CV Homework 6

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Q3

For K Means I tried several methods. Using my own K means with Chi Squared as the distance metric, I got the following:

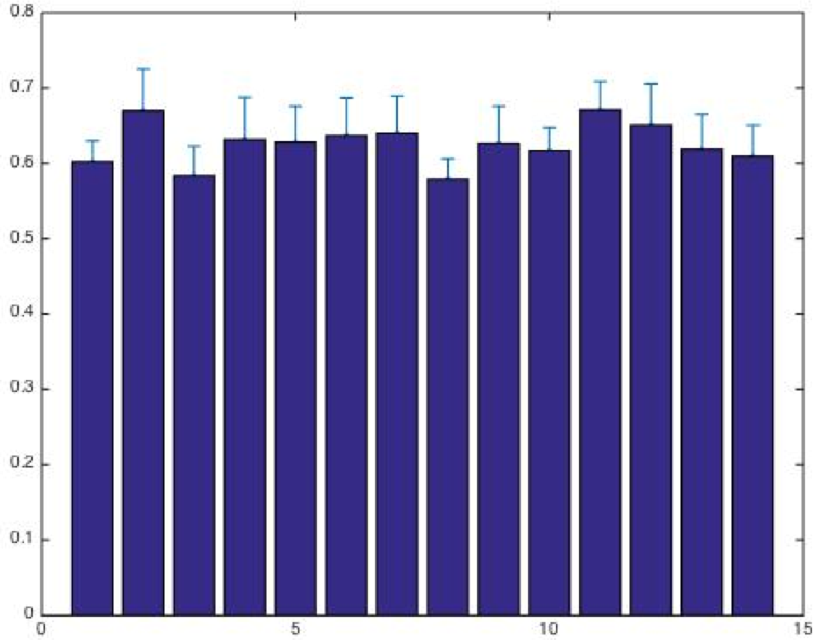

Figure 1: Accuracy of KMeans with 90 clusters, 100 superpixels

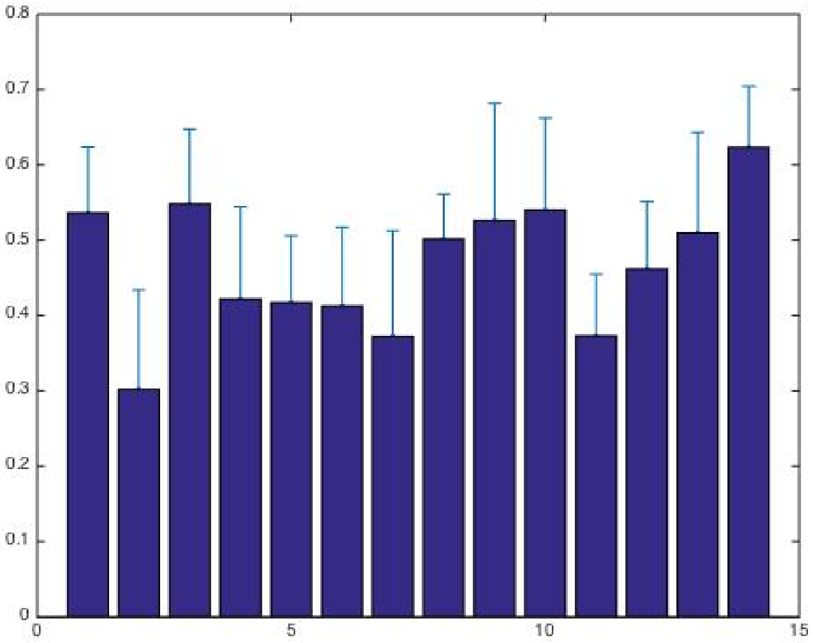

Figure 2: F1 of KMeans with 90 clusters, 100 superpixels

I then changed to use a different KMeans function (Matlab's own) and 'cosine' distance. As you can see the accuracy was similar. Using Matlab's KMeans:

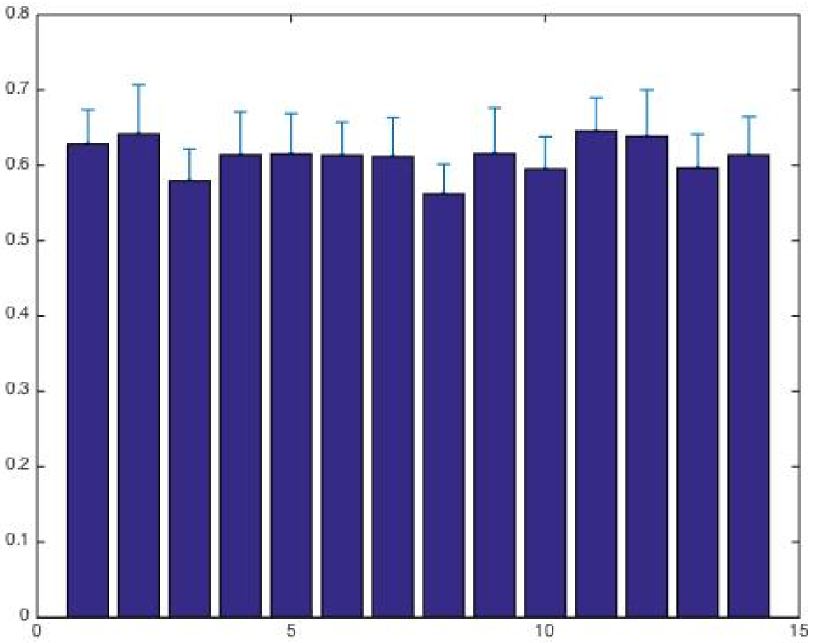

Figure 3: Accuracy of KMeans with 90 clusters, 200 superpixels

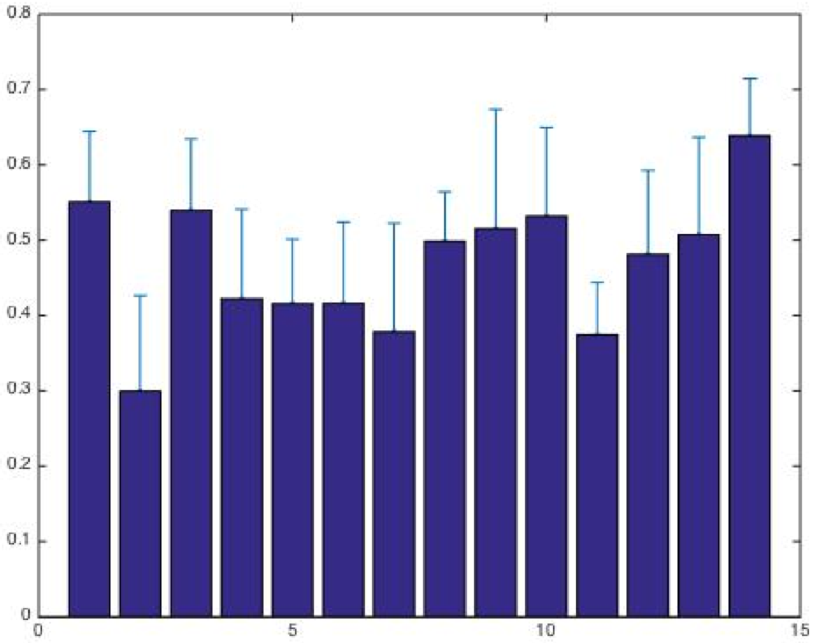

Figure 4: F1 of KMeans with 90 clusters, 200 superpixels

I also used different clusters (for the original wordmaps) but wound up selecting 90 words. I used different superpixel numbers (as noted in the figures), but did not notice large differences (until the supervised learning part).

Running it finally with 300 superpixels and Matlab's Kmeans with cosine distance, I got:

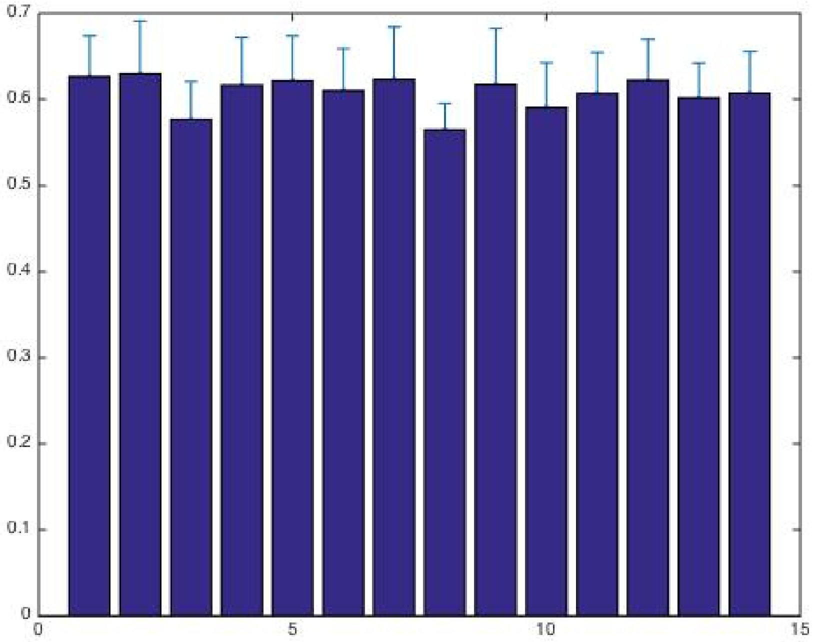

Figure 5: Accuracy of KMeans with 90 clusters, 300 superpixels

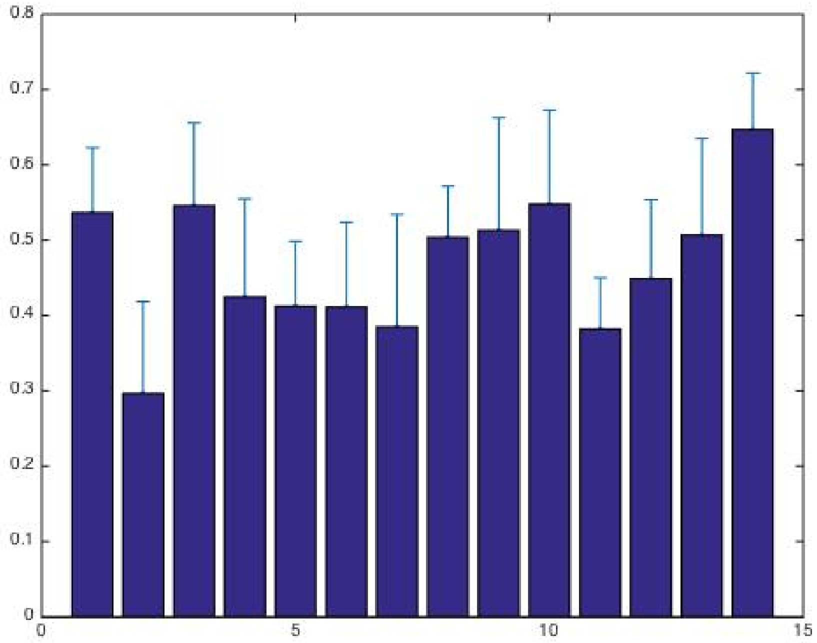

Figure 6: F1 of KMeans with 90 clusters, 300 superpixels

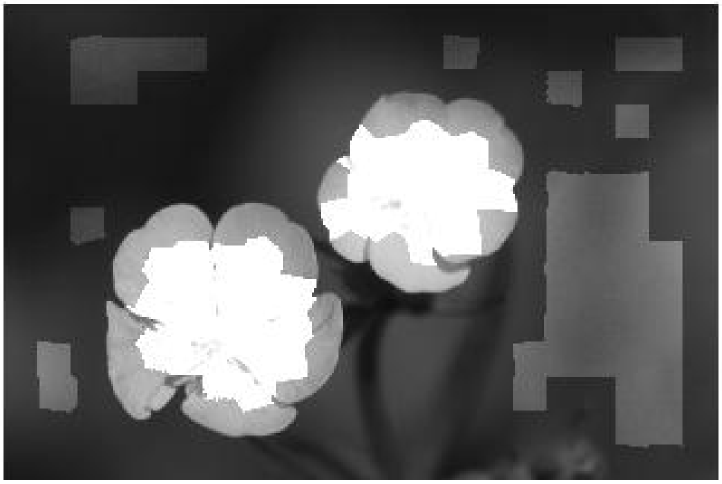

Figure 7: Flower Segmentation from KMeans with 90 clusters, 300 superpixels

Kmeans is simple to implement and does not require an prior knowledge of foreground/background ground truths, just buckets the images into two groups. This is also a weakness, however, as it does not perform that much better than pure chance. Considering that there is probably less foreground than background, labeling everything one class might even provide similar accuracy.

Q4

Using Spectral Clustering, I tried a variety of distance metrics. I tried a variety of superpixels, but found errors in the spectral clustering function using less than 300. Using 300 superpixels and 1 - pdist2 (using cosine distance) for my affinity matrix, I got:

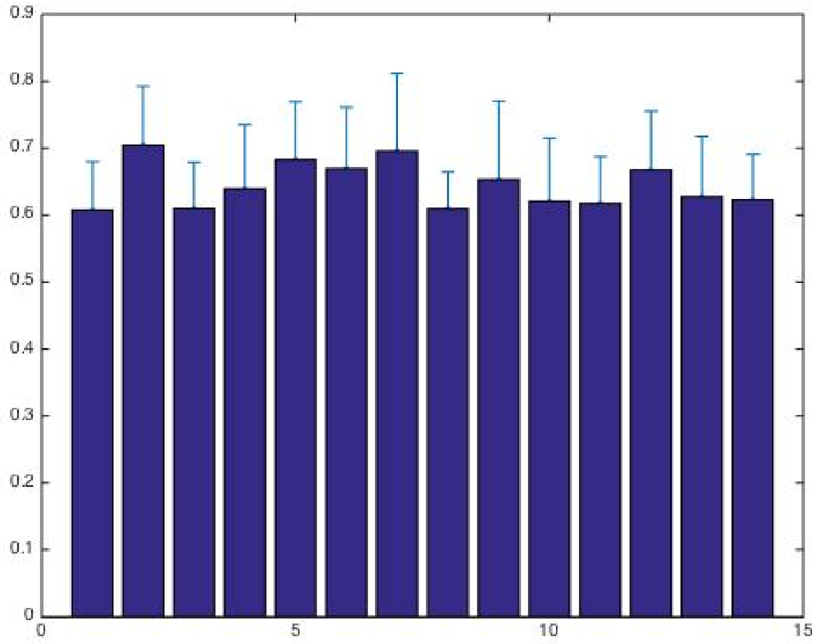

Figure 8: Accuracy of Spectral Clustering

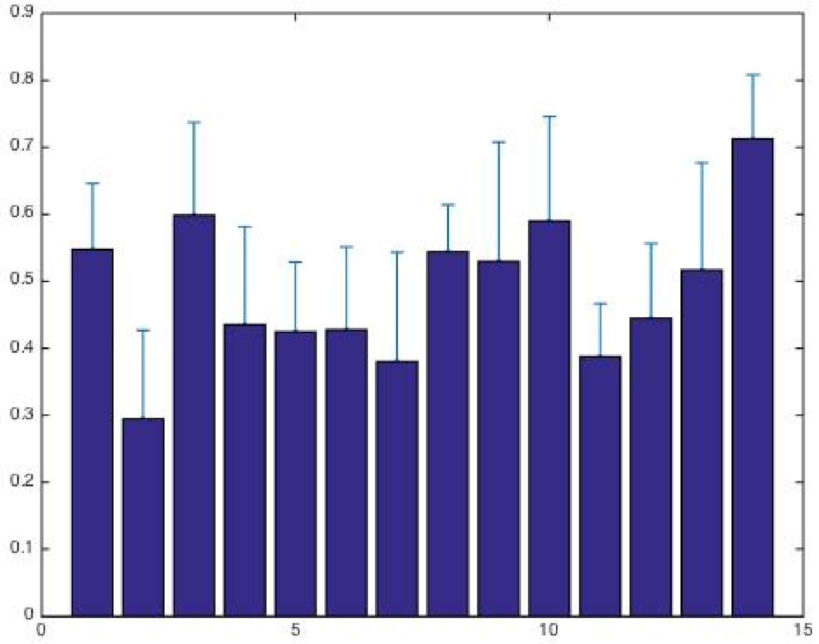

Figure 9: F1 of Spectral Clustering

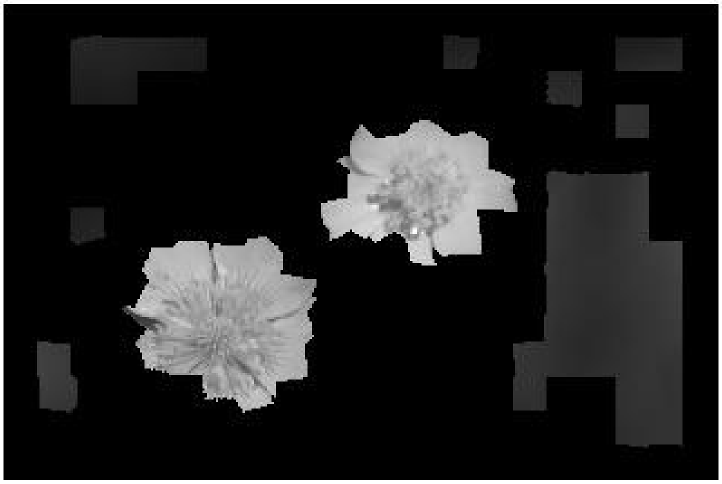

Figure 10: Spectral Clustering of Flower

Spectral Clustering did not produce results that much greater than KMeans, but it was faster (because it was repeatable, it did not need to run multiple times per image). It did not need to run multiple times on one image. Looking at the flower image, it seems to segment the flowers very similarly to KMeans.

Q5

Using supervised learning, some were better and some were worse. On average though, supervised learning provided a decent benefit, with those that improved improving around 10 percent on average. The plane class improved the most, over 20 percent.

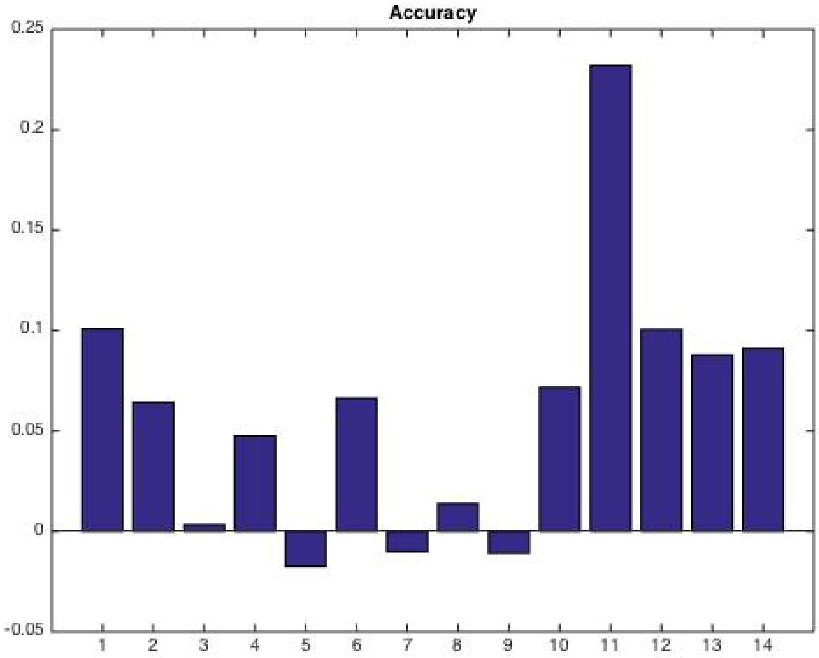

Figure 11: Accuracy of Known Supervised Learning vs Spectral Clustering

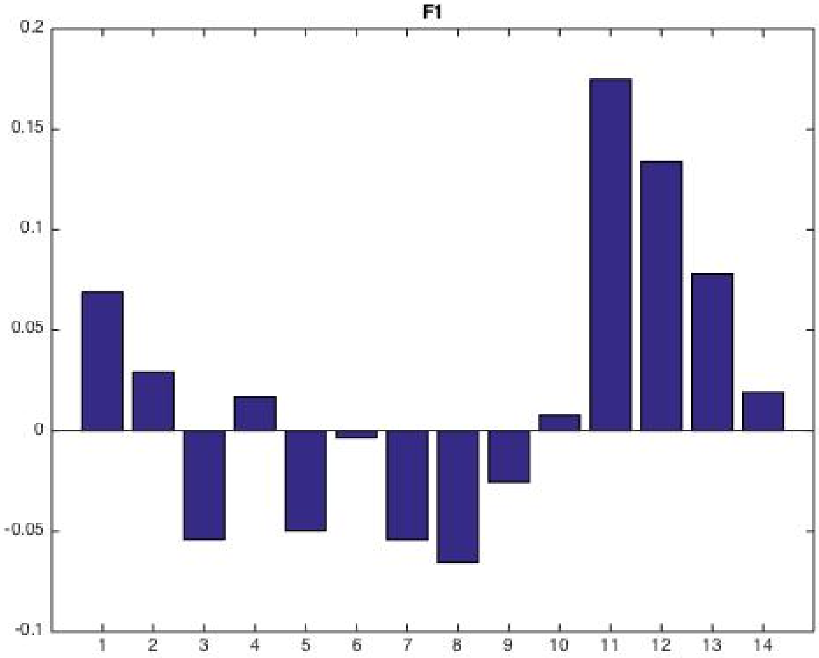

Figure 12: F1 of Known Supervised Learning vs Spectral Clustering

	Avg	Bike	Bird	Car	Cat	Chair	Cow	Dog	Face	Flower	House	Plane	Sheep	Sign	Tree
$\Delta Acc.$	0.060	0.101	0.064	0.003	0.05	-0.0173	0.066	-0.010	0.014	-0.01	0.072	0.232	0.101	0.088	0.09
$\Delta F1$	0.012	0.069	0.029	-0.054	0.017	-0.050	-0.004	-0.054	-0.066	-0.026	0.008	0.175	0.134	0.078	0.019

Table 1: Table of differences

To illustrate the difference in the plane class:

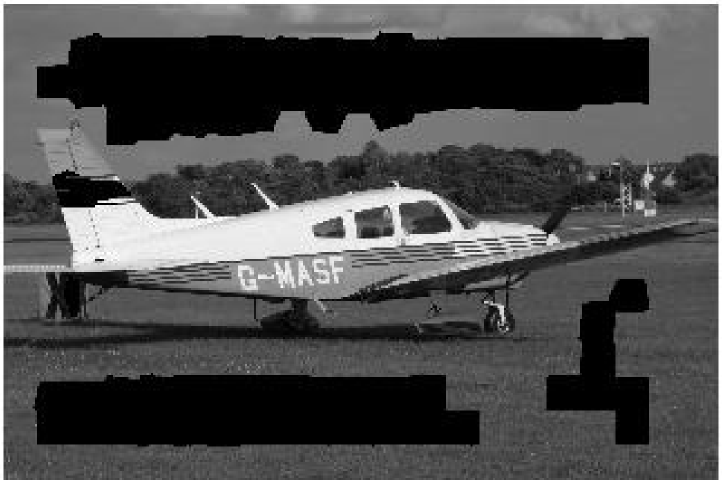

Figure 13: Accuracy of K Means

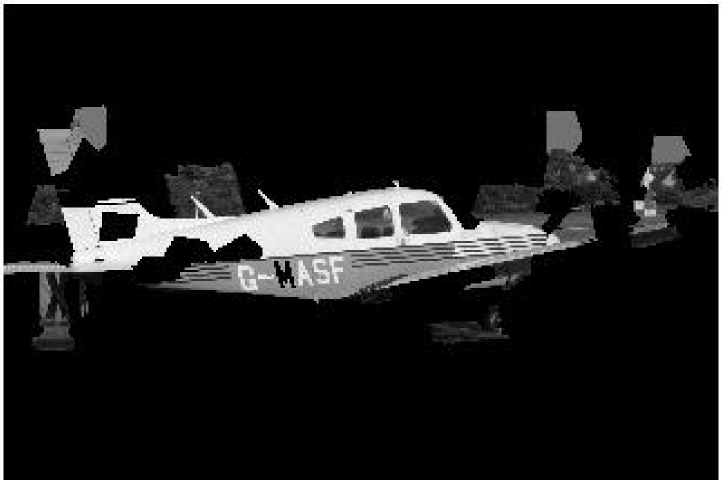

Figure 14: Accuracy of Known Supervised Learning

Q6

Using unsupervised learning, some were the same and some were worse. Tree class had the worse degredation. An example image from Tree looks like this with unknown supervised learning:

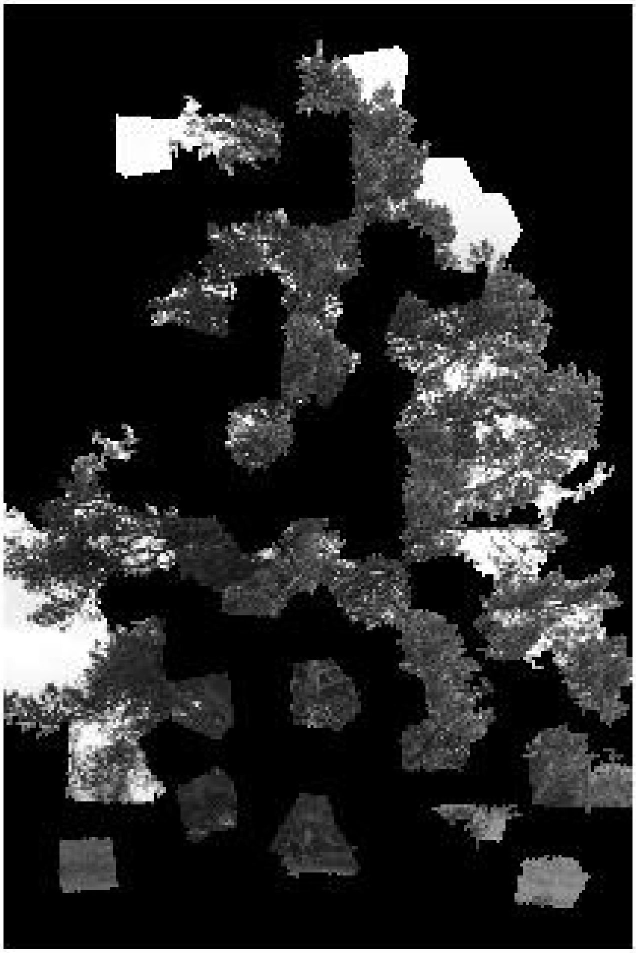

Figure 15: Tree with Unknown Supervised Learning

But this with known learning:

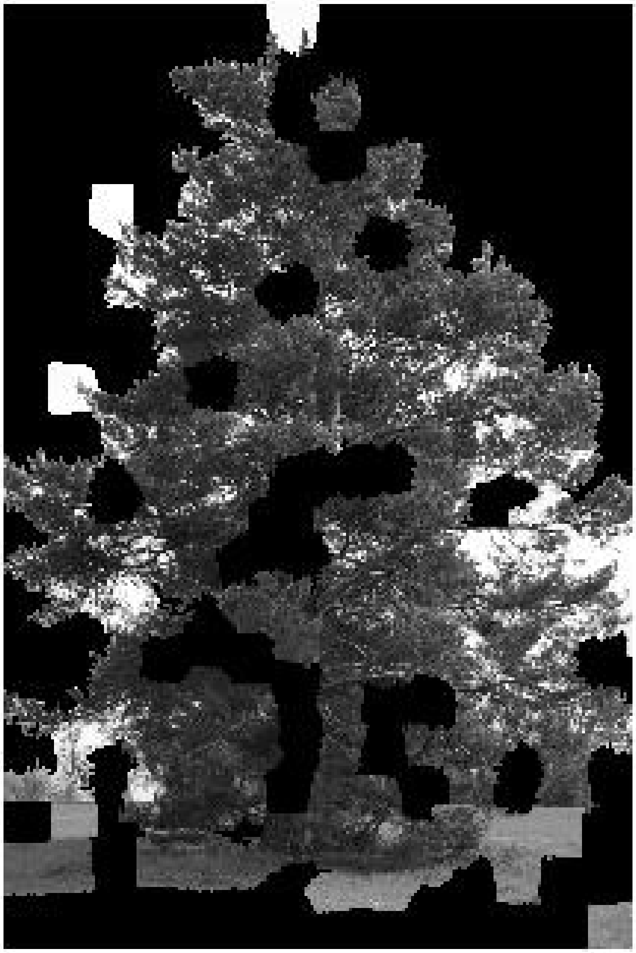

Figure 16: Tree with Known Supervised Learning

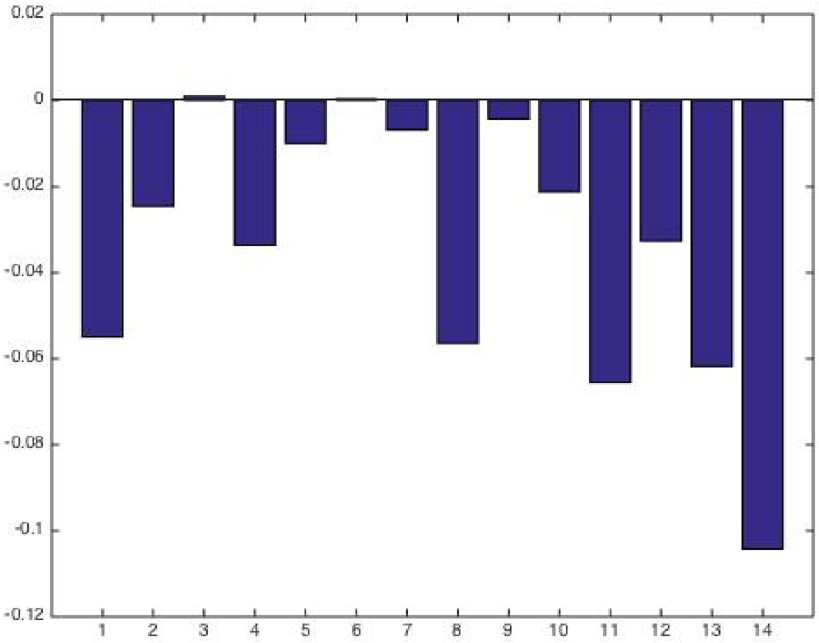

Figure 17: Accuracy of Unknown Supervised Learning vs Known Supervised Learning

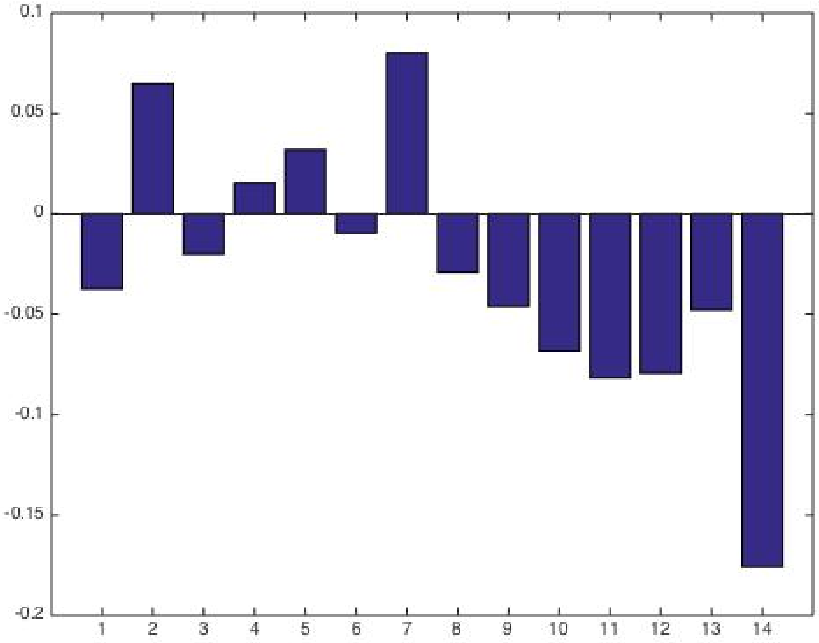

Figure 18: F1 of Unknown Supervised Learning vs Known Supervised Learning

	Avg	Bike	Bird	Car	Cat	Chair	Cow	Dog	Face	Flower	House	Plane	Sheep	Sign	Tree
$\Delta Acc.$	-0.034	-0.055	-0.025	0.001	-0.034	-0.01	0.0004	-0.007	-0.056	-0.004	-0.021	-0.066	-0.033	-0.062	-0.104
$\Delta F1$	-0.029	-0.037	0.065	-0.020	0.016	0.032	-0.01	0.080	-0.029	-0.046	-0.068	-0.082	-0.079	-0.048	-0.176

Table 2: Table of differences

QX

I first tried a different method of finding superpixels. Using a method that increased the superpixel size based on DBSCAN, I tried to use the new superpixel set with Spectral Clustering. The result was nearly the same.

I changed the classification algorithm to Support Vector Machines, and the results were improved.

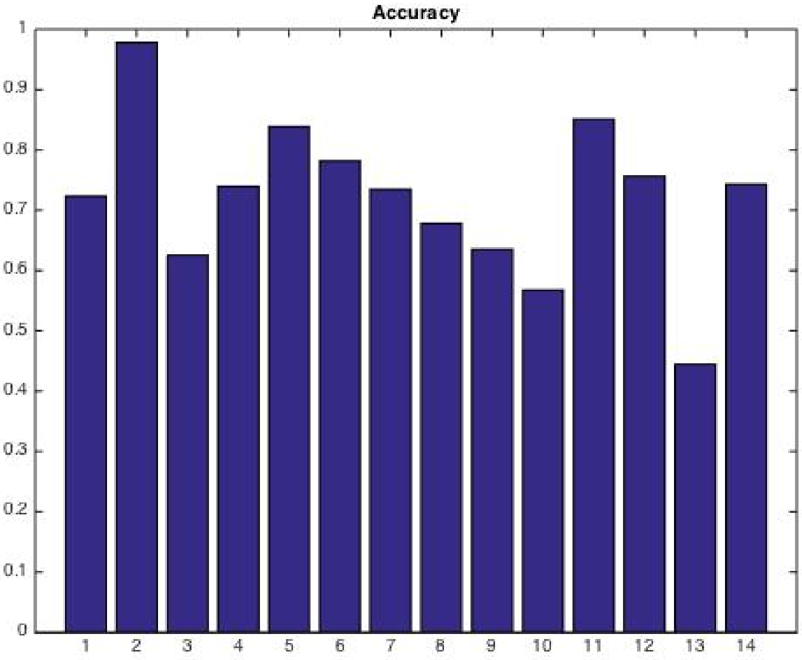

Figure 19: Accuracy of SVM Supervised Known

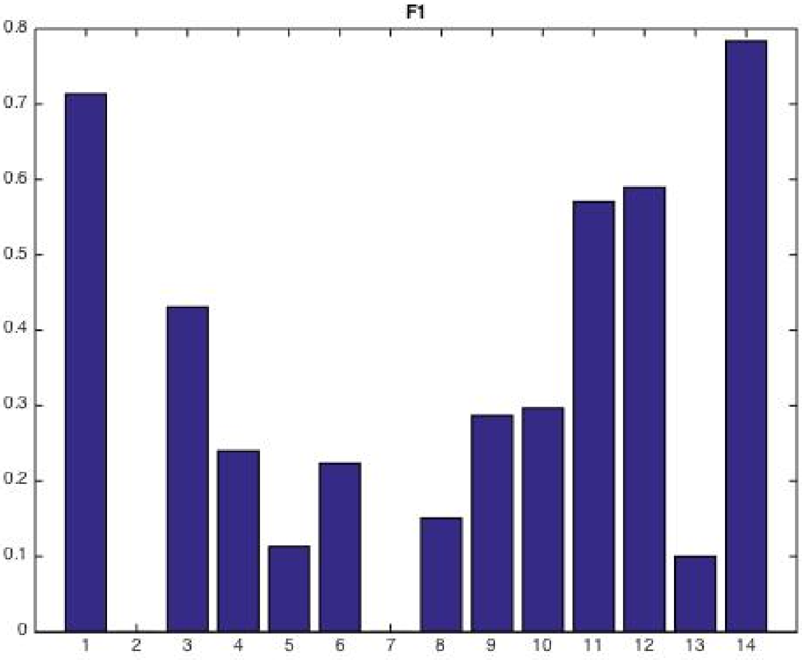

Figure 20: F1 of SVM Supervised Known