Practical No: 4

Problem statement: Write a program for error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode.(50% students will perform Hamming Code and others will perform CRC)

Objectives:

1. To understand how CRC/FCS is calculated
2. To Learn Error Detection and Correction.
3. To Learn Hamming Code method.

Procedure for Error Correcting Codes

Cyclic Redundancy Check (CRC) M = K

bit messages

F = n bits frame check sequence (FCS)

T = (k + n) bits frame where n<k

P = n+1 is the predermined divisor

We want mod (T,P) = 0

Rewrite $T = M\,2^n + F$ $F =$

$M\,2^n / P$

Ex: M = 1010001101 (10 bits) P =

110101 (6 bits)

P= 6 hence n=5 bits F = 5 bits to becalculated $M\,2^n$

$= M\,2^5$ =101000110100000

2^5 M / P = 101000110100000 / 110101

Method –I : Modulo-2 Arithmetic

110101	**1**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**Q**
	1	**1**	**0**	**1**	**0**	**1**										1
	x	1	1	1	0	1										
		1	**1**	**1**	**0**	**1**	**1**									
		1	**1**	**0**	**1**	**0**	**1**									1
		X	0	1	1	1	0									
			0	**1**	**1**	**1**	**0**	**1**	nd							
				0	0	0	0	0								0
				1	**1**	**1**	**0**	**1**	**0**							
				1	**1**	**0**	**1**	**0**	**1**							1
				x	**0**	**1**	**1**	**1**	**1**	**1**						
					0	0	0	0	0	0						0
						1	**1**	**1**	**1**	**1**	**0**					
						1	**1**	**0**	**1**	**0**	**1**					1
						x	**0**	**1**	**0**	**1**	**1**	0				
							0	0	0	0	0	0				0
							x	**1**	**0**	**1**	**1**	**0**	**0**			
								1	**1**	**0**	**1**	**0**	**1**			1
								x	**1**	**1**	**0**	**0**	**1**	0		
									1	**1**	**0**	**1**	**0**	**1**		1
	F= Remainder = R								**x**	**x**	**0**	**1**	**1**	**1**	0	0

Therefore F =

01110 T= M 2^n + F

101000110100000

\+ 01110

101000110101110

At the receiver , it receives T =101000110101110

At receiving end, it divides T by same P =**110101**

110101	1	0	1	0	0	0	1	1	0	1	0	1	1	1	0	Q
	1	1	0	1	0	1										1
	x	1	1	1	0	1										
		1	1	1	0	1	1									
		1	1	0	1	0	1									1
		X	0	1	1	1	0									
			0	1	1	1	0	1	nd							
				0	0	0	0	0								0
				1	1	1	0	1	0							
				1	1	0	1	0	1							1
				x	0	1	1	1	1	1						
					0	0	0	0	0	0						0
						1	1	1	1	1	0					
						1	1	0	1	0	1					1
						x	0	1	0	1	1	1				
							0	0	0	0	0	0				0
							x	1	0	1	1	1	1			

							1	1	0	1	0	1			1
							x	1	1	0	1	0	1		
								1	1	0	1	0	1		1
								0	0	0	0	0	0		
F= Remainder = R								x	x	0	0	0	0	0	0

If remainder is 0 then frame T is received correctly

Method –II : Polynomial Method Message = M(x) = (k+n) -bits Divisor = G(x) = P

= n+1 bits

F= g(x) = x^c = n-bits

G(x))M(x) * x^c (Q(x) T(x) = (k+n) bits

6 4 3

Ex. M(x) = x + x + x +1 g(x) = x^3

Therefore M(x) * x^c

9 7 6 3

= x + x + x + x

$x^3 + 1$) $x^9 + x^7 + x^6 + x^3$ ($x^6 + x^4 + x + 1x^9$ +

+ x^6

$X^7 + \quad + X^3$

$x^7 + \quad + x^4$

$x^4 + x^3$

$x^4 + x$

$x^3 + x$

x^3+1

Remainder R=F x + 1 **T(x) =** $x^9 + x^7 + x^6 + x^3 + x + 1$ **At receiver**

$x^3 + 1$) $x^9 + x^7 + x^6 + x^3 + x + 1$ ($x^6 + x^4 + x + 1$ x^9 +

+ x^6

---

x^7 + + x^3

$_x7$ + x^4

$x^4 + x^3 + x$

$_x4 + x$

$x^3 + 1$ and finally 0

1] MODULO 2 METHOD CODE: Sample Input and Output

Enter Message M: 1 1 1 0 0 1 1 0

M: 11100110

Enter Predetermined Divisor P: 1 1 0 0 1

P: 11001

----------T: 111001100000

R after the fist

time : 00101 1R=

001011

1S= 00000

2R= 010111

2S= 11001

3R= 011100

3S= 11001

4R= 001010

4S= 00000

5R= 010100

5S= 11001

6R= 011010

6S= 11001

7R= 000110

7S= 00000

CRC = 0110

2] POLYNOMIAL METHOD CODE: Sample Input and Output

Enter no of terms for M 5 : 1 2 5 6 7

Enter no of terms for G 3 : 0 3 4

M: x7 + x6 + x5 + x2 + x1 + G:

x4 + x3 + x0 +

T: x11 + x10 + x9 + x6 + x5 + S:

x11 + x10 + x7 +

11 cut off

10 cut off

T after putting -1s: x-1 + x-1 + x9 + x6 + x5 + Now T

after sorting 1 : x-1 + x-1 + x5 + x6 + x9 +

T after appending elements of S: x7 + x5 + x6 + x9 +

Final T: x9 + x7 + x6 + x5 +

S: x9 + x8 + x5 + x-1 + x-1 + x-1 +

==========

9 cut off

5 cut off

T after putting -1s: x-1 + x7 + x6 + x-

1 + Now T after sorting 1 : x-1 + x-1 +

x6 + x7 +

T after appending elements of S: x8 + x6 + x7

+ Final T: x8 + x7 + x6 +

S: x8 + x7 + x4 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 +

==========

8 cut off

7 cut off

T after putting -1s: x-1 + x-1 +

x6 + Now T after sorting 1 : x-1

+ x-1 + x6 +

T after appending elements of S: x4

+ x6 + Final T: x6 + x4 +

S: x6 + x5 + x2 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 +

==========

6 cut off

T after putting -1s: x-1 +

x4 + Now T after sorting

1 : x-1 + x4 +

T after appending elements of S: x2 + x5

+ x4 + Final T: x5 + x4 + x2 +

S: x5 + x4 + x1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 +

==========

5 cut off

4 cut off

T after putting -1s: x-1 + x-1 + x2 +

Now T after sorting 1 : x-1 + x-1 + x2 +

T after appending elements of S: x1 +

x2 + Final T: x2 + x1 +

S: x2 + x1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 + x-1 +
x-1 + x-1 + x-2 +

==========

-------FINAL ANSWER: CRC = x2 + x1 +

Conclusion: students understand of error detection and correction for 7/8 bits ASCII codes using Hamming Codes or CRC. Demonstrate the packets captured traces using Wireshark Packet Analyzer Tool for peer to peer mode

Signature with Date