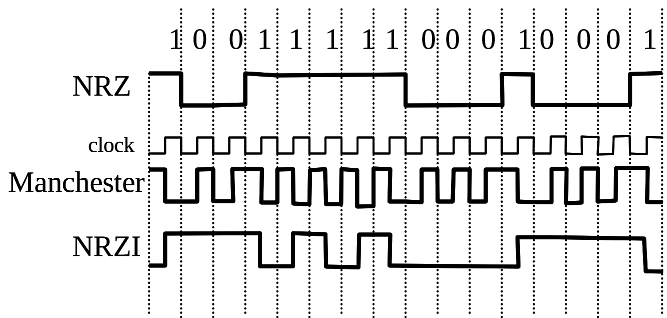
ECE 4380/6380: Computer Communications **Spring 2017**
Problem Set 2 Solutions

Each problem is worth 10 points

1. **Encoding**. Encoding for sequence 1001 1111 0001 0001



2. **Encoding** Chapter 2, number 4.

One can list all 5-bit sequences and count, but here is another approach: there are 2^3 sequences that start with 00, and 2^3 that end with 00. There are two sequences, 00000 and 00100, that do both. Thus, the number that do either is 8 + 8 – 2 = 14, and finally the number that do neither is 32 – 14 = 18. Thus there would have been enough 5-bit codes meeting the stronger requirement; however, additional codes are needed for control sequences.

3. **Framing**.

A `0` is stuffed in at the two places marked with the **0**.

original sequence	`1101 0111 1101 0111 1110 1011 1111 10,`
transmitted	`1101 0111 11`**0**`0 1011 111`**0** `1010 1111 1`**0**`110,`

4. **Framing** …, DLE, DLE, DLE, ETX, ETX

5. **Error detection with CRC**. Show that (x + 1) is not a factor of $C(x)$.

```
        _________________
11 | 1100000001101
     11
       000000011
              11
                01← remainder
```

Note that the standard CRC-12 polynomial is $x^{12} + x^{11} + x^3 + x^2 + x + 1$, and as can be easily verified, (x + 1) is a factor.

6. **Error detection with CRC**. . Calculate the CRC value of the bit sequence `0011 1010 1011`, and list the message that should be transmitted

```
                 _________________
100000111 | 001110101011.00000000
              100000111
               110100101
               100000111
                10100010 0
```

```
10000011 1
  100001 100
  100000 111
       1 01100000
       1 00000111
         01100111 ← remainder
```

`The transmitted sequence: 0011 1010 1011 0110 0111`

7. **Error detection with CRC**. Find a 13-bit burst error polynomial $E(x) = x^{12} + \ldots + 1$ that cannot be detected by a CRC check (with CRC-8)..

   An error polynomial cannot be detected if it is a multiple of $C(x)$. We are looking for a polynomial $P(x)$, such that $C(x)P(x) = E(x)$. One simple approach is to select a $P(x)$ that has the terms x^4 and 1, so that we get the terms x^{12} and 1 in $E(x)$. $P(x) = x^4 + 1$ is one such polynomial, and

   $$E(x) = (x^8 + x^2 + x + 1)(x^4 + 1)$$
   $$= x^{12} + x^8 + x^6 + x^5 + x^4 + x^2 + x + 1$$