Homework 3

Problem 1

a.

Decision levels: [0,0.7625) [0.7625,1.38833) [1.38833,2.08333) [2.08333,3)

Reconstruction levels: r0=0.525, r1=1, r2=1.77667, r3=2.39

b.

Quantized data: [0,0,0,0,1,1,1,1,1,1,1,1,1,1,2,2,2,2,2,2,3,3,3,3,3,3,3]

Dequantized data:
[0.525,0.525,0.525,0.525,1,1,1,1,1,1,1,1,1,1,1.77667,1.77667,1.77667,1.77667,1.77667,1.77667,2.39,2.39,2.39,2.39,2.39,2.39,2.39]

MSE = 0.0357272

c.

Decision levels: [0,1) [1,2) [2,3)

Quantized data: [0,0,0,0,0,0,0,1,1,1,1,1,1,1,1,1,1,1,1,1,2,2,2,2,2,2,2]

Dequantized data:
[0.5,0.5,0.5,0.5,0.5,0.5,0.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,1.5,2.5,2.5,2.5,2.5,2.5,2.5,2.5]

MSE = 0.104115

d.

Decision levels: [0,0.75) [0.75,1.5) [1.5,2.25) [2.25,3)

Reconstruction level: r0 = 0.525, r1 = 1, r2 = 1.8825, r3 = 2.466

Quantized data: [0,0,0,0,1,1,1,1,1,1,1,1,1,1,2,2,2,2,2,2,2,2,3,3,3,3,3]

Dequantized data:
[0.525,0.525,0.525,0.525,1,1,1,1,1,1,1,1,1,1,1.8825,1.8825,1.8825,1.8825,1.8825,1.8825,1.8825,1.8825,2.466,2.466,2.466,2.466,2.466]

MSE = 0.0419396

e.

MSE(optimal quantizer) < MSE(semi-uniform quantize) < MSE(uniform quantizer)

Problem 2

a.

The entropy of the river image is 6.617739618282519

b.

Entropy(G') = 2.378872043027084

SNR = 19.419938240233314

The image is shown: [problem2b.jpg]

c.

Entropy(G') = 2.378872043027084

SNR = 19.510872974668423

The image is shown: [problem2c.jpg]

d.

Entropy(G') = 2.405483178698946

SNR = 19.566819125946930

The image is shown: [problem2d.jpg]

e.

Entropy(b) = Entropy(c) < entropy(d)

The image in (b) is similar to the image in (c) except the contrast of (b) is a little higher than that of (c)

The image in (d) is closer to the original image comparing to (b) and (c)

Problem 3

b.

Entropy1 = 4.693651018117509,

Entropy2 = 4.950794159503234,

Entropy3 = 5.117367195732673,

Entropy4 = 5.092177858646918,

Entropy5 = 5.063869582877490

The group 1 has the lowest entropy

The residual image: [problem3b.jpg]

c.

Entropy(e) = 2.072230056288189;

d.

The image is shown: [problem3d.jpg]

SNR = -4.093905948756089

e.

The image is not recognizable because the quantize level is too small, causing too much information lost.

If we increase the quantizing levels, the quality may be better.

Problem 4

a.

bitrate: 9/64, compress ratio = 64/9

b.

The image is shown: [problem4b.jpg]

SNR = 14.157160402680258

c.

The image is shown: [problem4c.jpg]

SNR = 15.272749740066140

d.

The image is shown: [problem4d.jpg]

SNR = 15.748858685131538

e.

The image is shown: [problem4e.jpg]

SNR = 14.925232783485583

f.

bitrates(b) > bitrates(c) > bitrates(d) > bitrates(e)

SNR(d) > SNR(c) > SNR(e) > SNR(b)

Sharpness(b) > Sharpness(c) > Sharpness(d) > Sharpness(e)