

COSC 444/544 Progress Journal

Semantic Segmentation Project

Group Members

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Meeting – January 28

All group members (Rory, Aidan, Christian, and Beth) attended. We conducted an in-depth review of navigation and obstacle detection. Additionally, we began researching feature extraction methods and reviewing relevant literature.

Meeting – February 4

All group members were present. We focused on drafting the introduction, which includes a general overview of computer vision and basic segmentation techniques. In the 'Related Works' section, we plan to add techniques such as supervised and non-deep learning methods. We reviewed literature on Markov Random Fields and Pyramid Pooling as unsupervised segmentation and feature extraction strategies.

Meeting – February 18

All group members were present. The team reviewed SLIC (Simple Linear Iterative Clustering) for generating superpixels. We identified its strengths in low-light and noisy image environments, simplicity, and efficiency. Discussions included how SLIC could be paired with classifiers and its ease of implementation. Also looked at was the use of pyramid pooling for feature extraction, although it was ruled out due to it not having automatic feature labeling. Make up of the training data was also talked about, and an end goal including labeling each section of an image was made. Various python packages were also discussed such as sci-kit learn and SLIC being implemented via a python package. The delegation of parts to do for the literature review was also discussed. Rough draft of the literature review to be done by next meeting.

Meeting – February 22

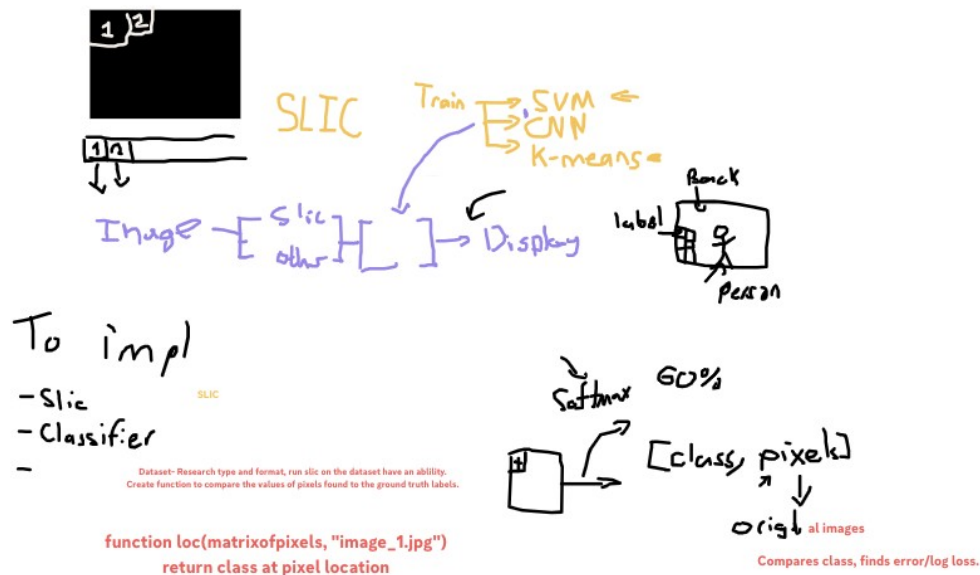
All group members were present. Group discussions focused on terminology (e.g., pixels and superpixels) and clarifying differences between Markov and SLIC in the literature review as well as including more citations and mentioning random forests of time permitted. Tasks were assigned for writing the conclusion, abstract, and refining technical details. Finished draft to be done by next meeting.

Meeting – February 27

All group members except Rory were present. We met with the TA, who advised incorporating traditional classifiers like SVM and K-nearest neighbors for comparison with CNNs. Our extraction methods were validated as effective.

Meeting – March 9

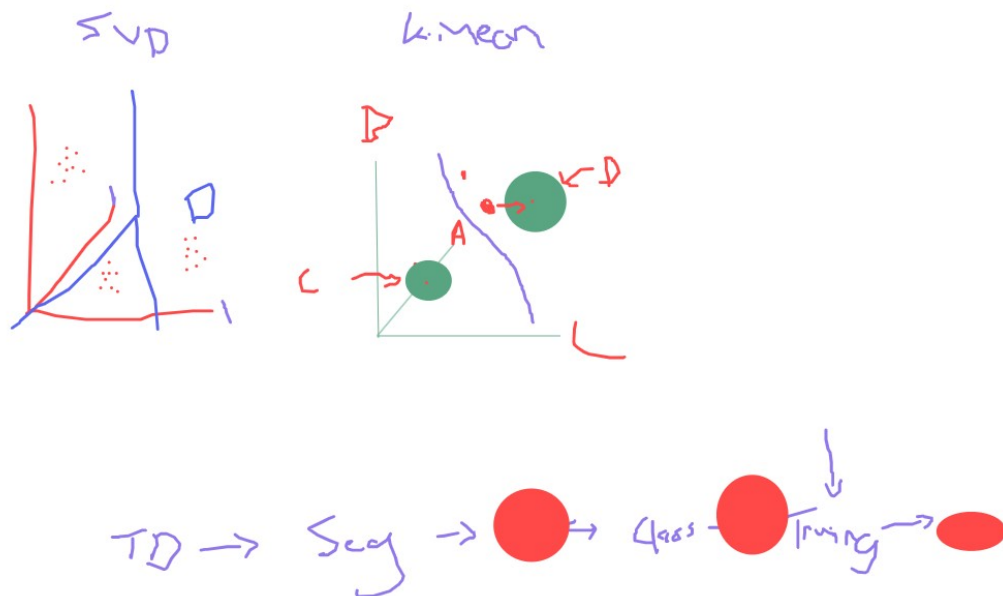
All group members were present. Testing different classifiers with the same training data, and comparing error rates was discussed. We agreed on an algorithm structure involving preprocessing, SLIC segmentation, feature extraction, and classification using SVM, CNN, and K-means.



Post-processing includes visualization using color coding with legends. The input would be pixel locations, and the output would be one of 8 main classes. Each group member was assigned implementation tasks for different modules (SLIC, classifiers, and the dataset).

Meeting - March 12

All group members were present. Discussed an algorithm issue in SLIC, including clusters sometimes overlapping with some pixels within clusters, as well as that it should return a segmented matrix where each point is the ID of the segment and the cluster center and center ID. The CNN is not fully working and needs data. Also discussed was SVM, it uses sklearn to recalculate centroid centres, prepares and takes dominant label, with the possibility of taking weighted labels, but we will come back to that another time, test svm between actual and predicted labels, start training using the dataset, and researching the possibility of using minor/major axis. In terms of K-means, we need to cluster the SLIC clusters into mega clusters based on lab colour model, and compare that with the ground truth for classification. Questions of the image data included its resolution, and implementation of test functions were shown including the tabled city labels, and the test sample images paired with dummy masks and outputting a class at that pixel. To do for next meeting included loading and preparing the dataset, a function to label each segment, running SLIC on the dataset, making a repository, test SVM and tweak it, build the training and test for CNN, and k means classification and training.



Meeting – March 18

All group members except Rory were present. Progress continued with running and testing SLIC, as reading from SLIC is now done. Training data preparation and evaluation planning were discussed such as setting training data to be saved into

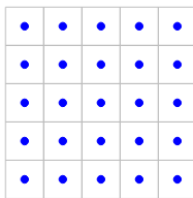
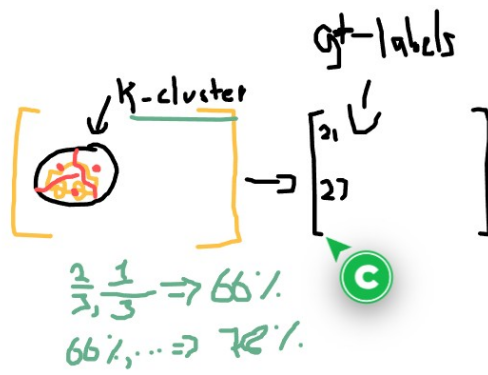
a file, and that training could take hours long. Questions on live demo preparations were had, like recording a video to avoid issues. Data splitting into train and test, reason unknown. To do for next meeting included CNN feature extraction, testing SVM, data layout concerns, running SLIC on windows and uploading results, test k means, update the progress journal, and look into evaluation of models. Results should be fully implemented by next meeting.

Meeting – March 26

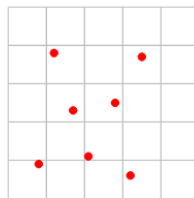
All group members were present. The SVM classifier is showing approximately 69% accuracy, possibly needs more clusters, or finer super pixels, or maybe even fewer super pixels. SVM combines into 7 classes, splits up based on LABXY in 5 dimensions fitting 8 hyperplanes, currently training on 50 images, lightweight. We discussed refining clustering methods and reconsidering CNN due to compatibility with superpixel-based input, possibly have the CNN label every pixel in the image with rough predictions, then cross compare based on the super pixels. In terms of k means, we discussed repurposing the SVM to apply labels to the k means clusters, and train it based off colours to find meaningful features. Tasks were assigned for the report and final presentation (Introduction, Literary review, system design, results, discussions, future work, figured and citations), with a focus on completing all deliverables including the presentation slides by the weekend.

Meeting – March 29

All group members were present. Some updates were discussed, namely encountering issues with the SLIC module in Jupyter Notebook. We ran tests comparing algorithm speed and image sizes across CPU/GPU. Adjusted number of SLIC clusters for optimization. Report sections underway, intro started, K-Means and SLIC literature reviews done. Some confusion on system design details (e.g., hardware/software separation, parameters like 1024 superpixels, SVM regularization, and SLIC connectivity). Added results table for SLIC and discussed SVM accuracy. Live demo file completed. Left to do is finish the presentation slides and the report.



SLIC Initial Layout
(a) SLIC - Regular Grid Initialization



K-Means Initial Layout
(b) K-Means - Random Initialization

Figure 1: Comparison of initial cluster placements: SLIC (left) uses a regular grid, while K-Means (right) starts with random centers.