

COMP 3721

Instructor: Md. Navid Bin Anwar

Assignment #3

All work should be done individually.

Total marks: 40

1. Consider a CRC mechanism, where the generator is 10011, and suppose that dataword is 1010101010.

- a) What is the remainder and codeword sent by the sender? (show binary division)
- b) Show the calculation on how the receiver will check the codeword is correct or not?

2. Assume that X, Y, Z, and W are the four active nodes competing for access to a channel utilizing slotted ALOHA. Imagine that there are infinite amounts of packets to send from each node. With probability p , each node tries to broadcast in each available slot. The first slot has the number 1, the second slot has the number 2, and so on.

- a) What is the probability is it that node X will succeed in slot 5?
- b) What is the probability is it that one of the nodes (X, Y, Z, or W) will be successful in slot 4?

Hints: probability that X succeeds in a slot $p(X)$ and unsuccessful $p(1-p(X))$. "X" will be successful when other stations are not transmitting, $(1-p)$.

3. A single-bit even parity check is used by two communication devices to identify errors. Due to channel noise, the receiver receives the bytes 10011010 instead of 10101010 from the transmitter. Will the recipient detect the errors? Why or why not.

4. Consider the Hamming-based FEC. The following table shows the list of codewords. Explain the receiver's actions in the following scenarios (include any computations if needed), and then summarize the result by responding to the five questions for each of the following cases.

Case I. The data 010 is to be transferred from transmitter to receiver. The first bit (MSB) sent is incorrect (meaning the 1st bit transmitted is different from the 1st bit received).

Case II. From transmitter to receiver, the data 100 must be transferred. During transmission first and second bits sent are incorrect. Actions taken by receiver for both of the above cases:



- a) Codeword received by receiver (before taking any action): _____
- b) Error detected by receiver? YES / NO
- c) Data received: ____ ____ ____ (if applicable else N/A)
- d) Is the correct data received? YES / NO
- e) Explanation (what does receiver will do?):

Data	Codeword
000	011011
001	100110
010	100111
011	010000
100	111100
101	001010
110	100101
111	001011

a) What is the remainder and codeword sent by the sender? (show binary division)

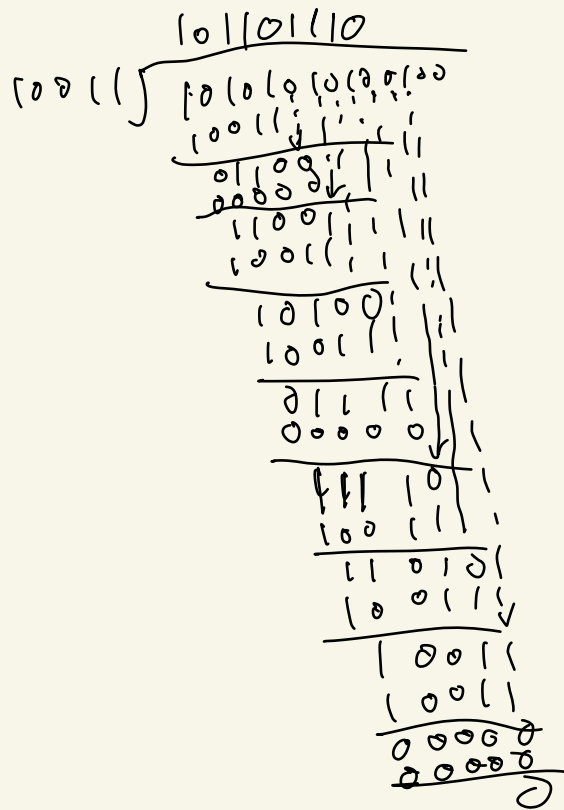
b) Show the calculation on how the receiver will check the codeword is correct or not?

A handwritten binary long division problem: $1001 \div 100$. The quotient is shown as 10. The steps are as follows:

$$\begin{array}{r}
10 \\
\underline{100 \overline{) 1001}} \\
100 \\
\underline{ 001} \\
000
\end{array}$$

$\therefore \text{remainder} = 0100$
Codeword $\downarrow = 101010100100$

b



Now data word is accepted.

2.

2. Assume that X, Y, Z, and W are the four active nodes competing for access to a channel utilizing slotted ALOHA. Imagine that there are infinite amounts of packets to send from each node. With probability p , each node tries to broadcast in each available slot. The first slot has the number 1, the second slot has the number 2, and so on.

a) What is the probability is it that node X will succeed in slot 5?

b) What is the probability is it that one of the nodes (X, Y, Z, or W) will be successful in slot 4?

Hints: probability that X succeeds in a slot $p(X)$ and unsuccessful $p(1-p(X))$. "X" will be successful when other stations are not transmitting, $(1-p)$.

$$a) P(X \text{ succeeds in slot 5}) = 0.75^4 \times 0.25 = 0.07910 = 7.91\%$$

$$b) P(X, Y, Z \text{ or } W \text{ successful in slot 4}) \\ 4 \times P(s) \times P(f)^3 \\ = 4 \times 0.25 \times (0.75)^3 = 0.421875 \\ \therefore 42.19\%$$

3.

3. A single-bit even parity check is used by two communication devices to identify errors. Due to channel noise, the receiver receives the bytes 10011010 instead of 10101010 from the transmitter. Will the recipient detect the errors? Why or why not.

It cannot detect error because the number of bits that were changed are even.

4. Consider the Hamming-based FEC. The following table shows the list of codewords. Explain the receiver's actions in the following scenarios (include any computations if needed), and then summarize the result by responding to the five questions for each of the following cases.

Case I. The data 010 is to be transferred from transmitter to receiver. The first bit (MSB) sent is incorrect (meaning the 1st bit transmitted is different from the 1st bit received).

Case II. From transmitter to receiver, the data 100 must be transferred. During transmission first and second bits sent are incorrect. Actions taken by receiver for both of the above cases:

Case 1

A) 000111

b) yes

c) 010

d) yes

e) Receiver detects an error and compares the received code word to valid code word. Then use hamming distance and assume data is 010.

- a) Codeword received by receiver (before taking any action): _____
b) Error detected by receiver? YES / NO
c) Data received: _____ (if applicable else N/A)
d) Is the correct data received? YES / NO
e) ~~Explanation (what does receiver will do?):~~

Data	Codeword
000	011011
001	100110
010	100111
011	010000
100	111100
101	001010
110	100101
111	001011

Case 2

A) 001100

B) Yes

C) 100 or 101

D) No (depends)

e) Since Receiver detects error but when receiver tries to get correct codeword, since first and second bit has error and hamming distance of 2 are there (100, or 101), it cannot guarantee that receiver will correct to actual codeword.

