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# CSCI 575 Final Project Proposal

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## Project Title: Unsupervised image segmentation of satellite imagery from Landsat 8

### Project Idea

For this project, we will investigate and compare various unsupervised learning methods for image segmentation by implementing each method on a series of scenes collected from Landsat 8 satellites. Additionally, we will compare our methods to those currently used in geophysics circles that are run using the MATLAB classification toolbox. This application is significant in fields such as geophysics, hydrology and ecology where satellite imagery is becoming a prominent data source.

### Dataset

For this project we will consider 10-30 scenes from two separate glaciers from the Landsat 8 satellite imagery dataset spanning over a decade long time frame. Each scene contains information for 10 different spectral bands.

### Software/ Programming Language

For this project we will work in Python using primarily the ScikitLearn, PyTorch and OpenCV packages.

### Papers to Read

- [1] D. Panjwani and G. Healey, "Markov random field models for unsupervised segmentation of textured color images," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 17, no. 10, pp. 939–954, Oct. 1995.
- [2] X. Xia and B. Kulis, "W-Net: A Deep Model for Fully Unsupervised Image Segmentation," *arXiv:1711.08506 [cs]*, Nov. 2017.
- [3] P. Arbeláez, M. Maire, C. Fowlkes, and J. Malik, "Contour Detection and Hierarchical Image Segmentation," *IEEE Transactions on Pattern Analysis and Machine Intelligence*, vol. 33, no. 5, pp. 898–916, May 2011.
- [4] O. C. Jensen <sup>†</sup> and G. A. S. Azofeifa, "Satellite-derived ecosystems classification: Image segmentation by ecological region for improved classification accuracy, a boreal case study," *International Journal of Remote Sensing*, vol. 27, no. 2, pp. 233–251, Jan. 2006.
- [5] M. P. Kirkbride and A. J. Dugmore, "Responses of mountain ice caps in central Iceland to Holocene climate change," *Quaternary Science Reviews*, vol. 25, no. 13, pp. 1692–1707, Jul. 2006.

### Teammates and Work Division

- Erik: Investigate Markov Random field techniques and evaluate feasibility for this project. Create github code repository for the project.
- Terran: Set up python to work with images and investigate packages for unsupervised k-means and deep learning techniques.
- Jeremiah: Data collection and preprocessing. Investigating current techniques used for Glacier analyses.
- Tianfei: Investigate various deep learning segmentation techniques and evaluate their feasibility for this project.

### Milestone Plan

For the milestone, we will finalize the learning techniques we will implement and compare. Several papers listed above have promising open-source components and several methods (such as k-means clustering with open CV) can be tested in python.

Specifically, our plans for the milestone includes:

- Have clean, properly formatted image data loaded and ready to work with in python, using OpenCV.
- Finalize selection unsupervised techniques.
- Make structured plan for implementation of each segmentation based on our investigations.