Intelligent Audio Systems:
A review of the foundations and applications of semantic audio analysis and music information retrieval
These lecture notes contain hyperlinks to the CCRMA Wiki.

On these pages, you can find additional supplement the lecture material found in the class - providing extra tutorials, support, references for further reading, or demonstration code snippets for those interested in a given topic.

Click on the symbol on the lower-left corner of a slide to access additional resources.

WIKI REFERENCES...
Review from Day 4

• What are the 3 major components of a MIR system?
• Define Temporal Attack time and how it might be used to characterize a sound...
• What’s “Spectral Brightness”?

k-means is an algorithm that does “hard clustering.” What does that mean?

• How did the lab go?
Supervised vs. Unsupervised

- Unsupervised - “clustering”
- Supervised – binary classifiers (2 classes)
- Multiclass is derived from binary
Classification

- Classification – class labels (discrete or nominal)
- Regression – models continuous-valued function
SVM

[draw on board]
SVM

- Hyperplane separates the data from the two classes with a “maximum margin”.
- Support Vectors - are those data points that the margin pushes up against
- SVM training is guaranteed to find the global minimum of the cost function.
- Less experience needed - fewer parameters to tune

- >> svmdemo
How would you classify this data?

Any of these would be fine..

..but which is best?

Define the **margin** of a linear classifier as the width that the boundary could be increased by before hitting a datapoint.

The **maximum margin linear classifier** is the linear classifier with the, um, maximum margin.

This is the simplest kind of SVM (Called an LSVM)
What effect do the parameters of an radial-basis-function SVM have on the separating the two data sets?

Using the RBF kernel, we have to choose values of:

- **gamma** = degree of curviness of the hyperplane / complexity of the contour
- **C** = allowance for points to overlap into each other’s class
RBF Parameters: C and gamma

• Grid search using cross-validation to find the best one. Coarse then fine grid search.
• e.g., 2-5, 2-3, ... 2+15, gamma = 2-15, 2-13, 2+3
• Why grid search
  – Psychological (If you have time for brute force... why chance it on approximations or heuristics)
  – Since there are only 2 params, grid search isn’t all the different from advanced estimation techniques
  – Easily parallelized (C and gamma are independent)
• Large datasets
  – Random sample as approximation
SVM Parameters

• Whew!
• Grid search for finding the optimum parameters.
• You can manually tweak to reduce F+ or F- rate, but is generally not necessary or wanted.

• You can get approx. probability information, too. (Distance from the margin)
Practical Guide to SVM: The Lab

- Feature selection?
- Scale feature data
  - Save scaling stats so we can scale the test data to be in the same range
- Feature format
- Class labels \{1,-1\} or \{0,1\}
- Kernels (linear, polynomial, RBF, sigmoid)
- Find best C and gamma (cross-validation)
- Train with entire training set
- Test with validation or test set

- easy.py or grid.py
One-class SVM

- Binary classifiers rely on positive and negative examples of training data.
- One-class classifiers, however, only rely on positive examples. Great for models where the negative examples are not easily definable. (e.g., a classifier that detects “funky” sounds)
- Parameter: $\nu$ (“nu”)
One-class SVM

- $\nu$ equals the % of training examples that you are willing to get wrong. (e.g., 10% error rate on training set is $\nu$ of 0.1)
SVM References

Libsvm and Libsvm Tools
- http://www.csie.ntu.edu.tw/~cjlin/libsvm/
- http://www.csie.ntu.edu.tw/~cjlin/libsvmtools/

SVM Practical (How to get good results without cheating)
- http://www.kyb.tuebingen.mpg.de/bs/people/weston/svmpractical/