Probability and Random Process
Assignment - 4
Report

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Explanation of Algorithm:

a) Take the number of pointers or markers according to in how many segments we want to divide the image.

b) Mark some pixels on the image with these different pointers

c) We construct a graph of the image by assigning the weights to the edges as given in the paper.

$$wij \ = \ exp - \beta(gi \ - \ gj)^2$$

here β is free parameter, wij is the weight to assignedto the linked between the edges gi and gj

gi is the intensity of the pixel i and gi is the intensity value of pixel j

d) The laplacian matrix of the image is formed using the given formula with the weighted graph we constructed using the above formula.

$$L_{ij} = \begin{cases} d_i & \text{if } i = j, \\ -w_{ij} & \text{if } v_i \text{ and } v_j \text{ are adjacent nodes,} \\ 0 & \text{otherwise,} \end{cases}$$

e) We find the Lu matrix and the B^T matrix by rearranging the laplacian matrix according to the seeds selection.

f) Lu matrix formed between the unmarked nodes

g) B^T is formed between the unmarked node and the marked nodes.

h) We construct a matrix M which has K columns (No of Segments), each column has the probabilities of the selected seeds for each label.

i) For each unselected pixel we can the probabilities of each label is given the following formula.

$$L_U X = -B^T M,$$

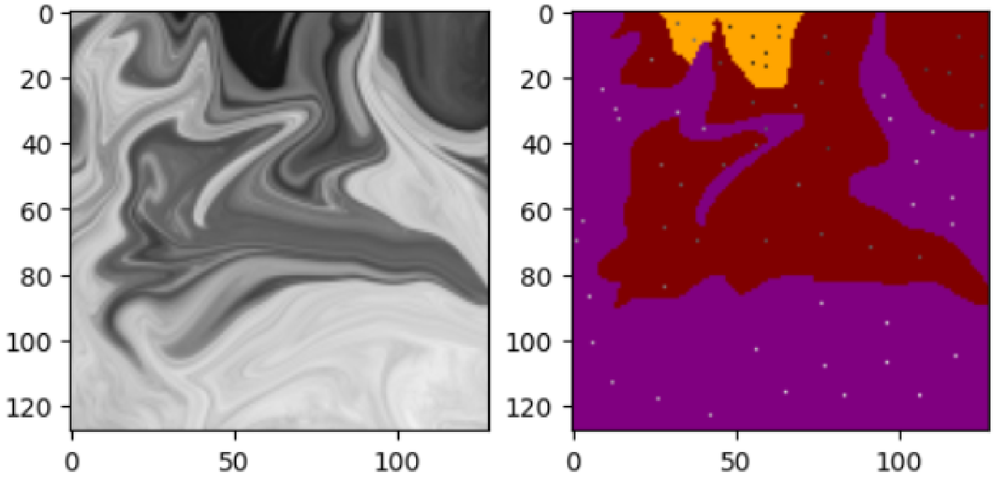
X = Contains the probability of each unseeded pixel

j) We classify or segments the pixels according to their probabilities.

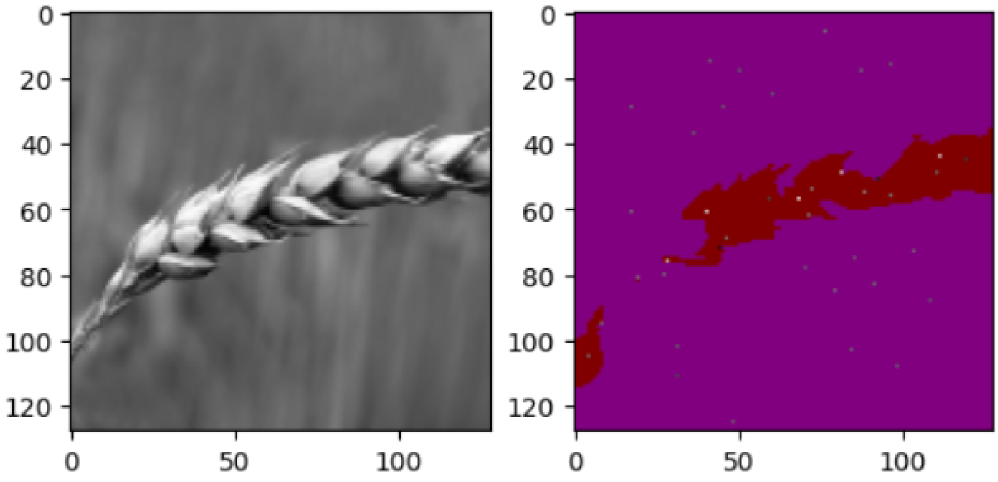
References used:

1) Taken help from friends to understand the algorithm.
2) Used for the implementation of callback function:
    a) https://www.opencv-srf.com/2011/11/mouse-events.html#:~:text=OpenCV%20Example%20Code&text=All%20you%20have%20do%20is,coordinate%20of%20a%20mouse%20click).
    b) https://stackoverflow.com/questions/59924396/how-to-detect-when-a-key-is-released-in-opencv
3) For the construction of the graph
    a) https://networkx.org/documentation/stable/reference/classes/generated/networkx.Graph.add_edge.html
    b) https://scikit-image.org/docs/stable/auto_examples/segmentation/plot_random_walker_segmentation.html
    c) https://www.rapidtables.com/web/color/RGB_Color.html

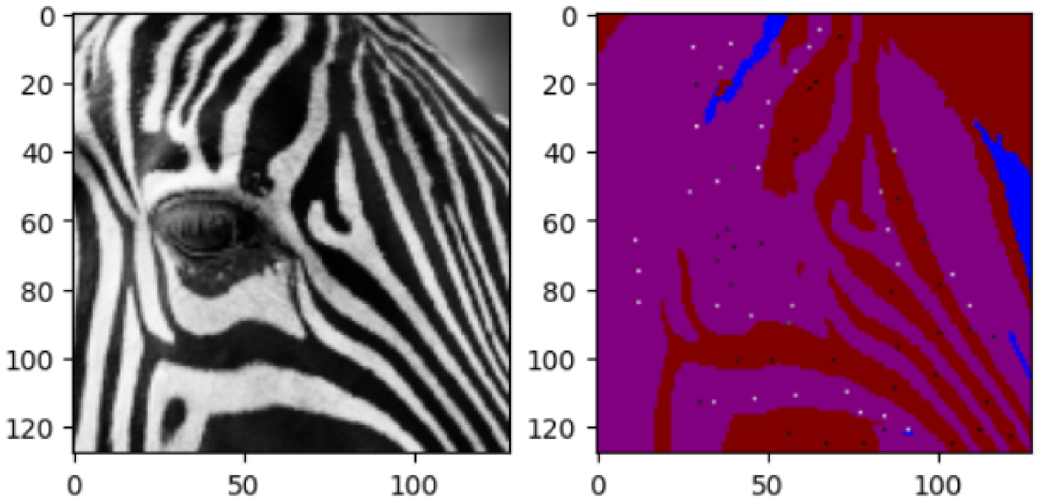
Examples of Some Segmented Images:



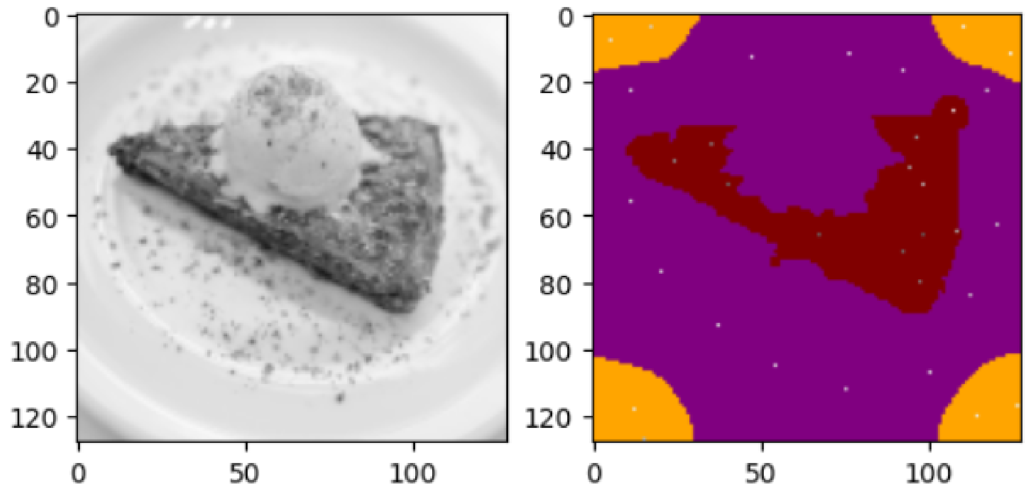
a)



b)



c)



d)

Note: I have only marked 3 pointers or markers for the above image. Therefore only 3 segments.

Comparsion with inbuilt function:

a) After running the image segmentation for the same image, the results were approximately equal. As same algorithm was used.

Conclusions:

a) Image segmentation is observed when marked minimum a 20 number of points.
b) Segmentation is directly proportional to the number of markers or pointers pointed on the image.