Quiz 6: CS4640 Name _____

1. Consider the image:

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21 21 21 95 169 243 243 243
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1a. What is the entropy (in bits) of the image? (Give details of the calculation, and assume $log_2(\frac{3}{8}) = -1.415$.)

Let the symbols be $a_1 = 21$, $a_2 = 95$, $a_3 = 169$, $a_4 = 243$

$P(a_1) = 3/8$

$P(a_2) = 1/8$

$P(a_3) = 1/8$

$P(a_4) = 3/8$

$$H = -\sum_{i=1}^{4} P(a_i) \log_2 (P(a_i)) = -\left(\frac{1}{8}\log_2\frac{1}{8} + \frac{3}{8}\log_2\left(\frac{3}{8}\right) + \frac{3}{8}\log_2\left(\frac{3}{8}\right) + \frac{1}{8}\log_2\frac{1}{8}\right)$$

$$= +\left(\frac{2}{8}3 + 2 * \frac{3}{8} * 1.415\right)$$

$$= \frac{6}{8} + \frac{6}{8} \cdot 1.415 = 1.8113$$

1b. Give the Run-Length Encoding of the image (assume runs are ordered left-to-right, top-to-bottom).

3,21,1,95,1,169,3,243,3,21,1,95,1,169,3,243,
3,21,1,95,1,169,3,243,3,21,1,95,1,169,3,243

2. Given the image in question 1, and using a 4x4 block from the image, suppose:

$$W = dct2(im(1:4, 3:6)) = \begin{matrix} 21 & 95 & 169 & 243 \\ 21 & 95 & 169 & 243 \\ 21 & 95 & 169 & 243 \\ 21 & 95 & 169 & 243 \end{matrix}$$

Also, suppose that all of 4x4 W_p is set to 0, except for $W_p(1,1)$ which is set to $W(1,1)$. Show the image, imr, reconstructed from W_p (i.e., imr = idct2(W_p)).

This will be the mean value of the window from the image

$$imr = \begin{bmatrix} 132 & 132 & 132 & 132 \\ 132 & 132 & 132 & 132 \\ 132 & 132 & 132 & 132 \\ 132 & 132 & 132 & 132 \end{bmatrix}$$

3. Suppose $N = 4$, and that:

$$\bar{s}_u(x) = \frac{1}{\sqrt{N}} e^{\frac{j2\pi ux}{N}}$$

$$\bar{s}_v(y) = \frac{1}{\sqrt{N}} e^{\frac{j2\pi vy}{N}}$$

$$S_{uv} = \bar{s}_u \bar{s}_v^T$$

Then what are the following values:

3a. $\sum\sum S_{01} . * S_{10} =$ 0

3b. $\sum\sum S_{00} . * S_{00} =$ 1

3c. $\sum\sum S_{12} . * S_{33} =$ 0

3d. $\sum\sum S_{22} . * S_{22} =$ 1

3e. $\sum\sum S_{44} . * S_{11} =$ 0