CS 675 final exam review sheet

1. Feature selection: chi-square, F-score, Pearson, multivariate
   a. Given the formula rank features by the statistics
2. Kernel methods – kernel k-means
   a. Distance between two points in kernel space
   b. Kernel version of nearest means and nearest neighbors
3. Dimensionality reduction: Principal component analysis, maximum margin criterion
   a. Variance and means of projected data
   b. Laplacian of graph – how does Laplacian connect to dimensionality reduction and clustering?
   c. Relaxing an NP-hard problem into a smooth objective
4. Clustering: k-means, graph methods
   a. Basic min-cut approach to clustering
   b. Spectral clustering (Shi and Malik)
   c. K-means algorithm – run on a simple example
5. Empirical and regularized risk
   a. Loss functions
   b. Effect of L1 vs L2 norm regularization
6. Decision trees
   a. Simple example on how to split a feature to create a new node (greedy algorithm)
   b. CART algorithm
7. Ensemble methods:
   a. Bagging, Random forest
   b. Boosting – Basic Adaboost algorithm
8. Regression
   a. Linear regression, support vector regression, regression with decision trees
   b. Regularized regression
9. HMMs: four problems
   a. Calculate probability of hidden and observed state sequence
   b. Find the most probable hidden sequence (Viterbi)
   c. Calculate probabilities from hidden sequences (maximum likelihood)
   d. Baum-Welch (forward probabilities, total probability, EM algorithm)
10. Runtimes:
    a. One iteration of gradient descent, one iteration of K-means
    b. Viterbi algorithm for HMMs
    c. CART (one recursion)
    d. Naïve-Bayes
11. Neural networks
    a. Optimization objective for a simple perceptron (least squares)
    b. Objective for a single layer neural network
12. Convolutional neural networks
    a. Convolution kernel
    b. Pooling
13. Multiple choice
    a. Comparison of classifiers
    b. Big data methods
14. Advanced topics
    a. Random projections for dimensionality reduction and classification
    b. What are the properties of random projections and signed random projections?
    c. Method for learning features based on k-means for image data