 & 5 & 2 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 3 & 3 \\ 0 & 1 & 2 & 4 & 2 & 2 & 3 \\ 0 & 1 & 3 & 3 & 2 & 1 & 1 \end{bmatrix}$$