CS 224(M): Tutorial 11

Framing, Error Control, Error Detection

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1. Yes, if the bit error is in the byte count or flag field. This can cause merging etc. and hence affect the next frame.

2. **DLE** DLE **DLE** ETX **ETX –** Two DLEs added as escape sequences, and the final ETX as the end of frame.

3. 1011111011111010

4. 110111111001

5. No it cannot. The first DLE acts as an escape sequence for the second DLE. Thus, We are left with an un–escaped ETX and hence this will correspond to the end of frame.

6. Triplication results in a Hamming Window size of 3. It cannot correct and detect at its maximum capacity, because when it is at maximum detection state, the correction would be at the closest state and hence revert to an incorrect state. In this case, correction mechanism assumes only one bit error.

7. 6 errors can be detected and 3 error can be corrected.
It cannot do both simultaneously. Correction assumes that the number of errors is less than (d–1)/2, so that correction to closest state is possible.

8.
C1 xor C2 = 3
C2 xor C3 = 7
C1 xor C5 = 7
…
Hamming distance would be the minimum of this number, hence 3.

9.

i) Error rate = (100/923) = 1.108

ii) Expected number of retransmissions = 1/(1−p) = 1.00001

Thus, we get (1.00001*955 − 923)/923 = 0.0346

10. Consider the case of 5 students.

The only possible case when the missing item can be found is when the professor splits them as 2−2−1.

- If the student who lies is in a group of 2, worst case is when that group has a conflict of opinions. The other two groups speak the truth in that case and hence the error can be corrected.
- If the student who lies in alone, same case and hence correction and identification is possible.

This would not be possible in the case of a 4 student group.

Drawing analogies to the Hamming Code scheme:

Bit position		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
Encoded data bits		p1	p2	d1	p4	d2	d3	d4	p8	d5	d6	d7	d8	d9	d10	d11	p16	d12	d13	d14	d15	
Parity bit coverage	p1	X		X		X		X		X		X		X		X		X		X		
	p2		X	X			X	X			X	X			X	X			X	X		...
	p4				X	X	X	X					X	X	X	X					X	
	p8								X	X	X	X	X	X	X	X						
	p16																X	X	X	X	X	

We need to obtain 2 data bits reliably. Following the Hamming scheme, we see that we would need 3 parity bits, for the 1st, 2nd and 4th bit patterns. Thus, a minimum of 5 bits would be required for successful error correction.

Extending the analogy to our case, we would need a minimum of 5 students, and 4 would not suffice. This theory can be extended to any number of students/rooms pretty easily!