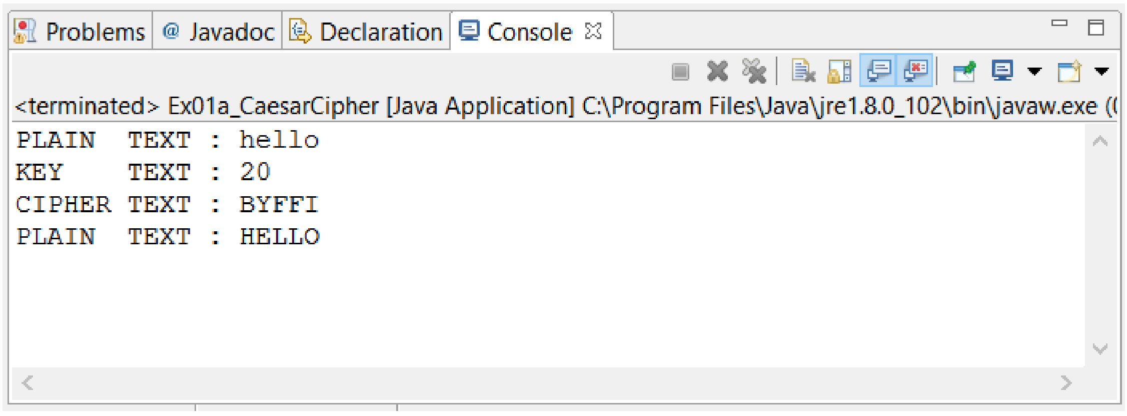
EX1A – CAESAR CIPHER

PROGRAM:

```
public class Ex01a_CaesarCipher {

	public static String crypt(String input, int key, boolean encrypt) {
		StringBuilder cipher = new StringBuilder("");
		for (char i : input.toCharArray()) {
			cipher.append((char) (((i - 'a' + (encrypt ? 1 : -1) * 
key) % 26 + 26) % 26 + 'a'));
		}
		return cipher.toString();
	}

	public static void main(String[] args) {
		String plain = "hello";
		int key = 20;

		System.out.println("PLAIN  TEXT : " + plain);
		System.out.println("KEY    TEXT : " + key);
		System.out.println("CIPHER TEXT : "
				+ crypt(plain, key, true).toUpperCase());
		System.out.println("PLAIN  TEXT : "
				+ crypt(crypt(plain, key, true), key, 
false).toUpperCase());
	}
}
```

OUTPUT:



```
<terminated> Ex01a_CaesarCipher [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (
PLAIN  TEXT : hello
KEY    TEXT : 20
CIPHER TEXT : BYFFI
PLAIN  TEXT : HELLO
```

RESULT:

THE CAESAR CIPHER WAS SUCCESSFULLY CREATED

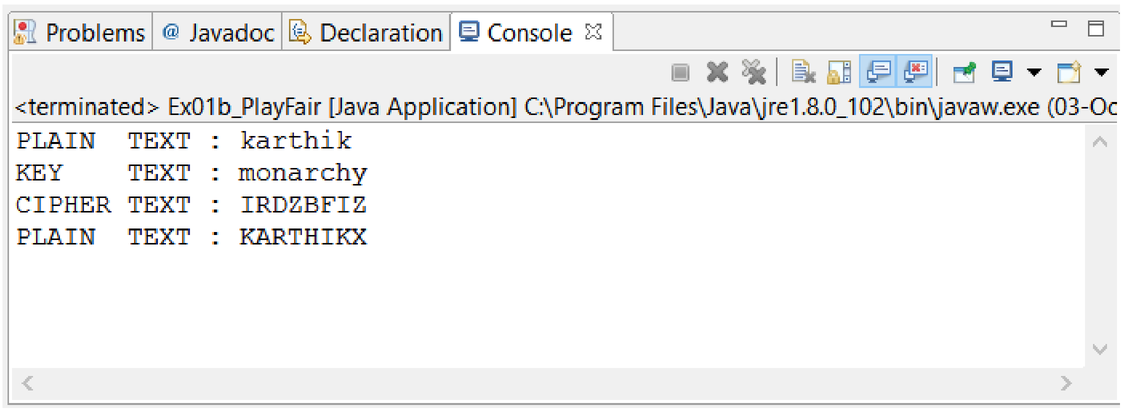
EX1B – PLAYFAIR CIPHER

PROGRAM:

```
public class Ex01b_PlayFair {
      public static int[][] processKey(String key) {
            int[][] keyMat = new int[26][2];

            int l = 0;
            for (char i : (key +
"abcdefghiklmnopqrstuvwxyz").toCharArray()) {
                  if (key.indexOf(i + "") < 0 || l < key.length()) {
                        keyMat[i - 'a'][0] = l / 5;
                        keyMat[i - 'a'][1] = l++ % 5;
                        if (i == 'i') {
                              keyMat[i - 'a' + 1][0] = l / 5;
                              keyMat[i - 'a' + 1][1] = l % 5;
                        }
                  }
            }

            return keyMat;
      }

      public static String crypt(String inputText, String key, boolean
encrypt) {
            int[][] keyMat = processKey(key);
            char[][] indMat = new char[5][5];
            for (int i = 0; i < keyMat.length; i++) {
                  indMat[keyMat[i][0]][keyMat[i][1]] = (char) ('a' + i);
            }
            String cipherText = "";

            for (int i = 0; i < inputText.length(); i += 2) {
                  char first = inputText.charAt(i);
                  char second = i + 1 == inputText.length()
                              || first == inputText.charAt(i + 1) ? 'x' :
inputText
                              .charAt(i + 1);

                  int fRow = keyMat[first - 'a'][0];
                  int fCol = keyMat[first - 'a'][1];
                  int sRow = keyMat[second - 'a'][0];
                  int sCol = keyMat[second - 'a'][1];

                  if (fRow == sRow) {
                        fCol = ((fCol + (encrypt ? 1 : -1)) % 5 + 5) % 5;
                        sCol = ((sCol + (encrypt ? 1 : -1)) % 5 + 5) % 5;
                  } else if (fCol == sCol) {
                        fRow = ((fRow + (encrypt ? 1 : -1)) % 5 + 5) % 5;
                        sRow = ((sRow + (encrypt ? 1 : -1)) % 5 + 5) % 5;
                  } else {
                        int tCol = fCol;
                        fCol = sCol;
                        sCol = tCol;
                  }

                  cipherText += (indMat[fRow][fCol]) + "" +
(indMat[sRow][sCol]);
            }
```

```
        return cipherText;
    }

    public static void main(String[] args) {
        String plain = "karthik";
        String key = "monarchy";

        System.out.println("PLAIN  TEXT : " + plain);
        System.out.println("KEY    TEXT : " + key);
        System.out.println("CIPHER TEXT : "
                + crypt(plain, key, true).toUpperCase());
        System.out.println("PLAIN  TEXT : "
                + crypt(crypt(plain, key, true), key,
false).toUpperCase());
    }
}
```

OUTPUT:



```
<terminated> Ex01b_PlayFair [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-Oc
PLAIN  TEXT : karthik
KEY    TEXT : monarchy
CIPHER TEXT : IRDZBFIZ
PLAIN  TEXT : KARTHIKX
```

RESULT:

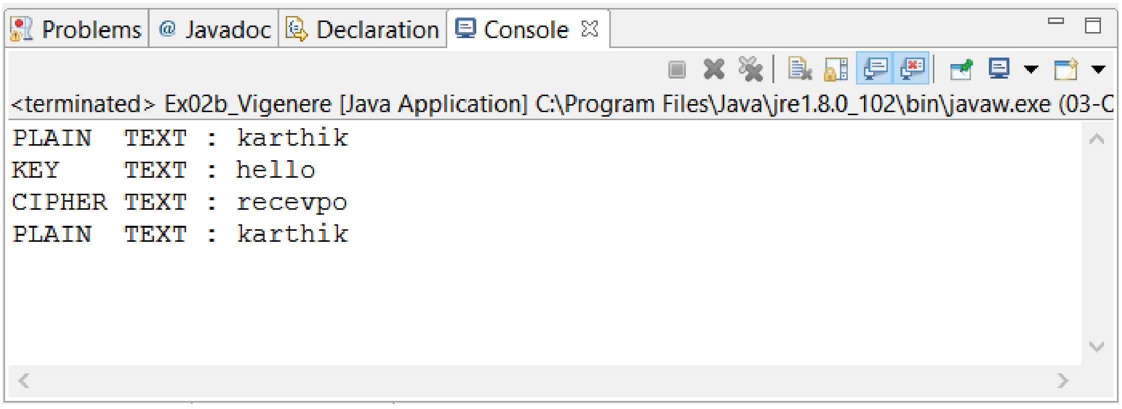
THE PLAY FAIR CIPHER ALGORITHM WAS IMPLEMENTED AND TESTED.

EX02A – VIGENERE CIPHER

PROGRAM:

```
public class Ex02b_Vigenere {
	public static String cryptic(String input, String key, boolean
encrypt) {
		StringBuilder output = new StringBuilder("");

		int j = 0;
		for (char i : input.toCharArray()) {
			output.append((char) (((i - 'a' + (encrypt ?
key.charAt(j) - 'a'
					: -key.charAt(j) + 'a')) % 26 + 26) % 26 +
'a'));
			j = (j + 1) % key.length();
		}
		return output.toString();
	}

	public static void main(String[] args) {

		String plain = "karthik", key = "hello";

		System.out.println("PLAIN  TEXT : " + plain);
		System.out.println("KEY    TEXT : " + key);
		System.out.println("CIPHER TEXT : " + cryptic(plain, key,
true));
		System.out.println("PLAIN  TEXT : "
				+ cryptic(cryptic(plain, key, true), key, false));
	}
}
```

OUTPUT:



```
<terminated> Ex02b_Vigenere [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-C
PLAIN  TEXT : karthik
KEY    TEXT : hello
CIPHER TEXT : recevpo
PLAIN  TEXT : karthik
```

RESULT:

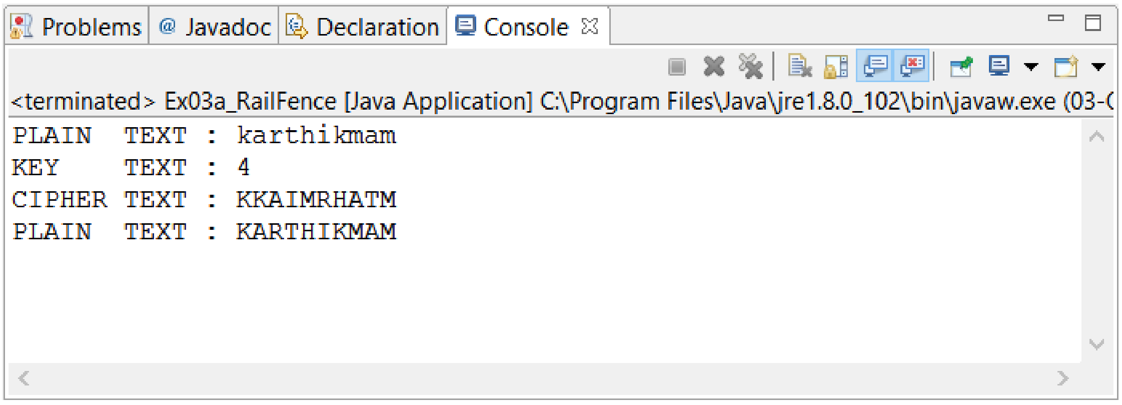
THE VIGENERE CIPHER ALGORITHM WAS SUCCESSFULLY IMPLEMENTED AND TESTED.

EX03A – RAIL FENCE ALGORITHM

PROGRAM:

```
public class Ex03a_RailFence {
	public static String crypt(String msg, int key, boolean encrypt) {
		char[] res = new char[msg.length()];

		for (int i = 0, k = 0; i < key; i++) {
			int inc = 2 * (key - i - 1);

			// format to take chars is j....(j + inc)....(j + 2 * 
(key - 1))
			for (int j = i; j < msg.length(); j += 2 * (key - 1)) {
				res[encrypt ? k++ : j] = msg.charAt(encrypt ? j : 
k++);
				if (i != key - 1 && i != 0 && (j + inc) < 
msg.length())
					res[encrypt ? k++ : j + inc] = 
msg.charAt(encrypt ? j + inc
							: k++);
			}
		}

		return new String(res);
	}

	public static void main(String[] args) {
		String plain = "karthikmam";
		int key = 4;

		System.out.println("PLAIN  TEXT : " + plain);
		System.out.println("KEY    TEXT : " + key);
		System.out.println("CIPHER TEXT : "
				+ crypt(plain, key, true).toUpperCase());
		System.out.println("PLAIN  TEXT : "
				+ crypt(crypt(plain, key, true), key, 
false).toUpperCase());
	}
}
```

OUTPUT:



```
<terminated> Ex03a_RailFence [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-(
PLAIN  TEXT : karthikmam
KEY    TEXT : 4
CIPHER TEXT : KKAIMRHATM
PLAIN  TEXT : KARTHIKMAM
```

RESULT:

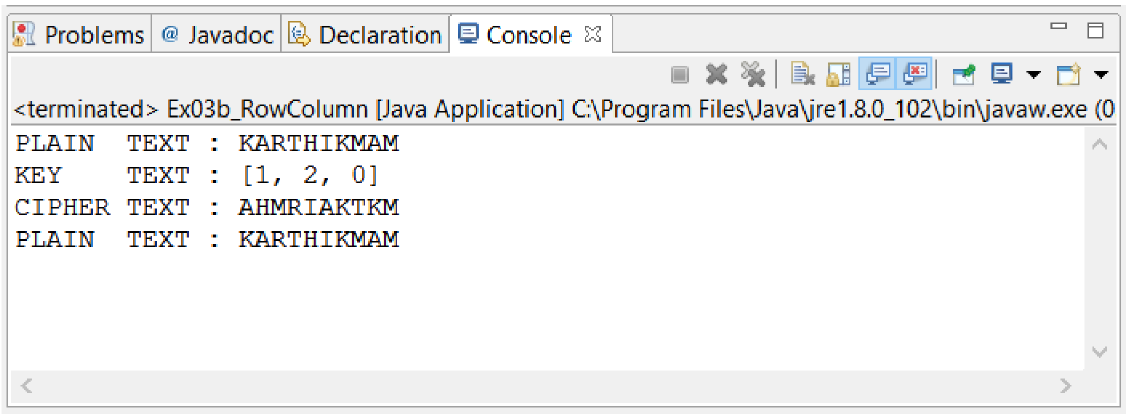
THE RAIL FENCE ALGORITHM WAS SUCCESSFULLY IMPLEMENTED AND TESTED.

EX03B – ROW COLUMN CIPHER

PROGRAM:

```
import java.util.Arrays;

public class Ex03b_RowColumn {
	public static String crypt(String msg, int[] key, boolean encrypt) {
		char[] res = new char[msg.length()];

		for (int i = 0, k = 0; i < key.length; i++)
			for (int j = key[i]; j < msg.length(); j += key.length)
				res[encrypt ? k++ : j] = msg.charAt(encrypt ? j : 
k++);

		return new String(res);
	}

	public static void main(String[] args) {
		// TODO Auto-generated method stub

		String plain = "KARTHIKMAM";
		int[] key = { 1, 2, 0 };

		System.out.println("PLAIN  TEXT : " + plain);
		System.out.println("KEY    TEXT : " + Arrays.toString(key));
		System.out.println("CIPHER TEXT : " + crypt(plain, key, true));
		System.out.println("PLAIN  TEXT : "
				+ crypt(crypt(plain, key, true), key, false));

	}

}
```

OUTPUT:



```
<terminated> Ex03b_RowColumn [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (0
PLAIN  TEXT : KARTHIKMAM
KEY    TEXT : [1, 2, 0]
CIPHER TEXT : AHMRIAKTKM
PLAIN  TEXT : KARTHIKMAM
```

RESULT:

THE ROW COLUMN CIPHER WAS SUCCESSFULLY IMPLEMENTED AND TESTED.

EX04 – DES

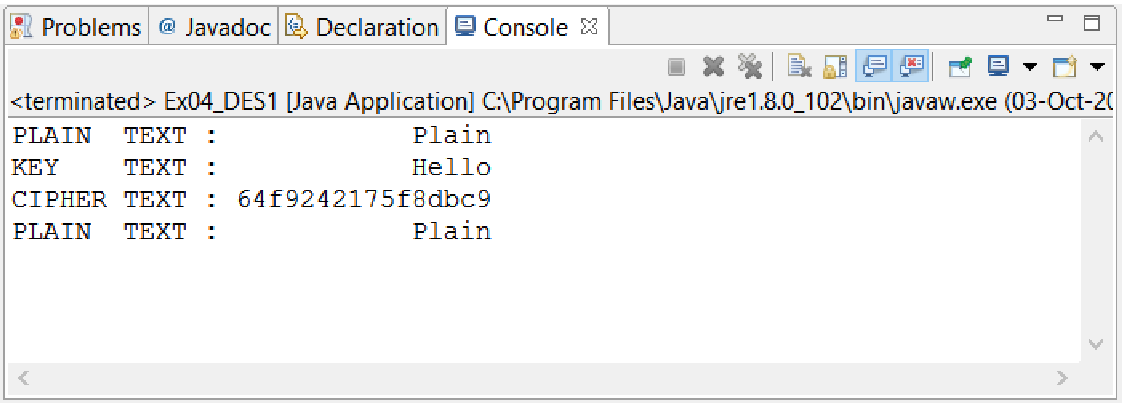
PROGRAM:

```java
import java.math.BigInteger;

public class Ex04_DES {
	private static final long GET_32B = (1L << 32) - 1;
	private static final long GET_28B = (1L << 28) - 1;
	private static final long GET_56B = (1L << 56) - 1;

	private static final short[] PC1 = {
		57, 49, 41, 33, 25, 17,  9,
		 1, 58, 50, 42, 34, 26, 18,
		10,  2, 59, 51, 43, 35, 27,
		19, 11,  3, 60, 52, 44, 36,
		63, 55, 47, 39, 31, 23, 15,
		 7, 62, 54, 46, 38, 30, 22,
		14,  6, 61, 53, 45, 37, 29,
		21, 13,  5, 28, 20, 12,  4 };
	private static final short[] PC2 = {
		14, 17, 11, 24,  1,  5,
		 3, 28, 15,  6, 21, 10,
		23, 19, 12,  4, 26,  8,
		16,  7, 27, 20, 13,  2,
		41, 52, 31, 37, 47, 55,
		30, 40, 51, 45, 33, 48,
		44, 49, 39, 56, 34, 53,
		46, 42, 50, 36, 29, 32 };
	private static final short[] L_ROT = { 1, 1, 2, 2, 2, 2, 2, 2, 1, 2,
2, 2, 2, 2, 2, 1 };
	private static final short[] IP = {
		58, 50, 42, 34, 26, 18, 10, 2,
		60, 52, 44, 36, 28, 20, 12, 4,
		62, 54, 46, 38, 30, 22, 14, 6,
		64, 56, 48, 40, 32, 24, 16, 8,
		57, 49, 41, 33, 25, 17,  9, 1,
		59, 51, 43, 35, 27, 19, 11, 3,
		61, 53, 45, 37, 29, 21, 13, 5,
		63, 55, 47, 39, 31, 23, 15, 7 };
	private static short[] IP_1 = {
		40, 8, 48, 16, 56, 24, 64, 32,
		39, 7, 47, 15, 55, 23, 63, 31,
		38, 6, 46, 14, 54, 22, 62, 30,
		37, 5, 45, 13, 53, 21, 61, 29,
		36, 4, 44, 12, 52, 20, 60, 28,
		35, 3, 43, 11, 51, 19, 59, 27,
		34, 2, 42, 10, 50, 18, 58, 26,
		33, 1, 41,  9, 49, 17, 57, 25 };
	private static final short[] E = {
		32,  1,  2,  3,  4,  5,
		 4,  5,  6,  7,  8,  9,
		 8,  9, 10, 11, 12, 13,
		12, 13, 14, 15, 16, 17,
		16, 17, 18, 19, 20, 21,
		20, 21, 22, 23, 24, 25,
		24, 25, 26, 27, 28, 29,
		28, 29, 30, 31, 32,  1 };
	private static long[][] S = {
			{ 14, 4, 13, 1, 2, 15, 11, 8, 3, 10, 6, 12, 5, 9, 0, 7,
0, 15, 7, 4, 14, 2, 13, 1, 10, 6, 12, 11, 9, 5, 3, 8, 4, 1, 14, 8, 13, 6,
2, 11, 15, 12, 9, 7, 3, 10, 5, 0, 15, 12, 8, 2, 4, 9, 1, 7, 5, 11, 3, 14,
10, 0, 6, 13 },
                  { 15, 1, 8, 14, 6, 11, 3, 4, 9, 7, 2, 13, 12, 0, 5, 10,
3, 13, 4, 7, 15, 2, 8, 14, 12, 0, 1, 10, 6, 9, 11, 5, 0, 14, 7, 11, 10, 4,
13, 1, 5, 8, 12, 6, 9, 3, 2, 15, 13, 8, 10, 1, 3, 15, 4, 2, 11, 6, 7, 12,
0, 5, 14, 9 },
                  { 10, 0, 9, 14, 6, 3, 15, 5, 1, 13, 12, 7, 11, 4, 2, 8,
13, 7, 0, 9, 3, 4, 6, 10, 2, 8, 5, 14, 12, 11, 15, 1, 13, 6, 4, 9, 8, 15,
3, 0, 11, 1, 2, 12, 5, 10, 14, 7, 1, 10, 13, 0, 6, 9, 8, 7, 4, 15, 14, 3,
11, 5, 2, 12 },
                  { 7, 13, 14, 3, 0, 6, 9, 10, 1, 2, 8, 5, 11, 12, 4, 15,
13, 8, 11, 5, 6, 15, 0, 3, 4, 7, 2, 12, 1, 10, 14, 9, 10, 6, 9, 0, 12, 11,
7, 13, 15, 1, 3, 14, 5, 2, 8, 4, 3, 15, 0, 6, 10, 1, 13, 8, 9, 4, 5, 11,
12, 7, 2, 14 },
                  { 2, 12, 4, 1, 7, 10, 11, 6, 8, 5, 3, 15, 13, 0, 14, 9,
14, 11, 2, 12, 4, 7, 13, 1, 5, 0, 15, 10, 3, 9, 8, 6, 4, 2, 1, 11, 10, 13,
7, 8, 15, 9, 12, 5, 6, 3, 0, 14, 11, 8, 12, 7, 1, 14, 2, 13, 6, 15, 0, 9,
10, 4, 5, 3 },
                  { 12, 1, 10, 15, 9, 2, 6, 8, 0, 13, 3, 4, 14, 7, 5, 11,
10, 15, 4, 2, 7, 12, 9, 5, 6, 1, 13, 14, 0, 11, 3, 8, 9, 14, 15, 5, 2, 8,
12, 3, 7, 0, 4, 10, 1, 13, 11, 6, 4, 3, 2, 12, 9, 5, 15, 10, 11, 14, 1, 7,
6, 0, 8, 13 },
                  { 4, 11, 2, 14, 15, 0, 8, 13, 3, 12, 9, 7, 5, 10, 6, 1,
13, 0, 11, 7, 4, 9, 1, 10, 14, 3, 5, 12, 2, 15, 8, 6, 1, 4, 11, 13, 12, 3,
7, 14, 10, 15, 6, 8, 0, 5, 9, 2, 6, 11, 13, 8, 1, 4, 10, 7, 9, 5, 0, 15,
14, 2, 3, 12 },
                  { 13, 2, 8, 4, 6, 15, 11, 1, 10, 9, 3, 14, 5, 0, 12, 7,
1, 15, 13, 8, 10, 3, 7, 4, 12, 5, 6, 11, 0, 14, 9, 2, 7, 11, 4, 1, 9, 12,
14, 2, 0, 6, 10, 13, 15, 3, 5, 8, 2, 1, 14, 7, 4, 10, 8, 13, 15, 12, 9, 0,
3, 5, 6, 11 } };
      private static short[] P = {
            16,  7, 20, 21,
            29, 12, 28, 17,
             1, 15, 23, 26,
             5, 18, 31, 10,
             2,  8, 24, 14,
            32, 27,  3,  9,
          19, 13, 30,  6,
            22, 11,  4, 25 };

      private static long mutate(long input, short[] table, long
originalLength) {
            long result = 0;
            for (int i = 0; i < table.length; i++) {
                  result = (result << 1) | (input >>> (originalLength -
table[i]))
                              % 2;
                  // System.out.printf("%x \n", result);
            }
            return result;
      }

      private long[] keys = new long[16];

      public Ex04_DES(long key) {
            long pKey = mutate(key, PC1, 64) & GET_56B;
            long c = pKey >>> 28;
            long d = pKey & GET_28B;

            for (int i = 0; i < 16; i++) {
```

```
                        c = ((c << L_ROT[i]) | (c >>> (28 - L_ROT[i]))) &
GET_28B;
                        d = ((d << L_ROT[i]) | (d >>> (28 - L_ROT[i]))) &
GET_28B;
                        keys[i] = mutate((c << 28) | d, PC2, 56);
                }
        }

        public long crypt(long msg, boolean encrypt) {
                msg = mutate(msg, IP, 64);

                long l = msg >>> 32;
                long r = msg & GET_32B;

                for (int i = 0; i < 16; i++) {
                        long temp = r;
                        r = l ^ f(r, keys[encrypt ? i : 16 - i - 1]);
                        l = temp;
                        // System.out.printf("%16s %16s %16x \n",
Long.toHexString(r),
                        // Long.toHexString(l), keys[encrypt ? i : 16 - i - 1]);
                }

                return mutate((r << 32) | l, IP_1, 64);
        }

        private long f(long r, long key) {
                r = mutate(r & GET_32B, E, 32) ^ key;

                long result = 0;
                for (int i = 7; i >= 0; i--) {
                        byte box = (byte) (r & 0x3F);
                        r = r >>> 6;

                        int row = ((box >>> 5) << 1) | (box & 1);
                        int col = (box >>> 1) & 0xF;

                        result |= S[i][row * 16 + col] << (28 - i * 4);
                }

                return mutate(result, P, 32);
        }

        public static void main(String[] args) {
                long plain = new BigInteger("Plain".getBytes()).longValue();
                long key = new BigInteger("Hello".getBytes()).longValue();

                Ex04_DES x = new Ex04_DES(key);

                System.out.printf("PLAIN  TEXT : %16s \n", new String(new
BigInteger(
                                plain + "").toByteArray()));
                System.out.printf("KEY    TEXT : %16s \n", new String(new
BigInteger(
                                key + "").toByteArray()));
                System.out.printf("CIPHER TEXT : %16s \n",
                                Long.toHexString(x.crypt(plain, true)));
                System.out.printf("PLAIN  TEXT : %16s \n", new String(new
BigInteger(""
                                + x.crypt(x.crypt(plain, true),
false)).toByteArray()));
```

```
            }
}
```

OUTPUT:



```
<terminated> Ex04_DES1 [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-Oct-2(
PLAIN  TEXT :              Plain
KEY    TEXT :              Hello
CIPHER TEXT : 64f9242175f8dbc9
PLAIN  TEXT :              Plain
```

RESULT:

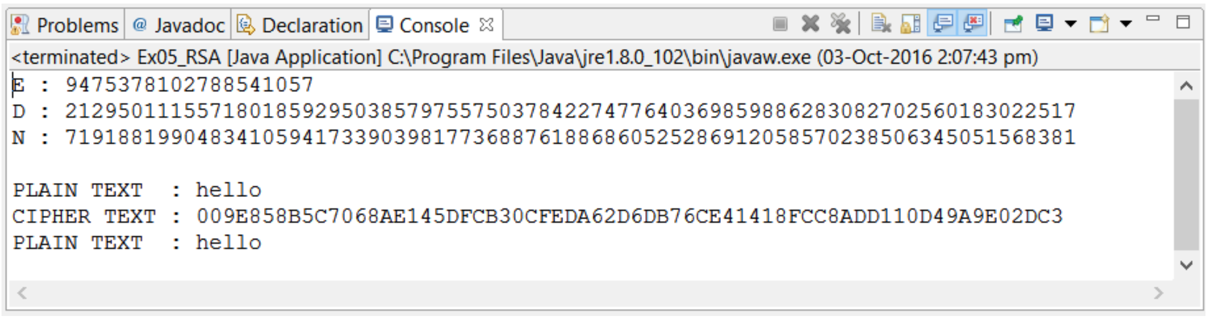
THE DES ALGORITHM WAS SUCCESSFULLY IMPLEMENTED AND TESTED.

EX05 – RSA

PROGRAM:

```
import java.math.BigInteger;
import java.util.Random;

import javax.xml.bind.DatatypeConverter;

public class Ex05_RSA {

	private static int bitLength = 128;
	private BigInteger n, e, d;

	public Ex05_RSA() {
		Random rnd = new Random();

		BigInteger p = BigInteger.probablePrime(bitLength, rnd);
		BigInteger q = BigInteger.probablePrime(bitLength, rnd);

		this.n = p.multiply(q);
		BigInteger phi = p.subtract(BigInteger.ONE).multiply(
				q.subtract(BigInteger.ONE));

		this.e = BigInteger.probablePrime(bitLength / 2, rnd);
		while (e.gcd(phi).compareTo(BigInteger.ONE) == 1
				&& e.compareTo(phi) < 1) {
			e.add(BigInteger.ONE);
		}
		this.d = e.modInverse(phi);

		System.out.println("E : " + e);
		System.out.println("D : " + d);
		System.out.println("N : " + n);
		System.out.println();
	}

	public byte[] crypt(byte[] input, boolean encrypt) {
		return new BigInteger(input).modPow(encrypt ? e : d,
n).toByteArray();
	}

	public static void main(String[] args) {
		Ex05_RSA rsa = new Ex05_RSA();
		String plain = "hello";

		System.out.println("PLAIN TEXT  : " + plain);
		System.out.println("CIPHER TEXT : "
				+
DatatypeConverter.printHexBinary(rsa.crypt(plain.getBytes(),
						true)));
		System.out.println("PLAIN TEXT  : "
				+ new String(
						rsa.crypt(rsa.crypt(plain.getBytes(),
true), false)));
	}

}
```

OUTPUT:



```
<terminated> Ex05_RSA [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-Oct-2016 2:07:43 pm)
E : 9475378102788541057
D : 21295011155718018592950385797557503784227477640369859886283082702560183022517
N : 71918819904834105941733903981773688761886860525286912058570238506345051568381

PLAIN TEXT  : hello
CIPHER TEXT : 009E858B5C7068AE145DFCB30CFEDA62D6DB76CE41418FCC8ADD110D49A9E02DC3
PLAIN TEXT  : hello
```

RESULT:

THE RSA ALGORITHM WAS SUCCESSFULLY IMPLEMENTED.

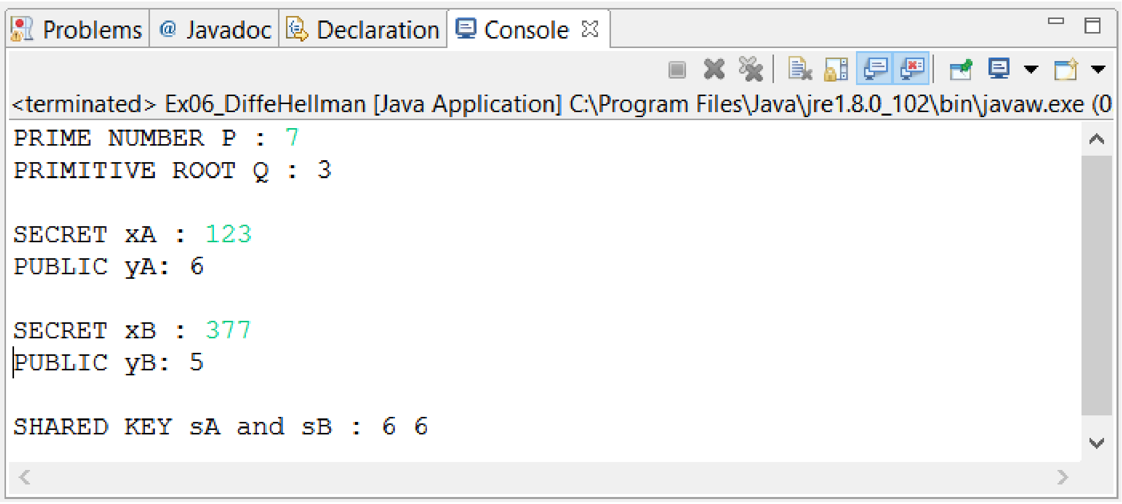
EX06 – DIFFE HELLMAN KEY EXCHANGE ALGORITHM

PROGRAM:

```
import java.math.BigInteger;
import java.util.ArrayList;
import java.util.Scanner;

public class Ex06_DiffeHellman {

	public static ArrayList<BigInteger> getPrimeFactors(BigInteger n) {
		ArrayList<BigInteger> res = new ArrayList<BigInteger>();

		for (BigInteger i = new BigInteger("2"); i.intValue() <
Math.sqrt(n
				.intValue()); i = i.add(BigInteger.ONE))
			if (i.isProbablePrime(100) == true && n.mod(i).intValue()
== 0)
				res.add(i);

		return res;
	}

	public static BigInteger primitiveRoot(BigInteger n) {
		BigInteger phi = n.subtract(BigInteger.ONE);

		ArrayList<BigInteger> primeFactors = getPrimeFactors(phi);
		for (BigInteger i = new BigInteger("2"); i.intValue() <
n.intValue(); i = i
				.add(BigInteger.ONE)) {
			boolean flag = true;
			for (BigInteger j = BigInteger.ZERO; j.intValue() <
primeFactors
					.size(); j = j.add(BigInteger.ONE))
				if
(i.modPow(phi.divide(primeFactors.get(j.intValue())), n)
						.longValue() == 1)
					flag = false;
			if (flag == true)
				return i;
		}

		return BigInteger.ZERO;
	}

	private static Scanner stdIn = new Scanner(System.in);

	public static void main(String[] args) {
		System.out.print("PRIME NUMBER P : ");
		BigInteger p = new BigInteger(stdIn.nextInt() + "");
		BigInteger q = primitiveRoot(p);
		System.out.println("PRIMITIVE ROOT Q : " + q);

		System.out.println();
		System.out.print("SECRET xA : ");
		BigInteger xA = new BigInteger(stdIn.nextInt() + "");
		BigInteger yA = q.modPow(xA, p);
		System.out.println("PUBLIC yA: " + yA);

		System.out.println();
		System.out.print("SECRET xB : ");
```

```
                BigInteger xB = new BigInteger(stdIn.nextInt() + "");
                BigInteger yB = q.modPow(xB, p);
                System.out.println("PUBLIC yB: " + yB);

                System.out.println();
                BigInteger sharedKeyA = yB.modPow(xA, p);
                BigInteger sharedKeyB = yA.modPow(xB, p);
                System.out.println("SHARED KEY sA and sB : " + sharedKeyA + " "
                            + sharedKeyB);
        }

}
```

OUTPUT:



```
<terminated> Ex06_DiffeHellman [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (0
PRIME NUMBER P : 7
PRIMITIVE ROOT Q : 3

SECRET xA : 123
PUBLIC yA: 6

SECRET xB : 377
PUBLIC yB: 5

SHARED KEY sA and sB : 6 6
```

RESULT:

THE DH ALGORITHM WAS SUCCESSFULLY IMPLEMENTED.

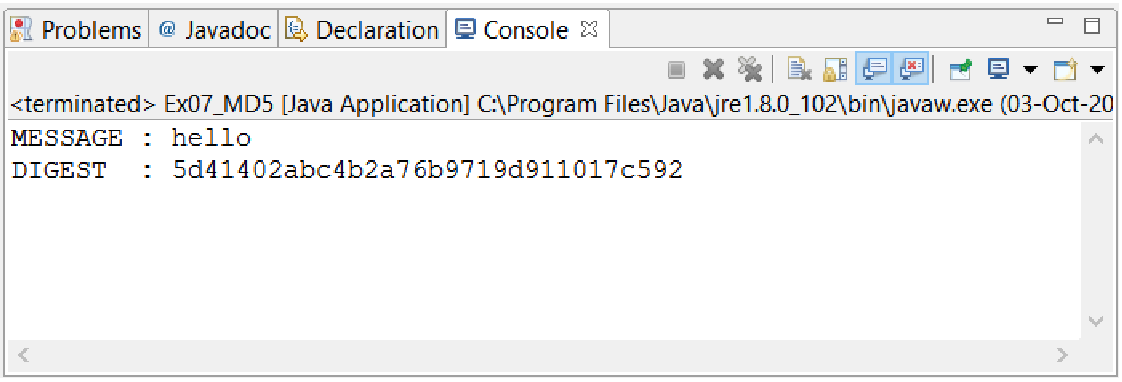
EX07 – MD5 HASH ALGORITHM

PROGRAM:

```
import java.util.Arrays;

public class Ex07_MD5 {
      private static final int[][] S = {
            { 7, 12, 17, 22 },
            { 5,  9, 14, 20 },
            { 4, 11, 16, 23 },
            { 6, 10, 15, 21 }
      };
      private static final int[] T;
      static {
            T = new int[64];
            for(int i = 0; i < 64; i++)
                  T[i] = (int) (long) ((1L << 32) * Math.abs(Math.sin(i +
1)));
      }

      private static final int F(int x, int y, int z) { return (x & y) |
(~x & z); }
      private static final int G(int x, int y, int z) { return (x & z) | (y
& ~z); }
      private static final int H(int x, int y, int z) { return (x ^ y ^ z);
}
      private static final int I(int x, int y, int z) { return y ^ (x |
~z); }

      private static final int R(int n, int i) { return (n << i) | (n >>>
(32 - i)); }

      public static String digest(String msg) {
            int[] words = new int[(int) (((long) msg.length() + (64 -
msg.length() % 64)) / 4)];

            for (int i = 0; i < msg.length(); i++)
                  words[i >>> 2] |= msg.charAt(i) << (24 - (i % 4) * 8);
            words[msg.length() >>> 2] |= 0x80 << (24 - (msg.length() % 4) *
8);

            for (int i = 0; i < words.length; i++)
                  words[i] = Integer.reverseBytes(words[i]);

            words[words.length - 2] = msg.length() * 8;
            words[words.length - 1] = (int) ((msg.length() * 8) / (1L <<
32));

            int a = Integer.reverseBytes(0x01234567);
            int b = Integer.reverseBytes(0x89abcdef);
            int c = Integer.reverseBytes(0xfedcba98);
            int d = Integer.reverseBytes(0x76543210);

            for (int i = 0; i < words.length / 16; i += 16) {
                  int[] word = Arrays.copyOfRange(words, i, i + 16);

                  int aa = a;
                  int bb = b;
                  int cc = c;
                  int dd = d;
                  int count = -1;

                  for (int j = 0, inc = -1; j < 4; j++) {
                        a = b + R((a + F(b, c, d) + word[inc = ((inc + 1) %
16)] + T[count += 1] ), S[0][0]);
                        d = a + R((d + F(a, b, c) + word[inc = ((inc + 1) %
16)] + T[count += 1] ), S[0][1]);
                        c = d + R((c + F(d, a, b) + word[inc = ((inc + 1) %
16)] + T[count += 1] ), S[0][2]);
                        b = c + R((b + F(c, d, a) + word[inc = ((inc + 1) %
16)] + T[count += 1] ), S[0][3]);
                  }

                  for (int j = 0, inc = -4; j < 4; j++) {
                        a = b + R((a + G(b, c, d) + word[inc = ((inc + 5) %
16)] + T[count += 1] ), S[1][0]);
                        d = a + R((d + G(a, b, c) + word[inc = ((inc + 5) %
16)] + T[count += 1] ), S[1][1]);
                        c = d + R((c + G(d, a, b) + word[inc = ((inc + 5) %
16)] + T[count += 1] ), S[1][2]);
                        b = c + R((b + G(c, d, a) + word[inc = ((inc + 5) %
16)] + T[count += 1] ), S[1][3]);
                  }

                  for (int j = 0, inc = 2; j < 4; j++) {
                        a = b + R((a + H(b, c, d) + word[inc = ((inc + 3) %
16)] + T[count += 1] ), S[2][0]);
                        d = a + R((d + H(a, b, c) + word[inc = ((inc + 3) %
16)] + T[count += 1] ), S[2][1]);
                        c = d + R((c + H(d, a, b) + word[inc = ((inc + 3) %
16)] + T[count += 1] ), S[2][2]);
                        b = c + R((b + H(c, d, a) + word[inc = ((inc + 3) %
16)] + T[count += 1] ), S[2][3]);
                  }

                  for (int j = 0, inc = -7; j < 4; j++) {
                        a = b + R((a + I(b, c, d) + word[inc = ((inc + 7) %
16)] + T[count += 1] ), S[3][0]);
                        d = a + R((d + I(a, b, c) + word[inc = ((inc + 7) %
16)] + T[count += 1] ), S[3][1]);
                        c = d + R((c + I(d, a, b) + word[inc = ((inc + 7) %
16)] + T[count += 1] ), S[3][2]);
                        b = c + R((b + I(c, d, a) + word[inc = ((inc + 7) %
16)] + T[count += 1] ), S[3][3]);
                  }

                  a = a + aa;
                  b = b + bb;
                  c = c + cc;
                  d = d + dd;
            }

            return String.format("%x%x%x%x",
                        Integer.reverseBytes(a),
                        Integer.reverseBytes(b),
                        Integer.reverseBytes(c),
                        Integer.reverseBytes(d));
      }

      public static void main(String[] args) {
```

```
                String msg = "hello";

                System.out.println("MESSAGE  :  " + msg);
                System.out.println("DIGEST   :  " + digest(msg));
        }
}
```

OUTPUT:



```
<terminated> Ex07_MD5 [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-Oct-20
MESSAGE  : hello
DIGEST   : 5d41402abc4b2a76b9719d911017c592
```

RESULT:

THE MD5 HASH ALGORITHM WAS SUCCESSFULLY IMPLEMENTED.

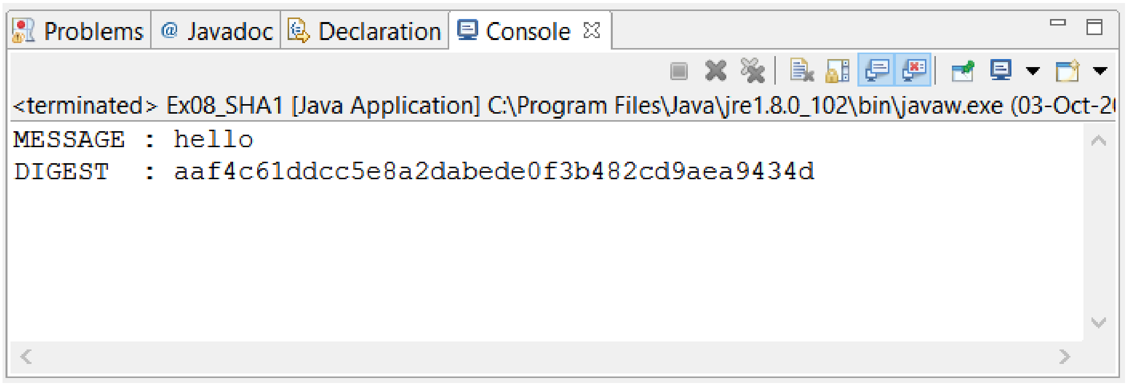
EX08 – SHA1 ALGORITHM

PROGRAM:

```
public class Ex08_SHA1 {

      private static int R(int n, int i) {
            return (n << i) | (n >>> (32 - i));
      }

      public static String digest(String msg) {
            int[] words = new int[(int) (((long) msg.length() + (64 -
msg.length() % 64)) / 4)];

            for (int i = 0; i < msg.length(); i++)
                  words[i >>> 2] |= msg.charAt(i) << (24 - (i % 4) * 8);

            words[msg.length() >>> 2] |= 0x80 << (24 - (msg.length() % 4) *
8);
            words[words.length - 1] = msg.length() * 8;

            int[] w = new int[80];

            int h0 = Integer.reverseBytes(0x01234567);
            int h1 = Integer.reverseBytes(0x89abcdef);
            int h2 = Integer.reverseBytes(0xfedcba98);
            int h3 = Integer.reverseBytes(0x76543210);
            int h4 = Integer.reverseBytes(0xf0e1d2c3);

            for (int i = 0; i < words.length; i += 16) {
                  int a = h0;
                  int b = h1;
                  int c = h2;
                  int d = h3;
                  int e = h4;

                  for (int j = 0; j < 80; j++) {
                        w[j] = (j < 16) ? words[i + j] : (R(w[j - 3]
                              ^ w[j - 8] ^ w[j - 14] ^ w[j - 16], 1));

                        int t = R(a, 5) + e + w[j] +
                  ( j < 20 ? (0x5a827999 + ((b & c) | ((~b) & d)))
                  : j < 40 ? (0x6ed9eba1 + (b ^ c ^ d))
                  : j < 60 ? (0x8f1bbcdc + ((b & c) | (b & d) | (c & d)))
                  : (0xca62c1d6 + (b ^ c ^ d)));
                        e = d;
                        d = c;
                        c = R(b, 30);
                        b = a;
                        a = t;
                  }

                  h0 += a;
                  h1 += b;
                  h2 += c;
                  h3 += d;
                  h4 += e;
            }

            return String.format("%x%x%x%x%x", h0, h1, h2, h3, h4);
      }
```

```
	public static void main(String args[]) {
		String msg = "hello";

		System.out.println("MESSAGE : " + msg);
		System.out.println("DIGEST  : " + digest(msg));
	}
}
```

OUTPUT:



```
<terminated> Ex08_SHA1 [Java Application] C:\Program Files\Java\jre1.8.0_102\bin\javaw.exe (03-Oct-2
MESSAGE : hello
DIGEST  : aaf4c61ddcc5e8a2dabede0f3b482cd9aea9434d
```

RESULT:

THE SHA1 ALGORITHM WAS SUCCESSFULLY IMPLMENETED.