COMP316-18A Artificial Intelligence

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Investigation of Image Matching

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Introduction

Background

Our assignment was to in clojure, construct a program that calculated three different image descriptors using filters. These were an edge magnitude filter, edge direction filter and an intensity filter. The image descriptors were each an 8 bin histogram. These were combined into an Image Descriptor which could be used to compare whether two images were the same.

Task

The task now was to evaluate how well our image descriptor performed. This would be done by coming up with a relevant experiment and testing its hypothesis. I chose to experiment with and analyse the image descriptor to find out which parts provided the most useful information in matching images.

The question I posed was:
What part of the Image Descriptor provides the highest comparison accuracy and does it provide a higher accuracy than the Full Image Descriptor?

Method

1. Create methods to calculate the similarities using different filters (Magnitude, Direction, Intensity, Full Image Descriptor).

```clojure
(defn image-similarity
  "checks if two images are similar by adding the minimum value of every bin to a total"
  [file1 file2]
  (let [f1 (image-descriptor file1)
        f2 (image-descriptor file2)]
    (reduce + (pmap (fn [i]
                      (float (min (get f1 i) (get f2 i)))) (range 0 24)))))
```

2. Create methods to loop through the entire set of car images to collect all the similarities.

```clojure
(defn get-all-sim
  [image-type]
  (let [files (get-all-files image-type)
        counter 0]
    (pp/pprint (into [] (map (fn [f]
                               (inc counter)
                               (if (mod counter 10)
                                 clear-cache)
                               (reduce + (map (fn [g]
                                                (inc counter)
                                                (if (mod counter 10)
                                                  clear-cache)
                                                (image-similarity g f)) files))) files)))))
```

3. Collate all the data into an excel spreadsheet.
4. Calculate and graph the results.

Images	Magnitude	Direction	Intensity	Full Image Descriptor
1	0.8382049657	0.894796852	0.7139710014	0.8156576064
2	0.8393465803	0.8910335608	0.6286345621	0.7863382344
3	0.9047491506	0.8767092557	0.7134926177	0.8316503414
4	0.8519522148	0.9304684974	0.5783000076	0.7869069066
5	0.9127719263	0.8999305702	0.7428285117	0.8518436694
6	0.9149574649	0.8948954928	0.693149895	0.8343342842
7	0.8562371427	0.9231619961	0.7413669208	0.8402553532
8	0.8407347869	0.9279684755	0.7006385131	0.8231139252
9	0.9038326536	0.9275575502	0.7642410554	0.8652104197
10	0.9075243294	0.9174600975	0.7558828657	0.8602890975
11	0.8449107861	0.916712237	0.680894062	0.8141723617

Results

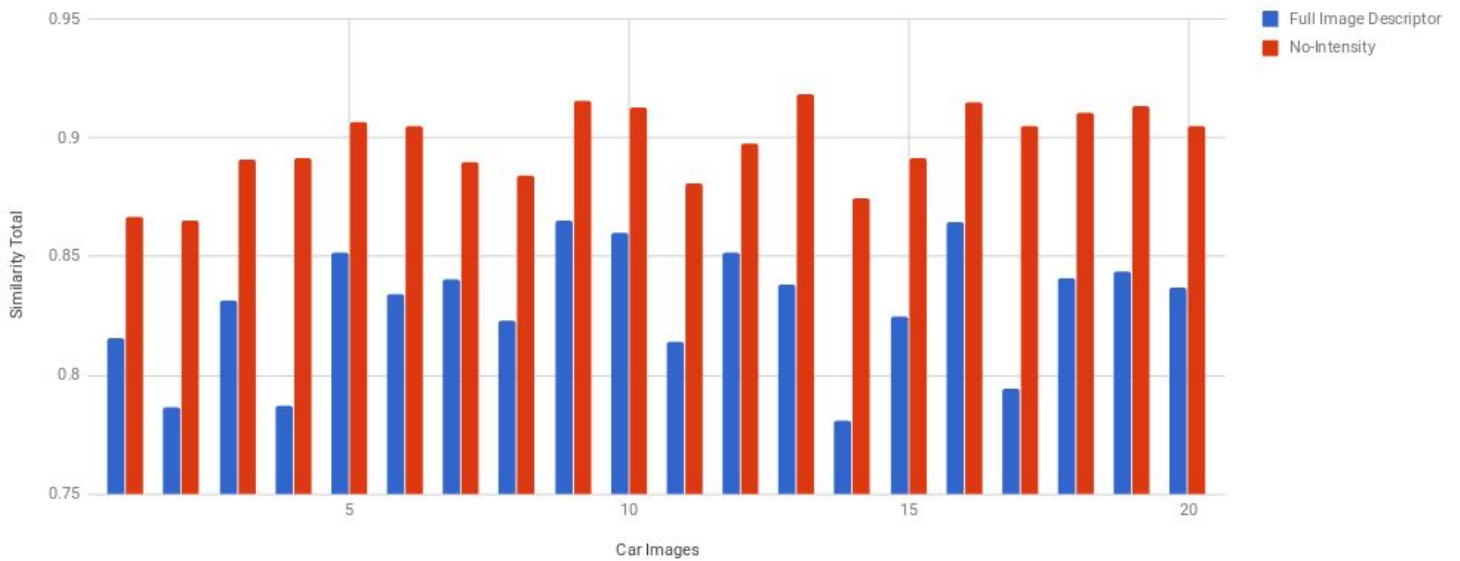Magnitude vs Direction vs Intensity vs Full Image Descriptor
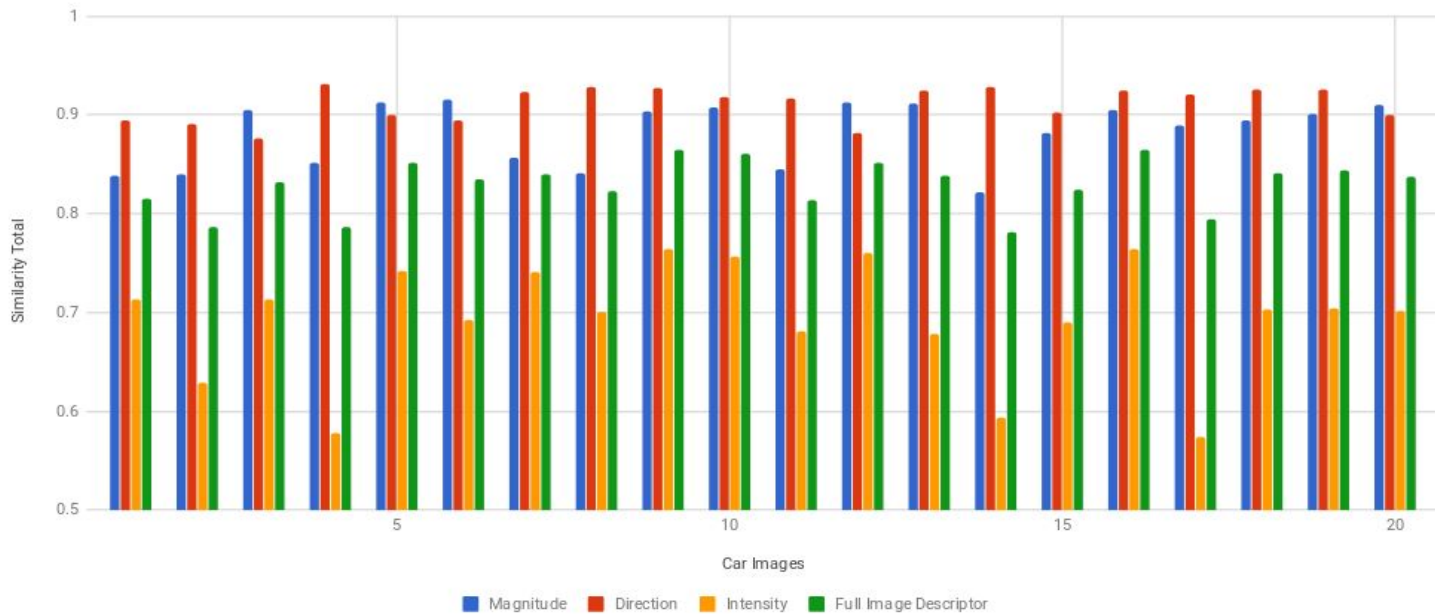
	Magnitude	Direction	Intensity	Full Image Descriptor
Total Percentage	0.8820496158	0.9117152856	0.6941772756	0.829314059

The results showed that intensity provided the least accuracy among cars and actually brought down the image descriptor accuracy. Direction had the highest accuracy being slightly above magnitude. Full Image Descriptor fell somewhere in the middle.

Discussion

Cars seemed to be least affected by the images intensity and couldn't be used accurately to predict whether something was a car or not. So I decided to try taking intensity out of the image descriptor.

Full Image Descriptor vs - Intensity

	Magnitude	Direction	Intensity	Full Image Descriptor	No-Intensity
Total Percentage	0.8820496158	0.9117152856	0.6941772756	0.829314059	0.8968824461

Taking it out of the image descriptor increased it's accuracy towards cars, so may provide a better way to detect whether something is a car or not.

Conclusion

In conclusion the part of the image descriptor that provided the highest accuracy was direction, which edged out just over magnitude. Intensity was the least useful giving the lowest margin of accuracy out the the filters. The image descriptor could be improved by taking out the intensity portion of the descriptor. This doesn't necessarily mean that it is the best way to test whether images are alike as no comparisons were done between images of other types.