Math 142 Reading Week 9

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1 4.1.3 Feature Matching

Once we have features and their descriptors, we need to establish matches between the images. This problem has two components:

1. Select a matching strategy

2. Devise efficient data structures and algorithms to perform this matching as quickly as possible

We first have to assume that the feature descriptors have been designed such that Euclidean distances in feature space can be directly used for ranking potential matches. If it turns out that certain parameters (axes) in a descriptor are more reliable than others, it may be preferable to re-scale these axes ahead of time.

A more general process involves transforming feature vectors into a new scaled basis is called **whitening**.

Given a metric, the simplest matching strategy is to set a threshold for maximum distance and return all matches from other images within this threshold. Setting it too high leads to false positives, and setting it too low leads to too many false negatives. Definitions:

- **TP**: True positives; the number of correct matches

- **FN**: False negatives; matches that were not correctly detected

- **FP**: False positives; proposed matches that are incorrect

- **TN**: True negatives, non-matches that were correctly rejected

We can use these to calculate statistics:

$$\text{True Positive Rate (TPR)} = \frac{TP}{TP + FN} \tag{1}$$

$$\text{False Positive Rate (FPR)} = \frac{FP}{FP + TN} \tag{2}$$

$$\text{Positive Predivtive Value (PPV)} = \frac{TP}{TP + FP} \tag{3}$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FP + TN + FN} \tag{4}$$

We sometimes call the PPV *precision* and the TPR *recall*. Any particular matching strategy can be rated by the TPR and the FPR. Namely, we want the TPR to be close to 1 and the FPR to be close to 0. As we vary the threshold, we can obtain a familt of (TPR, FPR) points. Collectively, we cann this the **receiver operating characteristic (ROC)** curve. The ROC curve can be used to calculate the *mean average precision*, which is the average PPV as you vary the threshold to select the best results, then the top two results, etc.