Learning distance measures from labeled data — An overview
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This is not a complete list, but a selective sampling of the main approaches.

Wrapper method Given a space of distance measures, e.g. all ways of weighting individual features for Euclidean distance, choose the one which minimizes the leave-one-out score of nearest neighbor. For 1-NN, this tries to ensure every individual's nearest neighbor is in the same class. Analogous to methods for feature selection. Very computational.

"Same versus different" classifier Set up a classification problem where the input is two individuals and the output is 0 if they are in the same class and 1 if they are in different classes. Solve it using a classifier which provides continuous output, like an SVM or neural network. The continuous output of the trained classifier can now be used as a distance measure. See (Mahamud, 2002).

Canonical distance measure Fit generative models to the classes. The distance measure is the probability that two individuals were sampled from different generative models. Model are often fit separately for each dimension, corresponding to a naive Bayes assumption. There are many papers on this. See (Blanzieri & Ricci, 1999) and references therein. Similar to, but more general than, relevance weighting approaches below.

"Relevance" weights Give each feature a weight based on some measure of its ability to separate classes. Can be done local to the points being compared. See (Friedman, 1994) and (Hastie & Tibshirani, 1996).

References

Blanzieri, E., & Ricci, F. (1999). A minimum risk metric for nearest neighbor classification. *Proc. 16th International Conf. on Machine Learning* (pp. 22–31). Morgan Kaufmann, San Francisco, CA.

Friedman, J. (1994). Flexible metric nearest neighbor classification.

Hastie, T., & Tibshirani, R. (1996). Discriminant adaptive nearest neighbor classification. *IEEE Pattern Analysis and Machine Intelligence*, *18*, 607–616. http://citeseer.nj.nec.com/hastie94discriminant.html.

Mahamud, S. (2002). *Discriminative distance measures for object detection*. Doctoral dissertation, CMU. http://www-2.cs.cmu.edu/ mahamud/recognition/recognition.html.