

Project 2 Report

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1. Introduction

The Images obtained are of Martian terrain acquired by the Mastcam instrument of the Mars Science Laboratory rover. The images contain rocks, soil, dust particles and parts of rover in them. The objective of the project is to obtain segmentation using techniques like Felzenszwalb's algorithm, SLIC algorithm. Region adjacency graph is built on the segments and hierarchical merging/ Ncuts is performed to obtain the final segmentation.

2. Experiment

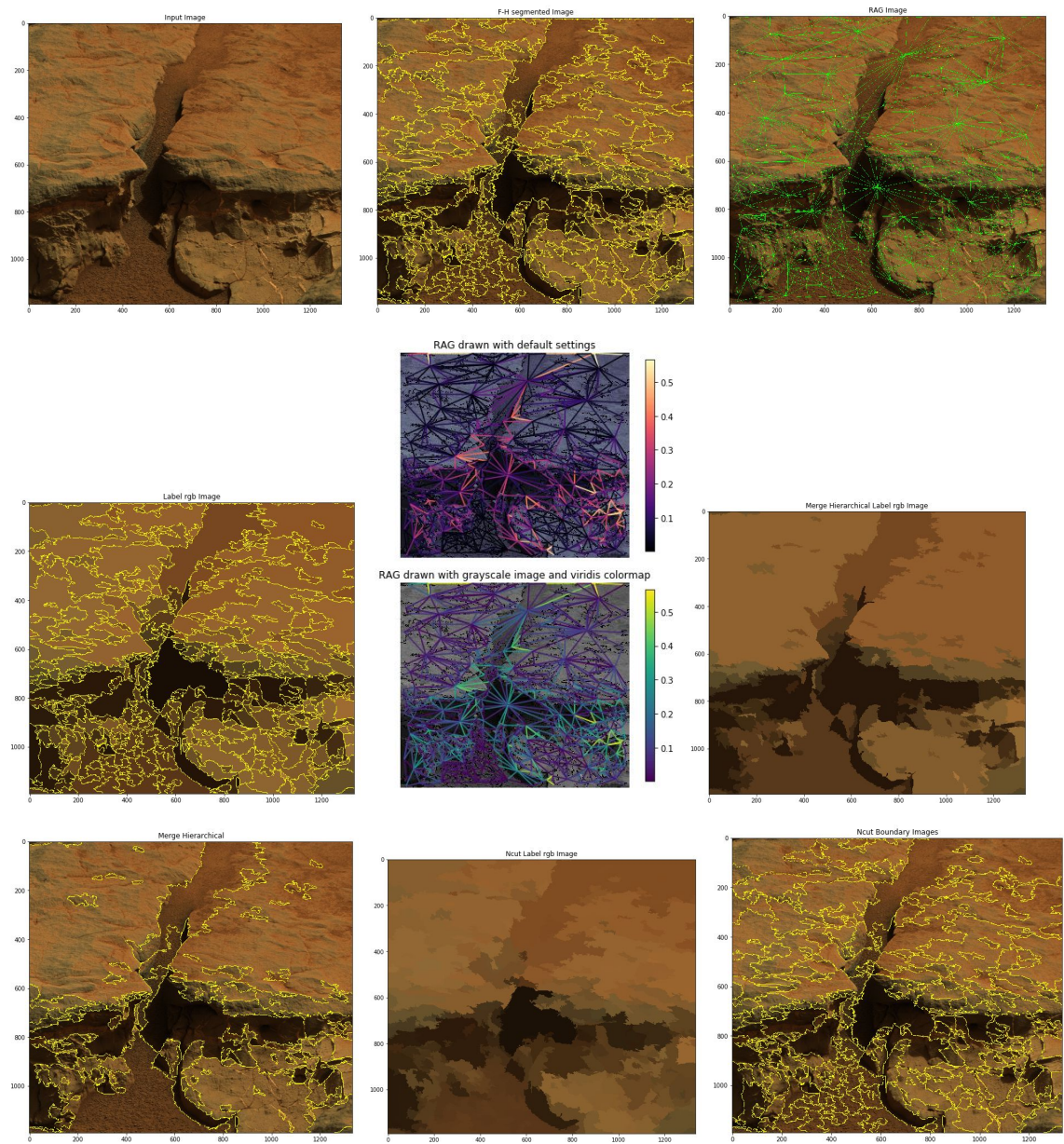
- a. The Felzenszwalb's algorithm was implemented to find the segmentation. The hyperparameters to be tuned included scale, sigma and min_size. Scale affecting the segment size and sigma influencing the gaussian kernel and min_size indicating the Minimum component size. The hyperparameters for FH algorithm were tuned for each individual image.
- b. The SLIC and SLIC0 algorithm were implemented to find the super pixel segmentation. The hyperparameters included n_segmet which is the number of segments in the output image, compactness which balances color and space proximity and max_iter which indicates the number of iterations for kmeans. Under the hood SLIC and SLIC0 are basically Kmeans algorithms performed on a 5D feature space. SLIC0 is the zero parameter version of SLIC algorithm which does not need compactness parameter to be specified.
- c. After finding the segmentation Region Adjacency Graph is formed where the nodes are the segments of the image and weighted edges exist between regions of adjacent pixels. The Region Adjacency Graph is plotted to see the performance of superpixel segmentation done before.
- d. We use Hierarchical merging techniques to merge all the similar nodes within a given threshold. Regions are merged until no highly similar region pairs exist.
- e. We use ncuts to perform a 2-way normalized cut on the rag where all the nodes that belongs to a subgraph which cannot be cut further are assigned an unique label.

3. Results

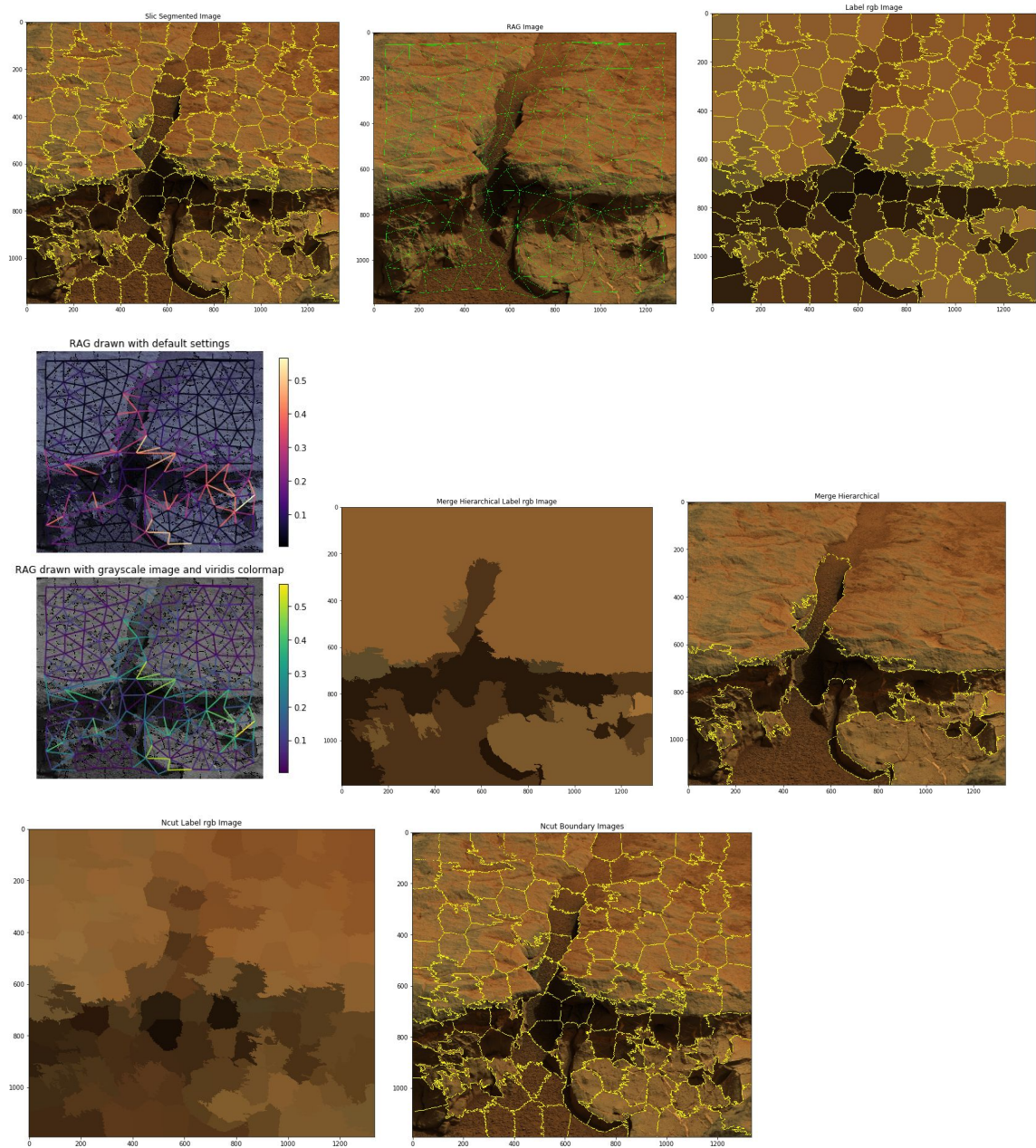
All of combination of the Hyperparameter tuned results for mastcam image 1 is plotted below. For rest of the mastcam images, the sequences of results which lead to the best segmentation is plotted below.

a. Plots for Image 1

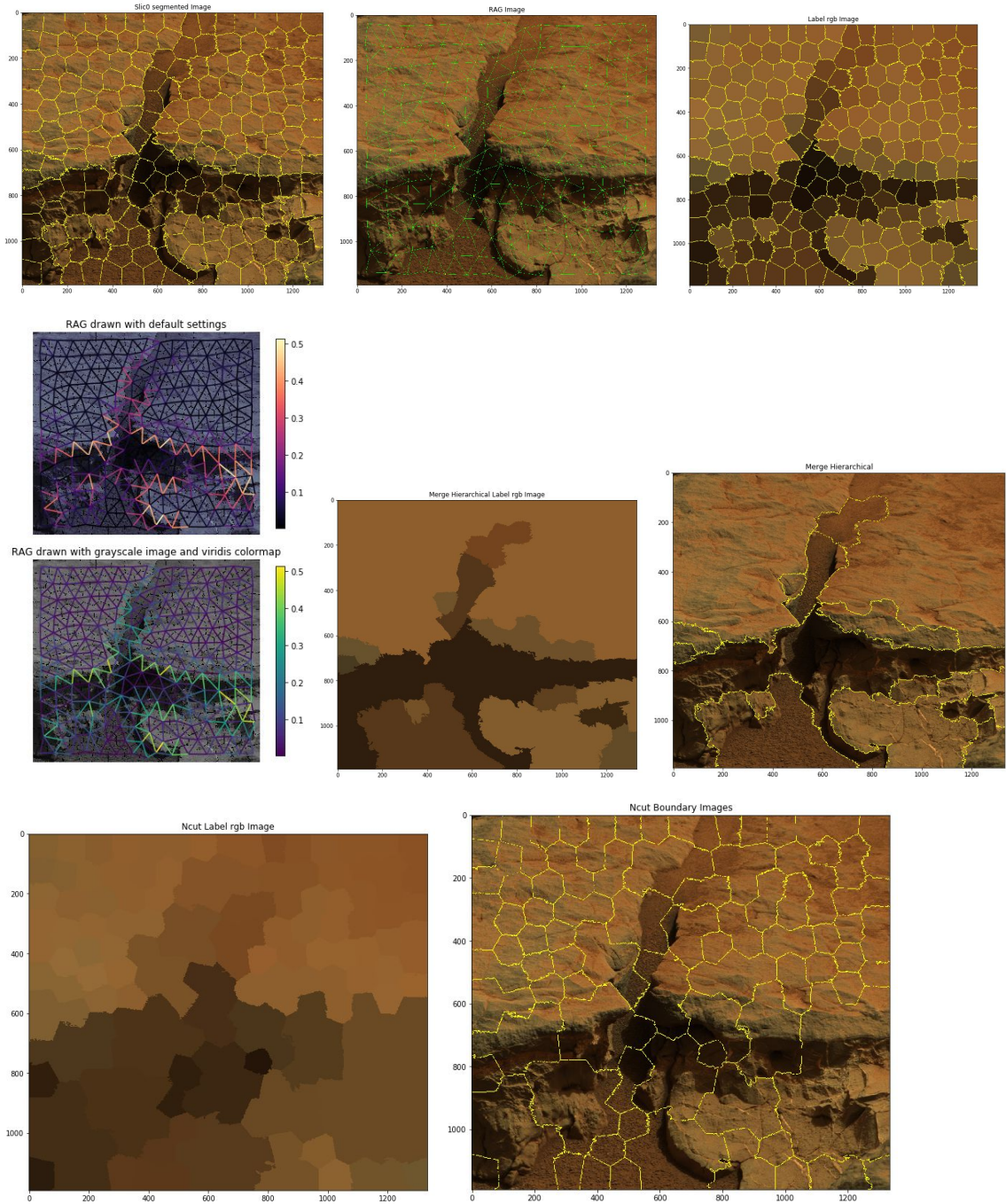
1. Sequence of results starting from FH algorithm.



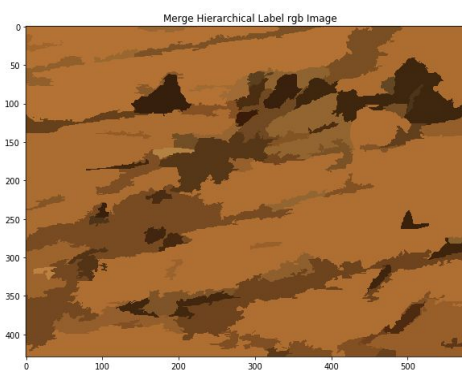
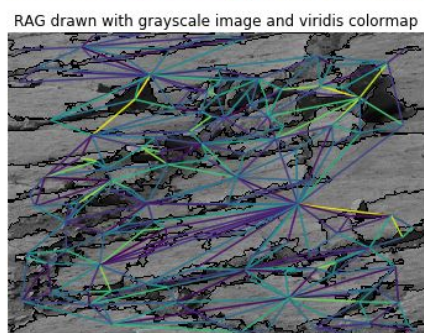
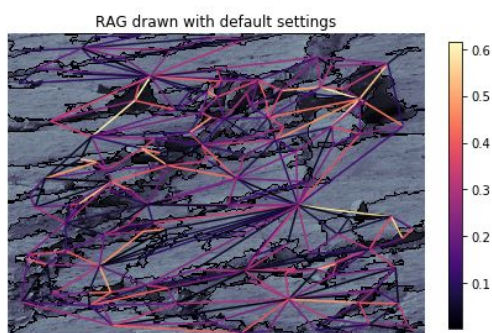
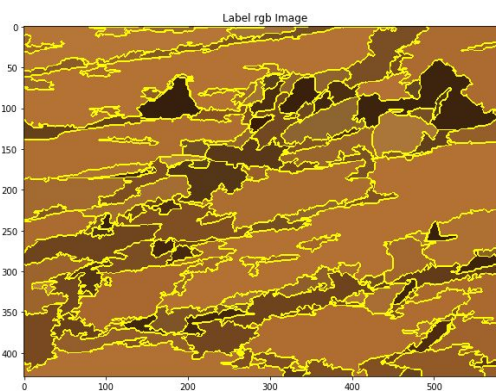
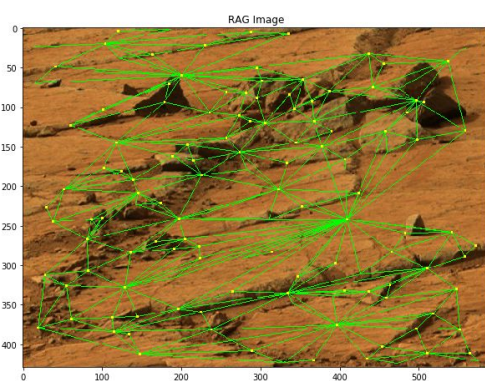
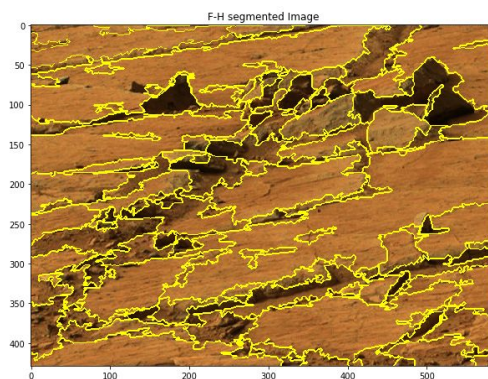
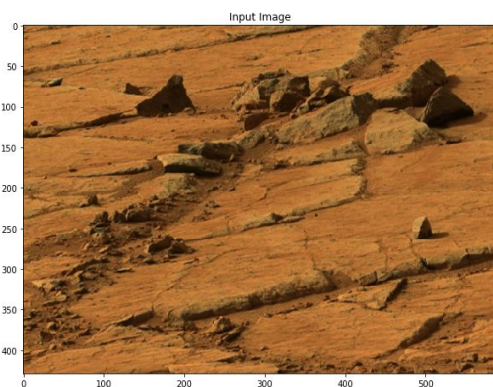
2. Sequence of results starting from SLIC algorithm.

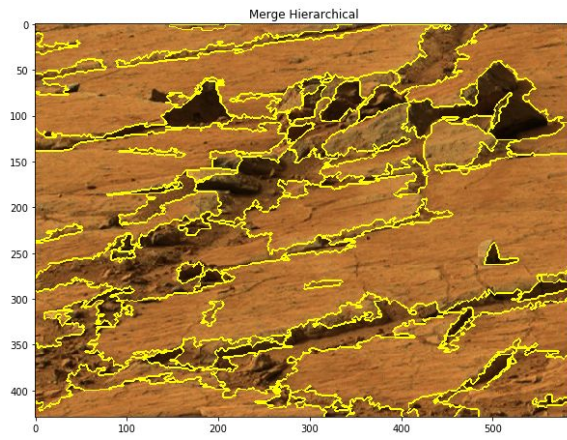


3. Sequence of results starting from SLIC0 algorithm.

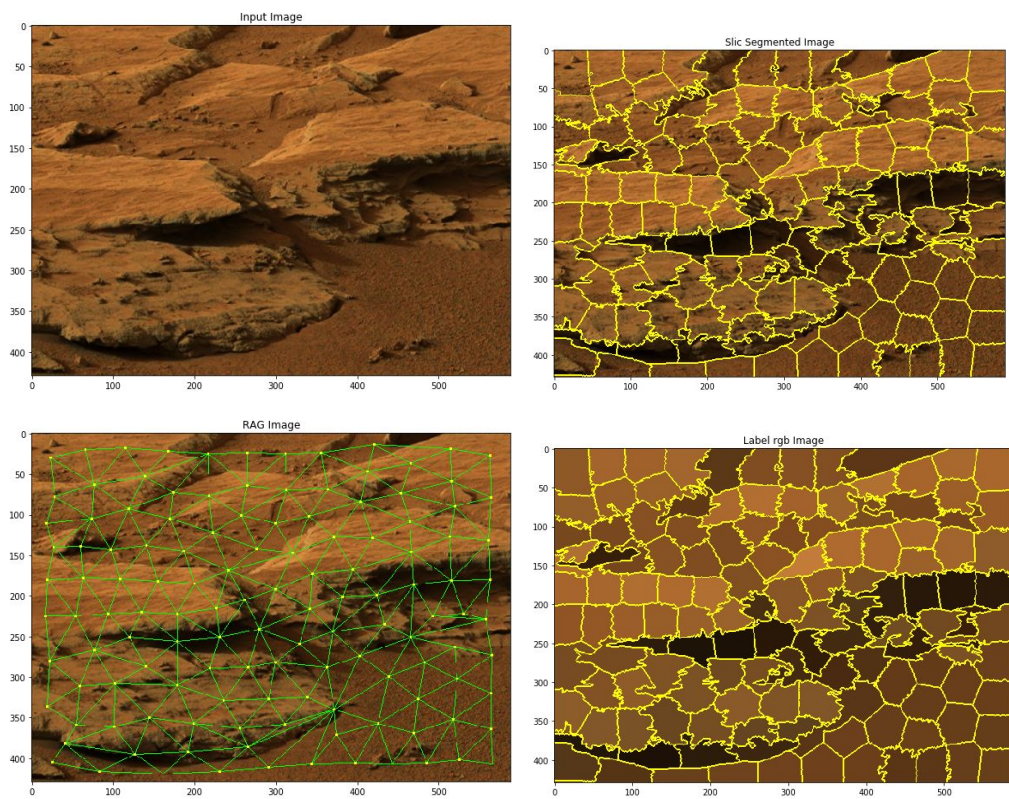


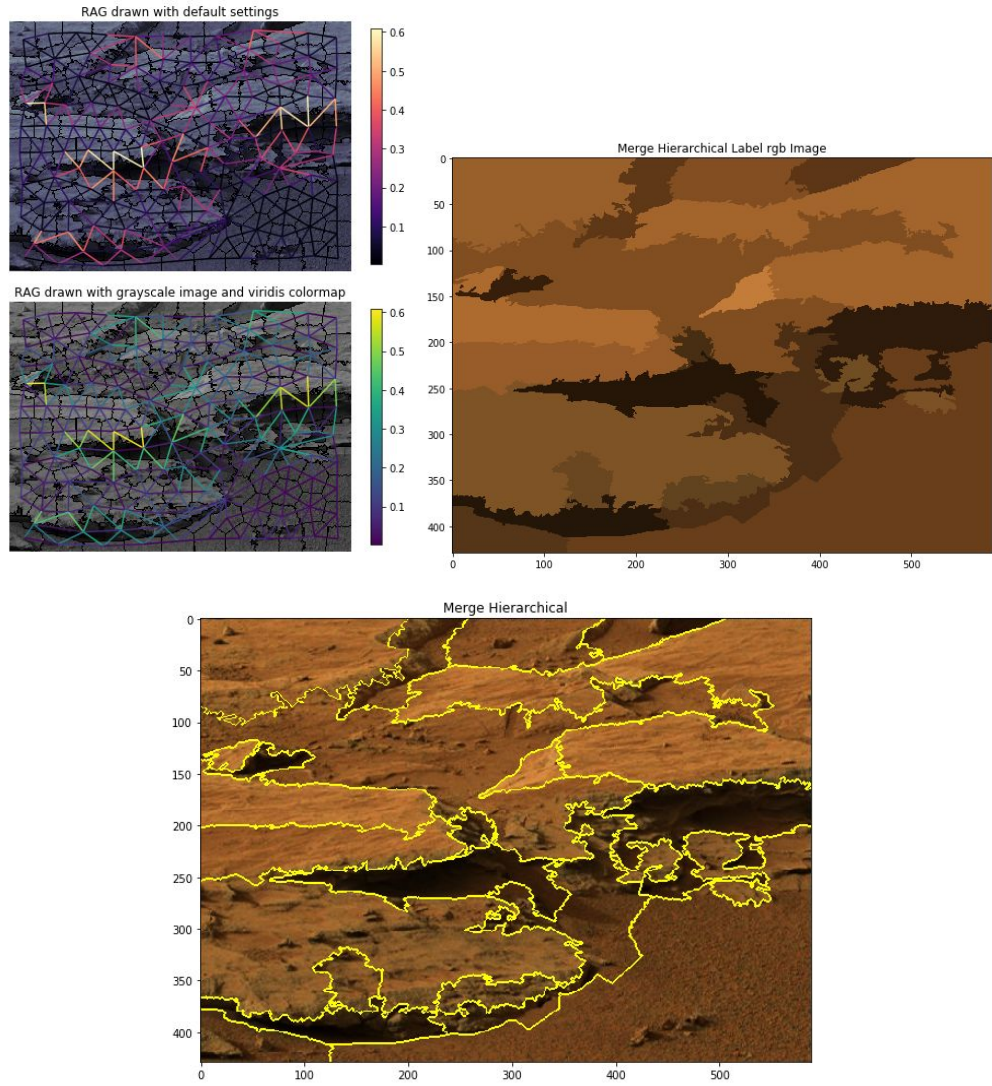
B. Sequences of Result Images resulting in the best segmentation of Image2



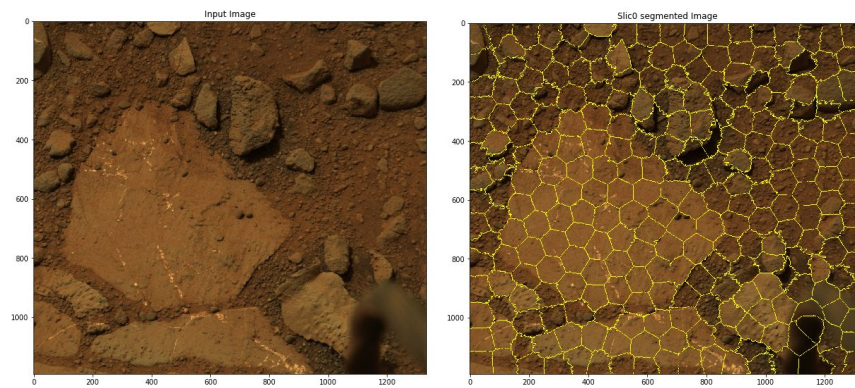


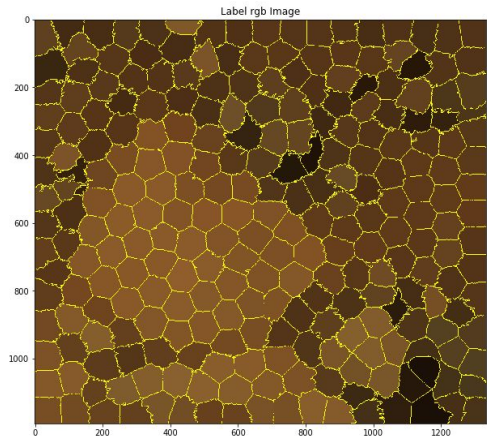
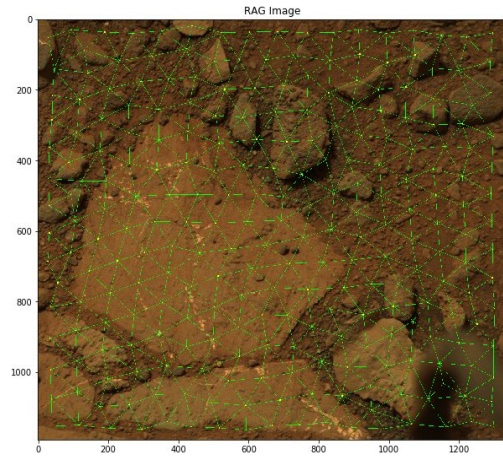
C. Sequences of Result Images resulting in the best segmentation of Image 3



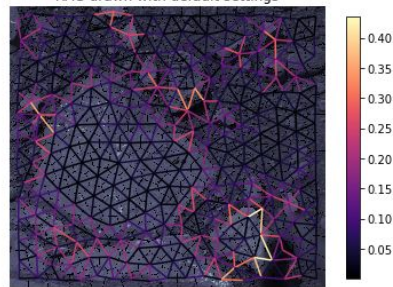


C. Sequences of Result Images resulting in the best segmentation of Image 4

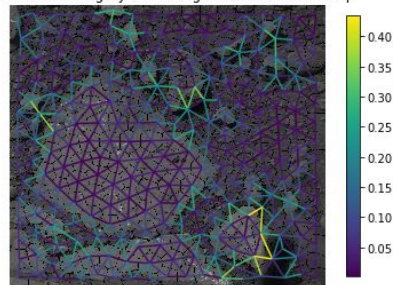




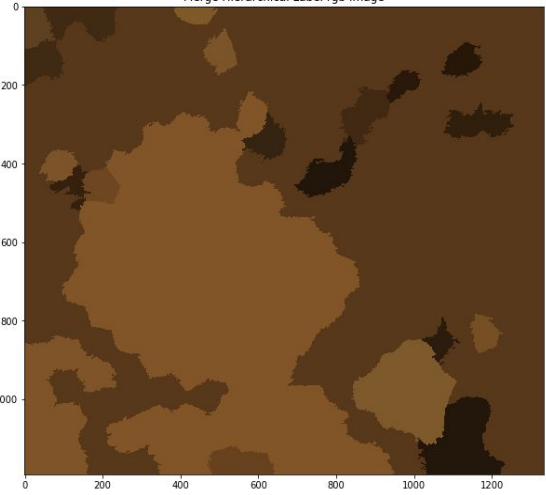
RAG drawn with default settings



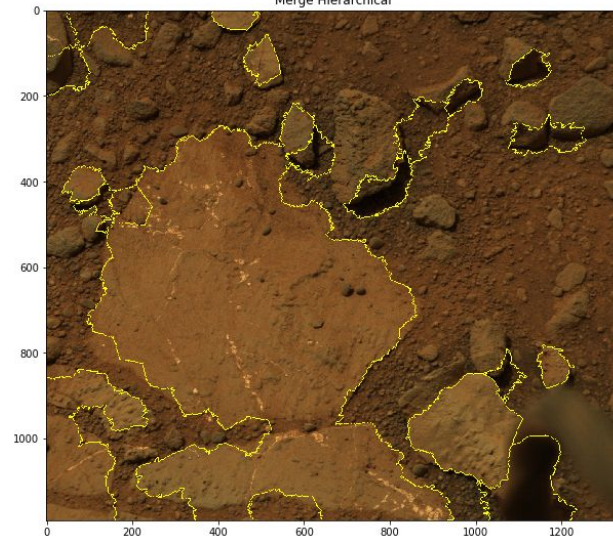
RAG drawn with grayscale image and viridis colormap



Merge Hierarchical Label rgb Image



Merge Hierarchical



4. Conclusions

Each image had unique combinations of algorithms which worked together to form meaningful segmentation. Hyperparameters were fine tuned for all of the algorithms to best segment the rock from soil. Generally SLIC algorithm with hierarchical merging of RAG had the best results.