

Scilab Manual for
Data Compression and Encryption
by Dr Saylee Gharge
Others
VESIT¹

Solutions provided by
Dr Saylee Gharge
Others
V.E.S.Institute of Technology

April 20, 2025

¹Funded by a grant from the National Mission on Education through ICT, <http://spoken-tutorial.org/NMEICT-Intro>. This Scilab Manual and Scilab codes written in it can be downloaded from the "Migrated Labs" section at the website <http://scilab.in>

Contents

List of Scilab Solutions	3
1 To implement Huffman coding.	5
2 To implement Arithmetic Coding.	12
3 To implement μ law encoding	16
4 To implement one dimension DCT	18
5 To implement two dimension DCT	21
6 To implement Chinese Remainder Theorem	23
7 To implement Ceaser Cipher Algorithm	26
8 To implement RSA Algorithm	28
9 To implement Diffie-Hellman Key exchange	31

List of Experiments

Solution 1.01	Huffman	5
Solution 2.02	arithmetic	12
Solution 3.03	ULAW	16
Solution 4.04	1DDCT	18
Solution 5.05	2DDCT	21
Solution 6.06	CRT	23
Solution 7.07	CCA	26
Solution 8.08	RSA	28
Solution 9.09	DIFFIE	31

List of Figures

1.1	Huffman	6
2.1	arithmetic	13
3.1	ULAW	17
4.1	1DDCT	20
5.1	2DDCT	22
6.1	CRT	24
7.1	CCA	27
8.1	RSA	29
9.1	DIFFIE	32

Experiment: 1

To implement Huffman coding.

Scilab code Solution 1.01 Huffman

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 printf("Enter the frequency of the 5 symbols in
    decreasing order (integer values only):"); //Input
    the frequency of the symbols sequentially as
    5,4,3,2,1 pressing enter after each frequency
6 s=[];r=[];
7 for i=1:5
8 s(i)=input("");
9 end
10 r(4)='0';r(5)='1';
11 if (s(4)+s(5))>=s(1) then
12 for i=1:3
13 temp(i+1)=s(i);
14 end
15 temp(1)=(s(4)+s(5));
16 for i=1:4
```

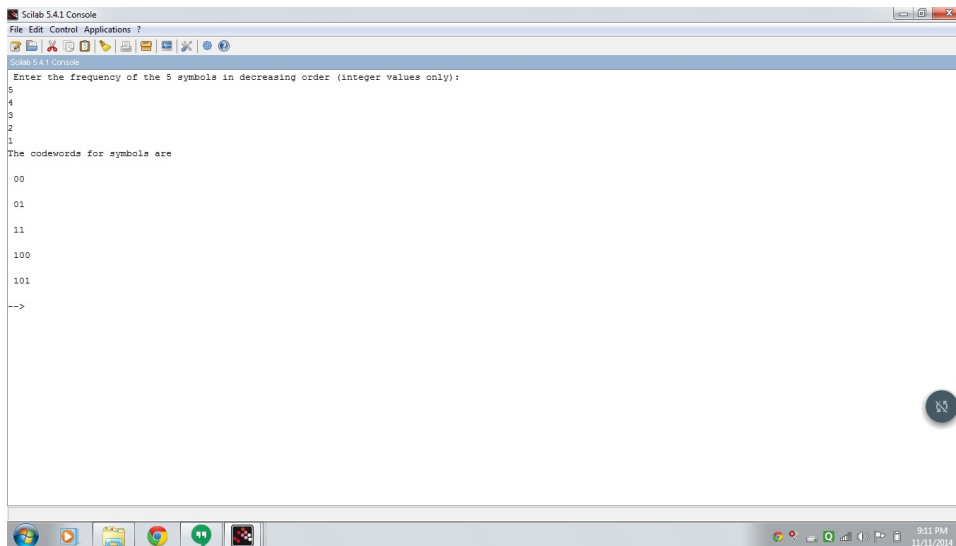


Figure 1.1: Huffman

```

17 s(i)=temp(i);
18 end
19 r(2)='0';r(3)='1';
20 if (s(3)+s(4))>=s(1) then
21 for i=1:2
22 temp(i+1)=s(i);
23 end
24 temp(1)=(s(3)+s(4));
25 for i=1:3
26 s(i)=temp(i);
27 end
28 r(1)='1';r(4)='00';r(5)='01';
29 if (s(2)+s(3))>=s(1) then
30     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
31     r(1)='01';r(2)='10';r(3)='11';r(4)='000';r
        (5)='001';
32 else s(2)=(s(2)+s(3));
33     r(1)='11';r(2)='00';r(3)='01';r(4)='100';r
        (5)='101';
34 end

```

```

35
36 elseif (s(3)+s(4))>=s(2) then
37     temp(2)=s(2);s(2)=(s(3)+s(4));s(3)=temp(2);
38 r(1)='1';r(2)='00';r(3)='01';
39 if (s(2)+s(3))>=s(1) then
40     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
41     r(1)='01';r(2)='000';r(3)='001';r(4)='10';r
        (5)='11';
42 else s(2)=(s(2)+s(3));
43     r(1)='11';r(2)='100';r(3)='101';r(4)='00';r
        (5)='01';
44 end
45 else s(3)=(s(3)+s(4));
46 r(1)='0';r(2)='10';r(3)='11';
47 if (s(2)+s(3))>=s(1) then
48     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
49     r(1)='00';r(2)='010';r(3)='011';r(4)='10';r
        (5)='11';
50 else s(2)=(s(2)+s(3));
51     r(1)='10';r(2)='110';r(3)='111';r(4)='00';r
        (5)='01';
52 end
53 end
54 elseif (s(4)+s(5))>=s(2) then
55 for i=2:3
56     temp(i+1)=s(i);
57 end
58 temp(2)=(s(4)+s(5));
59 for i=3:4
60     s(i)=temp(i);
61 end
62 r(2)='0';r(3)='1';
63 if (s(3)+s(4))>=s(1) then
64 for i=1:2
65     temp(i+1)=s(i);
66 end
67 temp(1)=(s(3)+s(4));
68 for i=1:3

```



```

69 s(i)=temp(i);
70 end
71 r(1)='0';r(4)='10';r(5)='11';
72 if (s(2)+s(3))>=s(1) then
73     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
74     r(1)='00';r(2)='10';r(3)='11';r(4)='010';r
        (5)='011';
75 else s(2)=(s(2)+s(3));
76     r(1)='10';r(2)='00';r(3)='01';r(4)='110';r
        (5)='111';
77 end
78
79 elseif (s(3)+s(4))>=s(2) then
80     temp(2)=s(2);s(2)=(s(3)+s(4));s(3)=temp(2);
81 r(1)='1';r(2)='00';r(3)='01';
82 if (s(2)+s(3))>=s(1) then
83     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
84     r(1)='01';r(2)='000';r(3)='001';r(4)='10';r
        (5)='11';
85 else s(2)=(s(2)+s(3));
86     r(1)='11';r(2)='100';r(3)='101';r(4)='00';r
        (5)='01';
87 end
88 else s(3)=(s(3)+s(4));
89     r(2)='10';r(3)='11';r(4)='00';r(5)='01';
90 if (s(2)+s(3))>=s(1) then
91     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
92     r(1)='1';r(2)='010';r(3)='011';r(4)='000';r
        (5)='001';
93 else s(2)=(s(2)+s(3));
94     r(1)='0';r(2)='110';r(3)='111';r(4)='100';r
        (5)='101';
95 end
96 end
97 elseif (s(4)+s(5))>=s(3) then
98     temp(3)=s(3);s(3)=(s(4)+s(5));s(4)=temp(3);
99 r(4)='00';r(5)='01';r(3)='1';
100 if (s(3)+s(4))>=s(1) then

```

```

101 for i=1:2
102 temp(i+1)=s(i);
103 end
104 temp(1)=(s(3)+s(4));
105 for i=1:3
106 s(i)=temp(i);
107 end
108 r(1)='0';r(2)='1';
109 if (s(2)+s(3))>=s(1) then
110     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
111     r(1)='00';r(2)='01';r(3)='11';r(4)='100';r
        (5)='101';
112 else s(2)=(s(2)+s(3));
113     r(1)='10';r(2)='11';r(3)='01';r(4)='000';r
        (5)='001';
114 end
115
116 elseif (s(3)+s(4))>=s(2) then
117     temp(2)=s(2);s(2)=(s(3)+s(4));s(3)=temp(2);
118     r(2)='1';r(3)='01';r(4)='000';r(5)='001';
119 if (s(2)+s(3))>=s(1) then
120     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
121     r(1)='1';r(2)='01';r(3)='001';r(4)='0000';r
        (5)='0001';
122 else s(2)=(s(2)+s(3));
123     r(1)='0';r(2)='11';r(3)='101';r(4)='1000';r
        (5)='1001';
124 end
125 else s(3)=(s(3)+s(4));
126     r(2)='0';r(3)='11';r(4)='100';r(5)='101';
127 if (s(2)+s(3))>=s(1) then
128     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
129     r(1)='1';r(2)='00';r(3)='011';r(4)='0100';r
        (5)='0101';
130 else s(2)=(s(2)+s(3));
131     r(1)='0';r(2)='10';r(3)='111';r(4)='1100';r
        (5)='1101';
132 end

```

```

133 end
134 else s(4)=(s(4)+s(5));
135 r(3)='0';r(4)='10';r(5)='11';
136 if (s(3)+s(4))>=s(1) then
137 for i=1:2
138 temp(i+1)=s(i);
139 end
140 temp(1)=(s(3)+s(4));
141 for i=1:3
142 s(i)=temp(i);
143 end
144 r(1)='0';r(2)='1';
145 if (s(2)+s(3))>=s(1) then
146     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
147     r(1)='00';r(2)='01';r(3)='10';r(4)='110';r
        (5)='111';
148 else s(2)=(s(2)+s(3));
149     r(1)='10';r(2)='11';r(3)='00';r(4)='010';r
        (5)='011';
150 end
151
152 elseif (s(3)+s(4))>=s(2) then
153     temp(2)=s(2);s(2)=(s(3)+s(4));s(3)=temp(2);
154     r(2)='1';r(3)='00';r(4)='010';r(5)='011';
155 if (s(2)+s(3))>=s(1) then
156     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
157     r(1)='1';r(2)='01';r(3)='000';r(4)='0010';r
        (5)='0011';
158 else s(2)=(s(2)+s(3));
159     r(1)='0';r(2)='11';r(3)='100';r(4)='1010';r
        (5)='1011';
160 end
161 else s(3)=(s(3)+s(4));
162     r(2)='0';r(3)='10';r(4)='110';r(5)='111';
163 if (s(2)+s(3))>=s(1) then
164     temp(1)=s(1);s(1)=(s(2)+s(3));s(2)=temp(1);
165     r(1)='1';r(2)='00';r(3)='010';r(4)='0110';r
        (5)='0111';

```

```
166 else s(2)=(s(2)+s(3));
167     r(1)='0';r(2)='10';r(3)='110';r(4)='1110';r
        (5)='1111';
168 end
169 end
170 end
171 printf("The codewords for symbols are \n")
172 for i=1:5
173 disp(r(i));
174 end
175 //Output for ex:
176 //The codewords for symbols are :
177 //00
178 //01
179 //11
180 //100
181 //101
```

Experiment: 2

To implement Arithmetic Coding.

Scilab code Solution 2.02 arithmetic

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 n=input("Enter the no. of symbols : ");//Input:
    Taking the no. of symbols (ex 5)
6 //Note:The sum of probabilities of all symbols must
    be one(1)
7 for i = 1:n
8     printf("\\nEnter the probability(<=1) of symbol
        %d: ",i);//Input: Taking the probability of
        occurence
9 p(i)=input("");
10 end
11 //Sample Input for probability of symbols
12 // Symbol Probability
13 // 1 0.3
```

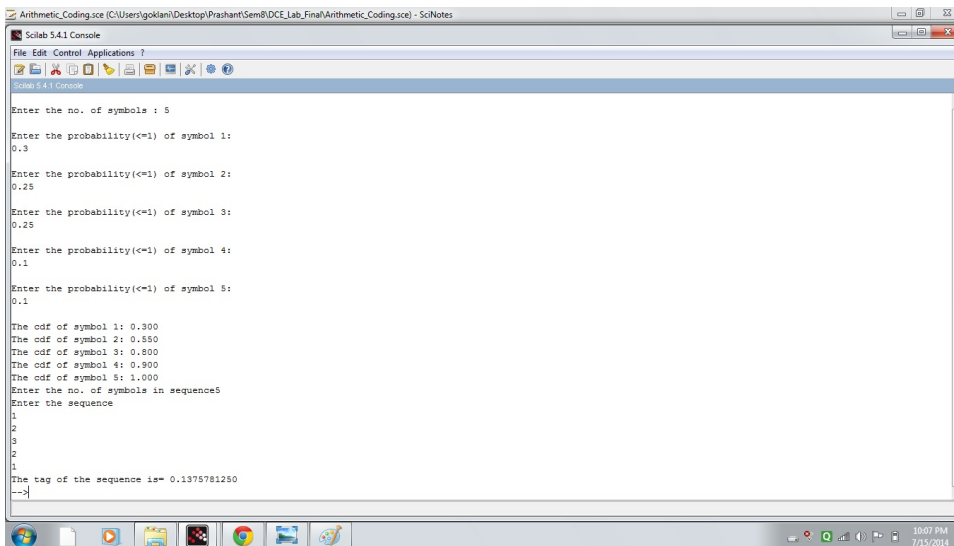


Figure 2.1: arithmetic

```

14 //      2          0.25
15 //      3          0.25
16 //      4          0.1
17 //      5          0.1
18 printf("\nThe cdf of symbol 1: %.3f ",p(1));
19 //Output CDF for example input
20 // Symbol          CDF
21 //      1          0.3
22 //      2          0.550
23 //      3          0.800
24 //      4          0.900
25 //      5          1.000
26
27 c(1)=p(1);
28 for i = 2:n
29     c(i)=p(i)+c(i-1);
30     printf("\nThe cdf of symbol %d: ",i);
31     printf("%.3f",c(i));
32 end
33 s=input("Enter the no. of symbols in sequence");//

```

```

    Input: No. of symbols(for ex if the sequence to
    be coded is: 1 2 3 2 1 where 1,2,3...are symbol
    numbers then no. of symbols are 5)
34 //ex No. of symbols in sequence=5
35 printf("Enter the sequence ");//Input: Sequence(For
    example to enter the sequence 1 2 3 2 1, press
    each symbol and then enter. So for our case,
    press 1 and then enter then similarly 2 then
    enter and so on)
36 //Input ex Sequence: 1 (press Enter)
37 //                2 (press Enter)
38 //                3 (press Enter)
39 //                2 (press Enter)
40 //                1 (press Enter)
41 for j = 1:s
42 b(j)=input("");//Inserting the sequence
43 end
44 //Setting the lower and upper limit for 1st stage
45 if b(1) == 1 then
46 l(1)=0;
47 u(1)=c(b(1));
48 else
49 l(1)=c(b(1)-1);
50 u(1)=c(b(1));
51 end
52 //Calculating lower and upper limits for 2nd stage
    and ahead
53 for k = 2:s
54 if b(k) == 1 then
55 l(k)=l(k-1);
56 u(k)=l(k-1)+((u(k-1)-l(k-1))*c(b(k)));
57 else
58 l(k)=l(k-1)+((u(k-1)-l(k-1))*c(b(k)-1));
59 u(k)=l(k-1)+((u(k-1)-l(k-1))*c(b(k)));
60 end
61 end
62
63 tag=(l(s)+u(s))/2; //Generating tag

```

```
64 printf("The tag of the sequence is= %.10f",tag);//  
    Output: The tag of the sequence  
65 //Output for ex tag=0.1375781250
```

Experiment: 3

To implement μ law encoding

Scilab code Solution 3.03 ULAW

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 n=input("Enter the input sample(no. to be coded) : ")
   );//Input: Taking Input Sample from user
6 //Input ex. n=-656
7 if n<0 then
8     P=49;//ascii code for 1=49
9 else
10    P=48;//ascii code for 0=48
11 end
12 Pc=asciimat(P);//Sign Bit
13 printf("The encoded word is : ");//Output: The
   encoded word
14 printf("%c",Pc);
15 s1=abs(n)+33;
16 s1b=dec2bin(s1);
17 l=length(s1b);
18 s1bl=length(s1b)-1;
19 s1bls=s1bl-5;
```

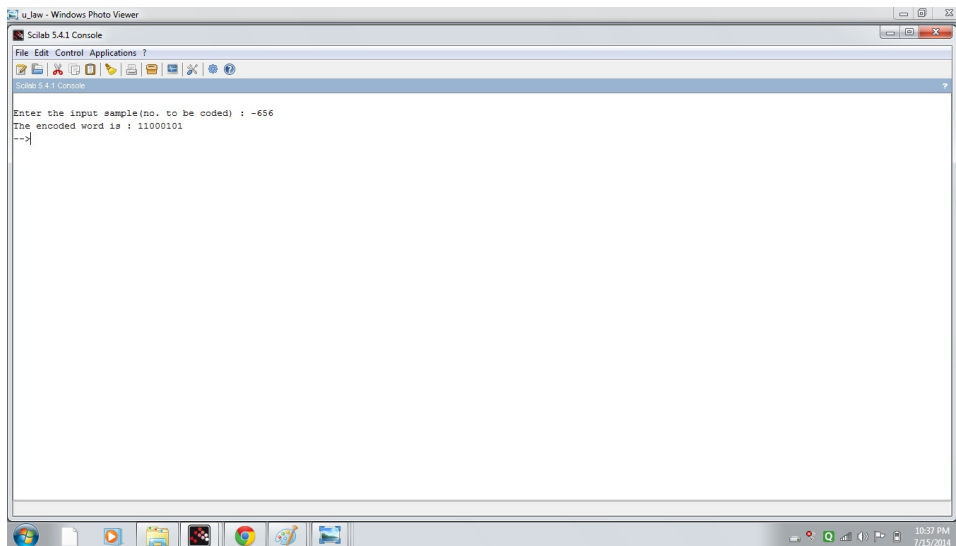


Figure 3.1: ULAW

```
20 segcod=dec2bin(s1b1s,3); //segment code
21 printf("%s",dec2bin(s1b1s,3));
22 grev=part(s1b,1:4);
23 q=strev(qrev); //quantization code
24 printf("%s",q);
25 //Output for ex. 11000101
```

Experiment: 4

To implement one dimension DCT

Scilab code Solution 4.04 1DDCT

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 //one dimensional cosine transform
4 clc;
5 clear all;
6 f=[1 2 4 7]; //Input: A row matrix
7 //Input ex. f=[1 2 4 7]
8 N=length(f); //finding length of input sequence
9 F=zeros(1,N); //cosine transform of input
10 //C=zeros(N,N);
11 for k=1:N
12     for n=1:N
13         if (k-1)==0
14             C(k,n)=inv(sqrt(N)); //cosine transform
15                                     matrix
16         else
17             C(k,n)=sqrt(2)*inv(sqrt(N))*cos(%pi*(2*(n
18                 -1)+1)*(k-1)/(2*N));
19         end
20     end
21 end
```

```

18     end
19 end
20
21 for u=1:N
22     for x=1:N
23         if (u-1)==0
24             F(u)=F(u)+inv(sqrt(N))*f(x)*cos(%pi*(2*(x
                -1)+1)*(u-1)/(2*N));
25         else
26             F(u)=F(u)+sqrt(2)*inv(sqrt(N))*f(x)*cos(
                %pi*(2*(x-1)+1)*(u-1)/(2*N));
27         end
28     end
29 end
30
31 disp(F," is ",f," Discrete Cosine Transform of");//
    Output: The discrete cosine transform of 1D
    sequence
32 //Output for ex.: [7 -4.460885 1 -0.3170253]

```

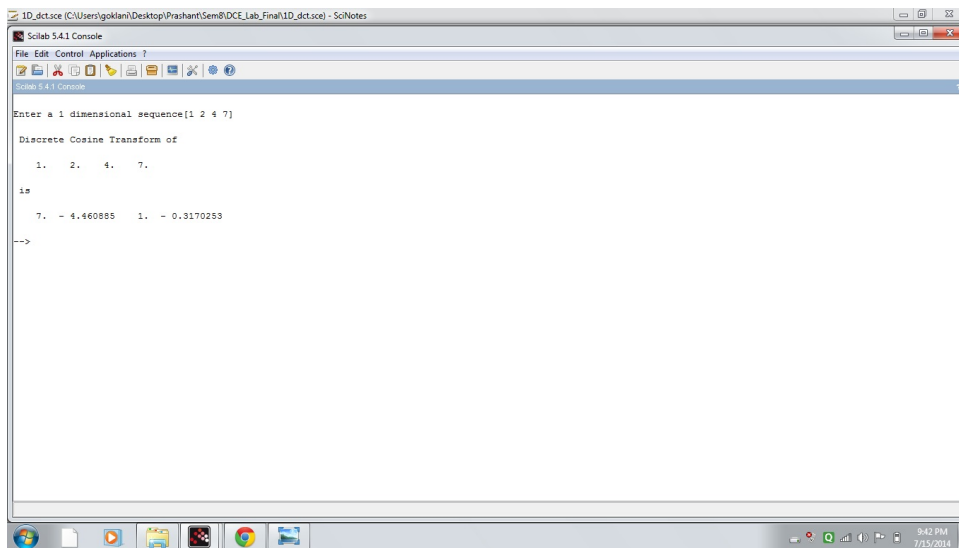


Figure 4.1: 1DDCT

Experiment: 5

To implement two dimension DCT

Scilab code Solution 5.05 2DDCT

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 //two dimensional cosine transform
4 clc;
5 clear all;
6 f=[2 4 4 2;4 6 8 3;2 8 10 4;3 8 6 2]; //Input: Enter
   a square matrix
7 //Input ex. f=[2 4 4 2;4 6 8 3;2 8 10 4;3 8 6 2]
8 [M N]=size(f); //finding length of input sequence
9 for k=1:N
10     for n=1:N
11         if (k-1)==0
12             C(k,n)=inv(sqrt(N)); //cosine transform
                                   matrix
13         else
14             C(k,n)=sqrt(2)*inv(sqrt(N))*cos(%pi*(2*(n
                                   -1)+1)*(k-1)/(2*N));
15         end
16     end
```

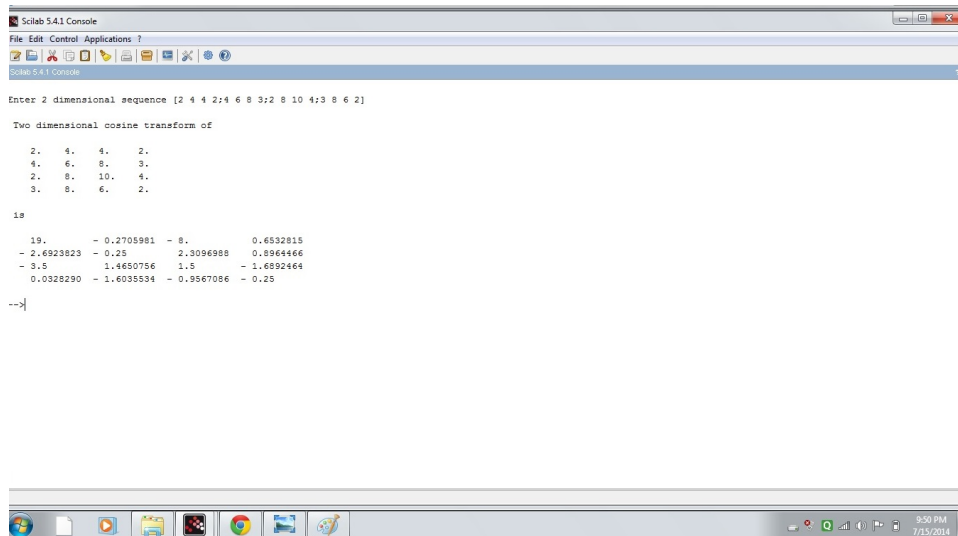


Figure 5.1: 2DDCT

```

17 end
18
19 F=C*f*C'; //discrete cosine transform of input for
    non-symmetric DCT
20 disp(F," is ",f,"Two dimensional cosine transform of")
    ; //Output: Two dimensional cosine transform of
    the matrix
21 //Output for ex. :
22 //      19.      - 0.2705981  - 8.
    0.6532815
23 // - 2.6923823 - 0.25      2.3096988
    0.8964466
24 // - 3.5      1.4650756  1.5      -
    1.6892464
25 //      0.0328290 - 1.6035534  - 0.9567086  - 0.25

```

Experiment: 6

To implement Chinese Remainder Theorem

Scilab code Solution 6.06 CRT

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 //Standard Equations for CRT
6 //x=a1 mod m1
7 //x=a2 mod m2
8 //x=a3 mod m3
9 //Taking the parameters of standard equation from
   the user
10 m1=[3];//input("Enter the value m1 : ");//Input:
   Value of m1 from equations
11 //Input ex. m1=3
12 m2=[4];//input("Enter the value m2 : ");//Input:
   Value of m2 from equations
13 //Input ex. m2=4
14 m3=[5];//("Enter the value m3 : ");//Input: Value of
```

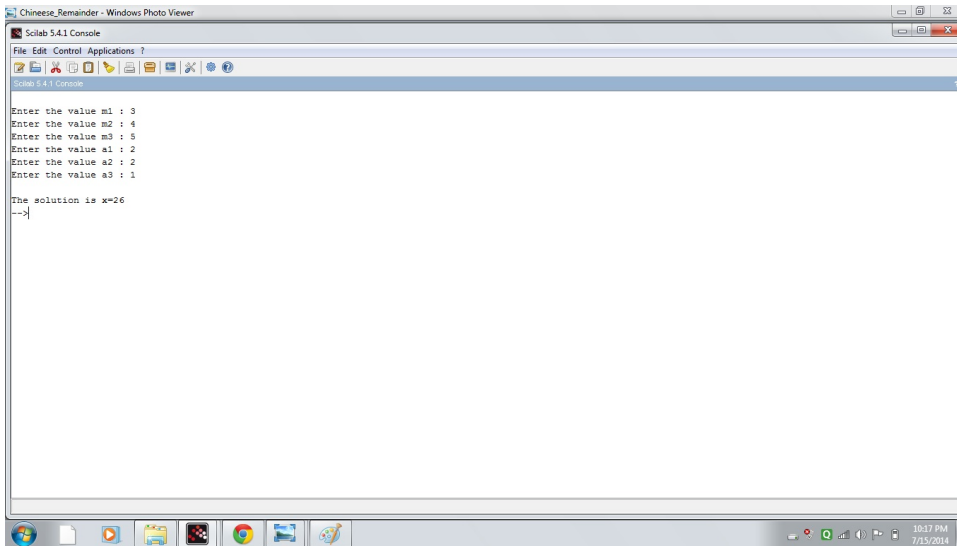



Figure 6.1: CRT

```

    m3 from equations
15 //Input ex. m3=5
16 a1=[2]; //input("Enter the value a1 : "); //Input:
    Value of a1 from equations
17 //Input ex. a1=2
18 a2=[2]; //input("Enter the value a2 : "); //Input:
    Value of a2 from equations
19 //Input ex. a2=2
20 a3=[1]; //("Enter the value a3 : "); //Input: Value of
    a3 from equations
21 //Input ex. a3=1
22 M=m1*m2*m3;
23 M1=M/m1;
24 M2=M/m2;
25 M3=M/m3;
26
27 for i = 1:10
28     if modulo(((M1*i)-1),m1) == 0 then
                                                //Calculating
    Mlinverse

```

```

29         M1in=i;
30         break;
31     end
32 end
33 for i = 1:10
34     if modulo(((M2*i)-1),m2) == 0 then
35         .....//
36         Calculating M2inverse
37         M2in=i;
38         break;
39     end
40     if modulo(((M3*i)-1),m3) == 0 then
41         .....//
42         Calculating M3inverse
43         M3in=i;
44         break;
45     end
46 x=modulo(((a1*M1*M1in)+(a2*M2*M2in)+(a3*M3*M3in)),M)
47     ;//Solution of equations
48 printf("\nThe solution is x=%d",x);// Output: The
49     solution for the set of equations
50 //Output for ex. x=26

```

Experiment: 7

To implement Ceaser Cipher Algorithm

Scilab code Solution 7.07 CCA

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 n=input("Enter the length of the text:");//Input:
    Taking the length of the text to be encoded from
    the user (for ex to encode abcde the length is 5)
6 //Input ex n=5
7 t=tokens(input("Please type string wih a space in
    between alphabets:", "string"));//Input: Taking
    the string to be encoded
8 //Inpu ex. t=a b c d e
9 printf("The encrypted string is: ");//Output: The
    encrypted string
10 for i = 1:n
11     c(i)=ascii(t(i))+3;//Caeser Cipher encoding with
        offset=3
```

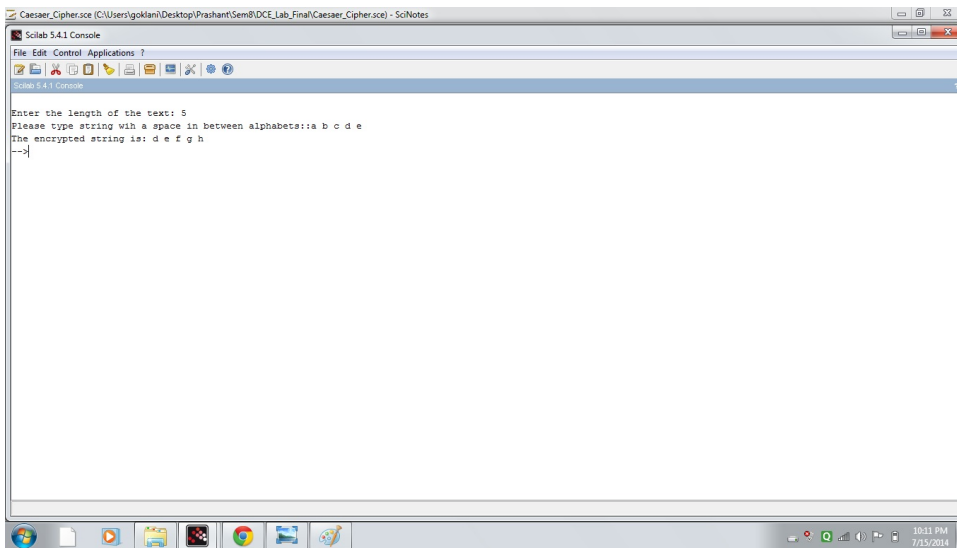


Figure 7.1: CCA

```
12     c1(i)=asciimat(c(i));  
13     printf("%c ",c1(i)); //Printing the encoded word  
14 end  
15 //Output for ex. d e f g h
```

Experiment: 8

To implement RSA Algorithm

Scilab code Solution 8.08 RSA

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 p=input("Enter the 1st prime no.");//Input: Taking
   the first prime no. for RSA
6 //Input ex. p=11
7 q=input("Enter the 2nd prime no.");//Input: Taking
   the second prime no. for RSA
8 //Input ex. q=5
9 n=p*q;
10 phi=(p-1)*(q-1);//Tuotient Function
11 printf("Enter the value of e");//Input: value of e (
   such that phi and the no. entered by you are
   relatively prime)
12 //Input ex. phi=7
13 e=input("");
14 for i = 1:n
15     z=modulo((i*e),phi);
```

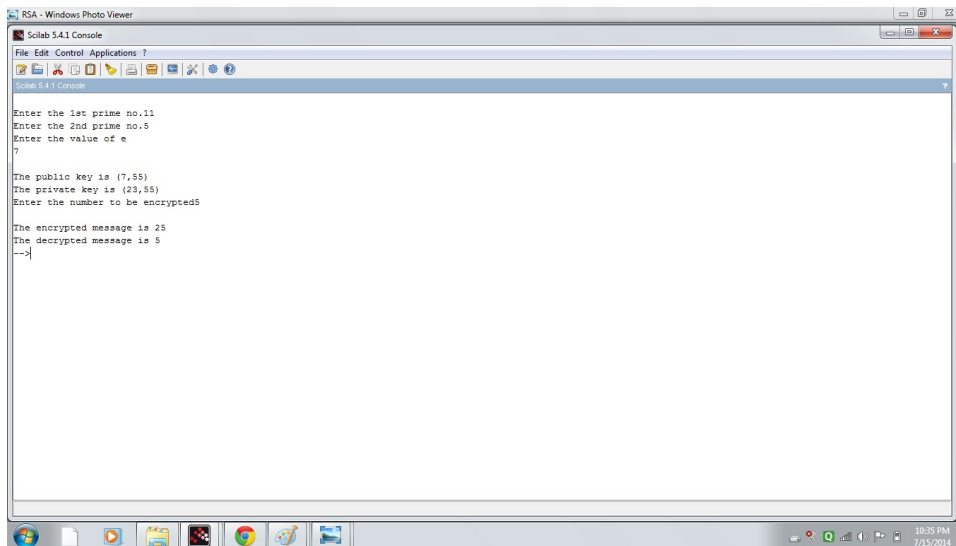


Figure 8.1: RSA

```

16     if z == 1 then
17 break;
18 end
19 end
20 printf("\nThe public key is (%.d",e);//Output: The
    public key is (e,n)
21 //Output for ex. public key (7,55)
22 printf(" ,%.d)",n);
23 printf("\nThe private key is (%.d",i);//Output:
    The private key is (i,n)
24 //Output ex. private key (23,55)
25 printf(" ,%.d)",n);
26 m=input("Enter the number to be encrypted");//Input
    : Taking the message to be encrypted
27 //Input ex. 5
28 a=m^e;
29 c=modulo(a,n);
30 printf("\nThe encrypted message is %.d ",c);//Output
    : Printing the encrypted message
31 //Output for ex. 25

```

```
32 b=c^i;
33 t=modulo(b,n);
34 printf("\nThe decrypted message is %.d ",m);//Output
    : Decrypted Message
35 //Output for ex. 5
```

Experiment: 9

To implement Diffie-Hellman Key exchange

Scilab code Solution 9.09 DIFFIE

```
1 //OS: Windows 7
2 //Scilab Version: Scilab 5.4.1
3 clc;
4 clear all;
5 p=[13]; //input("Enter the common prime number(p) ")
   //Input: taking common prime number as input
6 //Input ex. p=13
7 g=[6]; //input("Enter the primitive root(g) (any no.)
   //Input: taking primitive root as input
8 //Input ex. g=6
9 a=[3]; //input("Enter secret key of first user (any
   no.) "); //Input: Taking secret key for user 1
10 //Input ex. a=3
11 b=[10]; //input("Enter secret key of second user (any
   no.) "); //Input: Taking secret key for user 2
12 //Input ex. b=10
13 A=modulo(g^a,p); //public key of user 1
14 B=modulo(g^b,p); //public key of user 2
15 common_key=modulo(A^b,p); //common key
```

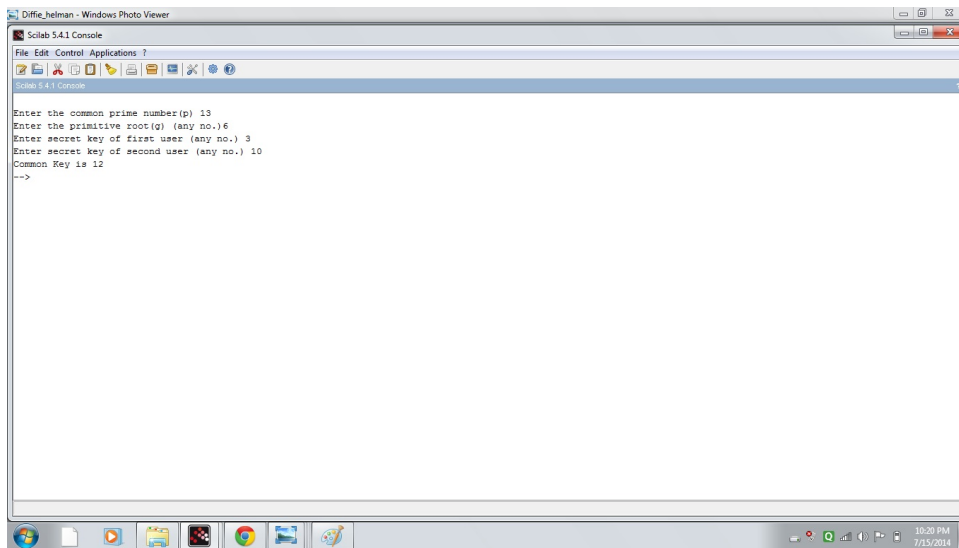



Figure 9.1: DIFFIE

```
16 printf("Common Key is %.d", common_key) ; //Output :  
    Produced common key  
17 //Output for ex. Common Key=12
```
