Question 4

Note:
Please refer to the zip file containing the Java Codes (Arithmetic.java and GenerateMutants.java) and the text file (mutant.txt).

Arithmetic Code:
Here, there are four lines of code under test in which mutants may be inserted.

```
1  public class Arithmetic
2  {
3
4      public static void main(String[] args)
5      {
6          int n1 = 10;
7          int n2 = 5;
8
9          int sum = n1 + n2;
10
11         int difference = n1 - n2;
12
13         int product = n1 * n2;
14
15         int quot = n1 / n2;
16
17
18         //Displaying the values
19         System.out.println("n1 : "+n1);
20         System.out.println("n2 : "+n2);
21         System.out.println("sum : "+sum);
22         System.out.println("diff : "+difference);
23         System.out.println("product : "+product);
24         System.out.println("div : "+quot);
25     }
26 }
27
```

Text File Generation (library of mutants) Code:

```java
import java.util.Scanner;
import java.io.*;

public class GenerateMutants {
    public static void main(String[] args) {
        // Create an instance of File for data.txt file.
        File file = new File("Arithmetic.java");
        int totalmutants=0;

        // + mutants
        try {
            Scanner scanner = new Scanner(file);
            File fout1 = new File("mutantplus1.txt");
            FileOutputStream fos1 = new FileOutputStream(fout1);
            BufferedWriter bw1 = new BufferedWriter(new OutputStreamWriter(fos1));

            File fout2 = new File("mutantplus2.txt");
            FileOutputStream fos2 = new FileOutputStream(fout2);
            BufferedWriter bw2 = new BufferedWriter(new OutputStreamWriter(fos2));

            File fout3 = new File("mutantplus3.txt");
            FileOutputStream fos3 = new FileOutputStream(fout3);
            BufferedWriter bw3 = new BufferedWriter(new OutputStreamWriter(fos3));
            int line1_nb=0;
            int line2_nb=0;
            int line3_nb=0;

            File fout_mutant = new File("mutant.txt");
            FileOutputStream fos_mutant = new FileOutputStream(fout_mutant);
            BufferedWriter bw_mutant = new BufferedWriter(new OutputStreamWriter(fos_mutant));


            while (scanner.hasNextLine()) {
                String line = scanner.nextLine();
                line1_nb++;
                if (line.contains("n1 +")) {
                  String line1 = line.replace("n1 + n2", "n1 - n2");
                  String line2 = line.replace("n1 + n2", "n1 * n2");
                  String line3 = line.replace("n1 + n2", "n1 / n2");

```

```
40
41                  bw1.write("// origin line: " + line);bw1.write("\n");
42                  bw1.write("// below is mutant line: Mutant type -");bw1.write("\n");
43                  bw1.write(line1);bw1.write("\n");
44                  totalmutants++;
45                  bw2.write("// origin line: " + line);bw2.write("\n");
46                  bw2.write("// below is mutant line: Mutant type *");bw2.write("\n");
47                  bw2.write(line2);bw2.write("\n");
48                  totalmutants++;
49                  bw3.write("// origin line: " + line);bw3.write("\n");
50                  bw3.write("// below is mutant line: Mutant type /");bw3.write("\n");
51                  bw3.write(line3);bw3.write("\n");
52                  totalmutants++;
53
54                  bw_mutant.write(line1_nb + ":" + "+" + ":" + "-,*,/");bw_mutant.write("\n");
55
56
57                }
58
59                if (line.contains("n1 -")) {
60                    bw_mutant.write(line1_nb + ":" + "-" + ":" + "+,*,/");bw_mutant.write("\n");
61                    totalmutants+=3;
62                }
63
64                if (line.contains("n1 *")) {
65                    bw_mutant.write(line1_nb + ":" + "*" + ":" + "+,-,/");bw_mutant.write("\n");
66                    totalmutants+=3;
67                }
68                if (line.contains("n1 /")) {
69                    bw_mutant.write(line1_nb + ":" + "/" + ":" + "+,-,*");bw_mutant.write("\n");
70                    totalmutants+=3;
71                }
72                else {
73                  bw1.write(line);
74                  bw1.write("\n");
75
76                  bw2.write(line);
77                  bw2.write("\n");
78
79                  bw3.write(line);
80                  bw3.write("\n");
81                }
82            }
```

```
83
84              bw_mutant.write("Total Possible Mutants: " + totalmutants);bw_mutant.write("\n");
85              bw1.close();
86              bw2.close();
87              bw3.close();
88              bw_mutant.close();
89          } catch (FileNotFoundException e) {
90              e.printStackTrace();
91          } catch (IOException e) {
92            // Problem when writing to the file
93            e.printStackTrace();
94          }
95      System.out.println("Total number of possible mutants: "+ totalmutants);
96
97      }
98  }
99
```

Text File with library of mutants: