Homework 3
CS273A Machine Learning
Fall 2015
Due: Tuesday October 27 11:59pm on EEE

Choose one of these two problems:

1. Implement and test the k-means algorithm and the EM algorithm for mixture of Gaussians clustering with unknown cluster means (at least). Compare the two quantitatively, as in previous homeworks, using synthetic data (from a mixture of Gaussians).

   Hint: It should be straightforward to find a parameter regime in which the EM algorithm has more accurate clustering performance, for example in terms of cluster means and cluster memberships. Generically, i.e. almost everywhere in parameter space, k-means should be less expensive to run in terms of computational resources. We would like to understand the tradeoff.

2. Back-propagation multilayer perceptron (MLP): Modify your backpropagation code from HW2 to add tangent propagation (Bishop 5.5.4) *or* convolutional network (Bishop 5.5.6), or other rotation-resistant method of your choice (beyond vanilla back-propagation). Test on OCR (as in previous homeworks), but now *with* rotations of up to plus or minus some limiting angle θ (for tangent propagation) and/or translations of up to plus or minus P pixels (for convolutional network). Test quantitatively, as in previous homeworks. For what θ or P are you able to get adequate classification? (And what criterion for "adequate" did you use?)

   Alternatively, code up and test quantitatively some other advanced MLP backpropagation method that interests you, such as second order optimization methods (Bishop 5.4) or the drop-out algorithm (not covered in class).

Extra credit: Do the other problem, too.