Use MATLAB/Python to do the tasks below. Your submission should include all the program files and generated output files. Submission should be a compressed file named 'EE277_ME2_<lastname>.zip'.

EE 277 Machine Exercise #2

Error Correction in Image Files

Introduction: Consider an image file being transferred from one memory location to another through a binary symmetric channel (BSC) with error probability p (shown in figure 1). As expected, some image bits flip from '0' to '1' and vice versa when the message is passed through a BSC. The effect of the flipped bits is depicted in the noisy output image in figure 1. In order to reduce the effect of noise in the output image, we can add an error-correcting code (ECC) to the system. A comparison of the image quality between an image transfer with error correction and without error correction at p = 0.025 is shown in figure 2a and 2b.

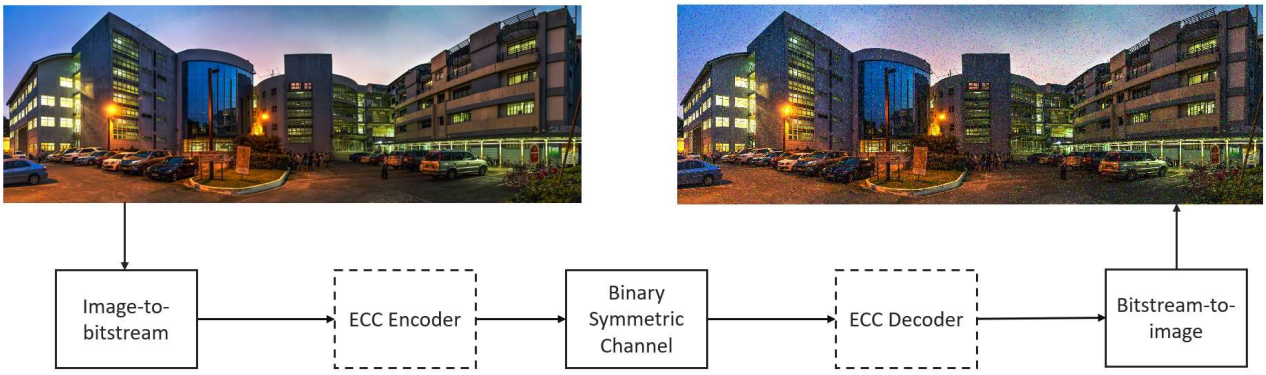


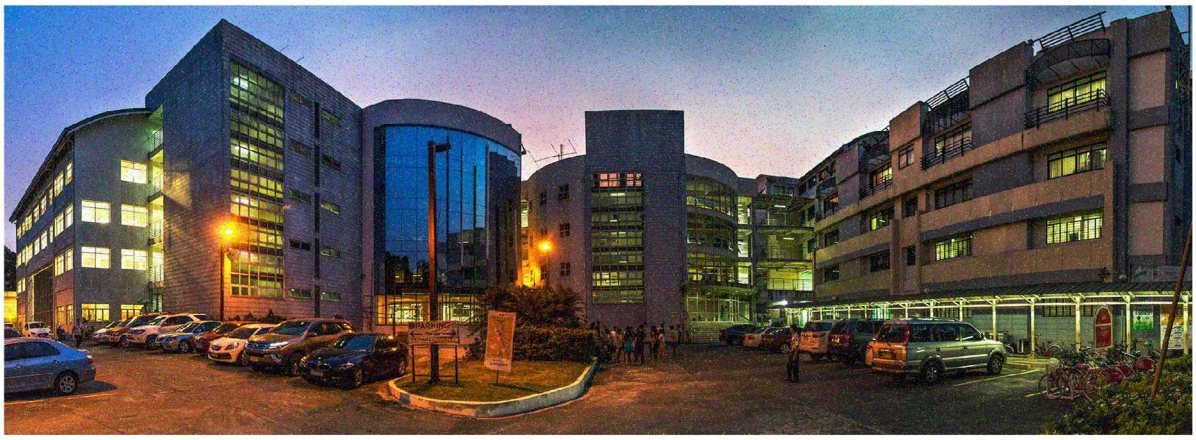
Figure 1. Block diagram of image transfer

Task: You are already given a MATLAB code template for the image-to-bitstream converter, Binary Symmetric Channel, and bitstream-to-image converter. Your task is to implement a (7,4) Hamming code encoder and decoder block. Details on how to implement the (7,4) Hamming code can be found on the SimEx2 supplementary notes uploaded in UVLE. You may use the EEEI_bldg.bmp as your test image.

Your submission should include the MATLAB scripts used for the simulation exercise and a document that shows and explains the output of the following subtasks:

T1: Take a selfie and use it as input to your MATLAB scripts. Generate the output of the system with ECC and system without ECC for p = 0.05, p = 0.025, p = 0.0125. Save the results in a .bmp file and/or .fig file.

T2: For the given test image, plot the ratio of the number of correct pixels to the total number of pixels as a function of the BSC error probability p. Do this for both no ECC and with ECC and superimpose the plots into one figure. X-axis should be from p = 0.005 to 0.05 with increments of 0.005. Discuss your results. (HINT: Total number of pixels is 736x2048 = 1,507,328). Save the plot in a .png file and/or .fig file.



(a) Output image w/o ECC

(b) Output image w/ ECC

Figure 2. Comparison of output images @ p = 0.025 with and without ECC