Instance Segmentation with Deep Spectral Clustering

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Abstract

- Efforts have been made for converting semantic segmentation to instance segmentation using Spectral Clustering techniques[1].
- We intend to use Deep Spectral Clustering Network to solve an instance segmentation problem, but fails to convey adequate results mainly due to the complexity of the chosen dataset.

Motivation

- To investigate whether Spectral Clustering with Deep Learning could work on high difficulty instance segmentation task.

Problem Formulation

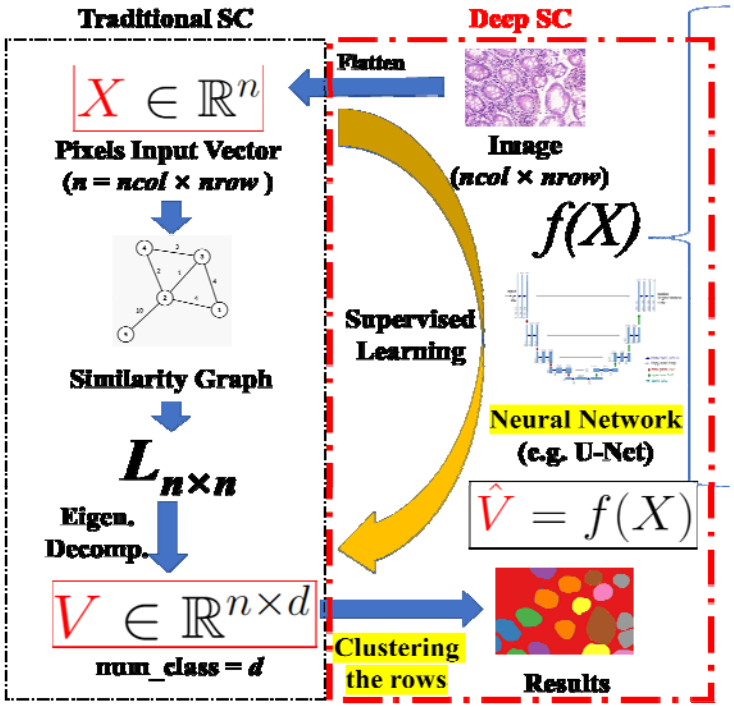
- Dataset : Train + Test = 78 + 52 labeled histology images containing glandular objects from digitized whole-slide images
- Number of Class: 2(Glandular Objects or Background)
- Task: Instance Segmentation

Reference

[1] Barnes M, Dubrawski A. "Deep Spectral Clustering for Object Instance Segmentation", Workshop track - ICLR, 2018.

[2] Ulrike von Luxburg. "A tutorial on spectral clustering". Statistics and Computing, 17(4):395–416, 2007

Methodology



Spectral Loss

$loss = ||f(X)f(X)^\top - A||$

$f^*(X) = \underset{f}{\operatorname{argmin}}\ loss = V$

Ground Truth

$L_{n\times n} = A \cdot D$

$v_i^\top v_j$

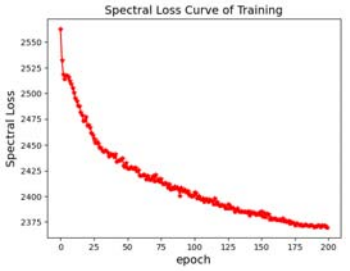
measures similarity between pixel *i* and *j* (*v* is rows of *V*)

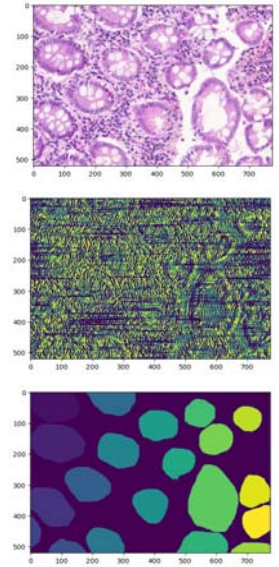
$L = V_o \Lambda V_o^\top$

$V = V_o \Lambda^{1/4}$

orthogonal eigenvectors normalized according to their eigenvalues

Experiment and Results





- Loss 'converges' to a very high level.
- Segmentation results are not good.

Conclusion

1. High training loss is due to the failure of convergence of neural network.
2. Deep Spectral Clustering in our work fails on 'Deep' because it fails to effectively learn from ground truth *A*. However, Our model reflects functionality of traditional spectral clustering, which successfully clusters different colors.
3. Using a Pixel Input Vector makes spectral clustering hard to recognize complicated patterns of an image.