Homework 1 **EECS 651** **Due: Fri., Jan. 12, 2001**
in class, before lecture begins

Reading Assignment: Read Chapter 1, *Digital Video: an Introduction to MPEG-2*,
by Haskell, Puri, &Netravali

In this homework you will run the JPEG image compression algorithm on the image "lena" with various "quality factors" and compute encoding rates and signal-to-noise ratios. Instructions for doing so are given below. The goal is to give you some feeling for typical values of encoding rate and the significance of various signal-to-noise ratios.

(1) (a) By trial and error encoding and decoding of the image, find (to within a couple of tenths) the smallest encoding rate (in bits/pixel) at which the compressed image is indistinguishable from the original. The answer is somewhat subjective. What quality factor did you select?

(b) Compute the resulting signal-to-noise ratio (SNR) in dB. The signal-to-noise ratio, is the ratio of the empirical variance of the image to the average of the squared differences between pixels of the original and encoded versions of the image. Taking $10 \log_{10}$ of the ratio gives the SNR in dB.

(2) Estimate the smallest encoding rate that gives "satisfactory quality". This is even more subjective than the part (a). State the quality factor and compute the resulting SNR (in dB).

(3) Encode the image using half the rate found in (2), state the quality factor, compute the resulting SNR, and comment on the appearance of the decoded image in comparison to the decoded image in (2).

(4) Encode the image at SNR 3 dB less than found in (2). State the quality factor, find the resulting rate, and comment on the appearance of the decoded image in comparison to the decoded image in (2).

(5) Find the encoding rate achieved by the UNIX "compress" command applied to lena. This applies a version of the Lempel-Ziv lossless compression algorithm. (As a sanity check, you may want to decode the compressed file using "uncompress" and check that the original and decompressed files are identical using the "diff" command.) Compare the rate to that found in (1).

(6) Find the encoding rate achieved by "compress" on the encoded versions of the image produced in (1) and (3). Did "compress" achieve significant additional compression?

Instructions for obtaining the image "lena" and for JPEG encoding/decding and for computing signal-to-noise ratio can be found on the class website at

www.eecs.umich.edu/courses/eecs651/hw1_instrns.html