CENG 3331 Intro to Telecommunication and networks- Homework 5

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**Problem 1:**

| | $C_4$ | $C_3$ | $C_2$ | $C_1$ | $C_0$ | $C_4 \oplus C_3 \oplus I$ | $C_4 \oplus C_1 \oplus I$ | $C_4 \oplus I$ | $I$=input |
|---|---|---|---|---|---|---|---|---|---|
| Initial | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| Step 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 |
| Step 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 1 |
| Step 3 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 |
| Step 4 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| Step 5 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| Step 6 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 |
| Step 7 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| Step 8 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 0 |
| Step 9 | 1 | 0 | 1 | 1 | 1 | 0 | 1 | 0 | 1 |
| Step 10 | 0 | 1 | 1 | 1 | 0 | | | | |

$C_4 \oplus C_3 \oplus I = 1 \oplus 0 \oplus 0 = 1$ $C_4 \oplus C_1 \oplus I = 1 \oplus 0 \oplus 0 = 1$ $C_4 \oplus I = 1 \oplus 0 = 1$

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**Problem 2:**

The receiver will not detect the error because it uses single-bit even parity check. Because there are 2 bits that were changed, it will be unable to detect the error.

**Problem 3:** $P = n - k + 1$ $T = 2^{n-k} D + R$

P = n – k + 1 → 6 = n – 8 + 1 → n = 13

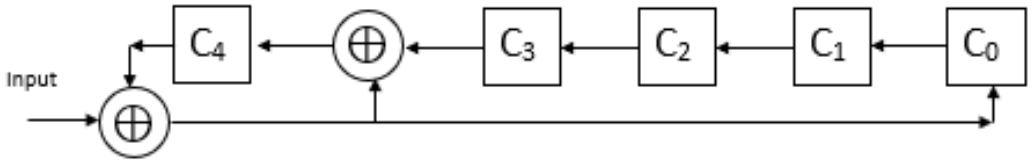
$T = 2^{n-k} D + R = 2^{13-8} D + R = 2^5 D + R$

```
            10110110
          ____________
110011|1110001100000
       110011
       ------
       00101111
         110011
         ------
         0111000
          110011
          ------
          00101100
            110011
            ------
            0111110
             110011
             ------
             0011010
```

CRC = 11010

**Problem 4:** P = n – k + 1  $T = 2^{n-k} D + R$

**A)**




**B)**

K = 9

P = n – k + 1 → 5 = n – 9 + 1 → n = 13

```
          101110100
        ____________
11001|1110110010000
      11001
      -----
      0010010
        11001
        -----
        010110
         11001
         -----
         011111
          11001
          -----
          0011000
            11001
            -----
            0000100
```

T = 1110110010100

$T(x) = 2^{n-k} D + R = 2^{13-9} D + R = 2^4 D + R = 2^4(x^8 + x^7 + x^6 + x^4 + x^3 + 1) + x^2$

$= x^{12} + x^{11} + x^{10} + x^8 + x^7 + x^4 + x^2$

**C)**

```
          101110011
        ____________
11001|1110111010000
      11001
      -----
      0010011
        11001
        -----
        010100
         11001
         -----
         011011
          11001
          -----
          00010000
             11001
             -----
             010010
              11001
              -----
              01011
```

Because the remainder is 1011 and not 0 the detection algorithm will detect the error.

**Problem 5:**

**A)**

**Hamming Distance:**

01010 → 00000 = 2  10101 → 01010 = 5  10101 → 00000 = 3

**Minimum Hamming Distance:**

The smallest hamming distance from the above values is 2.

**B)**

**Hamming Distance:**

110110 → 000000 = 4  101010 → 000000 = 3

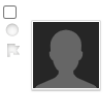
010101 → 000000 = 3  110110 → 010101 = 3

110110 → 101010 = 3  101010 → 010101 = 6

**Minimum Hamming Distance:**

The minimum hamming distance from the above values is 3.

## Problem 6:



**Michael Lankford** Just now

**RE: Robotics**

1. There are 5 distinct types of robots: pre-programmed robots, humanoid robots, autonomous robots, teleoperated robots, augmenting robots.

2. The main components of a robot are: the CPU, sensors, actuators, a power supply, and end effectors.

3. Social robots interact with humans for a variety of tasks. These robots can respond to human behavior and emotions, and some believe they should also be able to differentiate between right and wrong.

4. As the AI field continuously gets better and closer to replicating human thought, there is the opportunity to power robots using this and let them be able to become intelligent and learn from everything around it, as humans do. For the present however, robots are only able to perform basic tasks using very basic AI, like problem-solving.

5. The future of robots is very large. Every day, humans are working to improve them in some way, like Boston Dynamics. Boston Dynamics have been developing a humanoid robot that is able to walk, run , and jump. This mobility has been one of the biggest breakthroughs in recent times because replicating the stability of a biped is extremely difficult, especially compared to quadrupeds who have 4 legs and distribute weight more evenly from front to back.

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