

## Homework 2, due Thu Sep 16, 2010

Hand in during lab, or email PDF file to Peter.

Total Points: 80

1. I mentioned that most of us see in 3 colors. (Colorblind deficient people in see 2 or 1.) However, it seems that a small fraction of people can see in 4 colors. Do some research on the web to answer this:

(10)

- a. Are these tetrachromatic people either sex, or mostly (or all) men, or mostly (or all) women?

Tetrachromats are mostly women.

- b. Why (in 50 words or less)?

The X Chromosome contains the 2 cone cell pigment genes. Since women have 2 X-chromosomes, they have the possibility of carrying 4 different cone cell pigment genes. There are two slightly different genes for the green cones, sensitive to different frequencies.

2. Are LCD displays additive or subtractive color? Why?

(5)

Additive. Uses Red, Green, and Blue to form display.

3. Read this [article](#) on *electronic paper*. Give one advantage and one disadvantage of electronic paper compared to an LCD display in an ebook. (You might have to think; the answer is not guaranteed to be in the article.)

(10)

Advantages: Extended battery life, easy on eyes,

Disadvantages: Lack of vibrant colors, limited to ambient light, not enough higher wavelength light to create blue,

4. Imagine that you are creating a film that is 1 hour long, with 24 frames per second. Each frame is 2000x3000 pixels. Each pixel uses 3 bytes of storage (before compression).

(25)

- a. How many pixels does the movie contain?

total pixels = 60(mins) \* 60(sec) \* 24(frames) \* 2000\*3000 = 5.184x10<sup>11</sup>

- b. If you can compress the data by a factor of 10, so that each pixel takes only 0.3 bytes, how much storage will the movie take?

space required=5.184x10<sup>11</sup> \* 3/10 = 1.5552x10<sup>11</sup>

- c. How many DVDs, at  $4.7 \times 10^9$  bytes each is that?

$$\text{no. of DVDs} = 1.5552 \times 10^{11} / 4.7 \times 10^9 = 33.09 \quad \text{round up to get 34 DVDs}$$

- d. If the movie is being streamed as you watch it, how many bits per second are needed?

required bits/sec for movie (**uncompressed**):

$$= 24(\text{frames/sec}) * 2000 * 3000(\text{pixels/frame}) * 3(\text{bytes/pixel}) * 8(\text{bits/byte}) \\ = 3.456 * 10^9 \text{ bits/sec} = 3456 \text{ Mbits/sec}$$

required bits/sec for movie (**compressed**):

$$= 3.456 * 10^9 (\text{bits/sec}) * 1/10 = 345.6 \text{ Mbits/sec}$$

- e. Comment on the numbers I gave you to work with. Are they reasonable?

On DVDs videos can be stored in NTSC (720x480) or PAL (720x576) or HDTV (1280x720 or 1920x1080) formats, considering such formats the specified format is not standard. These numbers are not reasonable for the standard video recording. They are reasonable but only for customized video recordings i.e. theatrical releases, military imaging which have high resolution capability.

5. OpenGL programming:

- Install GLUT (The OpenGL Utility Toolkit) on your system if necessary. <http://www.opengl.org/resources/libraries/glut/> points to downloads for various platforms. In Linux, install a package.
- Write a program to create the logo for the Target store (a small red circle inside a large red ring.) I don't care if your circles look polygonal. You decide what OpenGL primitive to use, and how to handle the fact that the ring is hollow.

(20)

Hand in source code and screen dump.



6. Why is ray tracing not compatible with the graphics pipeline?

(10)

Ray tracing works on a pixel-pixel basis whereas a graphics pipeline works on a vertex-vertex basis. Ray tracing is similar to the graphics pipeline except instead of applying reflection models we calculate the shadow rays from the intersection-surface point to the source. Also, the fact being ray tracing takes more amount data processing time to do the same. (We might also have to do hidden-surface calculations in the case of ray tracing).