

# LAB ASSIGNMENT-7

## CSN-361 Computer Networks Laboratory

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Enrollment no. - 17114059 (CSE)

**1**

### **Problem Statement**

Transmit a binary message (from a sender to a receiver) using socket programming in C and report whether the received msg is correct or not; using the following error detection algorithms:

1. Single Parity Check
2. Two-dimensional Parity Check
3. Checksum
4. Cyclic Redundancy Check (CRC)

## Algorithm

1. Create a sender with a socket it is listening to.
2. Create a receiver to connect to the socket.
3. The sender requests user for relevant information.
4. Then after adding error to the message and its encoding it passes the information to the receiver using a buffer.
5. The receiver receives, parses and checks if the data was correctly encoded and transmitted based upon the algorithm.

## Data Structures used

Char, int arrays, flags and sockets.

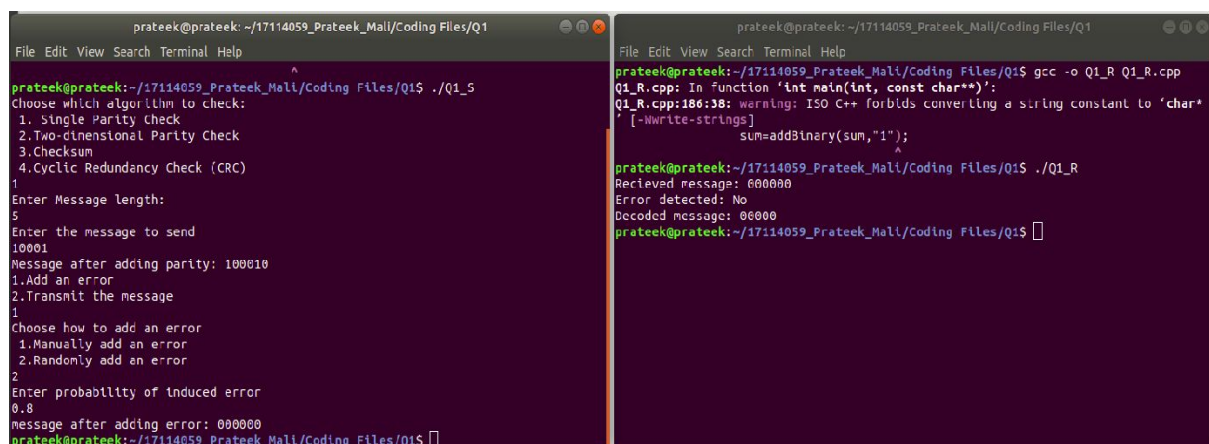
## Code Snippets

Code is quite big so the screenshots can't be added. Code can be seen in Coding Files folder.

## Screenshots of running code

### Single Parity Check :-

### Example - 1



```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_S
Choose which algorithm to check:
1. Single Parity Check
2. Two-dimensional Parity Check
3. Checksum
4. Cyclic Redundancy Check (CRC)
1
Enter Message length:
5
Enter the message to send
10001
Message after adding parity: 100010
1. Add an error
2. Transmit the message
1
Choose how to add an error
1. Manually add an error
2. Randomly add an error
2
Enter probability of induced error
0.8
Message after adding error: 000000
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_S.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Recieved message: 000000
Error detected: No
Decoded message: 00000
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

## Example - 2

```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Received message: 100010
Error detected: No
Decoded message: 10001
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

```
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_S Q1_S.cpp
Q1_S.cpp: In function 'int main(int, const char**)':
Q1_S.cpp:280:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_S
Choose which algorithm to check:
1. Single Parity Check
2. Two-dimensional Parity Check
3. Checksum
4. Cyclic Redundancy Check (CRC)
1
Enter Message Length:
5
Enter the message to send
10001
Message after adding parity: 100010
1.Add an error
2.Transmit the message
2
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

## Two-dimensional Parity Check :-

### Example - 1

```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Received message: 000000001
Error detected: No
Decoded message: 0000
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

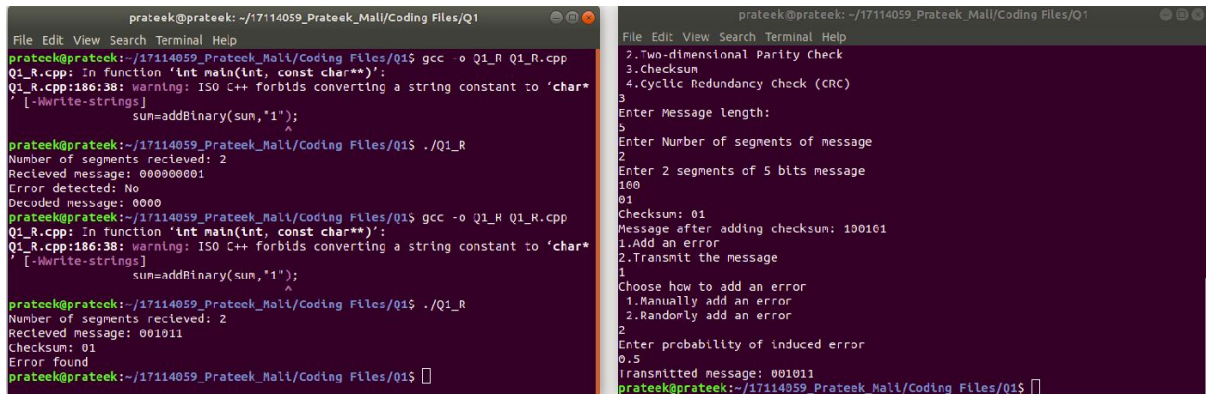
```
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_S Q1_S.cpp
Q1_S.cpp: In function 'int main(int, const char**)':
Q1_S.cpp:280:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_S
Enter Number of segments of message
2
Enter 2 segments of 5 bits message
101
11
Two dimensional parity matrix
1 0 1
1 1 0
0 1 1
1.Add an error
2.Transmit the message
2
Choose how to add an error
1.Manually add an error
2.Randomly add an error
2
Enter probability of induced error
0.6
Two dimensional parity matrix after adding error
0 0 0
0 0 0
0 0 1
Transmitted message: 000000001
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

### Example - 2

```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Received message: 100010
Error detected: No
Decoded message: 10001
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_S Q1_S.cpp
Q1_S.cpp: In function 'int main(int, const char**)':
Q1_S.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sum,"1");
                           ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_S
Choose which algorithm to check:
1. Single Parity Check
2. Two-dimensional Parity Check
3. Checksum
4. Cyclic Redundancy Check (CRC)
2
Enter Message Length:
5
Enter Number of segments of message
2
Enter 2 segments of 5 bits message
101
11
Two dimensional parity matrix
1 0 1
1 1 0
0 1 1
1.Add an error
2.Transmit the message
2
Transmitted message: 101110011
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

## Checksum :-

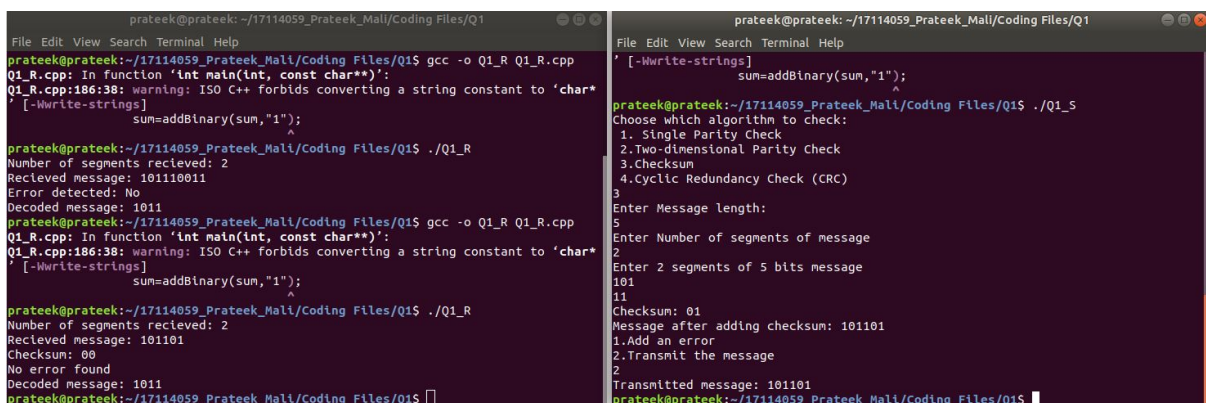
### Example - 1



```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Recieved message: 000000001
Error detected: No
Decoded message: 0000
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Recieved message: 001011
Checksum: 01
Error found
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$

prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
2.Two-dimensional Parity Check
3.Checksum
4.Cyclic Redundancy Check (CRC)
3
Enter Message length:
5
Enter Number of segments of message
2
Enter 2 segments of 5 bits message
100
01
Checksum: 01
Message after adding checksum: 100101
1.Add an error
2.Transmit the message
1
Choose how to add an error
1.Manually add an error
2.Randomly add an error
2
Enter probability of induced error
0.5
Transmitted message: 001011
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

### Example - 2

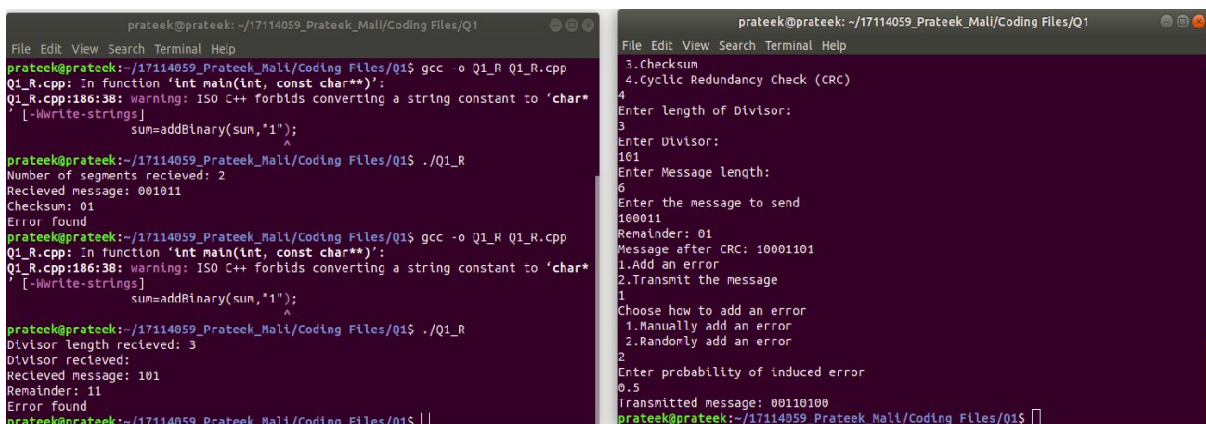


```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Recieved message: 101110011
Error detected: No
Decoded message: 1011
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Recieved message: 101101
Checksum: 00
No error found
Decoded message: 1011
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$

prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_5
Choose which algorithm to check:
1. Single Parity Check
2.Two-dimensional Parity Check
3.Checksum
4.Cyclic Redundancy Check (CRC)
3
Enter Message length:
5
Enter Number of segments of message
2
Enter 2 segments of 5 bits message
101
11
Checksum: 01
Message after adding checksum: 101101
1.Add an error
2.Transmit the message
2
Transmitted message: 101101
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

## Cyclic Redundancy Check :-

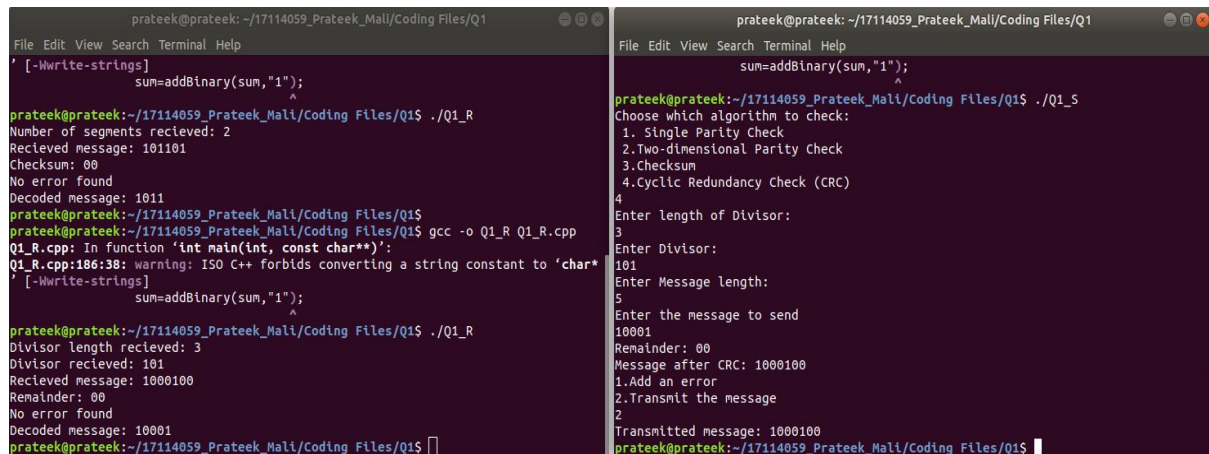
### Example - 1



```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Recieved message: 001011
Checksum: 01
Error found
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Wwrite-strings]
    sum=addBinary(sun,"1");
                                ^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Divisor length recieved: 3
Divisor recieved:
Recieved message: 101
Remainder: 11
Error found
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$

prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
3.Checksum
4.Cyclic Redundancy Check (CRC)
4
Enter length of Divisor:
3
Enter Divisor:
101
Enter Message length:
6
Enter the message to send
100011
Remainder: 01
Message after CRC: 10001101
1.Add an error
2.Transmit the message
1
Choose how to add an error
1.Manually add an error
2.Randomly add an error
2
Enter probability of induced error
0.5
Transmitted message: 00110100
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

## Example - 2



```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q1
File Edit View Search Terminal Help
' [-Write-strings]
sum=addBinary(sum,"1");
^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Number of segments recieved: 2
Recieved message: 101101
Checksum: 00
No error found
Decoded message: 1011
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ gcc -o Q1_R Q1_R.cpp
Q1_R.cpp: In function 'int main(int, const char**)':
Q1_R.cpp:186:38: warning: ISO C++ forbids converting a string constant to 'char*' [-Write-strings]
sum=addBinary(sum,"1");
^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_R
Divisor length recieved: 3
Divisor recieved: 101
Recieved message: 1000100
Remainder: 00
No error found
Decoded message: 10001
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$

prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
File Edit View Search Terminal Help
sum=addBinary(sum,"1");
^
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$ ./Q1_5
Choose which algorithm to check:
1. Single Parity Check
2. Two-dimensional Parity Check
3. Checksum
4. Cyclic Redundancy Check (CRC)
4
Enter length of Divisor:
3
Enter Divisor:
101
Enter Message length:
5
Enter the message to send
10001
Remainder: 00
Message after CRC: 1000100
1. Add an error
2. Transmit the message
2
Transmitted message: 1000100
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q1$
```

## 2

### Problem Statement

Transmit a binary message (from a sender to a receiver) using socket programming in C. Using Hamming code, detect and correct errors in the transmitted message, if any.

### Algorithm

1. Create a sender with a socket it is listening to.
2. Create a receiver to connect to the socket.
3. The sender requests the user for relevant information on size, data and error requirement and passes it to the receiver by sending the relevant parameters and errors to the buffer.
4. The sender encode it using the Hamming code to generate the final message .
5. The receiver receives, parses and checks if the data was correctly encoded and transmitted based on the Hamming code and finds if the code is corrupted.

### Data Structures used

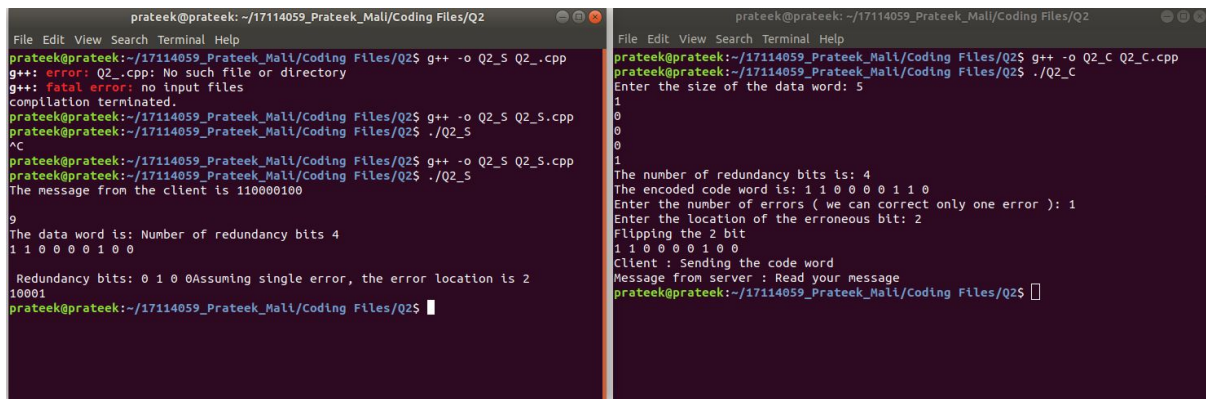
Char, int arrays, flags and sockets.



## Code Snippets

Code is quite big so it's screenshots can't be added. Code can be seen in Coding Files folder.

## Screenshots of running code



```
prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q2
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ g++ -o Q2_S Q2_.cpp
g++: error: Q2_.cpp: No such file or directory
g++: fatal error: no input files
compilation terminated.
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ g++ -o Q2_S Q2_S.cpp
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ ./Q2_S
^C
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ g++ -o Q2_S Q2_S.cpp
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ ./Q2_S
The message from the client is 110000100
9
The data word is: Number of redundancy bits 4
1 1 0 0 0 0 1 0 0
Redundancy bits: 0 1 0 0 Assuming single error, the error location is 2
10001
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$

prateek@prateek: ~/17114059_Prateek_Mali/Coding Files/Q2
File Edit View Search Terminal Help
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ g++ -o Q2_C Q2_C.cpp
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$ ./Q2_C
Enter the size of the data word: 5
1
0
0
0
1
The number of redundancy bits is: 4
The encoded code word is: 1 1 0 0 0 0 1 1 0
Enter the number of errors ( we can correct only one error ): 1
Enter the location of the erroneous bit: 2
Flipping the 2 bit
1 1 0 0 0 0 1 0 0
Client : Sending the code word
Message from server : Read your message
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q2$
```

## 3

## Problem Statement

Write a C++ program to compress a message non-binary, can be anything like a text message or a code like hexadecimal, etc.) using the following data compression algorithm:

1. Huffman
2. Shannon-Fano

## Algorithm

Huffman & Shannon-Fano are used for constructing a prefix code based on a set of symbols and their probabilities. The main objective is to generate a prefix code to encode the file data.

1. Pass the file to the program.
2. Select the algorithm.
3. Encode the files.
4. Save the results in output.txt file.

## Data Structures used

Char, int arrays, flags and sockets.

## Code Snippets

Code is quite big so it's screenshots can't be added. Code can be seen in Coding Files folder.

## Screenshots of running code

Huffman :-

```
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q3$ ./Q3 input.txt
Select Encoding
1. Huffman
2. Shannon-Fano
1
Huffman Codes are :
r:1111
l:1110
e:110
c:0100
t:0001
n:001
d:010110
:011
u:10001
k:0000
m:01010
w:010111
p:10000
s:10010
b:100110
l:100111
a:10100
g:10101
o:1011

Original string was :
computer networks lab computer science and engineering tit roorkee

Encoded string is :
01001011010101000010001000111011110110011100001010111101111100001001001110011110100100110011010010110101010000100010001110111101110010011101100001010110001101011110001110110111
111000110101011111011100001011111101110111110000110110

Encoded message length:260

Decoded string is:
prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q3$
```

## Shannon Fano :-

```
Select Encoding
1. Huffman
2. Shannon-Fano
2

19
e      0.151515      00
      0.121212      010
n      0.090909      0110
r      0.090909      0111
l      0.075758      100
o      0.075758      1010
c      0.060606      1011
t      0.060606      1100
a      0.030303      11010
g      0.030303      110110
k      0.030303      110111
m      0.030303      11100
p      0.030303      111010
s      0.030303      111011
u      0.030303      111100
b      0.015152      111101
d      0.015152      111110
l      0.015152      1111110
w      0.015152      1111111

101110101100111010111100110000011101001100011001111111010011110111111011010111110110101111011010111101011110011000001110101110111101000001101011000101101001101111100100001101101100011000
0001111000110110010100100110001001111010101001111101110000

Length of encoded message : 266

prateek@prateek:~/17114059_Prateek_Mali/Coding Files/Q3$
```