

## Neural Networks and Adaptive Systems (ECE656)

### **Computer Assignment 4 (SOM and Image Data Compression)**

The purpose of this computer assignment is to design a self-organized feature map (SOFM) 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 Computer Assignment 4 folder on Canvas namely Lena and B that could be used. These images are of size 512x512 pixels with 8 bits per pixel (bpp) resolution.

1. Partition one of the images used for training into non-overlapping blocks of sizes 4x4 and train various SOFM networks to establish the codebook vectors. To determine the optimum number of codebook vectors increase the number of neurons in SOFM from 16 to 256 (e.g., 16, 32, 64, 128, and 256).
2. Determine the topologically ordering of the SOFM that you generated. What is your observation/conclusion?
3. 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<sup>‡</sup> and distortion ( $SNR_{dB} = 10 \log_{10} \sigma_{original}^2 / \sigma_{error}^2$  where  $\sigma_{original}^2$  and  $\sigma_{error}^2$  are variances of the original and error images, respectively). Present the performance plots, SNR<sub>dB</sub> 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.
4. Demonstrate the generalization ability of the optimal SOFM structure on a different image and comment on the usefulness of the encoding process for real VQ implementation.
5. Provide a discussion on your results and point out the advantages/disadvantages of your SOFM network as an image encoding system in a brief report.

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<sup>‡</sup> In computing the compression rate the number of bits required for block locations and code string for each coded block should be considered. Here, we assume codebook vectors have already been encoded and available to the reconstruction system.