

Tutorial #8

Security in Computing COSC2356/2357

Q1: Discuss the general model of secured data hiding (i.e. steganography).

(Discuss with your peers and do it yourself)

Q2: Why steganography is important? Discuss.

(Discuss with your peers and do it yourself)

Q3: Say, Alice wants to hide a *secret binary message* ($M = 1010$) in an integer number 512876. Discuss, how the message 'M' can be hidden in the above integer (i.e. embedding procedure). What is the stego integer number and stego key?

[Hints: Use the online "Decimal to Binary Converter" to convert the number to binary and binary to decimal: http://www.binaryconvert.com/convert_unsigned_int.html

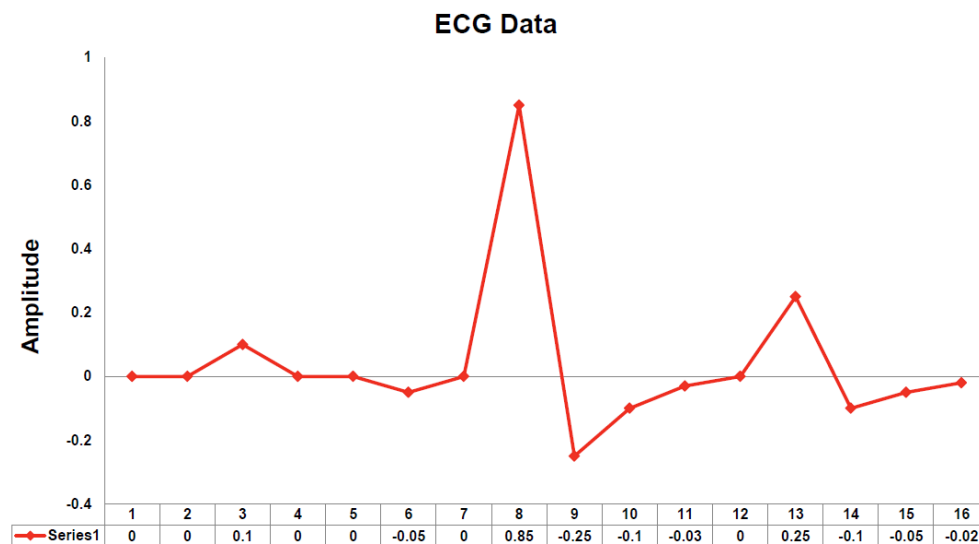
Use the online "Binary to Decimal Converter" to convert the number to binary and binary to decimal:

<https://www.mathsisfun.com/binary-decimal-hexadecimal-converter.html>

Select 4 random bits by your own to hide message bits.]

(Do it yourself)

Q4: Assume that Alice wants to hide a secret binary message ($M = 00110$) in an ECG Signal with **16 samples** as shown below:



Hence, the **cover data** becomes: $C = \{0, 0, 0.1, 0, 0, -0.05, 0, 0.85, -0.25, -0.1, -0.03, 0, 0.25, -0.1, -0.05, -0.02\}$. Show how Alice can hide **secret binary message** (M) within **cover data** (C). What would be the **stego data** (S) and **stego key** (S_k) that would be sent to Bob? Discuss, how Bob can extract secret message from the above five stego integers.

[Hints: Convert each ECG sample into 32-bit binary string using online calculator and use LSB of corresponding binary string to hide a bit of secret message].

Task-1 (Hiding Secret Message within HTML file)

Say, Alice has a HTML file "Text_Cover.html" that looks like as below when opened in a Web Browser:



The source of the HTML file is as follows:

```
<font color=#000000>"The time has come," the Walrus said,</font><br>
<font color=#000000>"To talk of many things: </font><br>
<font color=#000000>Of shoes and ships and sealing wax </font><br>
<font color=#000000>Of cabbages and kings </font><br>
<font color=#000000>And why the sea is boiling hot </font><br>
<font color=#000000>And whether pigs have wings." </font><br>
```

Assume that Alice has a secret message **M** = **010000010100001001000011**. Now, she hides the **M** in the HTML file to produce **stego HTML file**. Next, Alice sends the stego HTML file to Bob. Bob extracts the secret message **M** from the stego HTML file.

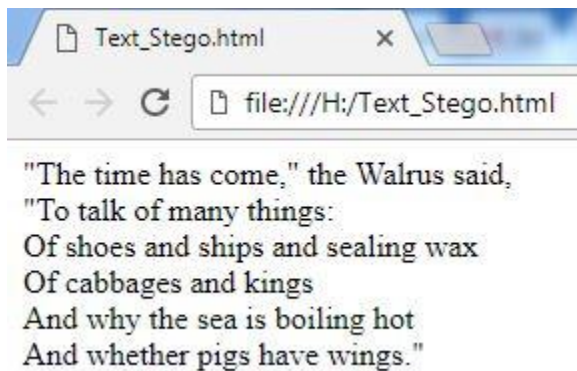
Embedding Procedure (By Alice):

- Here, length of secret message is **24** (i.e. $length = 24$) and cover data = {"Text_Cover.html"}

- Alice fragments 24 bits secret message into 4 segments of binary strings. Each segment has 6 bits (as *font-color* takes 6 bit binary value).
- The segments are: **010000, 010100, 001001, 000011**
- Alice sets message segments as the font-color of 1st, 2nd, 5th and 6th lines as follows:

```
<font color=#010000>"The time has come," the Walrus said,</font><br>
<font color=#010100>"To talk of many things: </font><br>
<font color=#000000>Of shoes and ships and sealing wax </font><br>
<font color=#000000>Of cabbages and kings </font><br>
<font color=#001001>And why the sea is boiling hot </font><br>
<font color=#000011>And whether pigs have wings." </font><br>
```

The stego HTML file (**Text_Stego.html**) is obtained as follows:



- Therefore, **Stego-Key (S_K)** becomes: $S_K = \langle \text{lines} \rangle = \langle \{1,2,5,6\} \rangle$

Alice sends **Text_Stego.html** and $S_K = \langle \{1,2,5,6\} \rangle$ to Bob.

Compare the Cover HTML file and Stego HTML file. Do you find any difference?

Extraction Procedure:

- Bob retrieves the colour codes from the lines of source files of **Text_Stego.html** as per given in S_K .
- The retrieved segments are: 010000, 010100, 001001, 000011
- The secret message is obtained as: $M_x = \mathbf{010000010100001001000011}$