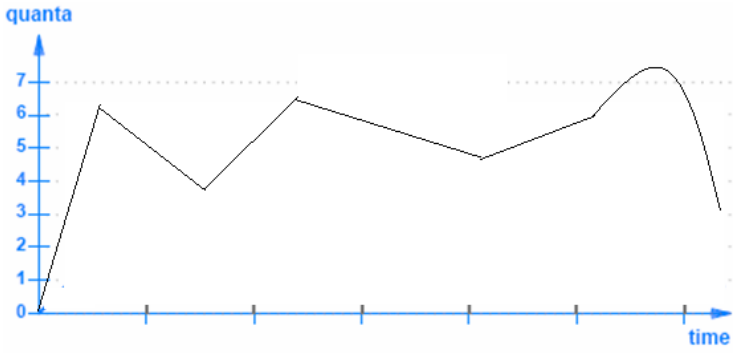
CSC 499/539 Advanced Information Security, Spring 2013
Instructor: Dr. Natarajan Meghanathan

Sample Questions on Module 10 – Steganography

1) Given the Stego-key below, compute the sequence of English sentences generated as cover to send the bit sequence: 1 0 1 1 0 0 1 1 0 1 0 1. Assume the source and destination knows the sequence length. You need to show the construction of the Huffman trees for the four variables S, A, B and C.

$$\Pi = \{\ S \rightarrow_{0.3} \texttt{Alice}\ B,\ S \rightarrow_{0.5} \texttt{Bob}\ B,\ S \rightarrow_{0.1} \texttt{Eve}\ B,\ S \rightarrow_{0.1} \texttt{I}\ A,$$
$$A \rightarrow_{0.5} \texttt{am working},\ A \rightarrow_{0.4} \texttt{am lazy},\ A \rightarrow_{0.1} \texttt{am tired},$$
$$B \rightarrow_{0.5} \texttt{is}\ C,\ B \rightarrow_{0.5} \texttt{can cook},$$
$$C \rightarrow_{0.3} \texttt{reading},\ C \rightarrow_{0.4} \texttt{sleeping},\ C \rightarrow_{0.3} \texttt{working}\}$$

2) Consider the continuous signal shown below in the figure and the Stego-key shown in the table. Use the predictive coding strategy to hide the 6-bit sequence 1 0 0 1 1 0 based on the 6 samples collected as marked in the figure. Compute the actual discrete signed values of the signal sent for each of the six samples before and after embedding.



Δi	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7
	1	0	0	1	0	1	1	1	0	1	0	1	0	0	1

3) Consider the unsorted palette table shown below. Do the following:
   a) First, sort the palette table based on Luminance: Y = 0.299R + 0.587G + 0.114B.
   b) Let the original image be represented with the two color indices: 100, 001. Compute the new values of the color indices if the 2-bit sequence to hide is 0 1.
      1. Use LSB-based embedding. 2. Use Parity-bit based embedding.

000	0, 0, 255
001	0, 25, 125
010	255, 225, 0
011	0, 50, 0
100	125, 255, 50
101	100, 150, 0
110	200, 200, 0
111	0, 75, 150

4) Why it is recommended to use a sorted palette table (rather than an unsorted palette table) as the key to embed secret information within a colored image?

5) **Parity-bit based Image Steganography:** Consider a cover-region with 9 pixels colored according to the 24-bit RGB model and the RGB values for the 9 pixel cover-region C1, C2, …, C9 are as follows:

	C1	C2	C3	C4	C5	C6	C7	C8	C9
Red	0	100	150	230	165	105	10	50	15
Blue	0	50	75	145	80	205	20	190	25
Green	255	30	0	175	20	245	30	240	45

The cover-region is divided into the following three disjoint cover-sets: {C1, C5, C8}; {C2, C3, C9} and {C4, C6, C7}. If the 3-bit sequence to hide is 1 0 1; compute the parity-bit of the three cover regions; what cover-regions do not have to undergo any changes?

6) If the number of bits to hide is 150 and the number of pixels in an image is 600 x 600, determine the probability of collision if we use random interval length method LSB-based steganography.
7) If the probability of collision is 0.25 and the number of pixels in an image is 1000 x 1000, determine the number of bits that can be hidden in the image by using random interval length method LSB-based steganography.
8) What is meant by a Type-I error and Type-II error in the context of Steganalysis? In general, how could the probabilities for Type-I and Type-II errors be related in steganography systems that are perfectly secure?
9) For ε-secure systems with no Type-I errors, how is the probability of a Type-II error related to ε? Comment on the nature of this relationship.
10) If both the probabilities for a Type-I error and Type-II error are non-zero, for what particular combinations of values of these two probabilities, we can expect to have a:
    a) Perfectly secure steganographic system?
    b) Highly imperfect steganographic system?
    Justify your answers for each case.
11) If the probabilities for a Type-I error and Type-II error are 0.3 and 0.7 respectively, determine the minimum value for the entropy of the steganographic system?
12) Explain the significance of "entropy" on the security of steganographic systems.
13) What is the difference between a "random access" cover based steganography and a "stream cover" based steganography? For what kind of covers would you use each of them? What are their pros and cons?
14) Explain the fundamental difference between steganography and cryptography. What are the pros and cons of each?