

Homework #8

Due Date: Apr. 9, 2002

1. [10 each] Lim, Problems 10.11, and 10.22.
2. [20] Lim, Problems 10.9. Let the training vector be $(f_1, f_2) = (1, -1), (0, 2), (-1, 1), (-2, 0)$. Use initialization vectors of $[(1, -1), (-1, 1)], [(-2, 0), (0, 0)],$ and $[(-2, 0), (-.5, 1.5)]$. Do these yield the same answer? Why? Compare the results, which is best?
3. [10] Pyramid coder. Suppose we have a 257×257 image that we wish to quantize using pyramid coding. We will quantize the following images using the following bit rates:

| | |
|-------------|-------------|
| $e_0(n, m)$ | 1 bit/pixel |
| $e_1(n, m)$ | 2 bit/pixel |
| $e_2(n, m)$ | 4 bit/pixel |
| $f_3(n, m)$ | 6 bit/pixel |

e_0 is the base of the pyramid and f_3 is the top level image.

 - a. What are the sizes of these four images to be coded?
 - b. What is the average bit rate for this example?
4. [50] Vector Quantization (VQ). Download the template `hw8_template.m` plus files `kmeans.m` and `dist2.m` for use in this problem. This problem will again use the house image from homework #7. We will implement VQ for 2×2 regions of the image (length 4 vectors).
 - a. For an average of 1 bit/pixel quantization, how many reconstruction levels, L , are required.
 - b. Choose 1000 training image vectors at random and use them to create an “optimal” set of reconstruction levels.
 - c. Quantize the entire image in to a code vector (one number for every 2×2 block of the image). Use the `hist` function to plot the frequency of each reconstruction level.
 - d. Reconstruct the image (Matlab code for this is already there) can calculate the average distortion. Display reconstructed image and error image using `imagesc`.
 - e. Repeat steps a.-d. for an average of 2 bits/pixel quantization.
5. [50] PCM with Robert’s pseudonoise technique. Using the same image as the VQ problem, we will investigate distortion .
 - a. Implement PCM *with* the Robert’s pseudonoise technique for 2 bits/pixel on the image of the house. Determine the average distortion.
 - b. Implement PCM *without* the Robert’s pseudonoise technique for 2 bits/pixel on the image of the house. Determine the average distortion.
 - c. Display reconstructed images and error images for each method.
 - d. Repeat part a. for 2-7 bits/pixel. Compare to distortion measures to those of VQ.