COMP316
Assignment 3 Report

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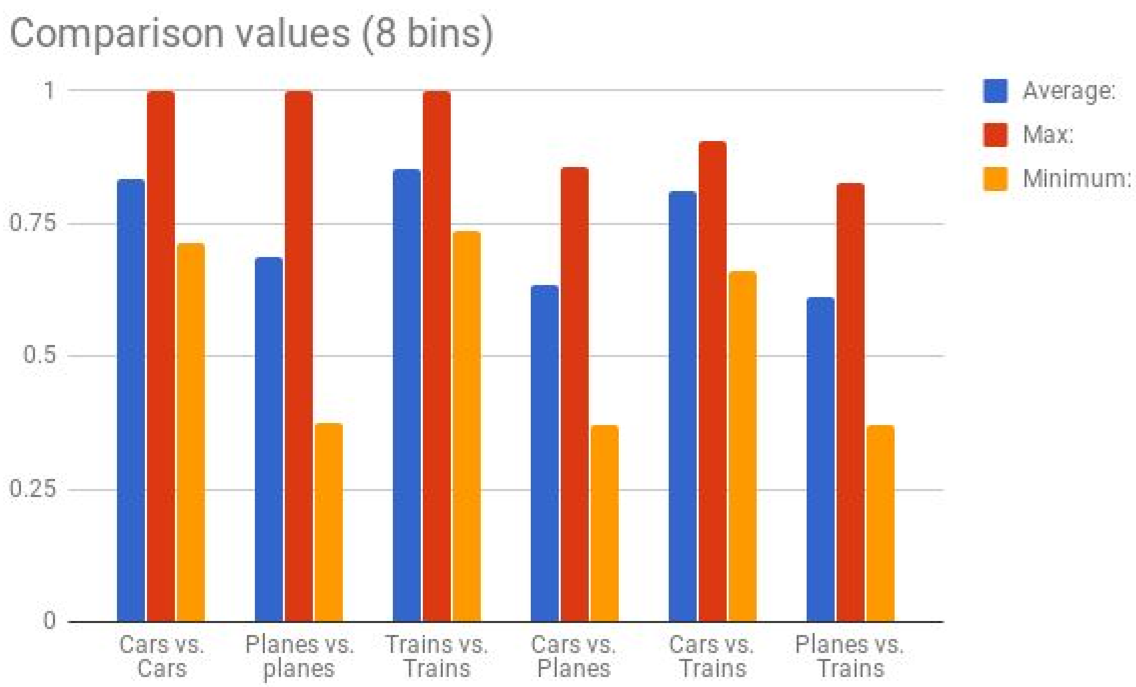
Introduction:

In this report I will be investigating the effect of different bin sizes have on image descriptors. I will evaluate whether a larger bin size gives better image descriptors/comparisons or if it gives worse. I will compare three sets of images against one another (planes, cars, and trains) and show how increasing the bin sizes effects the image descriptors of these images.

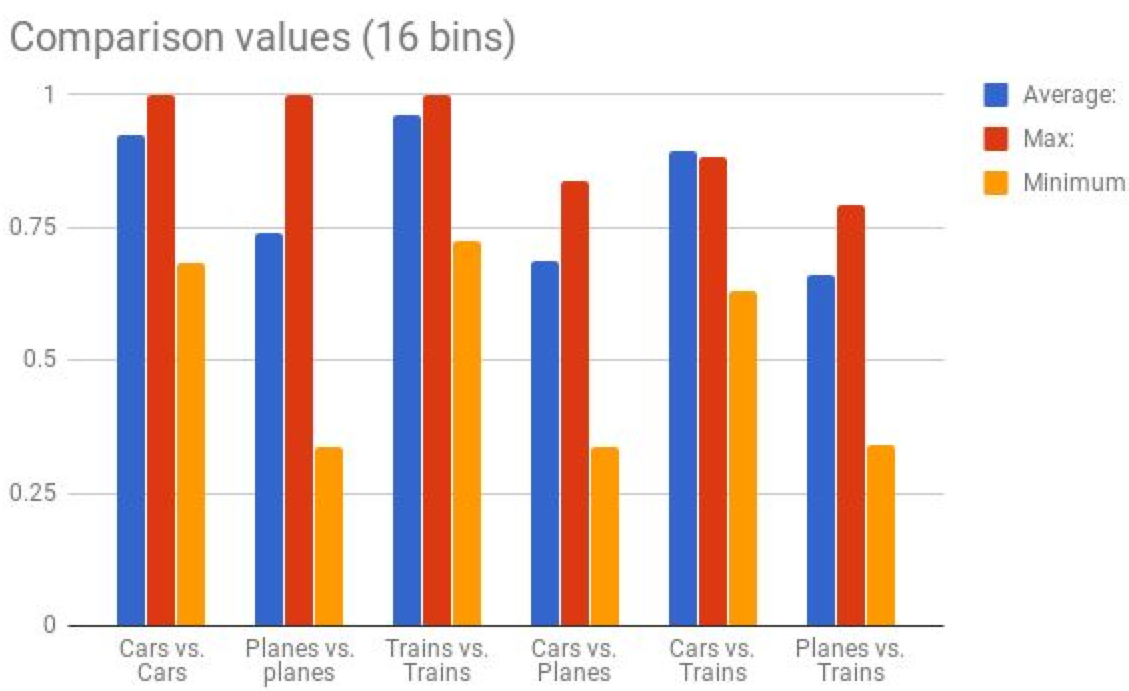
First, I started with a bin size of 8 for all of my histograms. I tested all of the car images against all of the car images, as well as planes against planes, trains against trains. This gave me a baseline of what images that are of the same type should produce. Then, I tested across the set (trains against planes, planes against cars, and cars against trains) which gave me how similar the disparate sets are from one another.



	Cars vs. Cars	Planes vs. planes	Trains vs. Trains	Cars vs. Planes	Cars vs. Trains	Planes vs. Trains
Average:	0.8337297848	0.686746274	0.853944446	0.6334968509	0.8099466401	0.6114706307
Max:	1	1	1	0.8567543914	0.9043705711	0.8253809286
Minimum:	0.7127991946	0.3761744518	0.7369071257	0.371789886	0.6619973378	0.3702918615

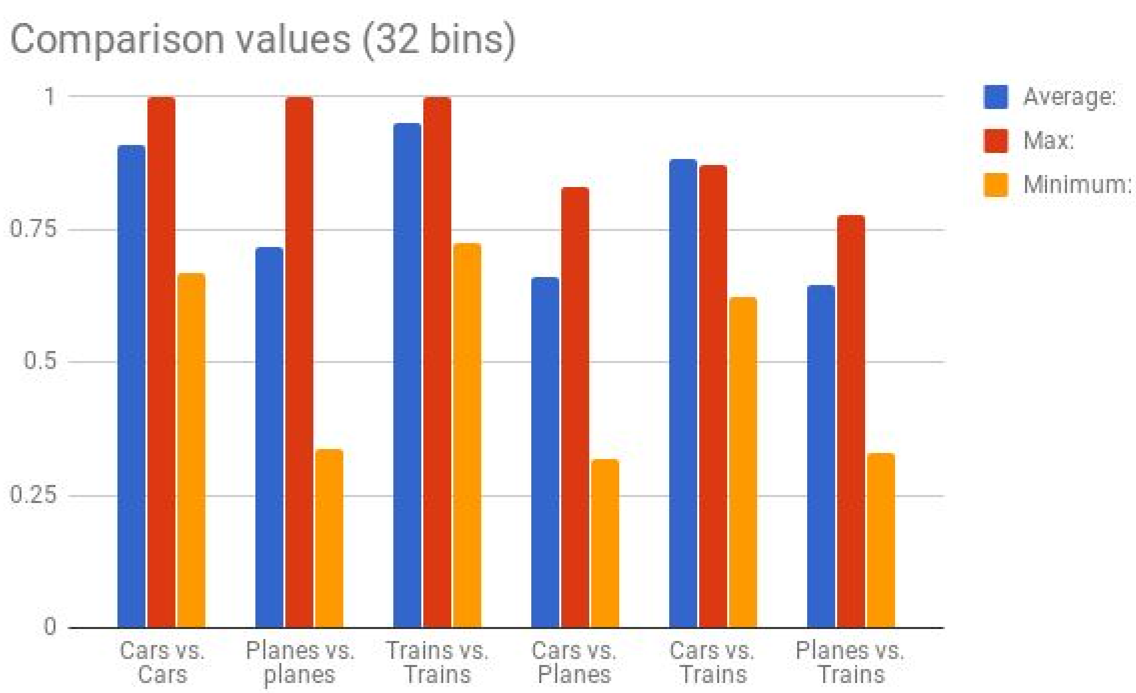
We can see, from this chart and table, a couple of things. One is that trains, planes and cars, when compared against themselves have higher statistical values than when compared against other objects. This is to be expected, and show that the image comparisons are, somewhat, working relatively well for these objects. However, cross comparisons between planes and cars have unusually high averages and a higher minimum value. This is something that, if having more bins does improve comparisons, will be rectified when we increase the bin size. This could be done by raising the other values, or lowering the minimum and average value for the car-plane comparison.

So, to see if this could be improved, I increased the bin sizes for the magnitude and intensity from 8 to 16. I didn't increase the size of the direction histogram because the binning is based on the kirch filters, and there's only 8 of them, meaning that even if I increased the bin size, the upper 8 value would all be 0. So, they'd be no point in increasing the bin size for the direction histogram.



	Cars vs. Cars	Planes vs. planes	Trains vs. Trains	Cars vs. Planes	Cars vs. Trains	Planes vs. Trains
Average:	0.9234483567	0.7391983921	0.9613471076	0.6879404567	0.8943794661	0.6619280188
Max:	1	1	1	0.8393907162	0.8825275813	0.7921328935
Minimum:	0.6814942165	0.3358064443	0.7252171515	0.3356292891	0.6321343568	0.341376706

From the 16 bin comparisons we can see that trains and cars, when compared with themselves, still have higher statistical values. This is better because we'd like for images that are more similar to have higher values, as it indicates that the images are more similar to one another. We can also see that averages have been increased across all groups, while minimums and maximums have decreased (aside from the same group maximums). This didn't improve the cars and trains comparisons, as the average and minimum are still higher than we'd like to see.
From these results I expected the 32-bin histogram to produce similar results, increase the statistical values and not to fix the high cars and trains comparison statistics. To increase the bin sizes I did the same as I did when increasing to 16 bins, increase the bin sizes for the magnitude histogram and intensity histogram, and keep the direction histogram the same.



	Cars vs. Cars	Planes vs. planes	Trains vs. Trains	Cars vs. Planes	Cars vs. Trains	Planes vs. Trains
Average:	0.9111175331	0.7168815523	0.9521091984	0.6622562302	0.8820022904	0.644064107
Max:	1	1	1	0.8295654039	0.8701845134	0.778297676
Minimum:	0.6698804316	0.3353697211	0.7232084488	0.3164544366	0.624228702	0.3296418547

From the results from the 32-bin histograms, we can see that the values very slightly decreased across the board, when compared with the 16-bin results. This means that the average comparison values for images of the same type is lower, making it slightly worse than the 16-bin results for the same reason the 16-bin results were better than the 8-bin results. The results are higher than the 8-bin results though, so it's still an improvement over that. The cars and trains values, however, still haven't been fixed. So, with 16-bin producing the highest averages for images within the same group, it seems 16-bins is the optimal number of bins.

From other image recognition systems we know that increasing the number of bins can increase accuracy. For example, histograms that are meant for human inspection have 256-bins, as this is where they're most accurate. However, image recognition systems that are automatic in nature perform better with 32-bins. So, bin size performance does seem to vary depending on use cases.

Conclusion:

Increasing the bin sizes of histograms does improve images descriptors, making them more precise, but only to a point. With the sizes I tested, 16-bins preformed much better than 8-bin, but 32-bins didn't perform better than 16-bins. The lower values for the 32-bin, when compared with the 16-bin, could be explained by noise in the images or that this set of images is too small or not varied enough. But, for this data set and this image comparison implementation, the 16-bin histograms are superior to the 32-bin histograms.