

Neural Networks and Adaptive Systems (ECE656)

Computer Assignment 4 (SOM and Image Data Compression-Due Dec 10, 2015)

The purpose of this computer assignment is to design a self-organized feature map (SOM) to perform vector quantization (VQ) on digital images. The aim is to reduce the number of bits for efficient representation of images prior to transmission or storage. There are several images in class URL namely Lena and Baboon that could be used. These images are of size 512x512 pixels with 8 bits per pixel (bpp) resolution.

1. Partition one of the images into non-overlapping blocks of sizes 4x4 and train various SOM networks to establish the codebook vectors. To determine the optimum number of codebook vectors increase the number of neurons in SOM from 16 to 256 (e.g., 16, 32, 64, 128, and 256).
2. Devise a scheme to reconstruct the image from the string of codes and using the codebook vectors. For each case in Part 1, compute the compression rate[‡] and distortion ($SNR_{dB} = 10 \log_{10} \sigma_{original}^2 / \sigma_{error}^2$ where $\sigma_{original}^2$ and σ_{error}^2 are variances of the original and error images, respectively). Present the performance plots, SNR versus bpp, for each case and then experimentally determine the optimum number of codebook vectors considering both the visual appearance of the reconstructed image and compression rate versus distortion trade-off. For the optimal number of the codebook vectors, study the effects of increasing the block size to 8x8 on the visual appearance of the reconstructed images and performance of the encoding process.
3. Demonstrate the generalization ability of the optimal SOM structure on a different image and comment on the usefulness of the encoding process for real VQ implementation.
4. Provide a discussion on your results and point out the advantages/disadvantages of your SOM network as an image encoding system in a brief report.

[‡] In computing the compression rate the number of bits required for codebook vectors, block locations, and code string for each coded block should be considered.