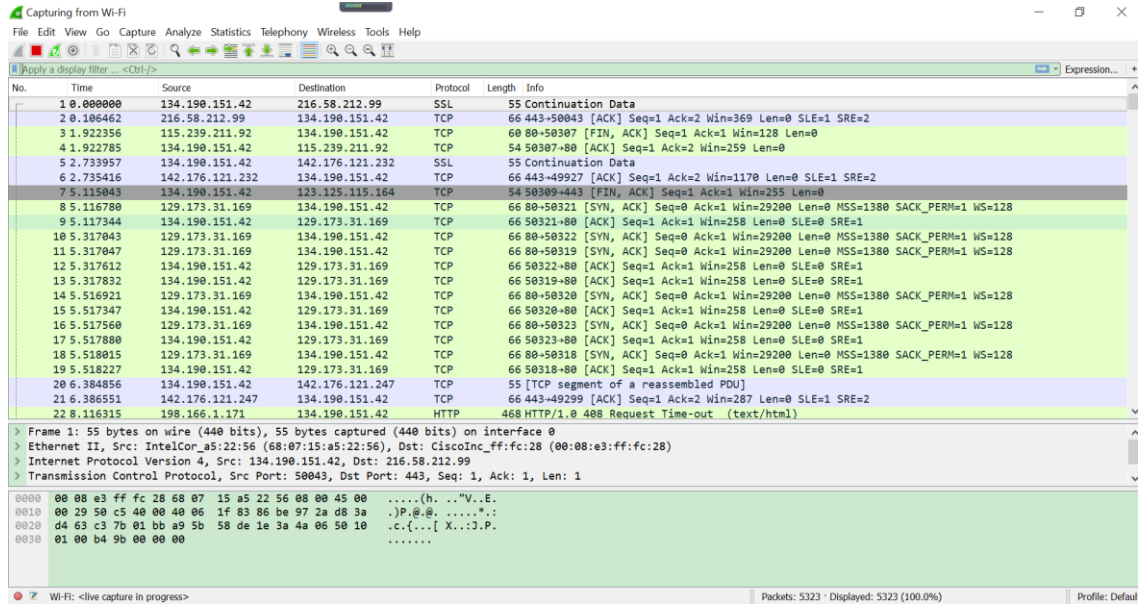


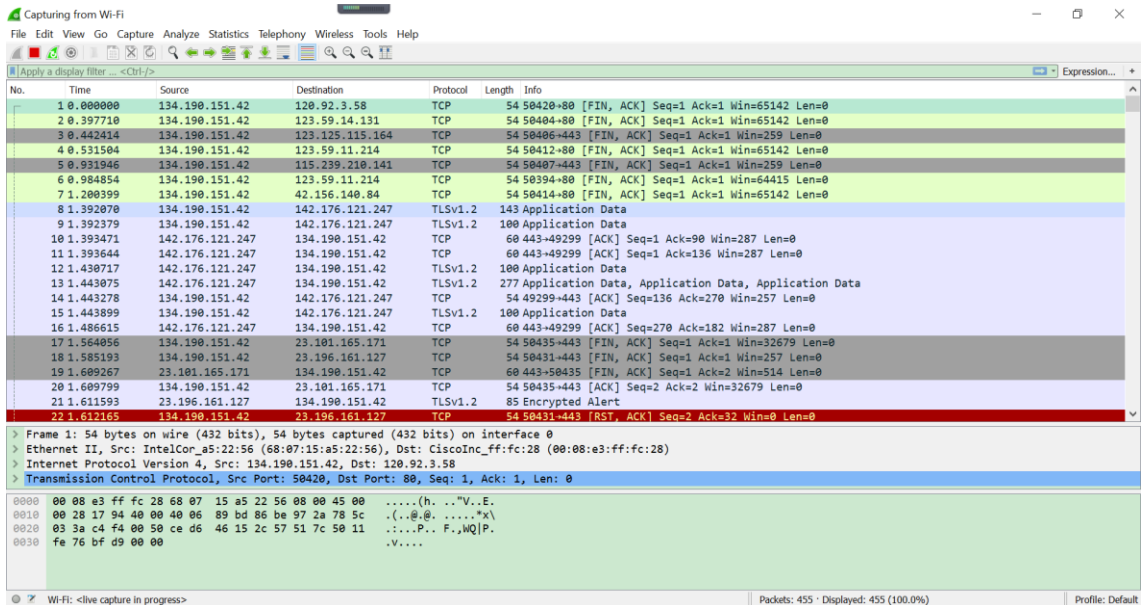
Assignment 2

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1. Experimental study with Wireshark
b) www.cisco.com



www.google.ca



www.facebook.com

Capturing from Wi-Fi

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl>/> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	134.190.151.42	120.92.3.58	TCP	54	50420->80 [RST, ACK] Seq=1 Ack=1 Win=0 Len=0
2	0.369827	31.13.80.8	134.190.151.42	TCP	1440	[TCP segment of a reassembled PDU]
3	0.370142	31.13.80.8	134.190.151.42	TLSv1.2	351	Application DataApplication Data
4	0.370322	134.190.151.42	31.13.80.8	TCP	54	50484->443 [ACK] Seq=1 Ack=1684 Win=259 Len=0
5	0.370540	31.13.80.8	134.190.151.42	TLSv1.2	96	Application Data
6	0.391449	134.190.151.42	31.13.80.8	TLSv1.2	280	Application Data
7	0.391952	134.190.151.42	31.13.80.8	TCP	1440	[TCP segment of a reassembled PDU]
8	0.392000	134.190.151.42	31.13.80.8	TCP	1440	[TCP segment of a reassembled PDU]
9	0.392041	134.190.151.42	31.13.80.8	TLSv1.2	172	Application Data
10	0.392415	134.190.151.42	31.13.80.8	TLSv1.2	472	Application Data
11	0.407940	134.190.151.42	31.13.80.36	TLSv1.2	355	Application Data
12	0.408401	134.190.151.42	31.13.80.8	TLSv1.2	294	Application Data
13	0.414361	31.13.80.8	134.190.151.42	TCP	60	443->50484 [ACK] Seq=1726 Ack=227 Win=127 Len=0
14	0.414465	31.13.80.8	134.190.151.42	TLSv1.2	96	Application Data
15	0.415046	31.13.80.8	134.190.151.42	TCP	60	443->50484 [ACK] Seq=1768 Ack=3117 Win=150 Len=0
16	0.431558	31.13.80.36	134.190.151.42	TLSv1.2	96	Application Data
17	0.431559	31.13.80.8	134.190.151.42	TCP	60	443->50484 [ACK] Seq=1768 Ack=3775 Win=172 Len=0
18	0.431559	31.13.80.8	134.190.151.42	TLSv1.2	96	Application Data
19	0.431728	134.190.151.42	31.13.80.8	TCP	54	50484->443 [ACK] Seq=3775 Ack=1810 Win=259 Len=0
20	0.446665	31.13.80.8	134.190.151.42	TLSv1.2	170	Application Data
21	0.475519	31.13.80.36	134.190.151.42	TLSv1.2	859	Application Data
22	0.475520	31.13.80.36	134.190.151.42	TLSv1.2	93	Application Data

Frame 1: 54 bytes on wire (432 bits), 54 bytes captured (432 bits) on interface 0
Ethernet II, Src: IntelCor_a5:22:56 (68:07:15:a5:22:56), Dst: CiscoInc_ff:fc:28 (00:08:e3:ff:fc:28)
Internet Protocol Version 4, Src: 134.190.151.42, Dst: 120.92.3.58
Transmission Control Protocol, Src Port: 50420, Dst Port: 80, Seq: 1, Ack: 1, Len: 0

0000 00 08 e3 ff fc 28 68 07 15 a5 22 56 08 00 45 00(h...".V..E.
0010 00 28 17 9c 40 00 40 06 80 b5 86 be 97 2a 78 5c ...@.@....."X
0020 03 3a c4 f4 00 50 ce d6 46 16 2c 57 51 7c 50 14P..F.,WQ|P.
0030 00 00 be 4c 00 00L..

Wi-Fi: <live capture in progress> Packets: 277 - Displayed: 277 (100.0%) Profile: Default

c) www.cisco.com-TCP segment

Transmission Control Protocol, Src Port: 52936, Dst Port: 80, Seq: 1, Ack: 1, Len: 1460

Source Port: 52936
Destination Port: 80
[Stream index: 0]
[TCP Segment Len: 1460]
Sequence number: 1 (relative sequence number)
[Next sequence number: 1461 (relative sequence number)]
Acknowledgment number: 1 (relative ack number)
Header Length: 20 bytes
Flags: 0x018 (PSH, ACK)
Window size value: 958
[Calculated window size: 958]
[Window size scaling factor: -1 (unknown)]
Checksum: 0xb059 [unverified]
[Checksum Status: Unverified]
Urgent pointer: 0
> [SEQ/ACK analysis]

0			15 16		31	
Source port number:52936				Destination port number:80		
Sequence number:1						
Acknowledgement Number:1						
Header length : 20	Reserved: Not set	Flags: 0x018 (PSH, ACK)			Window size: 958	
TCP checksum = 0xb059				Urgent pointer: 0		
TCP Segment data = 1386 bytes						

www.cisco.com-IP datagram

```

Internet Protocol Version 4, Src: 96.16.43.95, Dst: 134.190.151.42
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 52
    Identification: 0xc47d (50301)
  > Flags: 0x02 (Don't Fragment)
    Fragment offset: 0
    Time to live: 58
    Protocol: TCP (6)
    Header checksum: 0xd2ee [validation disabled]
    [Header checksum status: Unverified]
    Source: 96.16.43.95
    Destination: 134.190.151.42
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]

```

0			16		31	
IP version:4	Header Length: 20 bytes	Differentiated Services Field: 0x00 (DSCP CS0: ECN: NOT-ECT)	Total length: 52			
Identification: 0Xc47d (50301)			Flags: 0x02 (Don't Fragment)	Fragment Offset: 0		
Time-to-live:58		Protocol: TCP(6)	Header Checksum: 0xd2ee			
Source IP Address: 96.16.43.95						
Destination IP Address: 134.190.151.42						

www.cisco.com-data link layer frame

```

Ethernet II, Src: ArrisGro_63:44:bd (dc:45:17:63:44:bd), Dst: IntelCor_a5:22:56 (68:07:15:a5:22:56)
  Destination: IntelCor_a5:22:56 (68:07:15:a5:22:56)
    Address: IntelCor_a5:22:56 (68:07:15:a5:22:56)
    .... 0. .... = LG bit: Globally unique address (factory default)
    .... 0. .... = IG bit: Individual address (unicast)
  Source: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
    Address: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
    .... 0. .... = LG bit: Globally unique address (factory default)
    .... 0. .... = IG bit: Individual address (unicast)
  Type: IPv4 (0x0800)

```

Ethernet Header:

Destination Address: 68:07:15:a5:22:56	Source Address: 45:17:63:44:bd	Type: IP v4(0x0800)
---	-----------------------------------	------------------------

www.google.com-TCP segment

Transmission Control Protocol, Src Port: 443, Dst Port: 64940, Seq: 1, Ack: 1, Len: 1386
 Source Port: 443
 Destination Port: 64940
 [Stream index: 0]
 [TCP Segment Len: 1386]
 Sequence number: 1 (relative sequence number)
 [Next sequence number: 1387 (relative sequence number)]
 Acknowledgment number: 1 (relative ack number)
 Header Length: 20 bytes
 > Flags: 0x010 (ACK)
 Window size value: 1672
 [Calculated window size: 1672]
 [Window size scaling factor: -1 (unknown)]
 Checksum: 0xb509 [unverified]
 [Checksum Status: Unverified]
 Urgent pointer: 0
 > [SEQ/ACK analysis]
 TCP segment data (1290 bytes)

0			15 16		31	
Source port number:443				Destination port number:64940		
Sequence number:1						
Acknowledgement Number:1						
Header length : 20	Reserved: Not set	Flags: 0x010 (ACK)			Window size: 1672	
TCP checksum = 0xb509				Urgent pointer: 0		
TCP Segment data = 1290 bytes						

www.google.com-IP datagram

Internet Protocol Version 4, Src: 142.176.121.236, Dst: 134.190.151.42
 0100 = Version: 4
 0101 = Header Length: 20 bytes (5)
 > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
 Total Length: 1426
 Identification: 0x6622 (26146)
 > Flags: 0x00
 Fragment offset: 0
 Time to live: 59
 Protocol: TCP (6)
 Header checksum: 0xedbe [validation disabled]
 [Header checksum status: Unverified]
 Source: 142.176.121.236
 Destination: 134.190.151.42
 [Source GeoIP: Unknown]
 [Destination GeoIP: Unknown]

0	16		31
IP version:4	Header Length: 20 bytes	Differentiated Services Field: 0x00 (DSCP CS0: ECN: NOT-ECT)	Total length: 1426
Identification: 0x6622 (26146)		Flags: 0x00 (Don't Fragment)	Fragment Offset: 0
Time-to-live:59		Protocol: TCP(6)	Header Checksum: 0xedbe
Source IP Address: 142.176.121.236			
Destination IP Address: 134.190.151.42			

www.google.com-data link layer frame

✓ Ethernet II, Src: ArrisGro_63:44:bd (dc:45:17:63:44:bd), Dst: IntelCor_a5:22:56 (68:07:15:a5:22:56)
 ✓ Destination: IntelCor_a5:22:56 (68:07:15:a5:22:56)
 Address: IntelCor_a5:22:56 (68:07:15:a5:22:56)
 0. = LG bit: Globally unique address (factory default)
 0. = IG bit: Individual address (unicast)
 ✓ Source: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
 Address: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
 0. = LG bit: Globally unique address (factory default)
 0. = IG bit: Individual address (unicast)
 Type: IPv4 (0x0800)

Destination Address: 68:07:15:a5:22:56	Source Address: 45:17:63:44:bd	Type: IP v4(0x0800)
---	-----------------------------------	------------------------

www.facebook.com-TCP segment

✓ Transmission Control Protocol, Src Port: 443, Dst Port: 49193, Seq: 1, Ack: 1, Len: 1386
 Source Port: 443
 Destination Port: 49193
 [Stream index: 0]
 [TCP Segment Len: 1386]
 Sequence number: 1 (relative sequence number)
 [Next sequence number: 1387 (relative sequence number)]
 Acknowledgment number: 1 (relative ack number)
 Header Length: 20 bytes
 > Flags: 0x010 (ACK)
 Window size value: 121
 [Calculated window size: 121]
 [Window size scaling factor: -1 (unknown)]
 Checksum: 0x5c52 [unverified]
 [Checksum Status: Unverified]
 Urgent pointer: 0
 > [SEQ/ACK analysis]
 TCP segment data (1386 bytes)

0			15 16		31	
Source port number:443			Destination port number:49193			
Sequence number:1						
Acknowledgement Number:1						
Header length : 20 bytes	Reserved: Not set	Flags: 0x010 (ACK)		Window size: 121		
TCP checksum = 0x5c52				Urgent pointer: 0		
TCP Segment data = 1386 bytes						

www.facebook.com-IP datagram

```

Internet Protocol Version 4, Src: 31.13.80.8, Dst: 134.190.151.42
  0100 .... = Version: 4
  .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 1426
    Identification: 0x272e (10030)
  > Flags: 0x02 (Don't Fragment)
    Fragment offset: 0
    Time to live: 87
    Protocol: TCP (6)
    Header checksum: 0x6a3a [validation disabled]
    [Header checksum status: Unverified]
    Source: 31.13.80.8
    Destination: 134.190.151.42
    [Source GeoIP: Unknown]
    [Destination GeoIP: Unknown]

```

0			16		31	
IP version:4	Header Length: 20 bytes	Differentiated Services Field: 0x00 (DSCP CS0: ECN: NOT-ECT)		Total length: 1426		
Identification: 0x272e (10030)			Flags: 0x02 (Don't Fragment)	Fragment Offset: 0		
Time-to-live:87		Protocol: TCP(6)	Header Checksum: 0x6a3a			
Source IP Address: 31.13.80.8						
Destination IP Address: 134.190.151.42						

www.facebook.com-data link layer frame

```

Ethernet II, Src: IntelCor_a5:22:56 (68:07:15:a5:22:56), Dst: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
  > Destination: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
    Address: ArrisGro_63:44:bd (dc:45:17:63:44:bd)
    .... 0. .... = LG bit: Globally unique address (factory default)
    .... 0. .... = IG bit: Individual address (unicast)
  > Source: IntelCor_a5:22:56 (68:07:15:a5:22:56)
    Address: IntelCor_a5:22:56 (68:07:15:a5:22:56)
    .... 0. .... = LG bit: Globally unique address (factory default)
    .... 0. .... = IG bit: Individual address (unicast)
  Type: IPv4 (0x0800)

```

Destination Address: 45:17:63:44:bd	Source Address: 68:07:15:a5:22:56	Type: IP v4(0x0800)
--	--------------------------------------	------------------------

d) According to the screen snapshot of the three websites, I found we can use Wireshark to know the packet, MAC/IP address, TCP/UDP port, protocol or the content of packet during the transmission and we can find the transmission process. The wireshark helps us to understand how the packet transmit in the different layer and what is the specific information of the transmission.

3.

$$a) M(x) = 11010011101 \quad G(x) = 1011$$

$$M'(x) = 11010011101000$$

$$\begin{array}{r}
 \begin{array}{r}
 111 \\
 10000011000 \\
 \hline
 1011 \overline{) 11010011101000} \\
 \underline{1011} \\
 1100 \\
 \underline{1011} \\
 1110 \\
 \underline{1011} \\
 1011 \\
 \underline{1011} \\
 0001 \\
 \underline{0000} \\
 0011 \\
 \underline{0000} \\
 0111 \\
 \underline{0000} \\
 1110 \\
 \underline{1011} \\
 1011 \\
 \underline{1011} \\
 0000 \\
 \underline{0000} \\
 0000 \\
 \underline{0000} \\
 0000 \\
 \underline{0000} \\
 0000 \\
 \underline{0000} \\
 000 - \text{Remainder}
 \end{array}
 \end{array}$$

Remainder is 000.

∴ There's no error.

$$\begin{aligned}
 P(x) &= M(x) + G(x) \\
 &= 11010011101000
 \end{aligned}$$

$$b) P(x) = M(x) + R(x) = 10110011101101$$

$$\begin{array}{r}
 \begin{array}{r}
 10100111010 \\
 \hline
 1001 \overline{) 10110011101101} \\
 \underline{1001} \\
 0100 \\
 \underline{0000} \\
 1000 \\
 \underline{1001} \\
 0011 \\
 \underline{0000} \\
 0111 \\
 \underline{0000} \\
 1111 \\
 \underline{1001} \\
 1100 \\
 \underline{1001} \\
 1011 \\
 \underline{1001} \\
 0101 \\
 \underline{0000} \\
 1010 \\
 \underline{1001} \\
 0111 \\
 \underline{0000} \\
 111
 \end{array}
 \end{array}$$

Remainder is 111 but not 000

∴ There is an error in the data unit.