EEL806: Major Test

November 23, 2013

Maximum Marks: 40

1. (a) Describe and compare moment based and contour based shape representation schemes. **[6]**

   (b) Discuss how irregular shaped objects can be compared using *any one* of the above representation schemes with reference to possible transforms (e.g., scaling, rotation, etc.) in the object. [Explain the principles — detailed formulae are not necessary.] **[4]**

2. Suppose that you have a collection of a million images. Suppose that you need to implement k-nearest neighbour (k-nn) search in the collection using an image feature (say, colour histogram) that is expressed as a 256-dimensional vector.

   (a) Describe a method *in detail* to implement such search. **[6]**

   (b) Will this method provide exact results or approximate results? Explain how. **[2]**

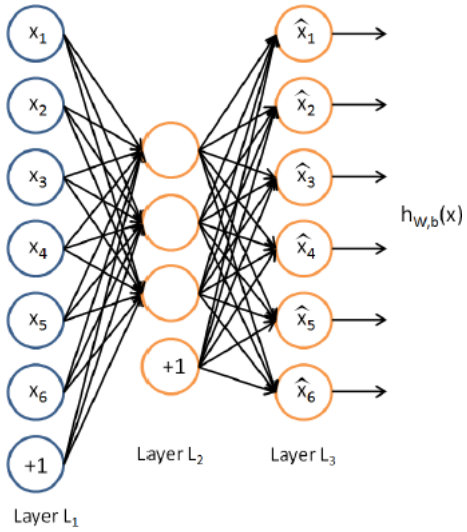
   (c) What will be the time-complexity of search using this method? **[2]**

3. Why are latent structure discovery and dimensionality reduction so useful in computer vision? Explain with an example. **[3]**

4. (a) Describe the process for forming a SIFT feature vector for a given image. What are the key aspects of an image that SIFT features are able to capture? **[6]**

   (b) How are SIFT features used to form a visual vocabulary for a bag-of-words model? How are such models useful? **[3]**

5. Shown below is a sparse autoencoder; this is trained via backpropagation, with the target value for output node $\hat{x}_i$ set equal to the corresponding input value x_i.



(a) State, in words, what function/mapping this is trying to learn. What is the purpose of doing so? **[1]**

(b) Describe how you could impose a sparsity constraint on the hidden units. How would your error function get modified in doing so? You may use whatever notation is helpful, but please make sure to explain it all clearly. **[5]**

(c) How can such a model be used to carry out *deep learning*? Why is this useful for vision applications? **[2]**