Part1: Use histogram-based approach to assign the class label for the given images

Steps:

1.Use HBCE approach to get centroids for the images by using following algo:

Reference paper: https://www.sciencedirect.com/science/article/pii/S1568494619307124

Graphical user interface, application, Word

Description automatically generated

2. Apply k-means clustering or Otsu to get the segmentation of the image

Input Image1:

A picture containing text, invertebrate

Description automatically generated

Input image1 Histogram:

Chart

Description automatically generated

Instead of getting beta\_intesity, beta\_frequency from GA algorithm, I am taking it manually

beta\_intesity = 40

beta\_frequency = 34

output centroid: [170, 174, 177, 182, 250]

Output Image1:

Using Manual thresholding

A picture containing text, tree, outdoor, image

Description automatically generated

Histogram of manual thresholding output:

Shape

Description automatically generated

Using k-means o/p:

Centroid values: [110.35921715718986, 152.28576151755917, 180.58552349213562, 207.35910263022177, 241.40362564551108]

A picture containing text, invertebrate

Description automatically generated

Histogram of kmean:

Chart

Description automatically generated

**Observations**: 1. kmeans is giving centroid which is clustered among different intensities, using hbce is making the convergence of kmeans faster.

2. Since I have not taken beta\_intensity and beta\_frequency from GA algorithm, seems like the centroid is nearer to each other

Part 2: Apply graph cut method to optimize the delineation of the gland from the background using minimization algorithms: alpha-expansion and alpha-beta swap

Have implemented alpha-beta swap and tried to implement alpha expansion.

Using alpha-beta swap o/p:

Cycle No:1 value of energy 177

A close-up of a suit

Description automatically generated with low confidence

Have got the segmentation using built-in alpha-beta and alpha expansion:

Alpha-Beta swap O/P:

A picture containing text

Description automatically generated

Alpha Expansion O/P:

A picture containing text

Description automatically generated

**Observations**: 1. While giving the unique pixels intensity got from the part1 code in Graph-cut method, alpha-beta swap is converging fast.

2. alpha-beta swap and alpha expansion is giving better segmentation result than kmeans clustering

3. In my image both alpha expansion and alpha-beta swap is giving same result

Part 3: Compare the segmentation results with the ground truth using metrics like accuracy, Dice similarity coefficient, Jaccard index (JAC), sensitivity, specificity

Ground Truth image1:

A picture containing silhouette

Description automatically generated

Accuracy: 1.0

Dice Similarity: 1.3509183042887158

Jaccard index(JAC): 2.08

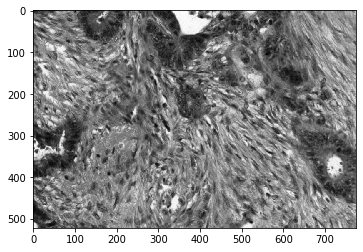
Sensitivity: 0.6754591521443579

Specificity: 1.0

**Results for Image2:**

Part1:

Image2 input:



Histogram of image2:

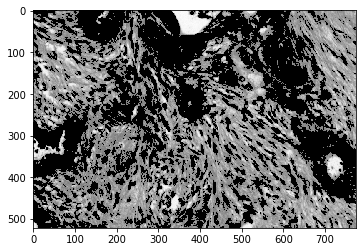
Chart, line chart

Description automatically generated

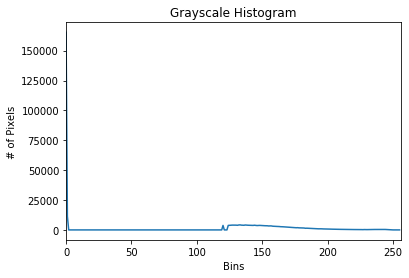
beta\_intesity = 10

beta\_frequency = -34

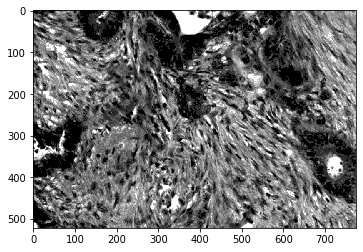
Manual threshold output:



Histogram of output:



Kmeans output:



Histogram of output:

Chart, histogram

Description automatically generated

Part2:

Alpha-beta swap:



Alpha expansion:



Ground Truth:



Accuracy: 0.15977505870720554

Sensitivity: 0.15977505870720554

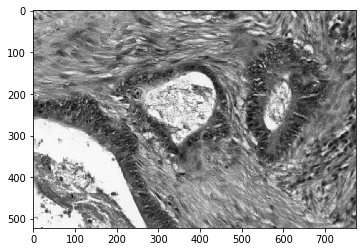
Specificity: 1.0

Dice: 0.3195501174144111

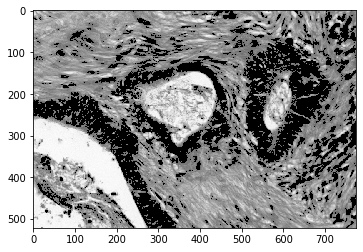
Jaccard: 0.1901574814732005

**Results for Image3:**

**Input image:**

****

Output Otsu:



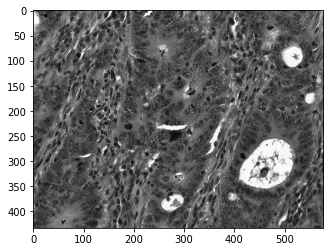
Output Graph cut:

****

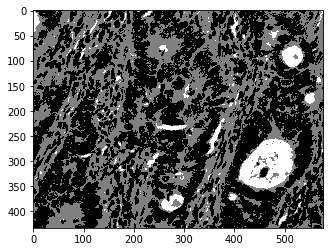
\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

**Image4 outputs:**

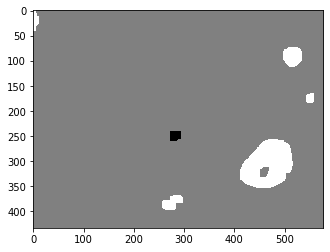
**Input image:**

****

**Kmeans output:**

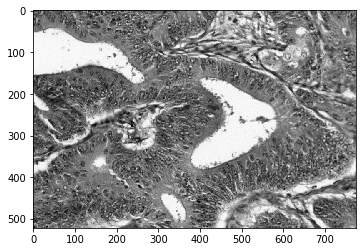
****

**Graph cut output:**

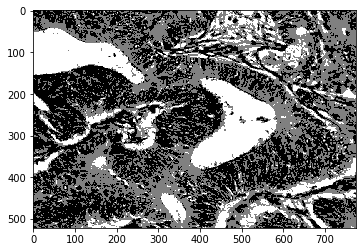
****

**Image 5 outputs:**

**Input:**

****

**Kmeans:**

****

**Graph cut output:**

****