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Lab 7

Supervised classification is a type of classification that involves a human analyst specifying examples of each class in the training data based on the analyst's expert knowledge. The algorithm then classifies the rest of the data based on those training examples by comparing each pixel in the full data set to the training samples and labeling the unknown pixels according to similarity. Maximum likelihood estimation is one type of supervised classification that uses decision rules based on probabilities. The algorithm calculates the probability that each pixel belongs to each class, and the pixel is assigned to the class with the highest probability.

Maximum likelihood is a widely used algorithm and tends to be accurate. It also takes more variables into account than other methods of classification. However, this algorithm assumes class samples are normally distributed, which might not always be the case. It is also computationally intensive because of the need to calculate a co-variance matrix, it is non-spatial (meaning that it doesn't consider where each pixel is located in the larger context of the full image), and it tends to overclassify signatures with large values in the covariance matrix (meaning that if a class has a lot of variability, many unknown pixels will end up in that class).

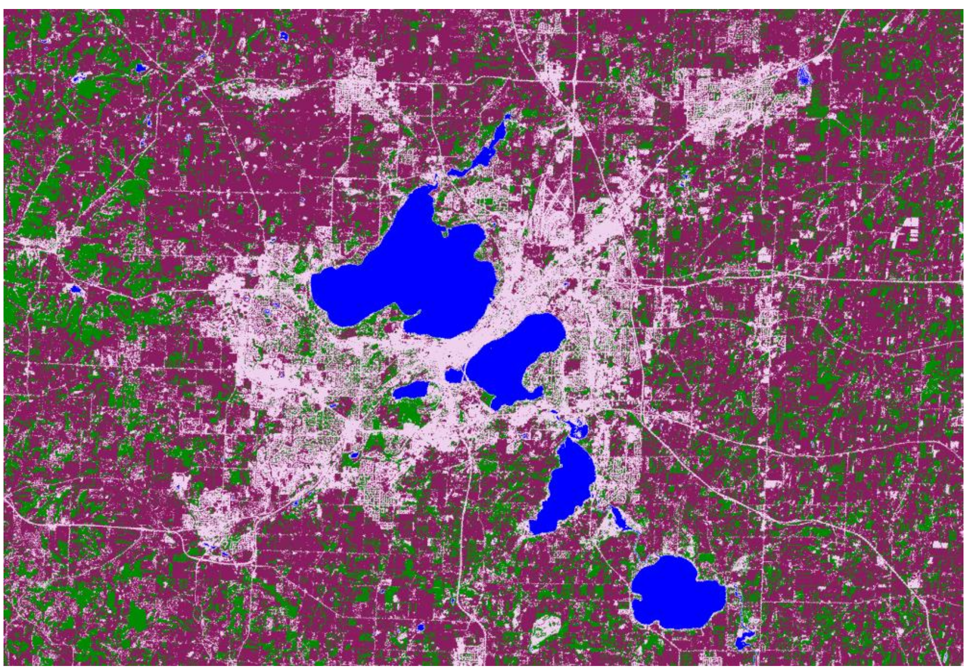

Figure 1. The map of the Madison, Wisconsin area produced using the maximum likelihood estimation supervised classification technique. In the map, water is shown in blue, crop cover is shown in dark pink, forest is shown in green, and built areas are shown in light pink.

Support vector machines (SVM) are another type of supervised classification algorithm. They are a linear classifier derived from statistical learning theory. The goal of this algorithm is to find the optimal hyperplane that separates the classes in the data. The algorithm calculates multiple “support vectors,” or lines through the data that separate classes, and then finds the line that maximizes the distance between all data points and the vector. This line becomes the optimal hyperplane that is used to classify the remainder of the data. SVM can also be extended to non-linear data by using kernal functions to transform training data into a higher dimensional feature space. SVM is traditionally a binary classifier. It can use a one vs. all other classes approach (comparing cropland to all other classes, then forest to all other classes, etc.) or a one vs. one approach for all class pairs (comparing forest to water, forest to cropland, water to cropland, etc.). This type of pairwise comparison can become very computationally intensive as the number of classes increases, so it is typically best to keep the classes broad and use hierarchical classification to get more granular classifications. For this reason, SVM is a good classifier to use with a small amount of training data, but it becomes more difficult with larger amounts of data. Unlike most other classifiers, adding more training data does not necessarily improve the output of the algorithm. Once the support vectors are calculated, additional training data is not used.

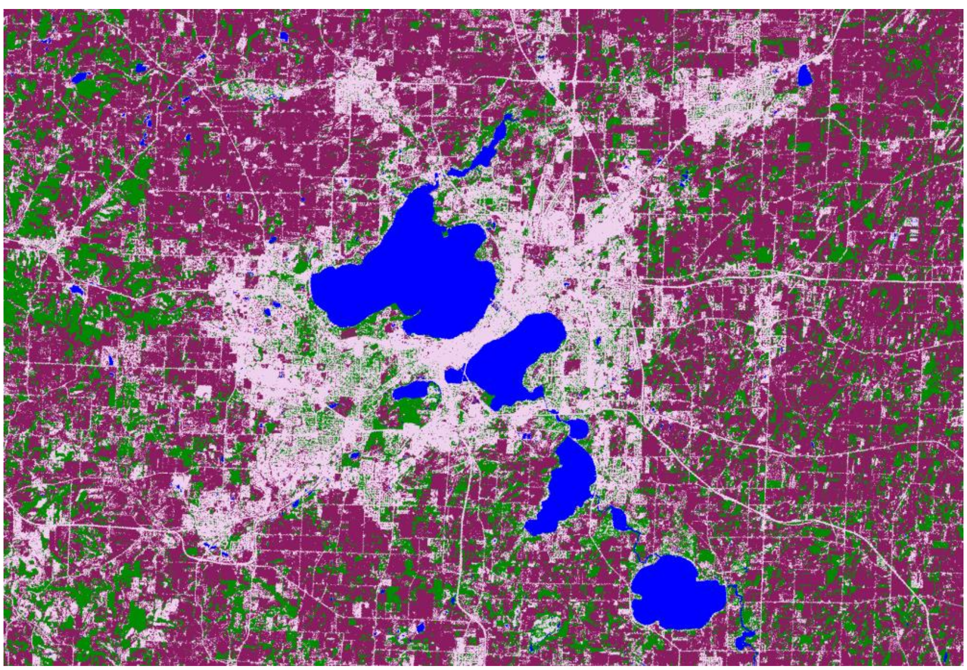

Figure 2. The map of the Madison, Wisconsin area produced using the support vector machine (SVM) supervised classification technique. In the map, water is shown in blue, crop cover is shown in dark pink, forest is shown in green, and built areas are shown in light pink.