CSc 461/561: Multimedia Systems (Spring 2006)

Solution for Assignment 1

To be discussed in class on Jan 31, 2006

1. For a fixed sampling frequency at 8KHz, please write down the frequency of the reconstructed signal, when the signal to be sampled is at the following frequency:

Freq of "to-be-sampled"	1KHz	2KHz	3KHz	4KHz	5KHz	6KHz
Freq of "reconstructed"	$1KHz$	$2KHz$	$3KHz$	$4KHz$	$3KHz$	$2KHz$

Freq of "to-be-sampled"	7KHz	8KHz	9KHz	10KHz	11KHz	12KHz
Freq of "reconstructed"	$1KHz$	$0KHz$	$1KHz$	$2KHz$	$3KHz$	$4KHz$

2. Suppose voice is digitized at 8K samples per second, 8-bit per sample.

   (a) What is the data rate (in bit-per-second) of the digitized voice? $64Kbps$

   (b) If 16-bit per sample is used instead, what is the improvement of signal-to-quantization-noise-ratio (in decibel) of the digitized voice? $48.16dB$

   (c) Given the fact that power is proportional to the square of voltage, what is the ratio (in decibel) of the quantization noise voltage with 8-bit sample to the quantization noise voltage with 16-bit sample? $24.08dB$

3. Explain the purpose of having adaptive quantizer and predictor in adaptive differential pulse code modulation (ADPCM). *To be discussed in class*

4. Given the RGB-to-YUV transformation

   - Y = 0.299R + 0.587G + 0.114B
   - U = 0.492(B - Y)
   - V = 0.877(R - Y)

   If (Y,U,V)=(0.5,0,0), please write down the corresponding (R,G,B). $(R, G, B) = (0.5, 0.5, 0.5)$

5. Explain the purpose of having gamma correction for CRT display. *To be discussed in class*

6. Suppose a digital video has the following format:

   - picture resolution: 352 x 288 pixels; frame rate: 30 frame/second
   - YUV color space: 8-bit each for Y, U and V; chroma subsampling: 4:2:0

   Please write down the raw data amount (in bytes), i.e., without compression, for 1-minute video of this format. $273,715,200 bytes$

7. Explain the purpose of having interlaced scanning in PAL/NTSC TV. *To be discussed in class*