198:334 Digital Imaging and Multimedia
Fall 2016

Assignment 1 – Multimedia Digitization
Due Date – online – Monday September 26th at 5pm.

Submission instructions:

- You need to create a report where you put all your results (use MS word or other word processors). Make sure to put all the images you created (whenever the assignment says "print" or "plot" something, it means to include it in the report), and the codes you written in that report.

- *Late submission policy:* 10% of the grade for each day late.

[Q1 – 10 pts]
a) A camera with a focal length f=50 mm is used to take a photo of a vertical column that is 12 meter high and 95 meter away from the camera. Determine its height in the image in mm and the number of pixels assuming the camera has a resolution of 300 dots per inch (dpi)

b) Determine the number of bytes necessary to store an uncompressed RGB color image of size 640x480 pixels using 8,10,12, and 14 bits per color channel.

[Q2 10 pts] (Read Section 2.2 of the Multimedia systems book – available on Sakai)

Suppose you have an 8-bit A/D converter that has a full-scale input range of 2V to 6V. When a particular voltage is applied, the computer records the hex number B3. Assuming a perfect calibration, answer the following questions:

- What output voltage does this value correspond to?
- What is the digitization (quantization) error in the voltage?
- By how much percent would this error change if 12 bits were used to approximate the output instead of 8 bits?

[Q3 10 pts]
The bandwidth of a speech signal is from 50 Hz through to 10 kHz and that of a music signal is from 15 Hz through to 20 kHz. You want to digitize these signals using the Nyquist criterion.

- What is the bit rate produced for the speech signal if 12 bits are used per sample?
- Perform the same for the music signal when 16 bits per sample are used.
- How many megabytes of storage do you need for 10 minutes of stereophonic music?

[Q4 10 pts]
The high-frequency limit of human hearing extends to approximately 20 kHz, but studies have shown that intelligible speech requires frequencies only up to 4 kHz.

- Justify why the sampling rate for an audio compact disc (CD) is 44.1 kHz. What is the Nyquist rate for reliable speech communications?

- Why do you think people sound different on the phone than in person?

- Suppose intelligible speech requires 7 bits per sample. If the phone system is designed to precisely meet the requirements for speech (which is the case), what is the maximum bit rate allowable over telephone lines?

- CDs use 16 bits per sample. What is the bit rate of music coming off a CD? Is a modem connection fast enough to support streamed CD quality audio?

[Q5 – 10pts] In this question we are testing the geometric and chromatic aberrations we have studied. Use a cell phone camera or a web camera to capture an image of a white sheet of paper with your name on it.
- Does your image show an instance of geometric aberration?
- Does your image show chromatic aberration?
Print your image and Mark the locations of these effects in the images. You can take images of other objects or scenes to show

these effects if the image of the white sheet of paper did not show it.

[Q6 – 25pts + 25 extra credit] This question will be a part of a multi-stage assignment with the goal of collecting statistics about images and video on the Internet. In this question we are trying to collect data about how many images and videos are available on the Internet. For this task, your job is to do some research to collect 5 to 10 data points about the number of images and/or videos uploaded to a given site or sites. For example a data point might be: "in 2011 6 Billion images were uploaded every month to Facebook according to source x" or "in 2011, 48 hours of video are uploaded every minute according to source y". The data points can also be cumulative, for example "in 2011 the total number of images in Facebook reached x Billion images"

The expected information in a data point is:
- The site name (Facebook, Flicker, YouTube, Instagram,…)
- The year
- Number of images or videos uploaded, or size of the image/video data (e.g. x terabyte)
- The unit time (per minute, per day, per month,…), or cumulative.
- The source for this information (e.g. URL, publication, etc.)

You need to collect 5 to 10 data points. Your grade will depend on the number of data points you collect, and the rareness/uniqness of these data points. For example, if many of you get the same data point, your grade for this data point will be less than if you come up with a data point that nobody else got. So, you need to be creative in your searches online to explore data about different sites.