BENC 4173: MULTIMEDIA TECHNOLOGY & APPLICATION
TUTORIAL 3: DIGITAL IMAGE

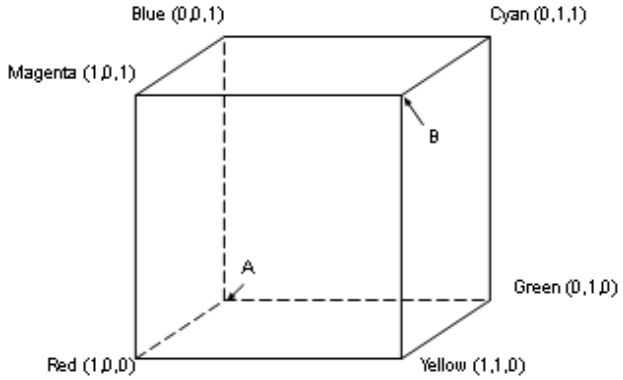
1. Which of the following can result from a sampling rate that is too low?

a. quantization noise
b. blurriness
c. both a and b
d. neither a nor b

2. Which of the following could result in a moiré pattern?

a. A woven fabric viewed through a screened window.
b. A sheer loosely-woven curtain that doubles back on itself and has the light shining through it.
c. A patterned tie in a digital photograph taken at an inappropriate resolution.
d. All of the above.

3. Where is black on the RGB cube below?



a. Point A
b. Point B
c. The center of the cube
d. Since black is the absence of color, it is not represented in the area of the cube.

4. Which of the following is (or are) true about the discrete cosine transform as a step in JPEG compression?

a. It is optional.
b. It makes compression possible by separating out the frequency components of an image.
c. It transforms image data from the frequency domain to the spatial domain.
d. It is the last step in JPEG compression.

5. What does 4:2:0 mean in chrominance subsampling?

a. For each block of four pixels, four total samples are taken for the chrominance components, and one sample is taken for the luminance component.

b. For each block of four pixels, four luminance samples are taken, two samples are taken for one of the chrominance components, and zero samples are taken for the other chrominance component.

c. For each block of four pixels, four luminance samples are taken, and two samples are taken for each of the chrominance components.

d. For each block of four pixels, four luminance samples are taken, and one sample is taken for each of the chrominance components.

6. Explain how moiré patterns are formed and how they are related to sampling rates and aliasing. What kind of digital images are most likely to result in moiré effects when sampled?

7. Briefly explain how the DCT can be utilized in image compression algorithms such as JPEG.

8. Suppose you have a detailed picture that you took on a digital camera. You import the picture into Photoshop, then attempt to save it. Should you save it as a GIF file or a JPEG file? Why?

9. Explain what is meant by the term “chrominance downsampling” with YUV color. Why is it used in the JPEG compression algorithm? Include the specifics of 4:2:0 chrominance downsampling.

10. Suppose you have an 8 x 8 block of pixels that you are going to compress using the JPEG method. They are currently represented as 24-bit RGB color, with eight bits per color component. Below, calculate the number of bytes necessary to store this image data in the RGB model and in the YUV model with 4:2:0 chrominance downsampling. Then calculate the compression rate.

11. Draw the dithered image based on the pixel given from the 8x8 image below with the pattern mask given as follow:

[0 2]
[3 1]

0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255
0	255	155	155	255	255	200	255

12. Based on the image given in Q11, do the dithering process by using (i) random dithering with random number 175 and (ii) error-difussion dithering algorithm.