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Final Project Proposal

Topic: Applications of Graph cutting algorithms concerning Image and Graph Segmentation

Type: Survey

I will investigate numerical algorithms, such as those concerning eigenvalue and eigenvector computations, to perform graph or image segmentation (via cut vectors) to discover the relationships between different parts of the graphs.

Ideally, if a graph resembled a heart, an algorithm could distinguish between the aorta, superior vena cava, left atrium, and others. One application of this would be with heart tumors. If there is a tumor in a heart, then this graph cut algorithm may aid medical staff find them more quickly. I do not expect to perform recognition on these different parts, but I would like to look at algorithms (and test out efficiency if there are multiple that do it well) to segment these graphs.

Some groups on SuiteSparse Matrix Collection have uploaded matrices and graphs that would be useful for this project.

For instance:

- Boeing has uploaded numerous (stiffness) graphs
- HB has uploaded similar matrices
- Oberwolfach has uploaded a heat transfer and cooling matrix
- Heat Distribution-related problems with steel objects
- Bydder has uploaded 2 MRI graph matrices

There are also several road networks of various regions in the world uploaded as matrices on SuiteSparse Matrix Collection, and I would like to test out if algorithms can segment out any specific parts (e.g., Midwest in the United States, the Central Valley in California).

I listed below some similar research papers I would like to discuss. These papers focus specifically on image segmentation with graph cutting algorithms.

- <http://people.cs.uchicago.edu/~pff/papers/seg-ijcv.pdf><https://people.eecs.berkeley.edu/~malik/papers/SM-ncut.pdf>
- Someone's lecture slides: <https://cs.gmu.edu/~kosecka/cs482/lect-segmentation-part2.pdf>
- <https://www2.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/papers/mfm-nips02.pdf>
- <https://www2.eecs.berkeley.edu/Research/Projects/CS/vision/grouping/papers/mfm-pami-boundary.pdf>
- https://www.researchgate.net/profile/Gareth-Funk-Lea/publication/244898935_Graph_Cuts_and_Efficient_ND_Image_Segmentation/links/004635366c074a1e34000000/Graph-Cuts-and-Efficient-ND-Image-Segmentation.pdf

These lists may not be complete – over the course of the investigation, I may choose to disregard some linked materials and include others that may provide invaluable information.