Scilab Textbook Companion for Switching And Finite Automata Theory by Z. Kohavi[1]

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August 16, 2013

[1]Funded by a grant from the National Mission on Education through ICT, http://spoken-tutorial.org/NMEICT-Intro. This Textbook Companion and Scilab codes written in it can be downloaded from the "Textbook Companion Project" section at the website http://scilab.in

Book Description

Title: Switching And Finite Automata Theory

Author: Z. Kohavi

Publisher: Tata McGraw - Hill Education

Edition: 2

Year: 2008

ISBN: 0-07-099387-4

Scilab numbering policy used in this document and the relation to the above book.

Exa Example (Solved example)

Eqn Equation (Particular equation of the above book)

AP Appendix to Example(Scilab Code that is an Appednix to a particular Example of the above book)

For example, Exa 3.51 means solved example 3.51 of this book. Sec 2.3 means a scilab code whose theory is explained in Section 2.3 of the book.

Contents

List of Scilab Codes

Chapter 1

Number System and Codes

Scilab code Exa 1.1 converts no to base 10

```
1  clc //clears the command window
2  clear//clears all the variables
3
4  i=1;w=1;//flags
5
6  bin=432.2//given octal number which should be
       expressed in base 10
7  temp1=floor(bin);//separating integer part from the
       given number
8  temp2=modulo(bin,1);//separating decimal part from
       the given number
9  temp2=temp2*10^3;//converting decimal value to
       interger for convenience
10 while(temp1>0)//storing each integer digit in vector
       for convenience
11     p(i)=modulo(temp1,10);
12     temp1=round(temp1/10);
13     i=i+1;
14 end
15 while(temp2>0)//storing each decimal digit in vector
       for convenience
```

```
16      q(w)=modulo(temp2,10);
17      temp2=(temp2/10);
18      temp2=round(temp2);
19      w=w+1;
20  end
21  temp1=0;//clearing temporary variable 'temp1'
22  for i=1:length(p)//checking whether it is a binary
       number or not
23      if(p(i)>8) then
24          disp('not a binary number');
25          abort;
26      end
27  end
28
29  for i=1:length(p)//multipliying the bits of integer
       part with their position values and adding
30      temp1=temp1+(p(i)*8^(i-1));
31  end
32
33  temp2=0;//flag bit
34
35  for z=1:length(q)
36  //multipliying the bits of decimal part with their
       position values and adding
37      temp2=temp2+(q(z)*8^(-1*(4-z)));
38  end
39  temp=temp1+temp2;
40  //finally adding both the integer and decimal parts
       to get total output.
41  disp(temp);//displaying the output
```

Scilab code Exa 1.2 converts binary number to base 10

```
1  clc;//clears the command window
2  clear;//clears all the variables
```

```
3  i=1;w=1;
4  bin=1101.01;//Given binary number which we need to
       be convert into decimal
5  temp1=floor(bin);//separating integer part from the
       given number
6  temp2=modulo(bin,1);//separating decimal part from
       the given number
7  temp2=temp2*10^3;//converting decimal value to
       interger for convenience
8  while(temp1>0)//storing each integer digit in vector
        for convenience
9      p(i)=modulo(temp1,10);
10     temp1=floor(temp1/10);
11     i=i+1;
12 end
13 while(temp2>0)//storing each decimal digit in vector
        for convenience
14     q(w)=modulo(temp2,2);
15     temp2=(temp2/10);
16     temp2=floor(temp2);
17     w=w+1;
18 end
19 temp1=0;//flag bit
20 for i=1:length(p)//checking whether it is a binary
       number or not
21     if(p(i)>1) then
22         disp('not a binary number');
23         abort;
24     end
25 end
26 for i=1:length(p)
27 //multipliying bits of integer part with their
       position values and adding
28     temp1=temp1+(p(i)*2^(i-1));
29 end
30 temp2=0;//flag bit
31 for z=1:length(q)
32 //multipliying bits of decimal part with their
```

```
    position values and adding
33      temp2=temp2+(q(z)*2^(-1*(4-z)));
34  end
35  temp=temp1+temp2;
36  //finally adding both the integer and decimal parts
    to get total output.
37  disp(temp);//displaying the output
```

Scilab code Exa 1.3 convert decimal number to base 8

```
1   clc;//clears the command window
2   clear;//clears all the variables
3   format('v',8);//making the default precision to 8
    significant digits
4   i=1;
5   dec=548;//given decimal number which should be
    expressed in base 8
6   temp=dec;
7   i=1;
8   d=8;
9   while(temp>0)//storing each integer digit in vector
    for convenience
10      p(i)=(modulo(floor(temp),d))
11      temp=floor(temp)/d;
12      i=i+1;
13  end
14  temp2=0;
15  for j=1:length(p)
16  //multipliying bits of integer part with their
    position values and adding
17      temp2=temp2+(p(j)*10^(j-1));
18  end
19  disp(temp2,"Octal number");
20  dec=345;
21  //given decimal number which should be expressed in
```

```
   base 8
temp=dec;
i=1;
d=6;
while(temp>0)//storing each integer digit in vector
   for convenience
     p(i)=(modulo(floor(temp),d))
     temp=floor(temp)/d;
     i=i+1;
end
temp2=0;
for j=1:length(p)
//multipliying bits of integer part with their
   position values and adding
    temp2=temp2+(p(j)*10^(j-1));
end
disp(temp2,"Base 6");
```

Scilab code Exa 1.4 Convert decimal value in base 10 to base 8

```
clc;//clears the command window
clear;//clears all the variables
format('v',8);//making the default precision to 8
   significant digits
i=1;
dec=0.3125;//given decimal number which should be
   expressed in base 8
temp=modulo(0.3125,1);//separating decimal part from
    the given number

while(temp~=0) //storing each decimal digit in
   vector for convenience
    temp=temp*8;
    p(i)=floor(temp);
    i=i+1;
```

```
12      temp=modulo(temp,1);
13  end
14
15  temp1=0; //flag bit
16  for j=1:length(p)
17  //multipliying bits of decimal part with their
       position values and adding
18      temp1=temp1+(10^(-1*j)*p(j))
19  end
20  disp(temp1);//displays the final output
```

Scilab code Exa 1.5 convert decimal number to base 2

```
1  clc;//clears the command window
2  clear;//clears all the variables
3  format('v',18);//changing the default prcision to 20
       significant digits
4
5  i=1;x=1;//flag bits
6
7  dec=432.354;//given decimal number which should be
       expressed in base 2
8  temp2=floor(dec);//separating integer part from the
       given number
9  temp4=modulo(dec,1);//separating decimal part from
       the given number
10
11 while(temp2>0)//storing each integer digit in vector
       for convenience
12      p(i)=(modulo(floor(temp2),2))
13      temp2=floor(temp2)/2;
14      i=i+1;
15 end
16
17 temp2=0;//clearing temporary variable 'temp2'
```

```
18
19 for j=1:length(p)
20 //multipliying bits of integer part with their
      position values and adding
21     temp2=temp2+(p(j)*10^(j-1));
22 end
23
24 while(temp4~=0) //storing each decimal digit in
      vector for convenience
25     temp4=temp4*2;
26     d(x)=floor(temp4);
27     x=x+1;
28     temp4=modulo(temp4,1);
29 end
30
31 temp5=0;          //clearing temporary variable '
      temp5'
32
33 for j=1:length(d)
34 //multipliying bits of decimal part with their
      position values and adding
35     temp5=temp5+(10^(-1*j)*d(j))
36 end
37
38 temp3=temp2+temp5;
39 //finally adding both the integer and decimal parts
      to get total output.
40 disp(temp3);//displays output
```

Scilab code Exa 1.6 Convert Octal number to Base 2

```
1 clc;//clears the command window
2 clear;//clears all the variables
3 format('v',8);//setting the default precision to 8
4
```

```
5  i=1;w=1;
6
7  bin=123.4; //Given octal number which we need to be
       convert into binary
8  temp1=floor(bin);//separating integer part from the
       given number
9  temp2=modulo(bin,1);//separating decimal part from
       the given number
10 temp2=temp2*10^3;//converting decimal value to
       interger for convenience
11
12 while(temp1>0)  //storing each integer digit in
       vector for convenience
13     p(i)=modulo(temp1,10);
14     temp1=round(temp1/10);
15     i=i+1;
16 end
17
18 while(temp2>0)  //storing each decimal digit in
       vector for convenience
19     q(w)=modulo(temp2,10);
20     temp2=(temp2/10);
21     temp2=round(temp2);
22     w=w+1;
23 end
24
25 temp1=0;  //clearing temporary variable 'temp1'
26
27 for i=1:length(p) //checking whether it is a binary
       number or not
28     if(p(i)>8) then
29         disp('not a binary number');
30         abort;
31     end
32 end
33
34 for i=1:length(p)
35 //multipliying bits of decimal part with their
```

```
    position values and adding
36      temp1=temp1+(p(i)*8^(i-1));
37  end
38
39  temp2=0;//clearing temporary variable 'temp2'
40
41  for z=1:length(q)
42  //multipliying bits of decimal part with their
        position values and adding
43      temp2=temp2+(q(z)*8^(-1*(4-z)));
44  end
45
46  temp=temp1+temp2;
47  //adding both integer and decimal parts to get total
        deciaml value.
48  dec=temp;
49
50  temp2=floor(dec); //separating integer part from the
        given number
51  temp3=modulo(dec,1);//separating decimal part from
        the given number
52  format('v',18);//setting the default precision to 8
53
54  i=1;x=1;//flag bits
55
56  while(temp2>0)//storing each integer digit in vector
        for convenience
57      p(i)=(modulo(floor(temp2),2))
58      temp2=floor(temp2)/2;
59      i=i+1;
60  end
61
62  temp2=0; //clears temporary variable 'temp2'
63
64  for j=1:length(p)
65  //multipliying bits of integer part with their
        position values and adding
66      temp2=temp2+(p(j)*10^(j-1));
```

```
67 end
68
69 temp4=modulo(temp3,1);
70
71 while(temp4~=0)//storing each decimal digit in
      vector for convenience
72     temp4=temp4*2;
73     d(x)=floor(temp4);
74     x=x+1;
75     temp4=modulo(temp4,1);
76 end
77
78 temp5=0; //clears temporary variable 'temp2'
79
80 for j=1:length(d)
81 //multipliying bits of decimal part with their
      position values and adding
82     temp5=temp5+(10^(-1*j)*d(j))
83 end
84
85 temp=temp2+temp5;
86 //finally adding both the integer and decimal parts
      to get total output.
87 disp(temp);//displaying the output
```

---

check Appendix AP 9 for dependency:

`bin21dec.sci`

check Appendix AP 6 for dependency:

`dec21bin.sci`

Scilab code Exa 1.7 Adds two binary numbers

```
1 clc;
2 a=0111.10;          //first number
```

```
3 b=1111.01;          //second number
4 A=bin21dec(a);    //converting a in to decimal number
5 B=bin21dec(b);    //converting b in to decimal number
6 S=A+B;           //adding the two decimal numbers
7 temp=dec21bin(S); //converting the decimal sum back
    to binary
8 format('v',10);    //changing the default precision
    to 8
9 disp(temp);         //displaying the final output
```

check Appendix AP 9 for dependency:

```
bin21dec.sci
```

check Appendix AP 6 for dependency:

```
dec21bin.sci
```

Scilab code Exa 1.8 Subtracts Two Binary numbers

```
1 clc;
2 format('v',8);  //changing the default precision to
    8
3 a=10010.11;       //first number
4 b=01100.10;       //second number
5 A=bin21dec(a);   //converting a in to decimal number
6 B=bin21dec(b);   //converting b in to decimal number
7 S=A-B;           //subtracting the two decimal
    numbers
8 temp=dec21bin(S);  //converting the decimal number
    back to binary
9 disp(temp);         //displaying the final output
```

check Appendix AP 9 for dependency:

```
bin21dec.sci
```

check Appendix AP 6 for dependency:

dec21bin.sci

Scilab code Exa 1.9 Multiplies two Binary numbers

```
clc;
format('v',8);  //changing the default precision to
   8
a=11001.1;      //first number
b=110.1;         //second number
A=bin21dec(a);  //converting a in to decimal number
B=bin21dec(b);  //converting b in to decimal number
S=A*B;           //multiply the two decimal numbers
temp=dec21bin(S); //converting the decimal product
   back to binary
disp(temp);       //displaying the final output
```

check Appendix AP 9 for dependency:

bin21dec.sci

check Appendix AP 6 for dependency:

dec21bin.sci

Scilab code Exa 1.10 Division of Two Binary Numbers

```
clc;
format('v',8);//changing the default precision to 8
a=1000100110;//first number
b=11001;//second number
A=bin21dec(a);//converting a in to decimal number
B=bin21dec(b);//converting b in to decimal number
S=A/B;         //multiply the two decimal numbers
temp=dec21bin(S);//converting the decimal product
   back to binary
```

```
9  disp("quotient");
10 disp(temp);//displaying the final output
```

Chapter 2

Sets Relations and Lattices

Scilab code Exa 2.1 Set Of All even Numbers

```
clear;
clc;
//lower=input("input the lower limit of the set");
//upper=input("input the upper limit of the set");
lower=1;    //lower limit of the set
upper=10;   //upper limit of the set
temp=lower;
h=1;i=1;
while(temp<=upper)
    if(modulo(temp,2)==0)        //checking whether a
        number is even or not
        e(h)=temp;
        h=h+1;
    else
        o(i)=temp;              //odd number
        i=i+1;
    end
    temp=temp+1;
end;
disp("the set of even number between the limits")
disp(e);
```

```
21 disp("the set of odd number between the limits")
22 disp(o);
```

Scilab code Exa 2.2 Subsets Of a Faces of a die

```
1  clear;
2  clc;
3  //N=input("enter the elements in the set");
4  //n=1;
5  //while(n<=N)
6  //     i(n)=input("enter the elements of first set");
7  //     n=n+1;
8  //end;
9  N=6;
10 i(1)='f1';i(2)='f2';i(3)='f3';i(4)='f4';i(5)='f5';i
      (6)='f6';
11 disp("null set");    //since null set is subset of
      any set.
12 for a=1:1:N         //set of single elements
13     disp(i(a));
14 end
15 c=1;
16 for a=1:1:N-1              //set of two elements
17     for b=a:1:N
18         if(a~=b)
19           m(c,1)=i(a);
20           m(c,2)=i(b);
21           c=c+1;
22         end
23     end;
24 end;
25 disp(m);
26 d=1;
27 for a=1:1:N             //set of three elements
28     for b=a:1:N
```

```
29          for c=b:1:N
30              if((a~=b)&(b~=c)&(c~=a))
31                  p(d,1)=i(a);
32                  p(d,2)=i(b);
33                  p(d,3)=i(c);
34                  d=d+1;
35              end
36          end
37      end
38  end
39  disp(p);
40  e=1;
41  for a=1:1:N                 //set of four elements
42      for b=a:1:N
43          for c=b:1:N
44              for d=c:1:N
45                  if((a~=b)&(b~=c)&(c~=d)&(d~=a)&(b~=d
                        )&(a~=c))
46                      q(e,1)=i(a);
47                      q(e,2)=i(b);
48                      q(e,3)=i(c);
49                      q(e,4)=i(d)
50                      e=e+1;
51                  end
52              end
53          end
54      end
55  end
56  disp(q);
57  f=1;
58  for a=1:1:N                 //set of five elements
59      for b=a:1:N
60          for c=b:1:N
61              for d=c:1:N
62                  for e=d:1:N
63                      if((a~=b)&(b~=c)&(c~=d)&(d~=e)&(
                            e~=a)&(a~=c)&(a~=d)&(b~=d)&(c
                            ~=e)&(b~=e))
```

```
64                              r(f,1)=i(a);
65                              r(f,2)=i(b);
66                              r(f,3)=i(c);
67                              r(f,4)=i(d);
68                              r(f,5)=i(e);
69                              f=f+1;
70                          end
71                      end
72                  end
73              end
74          end
75  end
76  disp(r);
77  for a=1:1:N                 //set of six elements
78      s(1,1)=i(1);
79      s(1,2)=i(2);
80      s(1,3)=i(3);
81      s(1,4)=i(4);
82      s(1,5)=i(5);
83      s(1,6)=i(6);
84  end
85  disp(s);
```

Scilab code Exa 2.4 Relation between two sets

```
1  clear;
2  clc;
3  N1=2;
4  N2=3;
5  //n=1;
6  //while(n<=N1)
7  //      i(n)=input("enter the elements of first set");
8  //      n=n+1;
9  //end;
10 i=['p' 'q'];      //set A
```

```
11 //n=1;
12 //while(n<=N2)
13 //     j(n)=input("enter the elements of second set")
       ;
14 //     n=n+1;
15 //end;
16 j=['r' 's' 't'];     //set B
17 c=1;d=1;
18 for a=1:1:N1     //realtion between sets A and B
19     for b=1:1:N2
20       m(c,d)=i(a);
21       m(c,d+1)=j(b);
22       c=c+1;
23     end;
24 end;
25 disp(m);
```

Scilab code Exa 2.5 Equivalence relation

```
1 clear;
2 clc;
3 //N=input("enter the no of elements in the set :");
4 //for i=1:1:N
5 //     s(1,i)=input("enter the elements in the set
      :");
6 //end;
7 //n=input("enter the number of pairs in the relation
      :");
8 //for j=1:1:n
9 //     for k=1:1:2
10 //          r(j,k)=input("enter the elements in the
      relation :");
11 //     end
12 //end
13 N=2;
```

```
14 s=['a' 'b'];          //elements in the set
15 n=3;
16 r=['a' 'a';'b' 'b';'a' 'b'];     //realtion between
      the elements in the above set.
17 ref=zeros(1,N);
18 for a=1:1:N
19    for b=1:1:n
20       if(r(b,1)==s(1,a)&r(b,2)==s(1,a))
21            ref(1,a)=1;
22       end
23    end
24 end
25 for i=1:1:N          //checking whether above relation
       is reflexive or not
26     if(ref(1,i)==1)
27         disp("the above relation is reflexive with
              elements ");
28         disp(s(1,i));
29         disp(" ");
30     end
31 end
32 sym=zeros(1,(N*N-1)/2);
33 s(1,N+1)=s(1,1);
34 for a=1:1:N              //checking whether above
      relation is symmetric or not
35    for b=1:1:n
36       if(r(b,1)==s(1,a)&r(b,2)==s(1,a+1))
37           for d=1:1:n
38             if(r(d,1)==s(1,a+1)&r(d,2)==s(1,a))
39                 sym(1,a)=1;
40                 disp("the above relation is
                       symmetric for these pairs :");
41                 disp(")",s(1,a+1),s(1,a),"(");
42             end
43           end
44        end
45     end
46 end
```

```
47 for a=1:1:n              //checking whether it is
      transtive or not.
48     u=r(a,1);
49     v=r(a,2);
50         for b=a:1:n
51             if(r(b,1)==v)
52                 w=r(b,2);
53                     for c=b:1:n
54                         if(r(c,1)==w&r(c,2)==u)
55                             disp("satisfies
                                  transtitve property")
                                  ;
56                             abort;
57                         end
58                     end
59             end
60         end
61 end
```

Scilab code Exa 2.6 Equivalence relation 2

```
1  clear;
2  clc;
3  //N=input("enter the elements in the set :");
4  //for i=1:1:N
5  //    s(i)=input("enter the elements :");
6  //end
7  N=2;
8  s=['a' 'b'];
9  disp("The equivalence relation of above set is :");
10 h=1;
11 for i=1:1:N          //to satisfy reflexive property
12     ref(h,1)=s(i);
13     ref(h,2)=s(i);
14     h=h+1;
```

```
15 end
16 for i=1:1:N          //to satisfy symmetric property
17     for j=i:1:N
18         if(i~=j)
19             ref(h,1)=s(i);
20             ref(h,2)=s(j);
21             h=h+1;
22         end
23     end
24 end
25 m=1;
26 for i=1:max(size(ref(:,1)))          //to satisfy
      transtive property
27     if(ref(i,1)~=ref(i,2))
28         ref1(m,1)=ref(i,2);
29         ref1(m,2)=ref(i,1);
30         m=m+1;
31     end
32 end
33 disp(ref);
34 disp(ref1);
```

Scilab code Exa 2.7 Function Check

```
1 clc;
2 clear;
3 //n1=input("enter the no of elements in the 1st set
     ");
4 //for i=1:1:n1
5 //    s1(i)=input("enter the elements of 1st set:");
6 //end
7 n1=3;
8 s1=['a1' 'a2' 'a3'];          //set A
9 //n2=input("enter the no of elements in the 2nd set
     ");
```

```
10 //for i=1:1:n2
11 //    s2(i)=input("enter the elements of 2ns set:");
12 //end
13 n2=2;
14 s1=['b1' 'b2'];          //set B
15 //N=input("enter the pairs in the relation which you
       want to check whether is a function");
16 //for i=1:1:N
17 //    for j=1:1:2
18 //        r(i,j)=input("enter the elements in the
       relation:");
19 //    end
20 //end
21 N=3;
22 r=['a1' 'b1';'a2' 'b2';'a2' 'b1'];          //Realtion
       r
23 for i=1:1:N              //checks whether the relation
       is function or not
24     for j=i:1:N
25         if(r(i,1)==r(j,1) & i~=j)
26             disp("the relation is not a function");
27             abort;
28          end
29     end
30 end
31 disp("the realtion is a fucntion");
```

Scilab code Exa 2.11 Partial Ordering Divisibilty Relation

```
1 clear;
2 clc;
3 //N=input("enter the number for which divisibilty ")
      ;
4 N=45;          //divident
5 h=1;
```

```
for i=1:N          //finding all the divisors of 45
    if(modulo(N,i)==0)
        r(h)=i;
        h=h+1;
     end
end
n=max(size(r));
disp("Hasse Diagram")          //displaying in the form
    of hasse diagram
disp("--------------")
disp(r(n));
h=2;
for i=n-1:-2:3
    disp("--------------");
    disp(r(i),r(i-1));
    h=h+1;
end
disp("------------")
disp(r(1));
```

Scilab code Exa 2.12 Ordering Relation

```
clear
clc
N=4;
//defining all the partial ordered sets
s(1,:)=[1 0];
s(2,:)=[0 1];
s(3,:)=[0 0];
s(4,:)=[1 1];
//Finding
a=1;b=1;
for i=1:1:N              //sorting based on the level
    for j=i:1:N
        if(i~=j)
```

```
14              u=s(i,1)+s(i,2);
15              v=s(j,1)+s(j,2);
16              if(u<v)
17                  temp(1)=s(i,1);
18                  temp(2)=s(i,2);
19                  s(i,1)=s(j,1);
20                  s(i,2)=s(j,2);
21                  s(j,1)=temp(1);
22                  s(j,2)=temp(2);
23              end
24          end
25      end
26  end
27  // displaying in the form of hasse graph form
28  disp("1st stage of Hasse diagram");
29  disp(s(1,:));
30  disp("2nd stage of Hasse diagram");
31  disp(s(2,:));
32  disp(s(3,:));
33  disp("3rd stage of Hasse diagram");
34  disp(s(4,:));
```

Scilab code Exa 2.15 Lattice Of subsets

```
1  clear
2  clc
3  N=3;
4  s=['a' 'b' 'c'];          //set for which lattice
       should be defined
5  for i=2:2^3
6      s(i,:)=s(1,:);
7  end
8  //defining 2nd level vertices of the lattice
9  for i=2:4
10     s(i,i-1)='0';
```

```
11 end
12 //defining 3rd level vertices of the lattice
13 for i=5:6
14     s(i,i-4)='0';
15     s(i,i-3)='0';
16 end
17 s(7,1)='0';s(7,3)='0';
18 //defining the final level of vertices of the
      lattice
19 s(8,:)=['0' '0' '0'];
20 disp("1st level");
21 disp(s(1,:));
22 disp("2nd level");
23 disp(s(2,:));
24 disp(s(3,:));
25 disp(s(4,:));
26 disp("3rd level");
27 disp(s(5,:));
28 disp(s(6,:));
29 disp(s(7,:));
30 disp("4th level");
31 disp(s(8,:));
```

Scilab code Exa 2.16 glb and ulb

```
1 clear;
2 clc;
3 par1=['ab','cde','fh','gi'];     //initial partitions
      par1
4 par2=['abc','de','fg','hi'];     //partition 2
5 //par=par1+par2;
6 //lub-lower upper bound
7 par_lub=['abcde','fghi'];
8 disp(par_lub);
9 //par=par1.par2
```

```
10 //glb-greatest lower bound
11 par_glb=['ab','c','de','f','g','h','i'];
12 disp(par_glb);
```

Chapter 3

Switching Algebra And Its Applications

Scilab code Exa 3.1 Simplify 1

```
1  clear
2  clc;
3  disp("T(x,y,z)=x^y^z+yz+xz");
4  disp("**Minimise the given expression**");
5  disp("**Since z is common in every term taking z
       common**");
6  disp("T(x,y,z)=z(x^y^+y+x)");
7  disp("**From the property a+a^b=a+b **");
8  disp("T(x,y,z)=z(x^+y+x)");
9  disp("**Since we know that a+a^=1 **");
10 disp("T(x,y,z)=z(1+y)");
11 disp("**we know that 1+a=1 **");
12 disp("T(x,y,z)=z.1");
13 disp("T(x,y,z)=z");
```

Scilab code Exa 3.2 Simplify 2

```
clear
clc
disp("T(x,y,z)=(x+y)[x^(y^+z^)]^+x^y^+x^z^");
disp("From the properties 1. (ab)^=a^+b^ 2. (a+b)^=a
   ^b^");
disp("T(x,y,z)=((x+y)(x+yz))+x^y^+x^z^");
disp("Multipliying the first 2 terms");
disp("T(x,y,z)=(x+xyz+xy+yz)+x^y^+x^z^");
disp("T(x,y,z)=(x(1+y+yz)+yz)+x^y^+x^z^");
disp("T(x,y,z)=x+yz+x^y^+x^z^");
disp("we know a+a^b=a+b");
disp("T(x,y,z)=x+y^+yz+x^z^");
disp("T(x,y,z)=x+z^+y^+yz");
disp("T(x,y,z)=x+z^+y^+z");
disp("since z+z^=1");
disp("T(x,y,z)=x+1+y^");
disp("T(x,y,z)=1")
```

Scilab code Exa 3.3 Prove the identity

```
clear
clc;
disp("L.H.S = xy+x^y^+yz");
disp("R.H.S = xy+x^y^+x^z");
disp("Based on consensus theorem")
disp("we can write x^y^+yz as x^y^+yz+x^z bcoz the
   two expressions are equal");
disp("(x^y^+yz+x^z(y+y^))=x^y^+yz+x^yz+x^y^z");
disp("x^y^+yz+x^yz+x^y^z=x^y^(1+z)+yz(1+x^)");
disp("x^y^+yz=x^y^+yz+x^z");
disp("so L.H.S=xy+x^y^+yz=xy+x^y^+yz+x^z");
disp("In the similar way xy+yz+x^z can be simplified
    as xy+x^z");
disp("so L.H.S becomes xy+x^z+x^y^");
disp("thus L.H.S= R.H.S");
```

```
14 disp("hence proved")
```

Scilab code Exa 3.4 Determine The Output of expression

```
1  clear;
2  clc;
3  //function definition
4  x=[0;0;0;0;1;1;1;1];
5  y=[0;0;1;1;0;0;1;1];
6  z=[0;1;0;1;0;1;0;1];
7  f=[1;0;1;1;0;0;1;1];
8  g=[0;1;0;1;1;0;1;0];
9  //calculating the values of expressions given
10 forg=bitor(f,g);
11 fandg=bitand(f,g);
12 fcmp=bitcmp(f,1);
13 s(:,1)=x;
14 s(:,2)=y;
15 s(:,3)=z;
16 s(:,4)=f;
17 s(:,5)=g;
18 s(:,6)=forg;
19 s(:,7)=fandg;
20 s(:,8)=fcmp;
21 p=['  x','  y','  z','  f','  g','  f+g','  fg'
     ,'  f^'];
22 disp(p);
23 disp(s);
```

Scilab code Exa 3.5 Simplify 3

```
1 clear;
2 clc;
```

```
3 disp("T(A,B,C,D)=A^C^+ABD+BC^D+AB^D^+ABCD^");
4 disp("Assume A^=x , C^=y , BD=z");
5 disp("Now from consensus theorem for the first three
      terms");
6 disp("BC^D is the redundant term so it can be
     removed");
7 disp("T(A,B,C,D)=A^C^+ABD+AB^D^+ABCD^");
8 disp("T(A,B,C,D)=A^C^+ABD+AD^(B^+BC)");
9 disp("we know that a+a^b=a+b");
10 disp("T(A,B,C,D)=A^C^+ABD+AD^(B^+C)");
11 disp("T(A,B,C,D)=A^C^+A(BD+D^(B^+C))");
```

Scilab code Exa 3.6 Simplify 4

```
1 clear
2 clc
3 disp("T(A,B,C,D)=A^B+ABD+AB^CD^+BC");
4 disp("T(A,B,C,D)=B(A^+AD)+C(AD^B^+B)");
5 disp("T(A,B,C,D)=B(A^+D)+C(AD^+B)");
6 disp("T(A,B,C,D)=A^B+BD+ACD^+BC");
7 disp("T(A,B,C,D)=A^B+BD+ACD^+BC(A+A^)");
8 disp("T(A,B,C,D)=A^B+A^BC+ABC+BD+ACD^");
9 disp("T(A,B,C,D)=A^B(1+C)+ABC+BD+ACD^");
10 disp("T(A,B,C,D)=A^B+ABC+BD+ACD^");
11 disp("**Now apply consensus theorem for 2nd 3rd and
     4th terms**");
12 disp("let x=D,y=B,z=AC");
13 disp("T(A,B,C,D)=A^B+BD+ACD^");
```

Scilab code Exa 3.7 Expand the Expression

```
1 clear;
2 clc;
```

```
3 disp("T(x,y,z)=x^y+z^+xyz");
4 disp("**To determine the canonical sum of products
    we have to check for a product which is not a min
     term and then multiply with the missing variable
     such that the expression value doesnt change**")
    ;
5 disp("T(x,y,z)=x^y(z+z^)+(x+x^)(y+y^)z^+xyz");
6 disp("T(x,y,z)=x^yz+x^yz^+xyz^+xy^z^+x^yz^+x^y^z^+
    xyz");
7 disp("T(x,y,z)=x^yz+x^yz^+xyz^+xy^z^+x^y^z^+xyz");
```

Scilab code Exa 3.8 Expand the Expression 2

```
1 clear;
2 clc;
3 disp("T(x,y,z)=x^(y^+z)");
4 disp("**To determine the canonical product of sums
    form you need to check for a product which is not
     a max term and then add it with the missing
    terms such that the expression value is not
    altered**");
5 disp("T(x,y,z)=(x^+yy^+zz^)(xx^+y^+z)");
6 disp("a+b+cc^ can be written as product of 2 max
    terms (a+b+c)(a+b+c^)");
7 disp("a+bb^+cc^ can be written as (a+b+c)(a+b+c^)(a+
    b^+c)(a+b^+c^)");
8 disp("from the above two properties we can write the
     T(x,y,z) as");
9 disp("T(x,y,z)=(x^+y+z)(x^+y+z^)(x^+y^+z)(x^+y^+z^)(
    x+y^+z)(x^+y^+z)");
10 disp("T(x,y,z)=(x^+y+z)(x^+y+z^)(x^+y^+z)(x^+y^+z^)(
    x+y^+z)");
```

Scilab code Exa 3.9 POS

```
clear;
clc;
disp("T(x,y,z)=x^y^z^+x^y^z+x^yz+xyz+xy^z+xy^z^");
disp("the complement T^ consists of those minterms
    which are not contained in the expression for T")
    ;
disp("T=[x^yz^+xyz^]^");
disp("(x+y^+z)(x^+y^+z)");
```

Scilab code Exa 3.10 Tabulate the Function of 2 variables

```
clear;
clc;
a1=0;a2=a1;a3=a1;
//all combinations of 2 varible inputs
f(:,1)=[0;0;1;1];
f(:,2)=[0;1;0;1];
disp("The turth table of f for all the combinations
    of a0,a1,a2,a3 are shown below")
//determining the values of f for all combinations
    of a0,a1,a2,a3
for a3=0:1
    for a2=0:1
        for a1=0:1
            for a0=0:1
                disp(['   a3' ' a2' ' a1' ' a0'])
                    ;
                disp([a3 a2 a1 a0]);
                    i=1;
                for x=0:1
                    for y=0:1
                        f0=bitand(a0,bitand(bitcmp(x
                            ,1),bitcmp(y,1)));
```

```
19                              f1=bitand(a1,bitand(bitcmp(x
                                   ,1),y));
20                              f2=bitand(a2,bitand(x,bitcmp
                                   (y,1)));
21                              f3=bitand(a3,bitand(x,y));
22                              f4=bitor(f0,f1);
23                              f5=bitor(f2,f3);
24                              f(i,3)=bitor(f4,f5);
25                              i=i+1;
26                          end
27                      end
28                      disp(['   x' '   y' '   f']);
29                      disp(f);
30                      disp('*--------------------*');
31                  end
32              end
33          end
34  end
```

Scilab code Exa 3.11 NOR

```
1  clear;
2  clc;
3  disp("x NOR x=(x+x)^");
4  disp("NOT Gate");
5  disp("x NOR x=x^x^=x^");
6  disp("OR Gate");
7  disp("(x NOR y) NOR (x NOR y) = (x^ NOR y^)^ = x+y")
       ;
8  disp("AND Gate");
9  disp("(x NOR x) NOR (y NOR y )= x^ NOR y^ = xy");
10 disp("NAND Gate");
11 disp(" NOT ((x NOR x) NOR (y NOR y))= NOT (x^ NOR y
       ^) = NOT(xy) = (xy)^");
12 disp("XOR Gate");
```

```
13 disp("(x^ NOR y^) NOR (x NOR y) = x^y+xy^");
14 disp("XNOR Gate");
15 disp("(x^ NOR y) NOR (x NOR y^) = xy+x^y^");
16 disp("Since every other gate can be implemented
      using NOR gate it is said to be functionally
      complete")
```

Scilab code Exa 3.12 Transmission function

```
1 clear;
2 clc;
3 disp("T=xy^+(x+y^)z");
4 disp("from the identity a+a^b=a+b");
5 disp("T=xy^+z");
```

Scilab code Exa 3.13 Air Conditioning System

```
1 clear;
2 clc;
3 disp("Air conditioning system of a storage warehouse
      will be turned on if and only if it satisfies
      these conditions");
4 disp("let W denotes weight of 100 tons or more");
5 disp("H denotes relative humidity of atleast 60
      percent");
6 disp("T denotes temparature above 60 degrees");
7 disp("P denotes barometric pressure of 30 or more");
8 disp("*-first condition-*");
9 disp("W<100 tons => W^ ,H>=60 => H , T>60 ");
10 disp("A1=W^HT");
11 disp("*-second condition-*");
12 disp("W>100 tons => W , T>60 => T");
13 disp("A2=WT");
```

```
14 disp("*-third condition-*");
15 disp("W<100 tons => W^ ,P>30 => P");
16 disp("A3=W^P");
17 disp("since Air condtioning system should be
      activated if any one of the above is satisfied so
      ");
18 disp("A=A1+A2+A3");
19 disp("A=W^HT+WT+W^P");
20 disp("A=T(W^H+W)+W^P");
21 disp("A=T(W+H)+W^P");
22 disp("Thus a combinational system with above
      expression makes the air conditioning system on
      when required")
```

Scilab code Exa 3.14 DeMorgans Law

```
1  clear;
2  clc;
3  i=1;
4  //all combinations of 2 variable inputs
5  f(:,1)=[0;0;1;1];
6  f(:,2)=[0;1;0;1];
7  //verifying D'morgan first law
8  for a=0:1
9      for b=0:1
10         f(i,3)=bitcmp(bitor(a,b),1);
11         f(i,4)=bitand(bitcmp(a,1),bitcmp(b,1));
12         i=i+1;
13     end
14 end
15 disp("   a    b    (a+b)^    a^b^");
16 disp(f);
17 disp("Therefore (a+b)^=a^ b^ ");
18 //verfying D'morgan 2nd law
19 i=1;
```

```
for a=0:1
    for b=0:1
        f(i,3)=bitcmp(bitand(a,b),1);
        f(i,4)=bitor(bitcmp(a,1),bitcmp(b,1));
        i=i+1;
    end
end
disp("   a    b    (ab)^    a^+b^");
disp(f);
//proving D'morgans laws theoritically
disp("(a+b)^=a^.b^");
disp("(a.b)^=a^+b^");
disp("we have show that (a+b)(a+b)^=0 and (a+b)+a^.b
   ^=1");
disp("(a+b)a^b^=aa^b^+ba^b^=0+a^bb^=0+0=0");
disp("(a+b)+a^b^=a+b+a^b^=a+b+a^=b+a+a^=b+1=1");
disp("This proves the first Dmorgan law and in the
   similar way 2nd law can also be proved");
```

Chapter 4

Minimization Of Switching Functions

check Appendix AP 2 for dependency:

```
number_of.sci
```

Scilab code Exa 4.1 Irredundant expressions

```
clc;
n=4;          //four variable kmap
k=[1 1 0 1;
   0 1 1 1;
   0 1 1 0;
   0 0 0 0];
k(:,:,2)=zeros(n,n);      //temporary matrix to know
   whether a element is paired or not
//declaring notations to display output
var=['y' 'z' 'w' 'x'];
p1=['y''z''' 'y''z' 'yz' 'yz''' ];
p2=['w''x''';'w''x';'wx';'wx''' ];
//minimum redundant elements accepted while pairing
cmn4=4;
cmn2=2;
```

```
temp=1;
disp("The minimal ecpression of the given Kmap ");
disp(k(:,:,1));
disp("is :");
disp(" ")
//16 cells
for i=1:n
    for j=1:n
        if(k(i,j)~=1)
            temp=0;
            break;
         end
    end
end
printf('f=');
if(temp==1)
    printf("1");
    abort;
end
//8 cells
z1=ones(2,4);
temp1=['00' '01' '11' '10'];
temp2=temp1';
for i=1:n
        if(i==4)
            t=1;
        else
            t=i+1;
        end
        z=[k(i,:,1);k(t,:,1)];
        if(z==z1)
            k(i,:,2)=[1 1 1 1];
            k(t,:,2)=[1 1 1 1];
            a=strsplit(temp2(i,1));
            b=strsplit(temp2(t,1));
            c=strcmp(a,b);
            for in=1:max(size(c))
                if(c(in)==0 & a(in)=='0')
```

```
                    printf('%s''',var(in));
                    printf('+');
                    break;
                else
                    if(c(in)==0 & a(in)=='1')
                        printf(var(in));
                        printf('+');
                        break;
                     end
                end
            end
        end
end
z2=ones(4,2);
for j=1:n
    if(j==4)
        t=1;
    else
        t=j+1;
    end
    z=[k(:,j,1) k(:,t,1)];
    if(z==z2)
        k(:,j,2)=[1;1;1;1];
        k(:,t,2)=[1;1;1;1];
        a=strsplit(temp1(1,j));
        b=strsplit(temp1(1,t));
        c=strcmp(a,b);
        for in=1:max(size(c))
            if(c(in)==0 & a(in)=='0')
                printf('%s''',var(2+in));
                printf('+');
                break;
             else
                if(c(in)==0 & a(in)=='1')
                    printf(var(2+in));
                    printf('+');
                    break;
                end
```

```
91                 end
92             end
93         end
94 end
95 //4 cells
96 z1=ones(1,4);
97 z2=ones(4,1);
98 z3=ones(2,2);
99 temp1=['00' '01' '11' '10'];
100 temp2=temp1';
101 for t=1:n
102             z=k(t,:,1);
103             no=number_of(k(t,:,2),1);
104             if(z==z1 & no<cmn4)
105                 k(t,:,2)=z1;
106                 a=strsplit(temp1(1,t));
107                 for in=1:max(size(a))
108                     if(a(in)=='0')
109                         printf('%s''',var(in));
110                      end
111                      if(a(in)=='1')
112                          printf(var(in));
113                      end
114                  end
115                  printf("+");
116               end
117 end
118 for t=1:n
119     z=k(:,t,1);
120     no=number_of(k(:,t,2),1);
121     if(z==z2 & no<cmn4)
122         k(:,t,2)=z2;
123         a=strsplit(temp2(t,1));
124         for in=1:max(size(a))
125             if(a(in)=='0')
126                 printf('%s''',var(2+in));
127              end
128              if(a(in)=='1')
```

```
129                     printf(var(2+in));
130                 end
131             end
132                 printf("+");
133         end
134     end
135     for i=1:n
136         for j=1:n
137             if(i==n)
138                 t1=1;
139             else
140                 t1=i+1;
141             end
142             if(j==n)
143                 t2=1;
144             else
145                 t2=j+1;
146             end
147             z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2,1)
                    ];
148             z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2,2)
                    ];
149             no=number_of(z5,1);
150             if(z4==z3 & no<cmn4)
151                 k(i,j,2)=1;
152                 k(i,t2,2)=1;
153                 k(t1,j,2)=1;
154                 k(t1,t2,2)=1;
155                 a=strsplit(temp2(i,1));
156                 b=strsplit(temp2(t1,1));
157                 c=strcmp(a,b);
158                 for in=1:max(size(c))
159                     if(c(in)==0 & a(in)=='0')
160                         printf('%s'',var(in));
161                     end
162                     if(c(in)==0 & a(in)=='1')
163                         printf(var(in));
164                     end
```

```
                end
                a=strsplit(temp1(1,j));
                b=strsplit(temp1(1,t2));
                c=strcmp(a,b);
                for in=1:max(size(c))
                    if(c(in)==0 & a(in)=='0')
                        printf('%s'',var(2+in));
                     end
                     if(c(in)==0 & a(in)=='1')
                         printf(var(2+in));
                     end
                 end
                 printf("+");
            end
        end
end
//2 cells
z6=[1 1];
z7=z6';
for i=1:n
    for j=1:n
        if(i==n)
            t1=1;
        else
            t1=i+1;
        end
       if(j==n)
            t2=1;
        else
            t2=j+1;
        end
        z8=[k(i,j,1) k(i,t2,1)];
        z9=[k(i,j,2) k(i,t2,2)];
        no1=number_of(z9,1);
        if(z8==z6 & no1<cmn2 & i+j~=2)
          k(i,j,2)=1;
          k(i,t2,2)=1;
          a=strsplit(temp1(1,j));
```

```
203             b=strsplit(temp1(1,t2));
204             c=strcmp(a,b);
205               for in=1:max(size(c))
206                   if(c(in)==0 & a(in)=='0')
207                       printf(p1(1,i));
208                       printf('%s'',var(2+in));
209                       printf("+");
210                    end
211                    if(c(in)==0 & a(in)=='1')
212                        printf(p1(1,i));
213                        printf(var(2+in));
214                        printf("+");
215                    end
216                end
217           end
218       end
219   end
220   for i=1:n
221       for j=1:n
222           if(i==n)
223               t1=1;
224           else
225               t1=i+1;
226           end
227          if(j==n)
228               t2=1;
229           else
230               t2=j+1;
231           end
232           z10=[k(i,j,1);k(t1,j,1)];
233           z11=[k(i,j,2);k(t1,j,2)];
234           no2=number_of(z11,1);
235           if(z10==z7 & no2<cmn2)
236             k(i,j,2)=1;
237             k(t1,j,2)=1;
238             a=strsplit(temp2(i,1));
239             b=strsplit(temp2(t1,1));
240             c=strcmp(a,b);
```

```
241                 for in=1:max(size(c))
242                     if(c(in)==0 & a(in)=='0')
243                         printf(p2(j,1));
244                         printf('%s'',var(in));
245                         printf("+");
246                      end
247                      if(c(in)==0 & a(in)=='1')
248                          printf(p2(j,1));
249                          printf(var(in));
250                          printf("+");
251                      end
252                  end
253             end
254         end
255 end
256 //single cell
257 for i=1:n
258     for j=1:n
259         if(k(i,j,2)==0 & k(i,j,1)==1)
260             a=strsplit(temp1(1,j));
261             b=strsplit(temp2(i,1));
262             for in=1:max(size(a(:,1)))
263                 if(a(in,1)=='1')
264                     printf(var(in+2));
265                 else
266                     if(a(in,1)=='0')
267                         printf('%s'',var(2+in));
268                     end
269                  end
270             end
271             for in=1:max(size(b(:,1)))
272                 if(b(in,1)=='1')
273                     printf(var(in));
274                 else
275                     if(b(in,1)=='0')
276                         printf('%s'',var(in));
277                     end
278                  end
```

```
279                 end
280                 if(i~=4 & j~=4)
281                     printf("+");
282                 end
283             end
284         end
285 end
286 printf("0");
```

---

check Appendix AP 2 for dependency:

number_of.sci

Scilab code Exa 4.2 Irredundant expressions 2

```
1  clc;
2  n=4;          //four variable kmap
3  k=[1 1 0 1;
4     0 1 1 1;
5     0 1 1 0;
6     0 0 0 0];
7  k(:,:,2)=zeros(n,n);      //temporary matrix to know
       whether a element is paired or not
8  //declaring notations to display output
9  var=['y' 'z' 'w' 'x'];
10 p1=['y^z^' 'y''z' 'yz' 'yz''];
11 p2=['w^x^';'w''x';'wx';'wx''];
12 //minimum redundant elements accepted while pairing
13 cmn4=1;
14 cmn2=1;
15 temp=1;
16 disp("The minimal ecpression of the given Kmap ");
17 disp(k(:,:,1));
18 disp("is :");
19 disp(" ")
20 //16 cells
```

```
21 for i=1:n
22     for j=1:n
23         if(k(i,j)~=1)
24             temp=0;
25             break;
26          end
27     end
28 end
29 printf('f=');
30 if(temp==1)
31     printf("1");
32     abort;
33 end
34 //8 cells
35 z1=ones(2,4);
36 z2=ones(4,2);
37 temp1=['00' '01' '11' '10'];
38 temp2=temp1';
39 for i=1:n
40         if(i==4)
41             t=1;
42         else
43             t=i+1;
44         end
45         z=[k(i,:,1);k(t,:,1)];
46         if(z==z1)
47             k(i,:,2)=[1 1 1 1];
48             k(t,:,2)=[1 1 1 1];
49             a=strsplit(temp2(i,1));
50             b=strsplit(temp2(t,1));
51             c=strcmp(a,b);
52             for in=1:max(size(c))
53                 if(c(in)==0 & a(in)=='0')
54                     printf('%s'',var(in));
55                     printf('+');
56                     break;
57                  else
58                      if(c(in)==0 & a(in)=='1')
```

```
                            printf(var(in));
                            printf('+');
                            break;
                        end
                    end
                end
            end
end
for j=1:n
    if(j==4)
        t=1;
    else
        t=j+1;
    end
    z=[k(:,j,1) k(:,t,1)];
    if(z==z2)
        k(:,j,2)=[1;1;1;1];
        k(:,t,2)=[1;1;1;1];
        a=strsplit(temp1(1,j));
        b=strsplit(temp1(1,t));
        c=strcmp(a,b);
        for in=1:max(size(c))
            if(c(in)==0 & a(in)=='0')
                printf('%s''',var(2+in));
                printf('+');
                break;
             else
                 if(c(in)==0 & a(in)=='1')
                     printf(var(2+in));
                     printf('+');
                     break;
                 end
             end
        end
    end
end
//4 cells
z1=ones(1,4);
```

```
z2=ones(4,1);
z3=ones(2,2);
temp1=['00' '01' '11' '10'];
temp2=temp1';
for t=1:n
        z=k(t,:,1);
        no=number_of(k(t,:,2),1);
        if(z==z1 & no<cmn4)
            k(t,:,2)=z1;
            a=strsplit(temp1(1,t));
            for in=1:max(size(a))
                if(a(in)=='0')
                    printf('%s'',var(in));
                 end
                 if(a(in)=='1')
                     printf(var(in));
                 end
              end
              printf("+");
          end
end
for t=1:n
    z=k(:,t,1);
    no=number_of(k(:,t,2),1);
    if(z==z2 & no<cmn4)
        k(:,t,2)=z2;
        a=strsplit(temp2(t,1));
        for in=1:max(size(a))
            if(a(in)=='0')
                printf('%s'',var(2+in));
             end
             if(a(in)=='1')
                 printf(var(2+in));
             end
        end
             printf("+");
    end
end
```

```
135 for i=1:n
136     for j=1:n
137        if(i==n)
138             t1=1;
139         else
140             t1=i+1;
141         end
142        if(j==n)
143             t2=1;
144         else
145             t2=j+1;
146         end
147         z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2,1)
               ];
148         z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2,2)
               ];
149         no=number_of(z5,1);
150         if(z4==z3 & no<cmn4)
151             k(i,j,2)=1;
152             k(i,t2,2)=1;
153             k(t1,j,2)=1;
154             k(t1,t2,2)=1;
155             a=strsplit(temp2(i,1));
156             b=strsplit(temp2(t1,1));
157             c=strcmp(a,b);
158             for in=1:max(size(c))
159                 if(c(in)==0 & a(in)=='0')
160                     printf('%s'',var(in));
161                  end
162                  if(c(in)==0 & a(in)=='1')
163                      printf(var(in));
164                  end
165              end
166             a=strsplit(temp1(1,j));
167             b=strsplit(temp1(1,t2));
168             c=strcmp(a,b);
169             for in=1:max(size(c))
170                 if(c(in)==0 & a(in)=='0')
```

```
                    printf('%s''',var(2+in));
                end
                if(c(in)==0 & a(in)=='1')
                    printf(var(2+in));
                end
            end
            printf("+");
        end
    end
end
//2 cells
z6=[1 1];
z7=z6';
for i=1:n
    for j=1:n
        if(i==n)
            t1=1;
        else
            t1=i+1;
        end
       if(j==n)
            t2=1;
        else
            t2=j+1;
        end
        z8=[k(i,j,1) k(i,t2,1)];
        z9=[k(i,j,2) k(i,t2,2)];
        no1=number_of(z9,1);
        if(z8==z6 & no1<cmn2)
          k(i,j,2)=1;
          k(i,t2,2)=1;
          a=strsplit(temp1(1,j));
          b=strsplit(temp1(1,t2));
          c=strcmp(a,b);
            for in=1:max(size(c))
                if(c(in)==0 & a(in)=='0')
                    printf(p1(1,i));
                    printf('%s''',var(2+in));
```

```
                    printf("+");
                end
                if(c(in)==0 & a(in)=='1')
                    printf(p1(1,i));
                    printf(var(2+in));
                    printf("+");
                end
            end
        end
    end
end
for i=1:n
    for j=1:n
        if(i==n)
            t1=1;
        else
            t1=i+1;
        end
       if(j==n)
            t2=1;
        else
            t2=j+1;
        end
        z10=[k(i,j,1);k(t1,j,1)];
        z11=[k(i,j,2);k(t1,j,2)];
        no2=number_of(z11,1);
        if(z10==z7 & no2<cmn2)
          k(i,j,2)=1;
          k(t1,j,2)=1;
          a=strsplit(temp2(i,1));
          b=strsplit(temp2(t1,1));
          c=strcmp(a,b);
            for in=1:max(size(c))
                if(c(in)==0 & a(in)=='0')
                    printf(p2(j,1));
                    printf('%s'',var(in));
                    printf("+");
                end
```

```
247                     if(c(in)==0 & a(in)=='1')
248                         printf(p2(j,1));
249                         printf(var(in));
250                         printf("+");
251                     end
252                 end
253             end
254         end
255 end
256 //single cell
257 for i=1:n
258     for j=1:n
259         if(k(i,j,2)==0 & k(i,j,1)==1)
260             a=strsplit(temp1(1,j));
261             b=strsplit(temp2(i,1));
262             for in=1:max(size(a(:,1)))
263                 if(a(in,1)=='1')
264                     printf(var(in+2));
265                 else
266                     if(a(in,1)=='0')
267                         printf('%s''',var(2+in));
268                     end
269                  end
270             end
271             for in=1:max(size(b(:,1)))
272                 if(b(in,1)=='1')
273                     printf(var(in));
274                 else
275                     if(b(in,1)=='0')
276                         printf('%s''',var(in));
277                     end
278                  end
279             end
280             printf("+");
281         end
282     end
283 end
284 printf("0");
```

check Appendix AP 2 for dependency:

`number_of.sci`

Scilab code Exa 4.3 Reduce Expression

```
clc;
n=4;          //four variable kmap
k=[0 0 1 0;
   1 1 1 0;
   0 1 1 1;
   0 1 0 0];
k(:,:,2)=zeros(n,n);      //temporary matrix to know
   whether a element is paired or not
//declaring notations to display output
var=['y' 'z' 'w' 'x'];
p1=['y^z^' 'y''z' 'yz' 'yz''];
p2=['w^x^';'w''x';'wx';'wx''];
//minimum redundant elements accepted while pairing
cmn4=1;
cmn2=1;
temp=1;
disp("The minimal ecpression of the given Kmap ");
disp(k(:,:,1));
disp("is :");
disp(" ")
//16 cells
for i=1:n
    for j=1:n
        if(k(i,j)~=1)
            temp=0;
            break;
         end
    end
end
```

```
printf('f=');
if(temp==1)
    printf("1");
    abort;
end
//8 cells
z1=ones(2,4);
z2=ones(4,2);
temp1=['00' '01' '11' '10'];
temp2=temp1';
for i=1:n
        if(i==4)
            t=1;
        else
            t=i+1;
        end
        z=[k(i,:,1);k(t,:,1)];
        if(z==z1)
            k(i,:,2)=[1 1 1 1];
            k(t,:,2)=[1 1 1 1];
            a=strsplit(temp2(i,1));
            b=strsplit(temp2(t,1));
            c=strcmp(a,b);
            for in=1:max(size(c))
                if(c(in)==0 & a(in)=='0')
                    printf('%s'',var(in));
                    printf('+');
                    break;
                 else
                     if(c(in)==0 & a(in)=='1')
                        printf(var(in));
                        printf('+');
                        break;
                      end
                 end
            end
        end
end
```

```
67  for j=1:n
68      if(j==4)
69          t=1;
70      else
71          t=j+1;
72      end
73      z=[k(:,j,1) k(:,t,1)];
74      if(z==z2)
75          k(:,j,2)=[1;1;1;1];
76          k(:,t,2)=[1;1;1;1];
77          a=strsplit(temp1(1,j));
78          b=strsplit(temp1(1,t));
79          c=strcmp(a,b);
80          for in=1:max(size(c))
81              if(c(in)==0 & a(in)=='0')
82                  printf('%s''',var(2+in));
83                  printf('+');
84                  break;
85               else
86                   if(c(in)==0 & a(in)=='1')
87                       printf(var(2+in));
88                       printf('+');
89                       break;
90                   end
91               end
92          end
93     end
94  end
95  //2 cells
96  z6=[1 1];
97  z7=z6';
98  for i=1:n
99      for j=1:n
100         if(i==n)
101             t1=1;
102         else
103             t1=i+1;
104         end
```

```
105         if(j==n)
106             t2=1;
107          else
108             t2=j+1;
109          end
110          z8=[k(i,j,1) k(i,t2,1)];
111          z9=[k(i,j,2) k(i,t2,2)];
112          no1=number_of(z9,1);
113          if(z8==z6 & no1<cmn2)
114             if(i==3 & i+j==5)
115                 ;
116             else
117               k(i,j,2)=1;
118               k(i,t2,2)=1;
119               a=strsplit(temp1(1,j));
120               b=strsplit(temp1(1,t2));
121               c=strcmp(a,b);
122                 for in=1:max(size(c))
123                     if(c(in)==0 & a(in)=='0')
124                         printf(p1(1,i));
125                         printf('%s'',var(2+in));
126                         printf("+");
127                      end
128                      if(c(in)==0 & a(in)=='1')
129                          printf(p1(1,i));
130                          printf(var(2+in));
131                          printf("+");
132                      end
133                  end
134             end
135          end
136      end
137  end
138  for i=1:n
139      for j=1:n
140          if(i==n)
141              t1=1;
142          else
```

```
143             t1=i+1;
144          end
145         if(j==n)
146             t2=1;
147          else
148             t2=j+1;
149          end
150          z10=[k(i,j,1);k(t1,j,1)];
151          z11=[k(i,j,2);k(t1,j,2)];
152          no2=number_of(z11,1);
153          if(z10==z7 & no2<cmn2)
154            k(i,j,2)=1;
155            k(t1,j,2)=1;
156            a=strsplit(temp2(i,1));
157            b=strsplit(temp2(t1,1));
158            c=strcmp(a,b);
159              for in=1:max(size(c))
160                  if(c(in)==0 & a(in)=='0')
161                      printf(p2(j,1));
162                      printf('%s'',var(in));
163                      printf("+");
164                   end
165                   if(c(in)==0 & a(in)=='1')
166                       printf(p2(j,1));
167                       printf(var(in));
168                       printf("+");
169                   end
170               end
171          end
172      end
173  end
174  //4 cells
175  z1=ones(1,4);
176  z2=ones(4,1);
177  z3=ones(2,2);
178  temp1=['00' '01' '11' '10'];
179  temp2=temp1';
180  for t=1:n
```

```
181          z=k(t,:,1);
182          no=number_of(k(t,:,2),1);
183          if(z==z1 & no<cmn4)
184              k(t,:,2)=z1;
185              a=strsplit(temp1(1,t));
186              for in=1:max(size(a))
187                  if(a(in)=='0')
188                      printf('%s''',var(in));
189                   end
190                   if(a(in)=='1')
191                       printf(var(in));
192                   end
193               end
194               printf("+");
195            end
196 end
197 for t=1:n
198     z=k(:,t,1);
199     no=number_of(k(:,t,2),1);
200     if(z==z2 & no<cmn4)
201         k(:,t,2)=z2;
202         a=strsplit(temp2(t,1));
203         for in=1:max(size(a))
204             if(a(in)=='0')
205                 printf('%s''',var(2+in));
206              end
207              if(a(in)=='1')
208                  printf(var(2+in));
209              end
210         end
211              printf("+");
212     end
213 end
214 for i=1:n
215     for j=1:n
216        if(i==n)
217             t1=1;
218          else
```

```
219             t1=i+1;
220          end
221         if(j==n)
222             t2=1;
223          else
224             t2=j+1;
225          end
226          z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2,1)
                ];
227          z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2,2)
                ];
228          no=number_of(z5,1);
229          if(z4==z3 & no<cmn4)
230             k(i,j,2)=1;
231             k(i,t2,2)=1;
232             k(t1,j,2)=1;
233             k(t1,t2,2)=1;
234             a=strsplit(temp2(i,1));
235             b=strsplit(temp2(t1,1));
236             c=strcmp(a,b);
237             for in=1:max(size(c))
238                 if(c(in)==0 & a(in)=='0')
239                     printf('%s'',var(in));
240                  end
241                  if(c(in)==0 & a(in)=='1')
242                      printf(var(in));
243                  end
244               end
245             a=strsplit(temp1(1,j));
246             b=strsplit(temp1(1,t2));
247             c=strcmp(a,b);
248             for in=1:max(size(c))
249                 if(c(in)==0 & a(in)=='0')
250                     printf('%s'',var(2+in));
251                  end
252                  if(c(in)==0 & a(in)=='1')
253                      printf(var(2+in));
254                  end
```

```
255                 end
256                 printf("+");
257             end
258         end
259     end
260     //single cell
261     for i=1:n
262         for j=1:n
263             if(k(i,j,2)==0 & k(i,j,1)==1)
264                 a=strsplit(temp1(1,j));
265                 b=strsplit(temp2(i,1));
266                 for in=1:max(size(a(:,1)))
267                     if(a(in,1)=='1')
268                         printf(var(in+2));
269                     else
270                         if(a(in,1)=='0')
271                             printf('%s''',var(2+in));
272                         end
273                      end
274                 end
275                 for in=1:max(size(b(:,1)))
276                     if(b(in,1)=='1')
277                         printf(var(in));
278                     else
279                         if(b(in,1)=='0')
280                             printf('%s''',var(in));
281                         end
282                      end
283                 end
284                 printf("+");
285             end
286         end
287     end
288     printf("0");
```

check Appendix AP 6 for dependency:

`dec21bin.sci`

check Appendix AP 7 for dependency:

`donkmap.sci`

check Appendix AP 2 for dependency:

`number_of.sci`

Scilab code Exa 4.4 BCD to Excess 3 Convertor

```
clc;
n=10;
//coverting decimal numbers into excess 3 values
for i=0:n-1
    c(i+1,1)=dec2bin(i+3);
end
a=c;
b=zeros(10,4);
//placing excess 3 outputs in matrix for convenience
for i=1:n
    j=4;
       while(a(i,1)>=1)
          b(i,j)=round(modulo(a(i,1),10));
          a(i,1)=a(i,1)/10;
          j=j-1;
       end
end
//dont care is represented by a 2 since scilab
   doesnt allow a matrix to contain string and a
   number.
for i=n+1:16
    b(i,:)=[2 2 2 2];
end
//map of each output variable
z=[b(1,1) b(5,1) b(13,1) b(9,1);b(2,1) b(6,1) b
   (14,1) b(10,1);
```

```
24      b(3,1) b(7,1) b(15,1) b(11,1);b(4,1) b(8,1) b
          (16,1) b(12,1)];
25  y=[b(1,2) b(5,2) b(13,2) b(9,2);b(2,2) b(6,2) b
       (14,2) b(10,2);
26      b(3,2) b(7,2) b(15,2) b(11,2);b(4,2) b(8,2) b
          (16,2) b(12,2)];
27  w=[b(1,3) b(5,3) b(13,3) b(9,3);b(2,3) b(6,3) b
       (14,3) b(10,3);
28      b(3,3) b(7,3) b(15,3) b(11,3);b(4,3) b(8,3) b
          (16,3) b(12,3)];
29  x=[b(1,4) b(5,4) b(13,4) b(9,4);b(2,4) b(6,4) b
       (14,4) b(10,4);
30      b(3,4) b(7,4) b(15,4) b(11,4);b(4,4) b(8,4) b
          (16,4) b(12,4)];
31  donkmap(w,1);
32  donkmap(x,2);
33  donkmap(y,3);
34  donkmap(z,4);
```

---

check Appendix AP 5 for dependency:

`check.sci`

check Appendix AP 4 for dependency:

`noof3.sci`

check Appendix AP 2 for dependency:

`number_of.sci`

Scilab code Exa 4.5 5 variable Kmap

```
1  // f=x^y^z+wxz+xy+v^w^yz^
2  clc;
3  n=4;
4  k=[0  0  0  0;
```

```
5      1 0 1 1;
6      0 1 1 0;
7      1 1 1 0];
8  k(:,:,2)=[0 0 0 0;
9              1 0 1 1;
10             0 1 1 0;
11             0 1 1 0];
12 //k=[1 0 0 0;
13 //    0 0 0 0;
14 //    0 0 0 0;
15 //    0 0 1 0];
16 //k(:,:,2)=[1 0 0 0;
17 //             0 0 0 0;
18 //             0 0 0 0;
19 //             1 0 0 0];
20 k(:,:,3)=zeros(n,n);
21 k(:,:,4)=zeros(n,n);
22 var=['y' 'z' 'v' 'w' 'x'];
23 p1=['y''z''' 'y''z' 'yz' 'yz''' ];
24 p2=['v''w''x'''; 'v''w''x'; 'v''wx'; 'v''wx''';
25 'vw''x'''; 'vw''x'; 'vwx'; 'vwx''' ];
26 cmn16=9;
27 cmn8=5;
28 cmn4=3;
29 cmn2=2;
30 temp=1;
31      printf('The minimal ecpression of the given Kmap
            ');
32      disp(k(:,:,1));
33      disp(k(:,:,2));
34      disp("is :");
35 printf('f');
36 printf("=");
37 //32 cells
38 for i=1:n
39      for j=1:n
40          for l=1:2
41              if(k(i,j,l)~=1 & k(i,j,l)~=2)
```

```
                    temp=0;
                    break;
                end
            end
        end
    end
    if(temp==1)
        printf("1");
        abort;
    end
    //16 cells
    //8+8 row cells
    z1=ones(2,4,2);
    z2=ones(4,2,2);
    temp1=['00' '01' '11' '10'];
    temp2=['000' '001' '011' '010' '100' '101' '111' '
       110'];
    for i=1:n
            if(i==4)
                t=1;
            else
                t=i+1;
            end
            z=[k(i,:,1:2);k(t,:,1:2)];
            z1=[k(i,:,3:4);k(t,:,3:4)];
            if(noof3(z,0)==0 & noof3(z1,1)<cmn16)
                k(i,:,3:4)=ones(4,2);
                k(t,:,3:4)=ones(4,2);
                a=strsplit(temp1(1,i));
                b=strsplit(temp1(1,t));
                c=strcmp(a,b);
                for in=1:max(size(c))
                    if(c(in)==0 & a(in)=='0')
                        printf('%s'',var(in));
                     else
                         if(c(in)==0 & a(in)=='1')
                            printf(var(in));
                          end
```

```
79                      end
80                  end
81                  k(i,:,3:4)=ones(1,4,2);
82                  k(t,:,3:4)=ones(1,4,2);
83              end
84  end
85  //8+8 column cells
86  for j=1:n
87      if(j==4)
88          t=1;
89      else
90          t=j+1;
91      end
92      z=[k(:,j,1:2) k(:,t,1:2)];
93      z1=[k(:,j,3:4) k(:,t,3:4)];
94      if(noof3(z,0)==0 & noof3(z1,1)<cmn16)
95          k(:,j,3:4)=ones(4,2);
96          k(:,t,3:4)=ones(4,2);
97          a=strsplit(temp2(1,j));
98          b=strsplit(temp2(1,t));
99          c=strsplit(temp2(1,j+4));
100         d=strsplit(temp2(1,t+4));
101         c1=check(a,b,c,d);
102         for in=1:max(size(c1))
103             if(c1(in)==0 & a(in)=='0')
104                 printf('%s''',var(2+in));
105              else
106                 if(c1(in)==0 & a(in)=='1')
107                     printf(var(2+in));
108                 end
109              end
110         end
111         printf("+");
112         k(:,j,3:4)=ones(1,4,2);
113         k(:,t,3:4)=ones(1,4,2);
114     end
115 end
116 //4x4 front matrix
```

```
117 if(number_of(k(:,:,1),0)==0 & number_of(k(:,:,3),1)<
       cmn16)
118     printf(var(3));
119     printf('''');
120     k(:,:,3)=ones(4,4);
121 end
122 //4x4 rear matrix
123 if(number_of(k(:,:,2),0)==0 & number_of(k(:,:,4),1)<
       cmn16)
124     printf(var(3));
125     k(:,:,4)=ones(4,4);
126 end
127 //8 cells
128 //2x2 front and rear cells
129 for i=1:n
130     for j=1:n
131         if(i==4)
132             t=1;
133         else
134             t=i+1;
135         end
136         if(j==4)
137             u=1;
138         else
139             u=j+1;
140         end
141         z=k(i,j,1:2);
142         z(1,2,:)=k(i,u,1:2);
143         z(2,1,:)=k(t,j,1:2);
144         z(2,2,:)=k(t,u,1:2);
145         z1=k(i,j,3:4);
146         z1(1,2,:)=k(i,u,3:4);
147         z1(2,1,:)=k(t,j,3:4);
148         z1(2,2,:)=k(t,u,3:4);
149         if(noof3(z,0)==0 & noof3(z1,1)<cmn8)
150             a=strsplit(temp1(1,i));
151             b=strsplit(temp1(1,t));
152             c=strcmp(a,b);
```

```
153                 for in=1:max(size(c))
154                     if(c(in)==0 & a(in)=='0')
155                         printf('%s''',var(in));
156                      else
157                          if(c(in)==0 & a(in)=='1')
158                             printf(var(in));
159                           end
160                      end
161                 end
162                 a=strsplit(temp2(1,j));
163                 b=strsplit(temp2(1,u));
164                 c=strsplit(temp2(1,4+j));
165                 d=strsplit(temp2(1,4+u));
166                 c1=check(a,b,c,d);
167                 for in=1:max(size(c1))
168                     if(c1(in)==0 & a(in)=='0')
169                         printf('%s''',var(2+in));
170                      else
171                          if(c1(in)==0 & a(in)=='1')
172                             printf(var(2+in));
173                           end
174                      end
175                 end
176                 k(i,j,3:4)=ones(1,1,2);
177                 k(i,u,3:4)=ones(1,1,2);
178                 k(t,j,3:4)=ones(1,1,2);
179                 k(t,u,3:4)=ones(1,1,2);
180                 printf("+");
181             end
182         end
183     end
184     //1x4 front and rear cells
185     for i=1:n
186         z=k(i,:,1:2);
187         z1=k(i,:,3:4);
188         if(noof3(z,0)==0 & noof3(z1,1)<cmn8)
189             printf(p1(i));
190             printf("+");
```

```
191           k(i,:,3:4)=ones(1,4,2);
192       end
193   end
194   //4x1 front and rear cells
195   for j=1:n
196       z=k(:,j,1:2);
197       z1=k(:,j,3:4);
198       if(noof3(z,0)==0 & noof3(z1,1)<cmn8)
199           a=strsplit(temp2(1,j));
200           b=strsplit(temp2(1,u));
201           c=strcmp(a,b);
202           for in=1:max(size(c))
203               if(c(in)==0 & a(in)=='0')
204                   printf('%s'',var(2+in));
205                else
206                    if(c(in)==0 & a(in)=='1')
207                       printf(var(2+in));
208                     end
209                end
210           end
211           printf("+");
212           k(:,j,3:4)=ones(1,2,4);
213       end
214   end
215   //2x4 front cells
216   for i=1:n
217       if(i==4)
218           t=1;
219       else
220           t=i+1;
221       end
222       z=k(i,:,1);
223       z(2,:,1)=k(t,:,1);
224       z1=k(i,:,3);
225       z1(2,:,1)=k(t,:,3);
226       if(number_of(z,0)==0 & number_of(z1,1)<cmn8)
227           a=strsplit(temp1(1,i));
228           b=strsplit(temp1(1,t));
```

```
229          c=strcmp(a,b);
230          for in=1:max(size(c))
231              if(c(in)==0 & a(in)=='0')
232                  printf('%s''',var(in));
233               else
234                   if(c(in)==0 & a(in)=='1')
235                      printf(var(in));
236                    end
237               end
238          end
239          printf('%s''',var(3));
240          printf("+");
241          k(i,:,3)=ones(1,4);
242          k(t,:,3)=ones(1,4);
243      end
244  end
245  //2x4 rear cells
246  for i=1:n
247      if(i==4)
248          t=1;
249      else
250          t=i+1;
251      end
252      z=k(i,:,2);
253      z(2,:,1)=k(t,:,2);
254      z1=k(i,:,4);
255      z1(2,:,1)=k(t,:,4);
256      if(number_of(z,0)==0 & number_of(z1,1)<cmn8)
257          a=strsplit(temp1(1,i));
258          b=strsplit(temp1(1,t));
259          c=strcmp(a,b);
260          for in=1:max(size(c))
261              if(c(in)==0 & a(in)=='0')
262                  printf('%s''',var(in));
263               else
264                   if(c(in)==0 & a(in)=='1')
265                      printf(var(in));
266                    end
```

```
267                 end
268             end
269             printf(var(3));
270             printf("+");
271             k(i,:,4)=ones(1,4);
272             k(t,:,4)=ones(1,4);
273         end
274     end
275     //4x2 front cells
276     for j=1:n
277         if(j==4)
278             u=1;
279         else
280             u=j+1;
281         end
282         z=k(:,j,1);
283         z(:,2,1)=k(:,u,1);
284         z1=k(:,j,3);
285         z1(:,2,1)=k(:,u,3);
286         if(number_of(z,0)==0 & number_of(z1,1)<cmn8)
287             a=strsplit(temp2(1,i));
288             b=strsplit(temp2(1,t));
289             c=strcmp(a,b);
290             for in=1:max(size(c))
291                 if(c(in)==0 & a(in)=='0')
292                     printf('%s'',var(in));
293                  else
294                      if(c(in)==0 & a(in)=='1')
295                         printf(var(in));
296                       end
297                  end
298             end
299             printf('%s'',var(3));
300             printf("+");
301             k(:,j,3)=ones(4,1);
302             k(:,u,3)=ones(4,1);
303         end
304     end
```

```
305 //4x2 rear cells
306 for j=1:n
307     if(j==4)
308         u=1;
309     else
310         u=j+1;
311     end
312     z=k(:,j,2);
313     z(:,2,1)=k(:,u,2);
314     z1=k(:,j,4);
315     z1(:,2,1)=k(:,u,4);
316     if(number_of(z,0)==0 & number_of(z1,1)<cmn8)
317         a=strsplit(temp2(1,i));
318         b=strsplit(temp2(1,t));
319         c=strcmp(a,b);
320         for in=1:max(size(c))
321             if(c(in)==0 & a(in)=='0')
322                 printf('%s'',var(4+in));
323              else
324                  if(c(in)==0 & a(in)=='1')
325                     printf(var(4+in));
326                   end
327              end
328         end
329         printf(var(3));
330         printf("+");
331         k(:,j,4)=ones(4,1);
332         k(:,u,4)=ones(4,1);
333     end
334 end
335 //4 cells
336 //1x4 front cells
337 for i=1:n
338     z=k(i,:,1);
339     z1=k(i,:,3);
340     if(number_of(z,0)==0 & number_of(z1,1)<cmn4)
341         printf(p1(1,i));
342         printf('%s'',var(3));
```

```
343             printf("+");
344             k(i,:,3)=ones(1,4);
345         end
346     end
347     //1x4 rear cells
348     for i=1:n
349         z=k(i,:,2);
350         z1=k(i,:,4);
351         if(number_of(z,0)==0 & number_of(z1,1)<cmn4)
352             printf(p1(1,i));
353             printf(var(3));
354             printf("+");
355             k(i,:,4)=ones(1,4);
356         end
357     end
358     //4x1 front cells
359     for j=1:n
360         z=k(:,j,1);
361         z1=k(:,j,3);
362         if(number_of(z,0)==0 & number_of(z1,1)<cmn4)
363             printf(p2(j,1));
364             printf("+");
365             k(:,j,3)=ones(4,1);
366         end
367     end
368     //4x1 rear cells
369     for j=1:n
370         z=k(:,j,2);
371         z1=k(:,j,4);
372         if(number_of(z,0)==0 & number_of(z1,1)<cmn4)
373             printf(p2(4+j,1));
374             printf("+");
375             k(:,j,4)=ones(4,1);
376         end
377     end
378     //2x1 front and rear matrix
379     for i=1:n
380         for j=1:n
```

```
381         if(i==4)
382             t=1;
383         else
384             t=i+1;
385         end
386         z=[k(i,j,1);k(t,j,1)];
387         z(:,:,2)=[k(i,j,2) k(t,j,2)];
388         z1=[k(i,j,3);k(t,j,3)];
389         z1(:,:,2)=[k(i,j,4) k(t,j,4)];
390         if(noof3(z,0)==0 & noof3(z1,1)<cmn4)
391             a=strsplit(temp1(1,i));
392             b=strsplit(temp1(1,t));
393             c=strcmp(a,b);
394             for in=1:max(size(c))
395                 if(c(in)==0 & a(in)=='0')
396                     printf('%s',var(in));
397                  else
398                      if(c(in)==0 & a(in)=='1')
399                          printf(var(in));
400                      end
401                  end
402             end
403             a=strsplit(temp2(1,j));
404             b=strsplit(temp2(1,4+j));
405             c=strcmp(a,b);
406             for in=1:max(size(c))
407                 if(c(in)==0 & a(in)=='0')
408                     printf('%s',var(2+in));
409                  else
410                      if(c(in)==0 & a(in)=='1')
411                          printf(var(2+in));
412                      end
413                  end
414             end
415             printf('+');
416         k(i,j,3)=1;k(t,j,3)=1;
417         k(i,j,4)=1; k(t,j,4)=1;
418         end
```

```
419     end
420 end
421 //1x2 front and rear matrix
422 for i=1:n
423     for j=1:n
424         if(j==4)
425             u=1;
426         else
427             u=j+1;
428         end
429         z=[k(i,j,1) k(i,u,1)];
430         z(:,:,2)=[k(i,j,2) k(i,u,2)];
431         z1=[k(i,j,3) k(i,u,3)];
432         z1(:,:,2)=[k(i,j,4) k(i,u,4)];
433         if(noof3(z,0)==0 & noof3(z1,1)<1)
434             printf(p1(i));
435             a=strsplit(temp2(1,j));
436             b=strsplit(temp2(1,u));
437             c=strsplit(temp2(1,4+j));
438             d=strsplit(temp2(1,4+j));
439             c1=check(a,b,c,d);
440             for in=1:max(size(c1))
441                 if(c1(in)==0 & a(in)=='0')
442                     printf('%s''',var(2+in));
443                  else
444                      if(c1(in)==0 & a(in)=='1')
445                          printf(var(2+in));
446                      end
447                  end
448             end
449             printf('+');
450         k(i,j,3)=1; k(i,u,3)=1;
451         k(i,j,4)=1; k(i,u,4)=1;
452         end
453     end
454 end
455 //2 cells
456 //1x2 front cells
```

```
457 for i=1:n
458     for j=1:n
459         if(j==4)
460             u=1;
461         else
462             u=j+1;
463         end
464         z=[k(i,j,1) k(i,u,1)];
465         z1=[k(i,j,3) k(i,u,3)];
466         if(number_of(z,0)==0 & number_of(z1,1)<cmn2)
467             printf(p1(1,i));
468             a=strsplit(temp2(1,j));
469             b=strsplit(temp2(1,u));
470             c=strcmp(a,b);
471             for in=1:max(size(c))
472                 if(c(in)==0 & a(in)=='0')
473                     printf('%s''',var(2+in));
474                  else
475                     if(c(in)==0 & a(in)=='1')
476                         printf(var(2+in));
477                     end
478                  end
479             end
480             printf('+');
481             k(i,j,3)=1; k(i,u,3)=1;
482         end
483     end
484 end
485 //1x2 rear cells
486 for i=1:n
487     for j=1:n
488         if(j==4)
489             u=1;
490         else
491             u=j+1;
492         end
493         z=[k(i,j,2) k(i,u,2)];
494         z1=[k(i,j,4) k(i,u,4)];
```

```
495         if(number_of(z,0)==0 & number_of(z1,1)<cmn2)
496             printf(p1(1,i));
497             a=strsplit(temp2(1,4+j));
498             b=strsplit(temp2(1,4+u));
499             c=strcmp(a,b);
500             for in=1:max(size(c))
501                 if(c(in)==0 & a(in)=='0')
502                     printf('%s'',var(2+in));
503                  else
504                      if(c(in)==0 & a(in)=='1')
505                          printf(var(2+in));
506                      end
507                  end
508             end
509             printf('+');
510             k(i,j,4)=1; k(i,u,4)=1;
511         end
512     end
513 end
514 //2x1 front cells
515 for i=1:n
516     for j=1:n
517         if(i==4)
518             t=1;
519         else
520             t=i+1;
521         end
522         z=[k(i,j,1);k(t,j,1)];
523         z1=[k(i,j,3) k(t,j,3)];
524         if(number_of(z,0)==0 & number_of(z1,1)<cmn2)
525             a=strsplit(temp1(1,i));
526             b=strsplit(temp1(1,t));
527             c=strcmp(a,b);
528             for in=1:max(size(c))
529                 if(c(in)==0 & a(in)=='0')
530                     printf('%s'',var(in));
531                  else
532                      if(c(in)==0 & a(in)=='1')
```

```
533                             printf(var(in));
534                         end
535                     end
536                 end
537                 printf(p2(j,1))
538                 printf('+');
539                 k(i,j,3)=1; k(i,u,3)=1;
540             end
541         end
542     end
543     //2x1 rear cells
544     for i=1:n
545         for j=1:n
546             if(i==4)
547                 t=1;
548             else
549                 t=i+1;
550             end
551             z=[k(i,j,2);k(t,j,2)];
552             z1=[k(i,j,4) k(t,j,4)];
553             if(number_of(z,0)==0 & number_of(z1,1)<cmn2)
554                 a=strsplit(temp1(1,i));
555                 b=strsplit(temp1(1,t));
556                 c=strcmp(a,b);
557                 for in=1:max(size(c))
558                     if(c(in)==0 & a(in)=='0')
559                         printf('%s'',var(in));
560                      else
561                         if(c(in)==0 & a(in)=='1')
562                             printf(var(in));
563                         end
564                     end
565                 end
566                 printf(p2(4+j,1))
567                 printf('+');
568                 k(i,j,4)=1; k(i,u,4)=1;
569             end
570         end
```

```
end
//1 cell front and rear matrix
for i=1:n
    for j=1:n
        z=k(i,j,1:2);
        z1=k(i,j,3:4);
        if(noof3(z,0)==0 & noof3(z1,1)<cmn2)
            printf(p1(1,i));
            a=strsplit(temp2(1,j));
            b=strsplit(temp2(1,4+j));
            c=strcmp(a,b);
            for in=2:max(size(c))
                if(a(in)=='0' & c(in)==0)
                    printf('%s'',var(2+in));
                 else
                     if(a(in)=='1' & c(in)==0)
                         printf(var(2+in));
                     end
                end
             end
             printf('+');
             k(i,j,3:4)=ones(1,1,2);
          end
      end
end
//single cell
for i=1:n
    for j=1:n
        for z=1:2
             if(k(i,j,z)==1 & k(i,j,z+2)==0)
                 printf(p2(j,1));
                 printf(p1(1,i));
                 printf('+');
             end
        end
    end
end
printf('0');
```

Scilab code Exa 4.6 Prime Implicants

```
clc;
clear;
z=1;
//evaluating first expression
for  i=0:1
    for j=0:1
        for k=0:1
            for l=0:1
                f1(z,1)=bitor(bitand(i,j),bitand(k,l
                    ));
                z=z+1;
            end
        end
    end
end
z=1;
//evaluating 2nd expression
for  i=0:1
    for j=0:1
        for k=0:1
            for l=0:1
                f2(z,1)=bitand(bitand(i,j),bitcmp(k
                    ,1));
                z=z+1;
            end
        end
    end
end
//determining whether f covers h or not.
for i=1:16
    if(f2(i,1)==1)
        if(f2(i,1)==f1(i,1))
```

```
31              ;
32              else
33              disp("f doesnt cover h");
34              abort;
35          end
36      end
37  end
38  disp("f covers h  and h implies f");
```

Scilab code Exa 4.7 Prime Implicants 2

```
1  clc;
2  clear;
3  disp("f=xˆy+xz+yˆzˆ");
4  disp("since xˆy is a prime implicant neither xˆ nor
     y alone implies f");
5  disp("only xˆy are covered by f");
```

check Appendix AP 1 for dependency:

`karmap.sci`

check Appendix AP 3 for dependency:

`karmap1.sci`

check Appendix AP 2 for dependency:

`number_of.sci`

Scilab code Exa 4.8 Prime Implicants Of a Function

```
1  clc;
2  k=[1  1  0  1;
3     0  1  1  1;
```

```
4     0 1 1 0;
5     0 0 0 0];
6 disp("The prime implicants of function f");
7 karmap(k);
8 karmap1(k);
```

check Appendix AP 1 for dependency:

`karmap.sci`

check Appendix AP 2 for dependency:

`number_of.sci`

Scilab code Exa 4.9 Prime Implicants Of a Function 2

```
1 clc;
2 k=[0 1 1 1;
3     0 1 1 0;
4     0 0 1 0;
5     0 0 1 0];
6 disp("The prime implicants of the function f");
7 karmap(k);
```

check Appendix AP 8 for dependency:

`karmap3.sci`

check Appendix AP 2 for dependency:

`number_of.sci`

Scilab code Exa 4.10 Cyclic Prime Implicant map

```
1 clc;
2 k=[1 1 0 1;
3     0 1 1 1];
4 karmap3(k);
```

Chapter 5

Logical Design

Scilab code Exa 5.1 Odd Parity Bit Generator

```
1  clc;
2  clear;
3  //Takes x input and check whether it is valid logic
      level or not.
4  x=input("x = ");
5  while(x~=0 & x~=1)
6      disp("enter a valid logical level");
7      x=input("x = ");
8  end
9  //Takes y input and check whether it is valid logic
      level or not.
10 y=input("y = ");
11 while(y~=0 & y~=1)
12     disp("enter a valid logical level");
13     y=input("y = ");
14 end
15 //Takes z input and check whether it is valid logic
      level or not.
16 z=input("z = ");
17 while(z~=0 & z~=1)
18     disp("enter a valid logical level");
```

```
19      z=input("z = ");
20  end
21  p1=bitand(bitand(bitcmp(x,1),bitcmp(y,1)),z);
22  p2=bitand(bitand(bitcmp(x,1),y),bitcmp(z,1));
23  p3=bitand(bitand(bitcmp(y,1),x),bitcmp(z,1));
24  p4=bitand(bitand(x,y),z);
25  p=bitor(bitor(p1,p2),bitor(p3,p4));
26  disp(p,"The output of the odd parity generator
       circuit is");
27  disp("p= x^y^z+x^yz^+xy^z^+xyz");
```

Scilab code Exa 5.2 Serial To Parallel converter

```
1   clc;
2   clear;
3   //Takes x input and check whether it is valid logic
       level or not.
4   disp("enter the vaLue of input Line & controL
       signaLs C1 and C2");
5   x=input("x = ");
6   while(x~=0 & x~=1)
7       disp("enter a vaLid LogicaL LeveL");
8       x=input("x = ");1
9   end
10  //Takes C1 input and check whether it is valid logic
       level or not.
11  C1=input("C1 = ");
12  while(C1~=0 & C1~=1)
13      disp("enter a vaLid LogicaL LeveL");
14      C1=input("C1 = ");
15  end
16  //Takes C2 input and check whether it is valid logic
       level or not.
17  C2=input("C2 = ");
18  while(C2~=0 & C2~=1)
```

```
19      disp("enter a vaLid LogicaL LeveL");
20      C2=input("C2 = ");
21  end
22  disp("--------OUTPUT--------");
23  disp(L1=bitand(bitand(bitcmp(C1,1),bitcmp(C2,1)),x),
       "L1 = ");
24  disp(L2=bitand(bitand(bitcmp(C1,1),C2),x),"L2 = ");
25  disp(L3=bitand(bitand(C1,bitcmp(C2,1)),x),"L3 = ");
26  disp(L4=bitand(bitand(C1,C2),x),"L4 = ");
27  disp("L1=xC1^C2^");
28  disp("L2=xC1^C2");
29  disp("L3=xC1C2^");
30  disp("L4=xC1^C2^");
```

Scilab code Exa 5.3 Transmission function for a network

```
1  clc;
2  clear;
3  //Takes input and check whether it is valid logic
       level or not.
4  w=input("w = ");
5  while(w~=0 & w~=1)
6       disp("enter a valid logical level");
7       w=input("w = ");
8  end
9  x=input("x = ");
10 while(x~=0 & x~=1)
11      disp("enter a valid logical level");
12      x=input("x = ");
13 end
14 y=input("y = ");
15 while(y~=0 & y~=1)
16      disp("enter a valid logical level");
17      y=input("y = ");
18 end
```

```
19 z=input("z = ");
20 while(z~=0 & z~=1)
21     disp("enter a valid logical level");
22     z=input("z = ");
23 end
24 disp("original network x^[((y^z+z^y)w^)+w+y^+x^z^]")
     ;
25 disp("x^[w^y^z+w^yz^+w+y^+x^z^]");
26 disp("x^[y^(w^z+1)+w^yz^+w+x^z^]");
27 disp("x^[y^+w+yz^+x^z^]");
28 disp("x^[y^+yz^+w+x^z^]");
29 disp("x^[y^+z^+x^z^+w]");
30 disp("x^[y^+z^+w]");
31 //output of the relay network for the inputs given
32 disp(p=bitand(bitcmp(x,1),bitor(bitor(bitcmp(y,1),
     bitcmp(z,1)),w)),"output = ");
```

Scilab code Exa 5.4 4 Input Contact Network

```
1 clc;
2 clear;
3 //Takes input and check whether it is valid logic
     level or not.
4 w=input("w = ");
5 while(w~=0 & w~=1)
6     disp("enter a valid logical level");
7     w=input("w = ");
8 end
9 x=input("x = ");
10 while(x~=0 & x~=1)
11     disp("enter a valid logical level");
12     x=input("x = ");
13 end
14 y=input("y = ");
15 while(y~=0 & y~=1)
```

```
16      disp("enter a valid logical level");
17      y=input("y = ");
18  end
19  z=input("z = ");
20  while(z~=0 & z~=1)
21      disp("enter a valid logical level");
22      z=input("z = ");
23  end
24  disp("We have 4 relays W,X,Y,Z which takes BCD
       number as input");
25  disp("so the max value value we can get is 1001");
26  disp("By drawing the Karnaugh map(consider all terms
       above 1001 as dont cares ) the minimised
       expression  is");
27  disp("T(w,x,y,z)=wz+xyz^+x^yz");
28  disp("T(w,x,y,z)=xyz^+x^yz");
29  disp("Draw the series parallel realization of T");
30  disp("We can identify the redundancy of y contact at
       the right end");
31  disp("which can be removed");
32  disp("The cutset realisation of the above minimized
       series parallel network  is");
33  disp("T(w,x,y,z)=(w+y)(x+z)(x^+z^)");
```

Scilab code Exa 5.5 Minimal contact Network

```
1  clc;
2  clear;
3  disp("Given minimal contact network is T(w,x,y,z)=
       wxy+wxz+w^x^y^z^+w^x^yz");
4  disp("T(w,x,y,z)=wx(y+z)+w^x^(y^z^+yz)");
5  disp("Draw the equivalent series parallel circuit of
       T");
6  disp("Interchange the locations of contacts of w^
       and x^ and connect the nodes");
```

```
7 disp("By connecting in the above manner there is no
     logical effect since the connection path is not
     at all used");
8 disp("now the lower branch of yz+y^z^ can be written
     as (y+z^)(y^+z) so transfer contacts can be used
     ");
9 disp("This parallel connection enables us to combine
     two parallel z contacts and thus the minimum
     spring connection is obtained");
```

Chapter 6

Functional Decomposition And Symmetric Functions

Scilab code Exa 6.1 Function Decomposition

```
1 clc;
2 clear;
3 disp("Given function f(w,x,y,z) can be written as
    follows");
4 disp("f(w,x,y,z)=w^x^z^+wx^z+w^yz+wyz^");
5 disp("f(w,x,y,z)=((w^z^+wz)x^+(w^z+wz^)y)");
6 disp("let Q=w^z^+wz");
7 disp("then we can rewrite f as f(w,x,y,z)=Qx^+Q^y");
8 disp("f(w,x,y,z)=Qx^+Q^y=F[Q(w,z),x,y]");
```

Scilab code Exa 6.3 Muliplicity

```
1 clc;
2 clear;
3 //determines the row and column multiplicity of a
    mtraix
```

```
4  //m=input("enter the number of variables in the
       function=");
5  m=4;
6  for i=1:m
7      for j=1:m
8          x(i,j)=0;
9      end
10 end
11 //k='y';
12 //disp("Enter the cells index whose values are 1 in
       the matrix representing your function");
13 //while(k~='n')
14 //     i=input("x index =");
15 //     j=input("y index =");
16 //     x(i,j)=1;
17 //     k=input("If you want to enter more enter y(in
       quotes) else n(in quotes) :");
18 //end
19 x=[1 0 1 1;
20    0 0 1 0;
21    0 1 1 1;
22    1 1 0 1];
23 l=0;
24 //checks every row and find the max no of ones in a
       row.
25 for i=1:m
26     k=0;
27     for j=1:m
28         if(x(i,j)==1)
29             k=k+1;
30         end
31     end
32     if(k>l)
33        l=k;
34     end
35 end
36 disp(l,"Row multiplicity =");
37 l=0;
```

```
38 //checks every column and find the max no of ones in
       a column.
39 for j=1:m
40     k=0;
41     for i=1:m
42         if(x(i,j)==1)
43             k=k+1;
44         end
45     end
46     if(k>l)
47        l=k;
48     end
49 end
50 disp(l,"Column multiplicity =");
```

Scilab code Exa 6.6 Symmetric

```
1 clc;
2 clear;
3 disp("f(x,y,z)=x^y^z+xy^z^+x^yz^");
4 disp("since interchanging any two variables gives us
      the same equation");
5 disp("for example interchange x and y");
6 disp("f(y,x,z)=y^x^z+yx^z^+y^xz^");
7 disp("f(x,y,z)=f(y,x,z)");
8 disp("So the function f(x,y,z) is symmetric");
```

Scilab code Exa 6.7 Symmetric 2

```
1 clc;
2 clear;
3 disp("f(x1,x2,x3)=x1^x2^x3^+x1x2^x3+x1^x2x3");
```

```
4 disp("you can check that above equatioin is not
     symmetric in x1,x2,x3");
5 disp("But it is symmetric in x1,x2,x3^");
6 disp("let us verify it with interchanging x1 and x3^
     ");
7 disp("f(x3^,x2,x1)=x3x2^x1+x3^x2^x1^+x3x2x1^");
8 disp("you can identify that f(x1,x2,x3)=f(x3^,x2,x1)
     ");
```

Chapter 7

Threshold Logic

Scilab code Exa 7.1 weighted Sum

```
1  clc;
2  clear;
3  //takes the input and check whether it is valid or
       not
4  x1=input("x1 = ");
5  while(x1~=0 & x1~=1)
6      disp("enter a valid logical level");
7      x1=input("x1 = ");
8  end
9  x2=input("x2 = ");
10 while(x2~=0 & x2~=1)
11     disp("enter a valid logical level");
12     x2=input("x = ");
13 end
14 x3=input("x3 = ");
15 while(x3~=0 & x3~=1)
16     disp("enter a valid logical level");
17     x3=input("x3 = ");
18 end
19 f=-x1+(2*x2)+x3;
20 if(f>0.5) then
```

```
21      f=1;
22  else
23      f=0;
24  end
25  disp(f,"output y is");
26  m=1;
27  //displays the output of the above expression for
       all the combinations of inputs.
28  for x=0:1
29      for y=0:1
30          for z=0:1
31              f1(m,1)=x;
32              f1(m,2)=y;
33              f2(m,3)=z;
34              f1(m,4)=-x+(2*y)+z;
35              if(f1(m,4)>0.5) then
36                  f1(m,5)=1;
37              else
38                  f1(m,5)=0;
39              end
40              m=m+1;
41          end
42      end
43  end
44  disp("    x1      x2      x3     sum      y");
45  disp(f1)
```

Scilab code Exa 7.2 Inequalities

```
1  clc;
2  clear;
3  y='y';
4  i=1;
5  //Takes the equivalent decimal value of the min
       terms for eg: x^yz=011=3
```

```
6  while(y=='y')
7      disp("enter the minterm of a 3 variable function
          ");
8      x(i)=input(": ");
9      while(x(i)>7)
10         disp("enter a valid minterm");
11     end
12     disp("press y if you want to enter more min
          terms else n :");
13     y=input("");
14     i=i+1;
15 end
16 a=1;
17 //Generating truth table for determining the
      inequalities
18 for i=0:1
19     for j=0:1
20         for k=0:1
21             for z=1:length(x)
22                 if(x(z)==a-1);
23                     f(a,4)=1;
24                 end
25             end
26             f(a,1)=i;
27             f(a,2)=j;
28             f(a,3)=k;
29             a=a+1;
30         end
31     end
32 end
33 //displaying the truth table
34 disp("   x1      x2      x3      f");
35 disp(f);
36 disp("");
37 a=1;
38 //generating inequalities
39 for i=0:1
40     for j=0:1
```

```
41          for k=0:1
42              if(f(a,4)==1)
43                  printf('%3d * w1 + %3d * w2 + %3d *
                       w3>=T',f(a,1),f(a,2),f(a,3))
44                  disp("")
45              else
46                  printf('%3d * w1 + %3d * w2 + %3d *
                       w3<T',f(a,1),f(a,2),f(a,3))
47                  disp("")
48              end
49              a=a+1;
50          end
51      end
52  end
53  disp("By solving the above inequalities we can get
       the values of weights and T");
```

Scilab code Exa 7.3 Unate Functions

```
1  clc;
2  clear;
3  disp("Given function is f=x1x2^+x2x3^");
4  disp("Since x1 has no complemented form in the above
       function f,f is positive in x1");
5  disp("x2 has both complemented and uncomplemented
       forms in f so f is not unate in x2");
6  disp("x3 is only in complemented form so f is
       negative in x3");
```

Scilab code Exa 7.4 three cube representation

```
1  clc;
2  clear;
```

```
3 disp("given function is f=x1^x2+x2x3^");
4 disp("Since the varibles x1 and x3 are only in their
      complemented form f is negative and unate in x1
     and x3");
5 disp("even x2 is only in its uncomplemented form so
     f is positive in x2");
```

Scilab code Exa 7.5 True Vertex

```
1  clc;
2  clear;
3  n=input("Enter the no of input variables :");
4  //Input the true minimal vertices
5  v=input("Enter the no of minimal true vertices :");
6  disp("vertex will be in the form of 101 if it is 3
     variable");
7  for i=1:v
8      printf('Vertex %3d :',i)
9      s(i)=input(" ");
10 end
11 tv=input("enter a vertex which you want find whether
      true vertex or not");
12 //determines whether the vertex is a true or not by
     comparing it with the true minimal vertices
13 for i=1:v
14     if(tv>s(i))
15         disp("It is a true vertex");
16         break;
17      else
18          if(i==v)
19              disp("It is not a true vertex since it
                    is not > than any of the min
                    vertices");
20          end
21     end
```

```
22 end
```

Chapter 8

Reliable Design And Fault Diagnosis

Scilab code Exa 8.1 NOR Logic Circuit

```
1  clc;
2  clear;
3  disp("To find whether h is s-a-0 or not");
4  disp("First we have to express f as function of h
      and x1,x2,x3,x4");
5  disp("Simplifying the given logical circuit we
      obtain the expression of output as");
6  disp("f(X,h) = x1x2x3x4 + h(x2x3 + x1^x2^x3^x4^))");
7  disp("Here h = x2^x3^");
8  disp("let G = x1x2x3x4 & H = h(x2x3 + x1^x2^x3^x4^)"
      );
9  disp("Taking derivative on both sides");
10 disp("df/dh=G^dH/dh");
11 disp("Appllying the formula d[f(X)+g(X)]/dx=f^(X)dg(
      X)/dx exor g^(X)df(X)/dx exor df(X)/dx.dg(X)/dx")
      ;
12 disp("df/dh=G^dH/dh=(x1^+x2^+x3^+x4^)(x2x3+x1^x2^x3^
      x4^)");
13 disp("df/dh=x1^x2x3+x2x3x4^+x1^x2^x3^x4^");
```

```
14 disp("To find tests for h s-a-0 we compute the
     values for which h(df/dh)=1");
15 disp("hdf/dh=x2^x3^(x1^x2x3+x2x3x4^+x1^x2^x3^x4^)");
16 disp("hdf/dh=x1^x2^x3^x4^");
17 disp("Thus the test set for h s-a-0 is X(0,0,0,0)");
```

Scilab code Exa 8.2 Path Sensitizing

```
1 clc;
2 clear;
3 disp("To prove whether there possibiliy of
     identifing the fault by sensitising just a single
      path");
4 disp("Let us sensitize the path G3 G6 G9");
5 disp("This requires G6=1 , G10=0 , G11=0 ,G8=0 ");
6 disp("Which inturn requires x2=0 and x3=0 (since G6
     =1)");
7 disp("G10=0 impiles that x4=1 regardless of whether
     there is a fault or not");
8 disp("G11=0 implies G7=1(since x3=0) which in turn
     implies x4=0");
9 disp("Evidently to satisfy both G10=0 and G11=0 we
     must set conflicting requirements on x4 and thus
     have a contradiction");
10 disp("By symmetry of the circuit it is obvious that
     an attempt to sensitize the path through G10 will
      also fail");
11 disp("Hence the method of one dimensional path
     sensitizing fails to generate the test inputs to
     detect the fault");
```

Scilab code Exa 8.3 Two level OR AND Network

```
clc;
clear;
disp("BY following the procedure discussed in
   Section 8.6");
disp("we find that {a}={0 or 2 or 3,9,15}");
disp("and {b}={7,8.11.13.14}");
disp("Thus the minimal sets of tests for the above
   network are ");
disp("{T}={0 or 2 or 3,7,8,9,11,13,14,15}");
disp("In this case the s-tests and b-tests
   correspond to s-a-0 and s-a-1 respectively");
```

Scilab code Exa 8.4 Various errors Summarized

```
clc;
clear;
disp("Various errors associated with some commonly
   used gates are summarised below");
disp("A 0-to-1 error in an AND gate with R identical
    inputs is subcritical");
disp("since the output depends on the other input so
    it is subcritical");
disp("If the same 0-to-1 error is in a OR gate with
   R identical inputs then it is critical error");
disp("since an error input struck at 1 will make the
    output of OR gate to 1 all the time");
disp("Similarly the critical error of AND gate is
   subcritical error of OR gate");
disp("Similarly the error classicfication in various
    gates is mentioned in Table 8-2")
```

Chapter 10

Capabilities Minimization and transformation Of Sequential Machines

Scilab code Exa 10.1 Reducing machine

```
1  clc;
2  clear;
3  disp("    ...                    NS          ");
4  disp("     PS          x=0          x=1   ");
5  disp("      A          E,0          C,0   ");
6  disp("      B          C,0          A,0   ");
7  disp("      C          B,0          G,0   ");
8  disp("      D          G,0          A,0   ");
9  disp("      E          F,1          B,0   ");
10 disp("      F          E,0          D,0   ");
11 disp("      G          D,0          G,0   ");
12 disp("Initial partition consists of all the states")
     ;
13 disp("P0=(ABCDEFG)");
14 disp("Since E only has 1 equivalent different from
     others,it can be partitioned from others");
15 disp("P1=(ABCDFG)E");
```

```
16 disp("now check for 2-equivalent i.e. 1-equivalent
     and their Ii succesors for all possible Ii are
     also 1 equivalent");
17 disp("A,F dont satisfy the 2-equivalent so they can
     be partitioned from others");
18 disp("P2=(AF)(BCDG)E");
19 disp("In the similar manner P3 can be obtained by
     splitting BD and CG since they dont have the same
      3 equivalent");
20 disp("P3=(AF)(BD)(CG)E");
21 disp("In the same way P4 can be obtained by
     splitting A and F");
22 disp("P4=(A)(F)(BD)(CG)E");
23 disp("P4 cant be splitted more so P5 will be the
     same and the partition stops");
24 disp("P5=(A)(F)(BD)(CG)(E)");
25 disp("so the reduced machine is");
26 disp("    ...                          NS          ");
27 disp("    .. PS            x=0             x=1    ");
28 disp("      A-----a        e,0             c,0    ");
29 disp("      F-----f        e,0             b,0    ");
30 disp("    .(BD)--b         c,0             a,0    ");
31 disp("     (CG)--c         b,0             c,0    ");
32 disp("      E-----e        f,1             b,0    ");
```

Scilab code Exa 10.2 Compaitability Graph

```
1 clc;
2 clear;
3 disp("Considering the merger graph of machine M6 in
     PG 339");
4 disp("A set of compaitabilities is said to be closed
      if and only if for every compaitable contained
     in the set and all its implied compaitabilities
     are also in the same set");
```

```
5 disp("A closed set of compaitables which contains
    all the states of M is called a closed covering")
    ;
6 disp("By observing the merger graph we can find that
     {(AD)(BE)(CD)} is a closed set ");
7 disp("And the set {(AB)(CD)(EF)} appears to be a
    closed covering");
```

Chapter 12

Structure Of Sequential Machines

Scilab code Exa 12.4 Closed Partitions

```
1  clc;
2  clear;
3  disp("we know that a partition pi on the set of
      states of a Sequential machine M is said to be
      closed if,for every two states Si and Sj which
      are in the same block of pi and any Ith input
      successor of Si and Sj are also in the same group
      ");
4  disp("Based on the above definition we can make
      seven closed partitions as below");
5  disp("**Parition 1**");
6  disp("{A,B,C,D,E,F,G,H}")
7  disp("**Parition 1**");
8  disp("{(ABCD)(EFGH)}");
9  disp("**Parition 2**");
10 disp("{(ADEH)(BCFG)}")
11 disp("**Parition 3**");
12 disp("{(AD)(BCFG)(EH)}");
13 disp("**Parition 4**");
```

```
14 disp("{(ADEH)(BC)(FG)}")
15 disp("**Parition 5**");
16 disp("{(AD)(BC)(EH)(FG)}")
17 disp("**Parition 6**");
18 disp("{(ABCCDEFGH)}");
19 disp("By assigning values from 000 to 111 to all the
     states from A to H and obtaining the functions
    for Y1,Y2,Y3 and z will result in this equations"
    );
20 disp("Y1=xˆy1ˆ");
21 disp("Y2=xˆy2+xy2ˆ");
22 disp("Y3=xy2+xˆy1ˆy2y3ˆ+y3ˆy2ˆy3+y1y2y3+xˆy1y2ˆy3ˆ")
    ;
23 disp("z=y1ˆy2ˆy3");
```

Scilab code Exa 12.5 Output Consistent

```
1 clc;
2 clear;
3 disp("For the 4 state machine M4 in PG 397");
4 disp("IF the four states A,B,C,D are assigned as
    00,01,10,11(ta={(AC)(BD)}) and 00,01,11,10(tb={(
    AD)(BC)})");
5 disp("And if the output,next state functions of both
     the assignments are calculated we can find that
    ");
6 disp("For first assignment ");
7 disp("Y1=xˆy1+xy1ˆ");
8 disp("Y2=xˆy2ˆ+y1ˆy2ˆ+xy1y2");
9 disp("z=xˆy1ˆy2ˆ+xˆy1y2+xy1ˆy2+xy1y2ˆ");
10 disp("Second Assignment ");
11 disp("Y1=xˆy1+xˆy1");
12 disp("Y2=xˆy2ˆ+xy1ˆy2+y1y2ˆ");
13 disp("z=xˆy2ˆ+xy2");
```

```
14 disp("Since the second assignment results in reduced
       output expression this partition is called as
      output-consistent partition")
```

Scilab code Exa 12.7 Dependence

```
1 clc;
2 clear;
3 disp("A partition pi0 on the states of a machine M
      is said to be output consistent if for every
      block pi0 and every input, all the states
      contained in the block have the same outputs");
4 disp("Considering the above definition It can be
      understood that");
5 disp("pi0={(AD),(BC)} is an output consistent
      partition of machine M4");
6 disp("since the outputs of A,D states for any inputs
       are same and similarly the outputs of B,C are
      same.");
7 disp("So the partition {(AD),(BC)} are said to be
      output consistent");
```

Scilab code Exa 12.8 input Consistent Matrix

```
1 clc;
2 clear;
3 disp("For the Machine M5 in PG 400");
4 disp("State A implies the identification of states C
       and D");
5 disp("similarly C implies the identification of E
      and F states");
6 disp("In the same way C implies the identification
      of A and B");
```

```
7 disp("Thus the smallest input consistent partition
    for M5 is ");
8 disp("pi={(AB),(CD),(EF)}");
9 disp("Any other partition that contains pi is also
    input consistent")
```

Scilab code Exa 12.9 Implementation of Input Consistent matrix

```
1 clc;
2 clear;
3 disp("In previosuly problems we have determined the
    input and output consistent partitions for the
    Machine M5");
4 disp("Input consistent partition {(AB),(CD),(EF)}");
5 disp("Output consistent partition {(ACE),(BDF)}");
6 disp("By assigning 000 to 101 to all the states from
     A to F");
7 disp("we can find the expressions for the next state
     and the output");
8 disp("Y1=y2");
9 disp("Y2=y1^y2^");
10 disp("Y3=xy3+xy2+x^y2^y3^+y2y3");
11 disp("z=xy3^");
```

Scilab code Exa 12.10 Autonous Clock

```
1 clc;
2 clear;
3 disp("Partition pi of the machine M5 is {(AB),(CD),(
    EF)}");
4 disp("If M5 posses a closed partition pi such that
    pi> i .if the autonomous clock has #pi states
```

```
    the period p will be less than or equal to #pi ")
    ;
5 disp("since in the above closed partition of M5 we
    have 3 states i.e. (AB) as one state and (CD) and
     (EF) as other two");
6 disp("So the periodof the autonomous clock is p=3")
```

Scilab code Exa 12.11 partition pair

```
1 clc;
2 clear
3 disp("From the definition of partition pair(T,T^)
    which is an ordered pair of partitions such that
    if Si and Sj are in the same block of t, then for
     every input Ik in I, next states are in the same
     block of T^ ");
4 disp("By applying the above definition we can obtain
     the following partition pairs");
5 disp("(pi1,pi1^)=({(ABC),(DEF)},{(ABC),(DEF)})");
6 disp("(t1,t1^)=({(ABCD),(EF)},{(AE),(BCDF)})");
7 disp("(t2,t2^)=({(AE),(BCDF)},{(ACDE),(BF)})");
```

Scilab code Exa 12.12 partition pair 2

```
1 clc;
2 clear;
3 //1 is equivalent to A ad 2 to B and so on.
4 p1=['A' 'D']; //pairs in partition t(1 and 4
    represents that 1st and 4th state are in the same
     block);
5 p2=['C' 'E'];
6
7 q1=['A' 'E'];  //pairs in partition t^
```

```
8  q2=['B' 'D'];
9  q3=['C' 'F'];
10
11 disp("the following are the partitions of the
       machine M8");
12 disp("T");
13 disp('F',p2(2),p2(1),'B',p1);
14 disp("T^");
15 disp(q3,q2,q1);
16 disp("------");
17 disp("T");
18 disp('F',p2,'B',p1);
19 disp("T^");
20 disp(q3,[q1 q2]);
21 disp("------");
```

Scilab code Exa 12.14 State Consistent Partitions

```
1  clc;
2  clear;
3  //assume the first cloumn values are of machine M1
       and 2nd column are of M2
4  p=[1,1;1 3;2 2;2 4;3 3;3 1;4 4;4 2];
5  z=1;
6  for i=1:length(p(:,1))
7      for j=i:length(p(:,1))
8          if(p(i,1)==p(j,1) & i~=j)
9              q(z,:)=[p(i,:) p(j,:)];
10             z=z+1;
11         end
12     end
13 end
14 disp("pi(R)");
15 disp(q);
16 z=1;
```

```
17 for i=1:length(p(:,1))
18     for j=i:length(p(:,1))
19         if(p(i,2)==p(j,2) & i~=j)
20             q(z,:)=[p(i,:) p(j,:)];
21             z=z+1;
22         end
23     end
24 end
25 disp("pi(S)");
26 disp(q);
```

Chapter 13

State Identificaiton And Fault Detection Experiments

Scilab code Exa 13.1 Fault DetectionExeriment

```
1  clc;
2  clear;
3  disp("By following the general procedure for fault
       detection in the text book  Page n.o 478");
4  disp("According to 3 & 4 steps of general procedure
       all the inputs are taken as 0 and the output is
       checked]");
5  disp("X:       0  0  0");
6  disp("        A  B  A  B");
7  disp("Z:       1  0  1");
8  disp("By following the step 5");
9  disp("X:       1  0");
10 disp("        B  B  A");
11 disp("Z:       0  0");
12 disp("Accoring to step 6");
13 disp("X:       1  0  0  1  0  0");
14 disp("        A  D  D  D  C  D  D");
15 disp("Z:       0  3  3  1  2  3");
16 disp("Step 7 & 8")
```

```
17 disp("X:       1   1   0");
18 disp("        D   C   A   B");
19 disp("Z:       1   1   1");
20 disp("Whole checking experiment")
21 disp("X:     0   0   0   1   0   1   0   0   1   0   0   1   1   0
      ");
22 disp("       A   B   A   B   B   A   D   D   D   C   D   D   C   A
       B");
23 disp("Z:       1   0   1   0   0   0   3   3   1   2   3   1   1
      1");
```

Chapter 14

Memory Definiteness Information Losslessness of Finite Automata

Scilab code Exa 14.2 Synchronizing tree

```
clc;
clear;
N=4;
//state table of the machine
s=[ 'PS' 'x=0' 'x=1';
    'A' 'A' 'B';
    'B' 'C' 'B';
    'C' 'A' 'D';
    'D' 'C' 'B'];

k=1;l=2;m=1;n=1;
f(k,4)='ABCD';
k=k+1;
for i=2:max(size(s(:,1)))
    for j=i:max(size(s(:,1)))
        if(s(i,2)==s(j,2) & i~=j)
            f(k,l)=strcat([s(i,1) s(j,1)]);
```

```
18                 l=l+4;
19                 if(s(i,2)==s(j,2))
20                     g(n,m)=s(i,2);
21                     g(n,m+1)='-';
22                     m=m+2;
23                 else
24                     g(n,m)=s(i,2);
25                     g(n,m+1)=s(j,2);
26                     g(n,m+2)='-';
27                     m=m+3;
28                 end
29                 if(s(i,3)==s(j,3))
30                     g(n,m)=s(i,3);
31                     g(n,m+1)='-';
32                     m=m+2;
33                 else
34                     g(n,m)=strcat([s(i,3) s(j,3)]);
35                     g(n,m+1)='-';
36                     m=m+2;
37                     for z=2:max(size(s(:,1)))
38                         if(s(z,3)==s(z,1))
39                             h(1,3)=s(z,2);
40                             h(1,5)=s(z,3);
41                         end
42                     end
43                  end
44             end
45         end
46 end
47 disp("Synchronizing tree for Machine M3 is ")
48 disp(f);
49 disp(g);
50 disp(h);
```

Scilab code Exa 14.3 Contracted State Machine

```
clc;
clear;
s=['PS' 'x=0' 'x=1';
    'A' 'A' 'B';
    'B' 'E' 'B';
    'C' 'E' 'F';
    'D' 'E' 'F';
    'E' 'A' 'D';
    'F' 'E' 'B'];
z=0;
disp("Original Machine M4");
disp(s);
p=s;
n=max(size(s(:,1)));
for i=2:n
    for j=i:n
        if(s(i,2)==s(j,2) & s(i,3)==s(j,3) & i~=j)
            z=z+1;
            for k=j:n-1
                p(k,:)=p(k+1,:);
            end
            for k=2:n-1
                if(p(k,2)==s(j,1))
                    p(k,2)=s(i,1);
                end
                if(p(k,3)==s(j,1))
                    p(k,3)=s(i,1);
                end
            end
        end
    end
end
s=p(1:n-z,:);
disp("The contracted Table M4");
disp(s);
p=s;
n=n-z;
z=0;
```

```
for i=2:n
    for j=i:n
        if(s(i,2)==s(j,2) & s(i,3)==s(j,3) & i~=j)
            z=z+1;
            for k=j:n-1
                p(k,:)=p(k+1,:);
            end
            for k=2:n-1
                if(p(k,2)==s(j,1))
                    p(k,2)=s(i,1);
                end
                if(p(k,3)==s(j,1))
                    p(k,3)=s(i,1);
                end
            end
        end
    end
end
s=p(1:n-z,:);
disp("Repeated Contractions of M4");
disp(s);
p=s;
n=n-z;
z=0;
for i=2:n
    for j=i:n
        if(s(i,2)==s(j,2) & s(i,3)==s(j,3) & i~=j)
            z=z+1;
            for k=j:n-1
                p(k,:)=p(k+1,:);
            end
            for k=2:n-1
                if(p(k,2)==s(j,1))
                    p(k,2)=s(i,1);
                end
                if(p(k,3)==s(j,1))
                    p(k,3)=s(i,1);
                end
```

```
77                  end
78              end
79          end
80  end
81  s=p(1:n-z,:);
82  disp(s);
83  p=s;
84  n=n-z;
85  z=0;
86  for i=2:n
87      for j=i:n
88          if(s(i,2)==s(j,2) & s(i,3)==s(j,3) & i~=j)
89              z=z+1;
90              for k=j:n-1
91                  p(k,:)=p(k+1,:);
92              end
93              for k=2:n-1
94                  if(p(k,2)==s(j,1))
95                      p(k,2)=s(i,1);
96                  end
97                  if(p(k,3)==s(j,1))
98                      p(k,3)=s(i,1);
99                  end
100             end
101         end
102     end
103 end
104 s=p(1:n-z,:);
105 disp(s);
```

Scilab code Exa 14.4 Testing Table

```
1  clc;
2  clear;
3  N=4;
```

```
s=[ 'PS' 'x=0' 'x=1';
    'A' 'A' 'B';
    'B' 'C' 'B';
    'C' 'A' 'D';
    'D' 'C' 'B'];
n=max(size(s(:,1)));
s(n+1,:)=['-' '-' '-'];
l=2;
for i=2:n
    for j=i:n
        if(i~=j)
            s(n+l,1)=strcat([s(i,1) s(j,1)]);
            s(n+l,2)=strcat([s(i,2) s(j,2)]);
            s(n+l,3)=strcat([s(i,3) s(j,3)]);
            l=l+1;
        end
    end
end
disp(s);
```

Scilab code Exa 14.6 Testing graph

```
clc;
clear;
s=['PS' 'x=0' 'x=1';
   'A' 'A' 'B';
   'B' 'C' 'D';
   'C' 'D' 'C';
   'D' 'B' 'A'];
q=[0 0;0 0;1 1;1 1];
n=max(size(s(:,1)));
l=1;
for i=2:n
    z=0;x=0;
    for j=i:n
```

```
14          if(q(i-1,1)==0 & q(i-1,2)==0  & i~=j & z==0)
15              p(l,1)=s(i,1);
16              p(l,2)=strcat([s(i,2) s(i,3)]);
17              p(l,3)='-';
18              l=l+1;z=z+1;
19          else
20              if(q(i-1,1)==1 & q(i-1,2)==1 & x==0)
21                  p(l,1)=s(i,1);
22                  p(l,2)='-';
23                  p(l,3)=strcat([s(i,2) s(i,3)]);
24                  l=l+1;x=x+1;
25              end
26          end
27      end
28  end
29  disp(['PS' 'z=0' 'z=1']);
30  disp(p);
31  disp(['AB'   '(AC)(AD)(BC)(BD)' '-';
32        'CD'   '-'  '(AC)(AD)(BC)(BD)']);
```

Scilab code Exa 16.7 Testing Table 2

```
1  clc;
2  clear;
3  s=['S' 'C1' 'SB1';
4      'B1' 'S' '-';
5      'C1' 'C2' '-';
6      'C2' '-' 'S'];
7  n=max(size(s(:,1)));
8  l=1;
9  for i=1:n
10     for j=i:n
11         if(i~=j)
12             p(l,1)=strcat([s(i,1) s(j,1)]);
13             if(s(i,2)=='-' | s(j,2)=='-')
```

```
14                  p(l,2)='-';
15              else
16                  p(l,2)=strcat([s(i,2) s(j,2)]);
17              end
18              if(s(i,3)=='-' | s(j,3)=='-')
19                  p(l,3)='-';
20              else
21                  p(l,3)=strcat([s(i,3) s(j,3)]);
22              end
23              l=l+1;
24          end
25      end
26  end
```

Chapter 15

Linear Sequential Machines

Scilab code Exa 15.3 Transfer function

```
clc;
clear;
T1=[1 2 1];
T2=[0 1 1];
n=max(size(T1));
a=n-1;
b=a;
T3=zeros(1,a+b+1);
for i=1:n
    b=n-1;
    for j=1:n
        T3(a+b+1)=T3(a+b+1)+(T1(i)*T2(j));
        b=b-1;
    end
    a=a-1;
end
m=max(size(T3));
i=1;
j=m;
while(i<=floor(m/2) & j>=(ceil(m/2)+1))
        t=T3(i);
```

```
22          T3(i)=modulo(T3(j),3);
23          T3(j)=modulo(t,3);
24          i=i+1;
25          j=j-1;
26  end
27  T3(ceil(m/2))=modulo(T3(ceil(m/2)),3);
28  disp("Top row of the below matrix is powers of the
       transfer function and bottom row is of
       coefficients of respective powers");
29  disp([4 3 2 1 0]);
30  disp(T3);
```

Scilab code Exa 15.4 Impulse response

```
1  clc;
2  clear;
3  T1=[1 0 1 1];
4  h=[1 1 0 1 0 0 0 0 0];
5  in=[1 0 1 1];
6  l=1;
7  for i=2:max(size(in(1,:)))
8      h1=h;
9      if(in(i)==1)
10         for k=1:i-1
11             t=h1(max(size(h1(1,:))));
12             for j=max(size(h1(1,:)))-1:-1:1
13                 h1(j+1)=h1(j);
14             end
15             h1(1)=t;
16         end
17         D(l,:)=h1(1,:);
18         l=l+1;
19     end
20 end
21 output=h+D(1,:)+D(2,:);
```

```
output=modulo(output,2);
disp(output);
```

Scilab code Exa 15.5 Null Sequence

```
clc;
clear;
//T=1+D+D^3 over GF(2)
//let X0 is the null sequence
//0=X0+DX0+D^3X0 since output of the null sequence is zero
//Adding X0 on both sides we get X0=DX0+D^3X0
nul=[0 0 1];
T=[0 1 0 1];
j=1;
for i=1:max(size(T));
    if(T(i)==1)
        s(1,j)=i-1;
        j=j+1;
    end
end
j=4;
for i=1:7
    nul(1,j)=nul(1,j-s(1))+nul(1,j-s(2));
    nul(1,j)=modulo(nul(1,j),2);
    j=j+1;
end
disp("Null Sequence for input 001 is ");
disp(nul);
```

Scilab code Exa 15.6 Null Sequence 2

```
clc;
```

```
clear;
//T=1+2D^2+D^3 over GF(3)
//let X0 is the null sequence
//0=X0+2D^2*X0+D^3*X0 since output of the null
   sequence is zero
//Adding X0 on both sides we get 2X0=2D^2*X0+D^3*X0
//X0=D^2*X0+2D^3*X0
nul=[1 1 1];
T=[0 0 1 2];
j=1;
for i=1:max(size(T));
    if(T(i)>=1)
        s(1,j)=i-1;
        j=j+1;
    end
end
j=4;
for i=1:15
    nul(1,j)=nul(1,j-s(1))+2*nul(1,j-s(2));
    nul(1,j)=modulo(nul(1,j),3);
    j=j+1;
end
disp("Null Sequence for input 001 is ");
disp(nul);
```

Scilab code Exa 15.10 Reducable

```
clc;
clear;
A=[0 1 1;
   1 0 0;
   1 0 0];
B=[1;1;0];
C=[1 1 0;
   1 1 1];
```

```
D=[0;1];
K=[C;C*A;C*(A*A)];
K=modulo(K,2);
disp("K matrix")
disp(K);
disp(rank(K),'since the rank of K is ');
disp("K is not further reducible");
//z=K * y;
```

Scilab code Exa 15.11 Linear Machine

```
clc;
clear;
A=[0 1 0;
   1 0 0;
   0 1 1];
B=[1;1;1];
C=[1 0 0];
D=[1];
K=[C;C*A;C*(A*A)];
disp(K);
disp(rank(K),'rank of K matrix is ');
disp("Since the rank is 2 K matrix can be reduced");
disp("As only  the first 2 rows are linearly
   independent therefore");
T=[1 0 0;0 1 0];
disp(T,'T =');
disp("In this case Q is");
Q=[1 0;0 1];
disp(Q);
Q_inv=inv(Q);
R=T';
//y_red=T*y;
A_red=T*A*R;
B_red=T*B;
```

```
24 C_red=C*R;
25 D_red=D;
```

Scilab code Exa 15.12 Linear Machine 2

```
1  clc;
2  clear;
3  A=[1  0  0  0;
4     0  0  1  1;
5     1  1  0  0;
6     1  0  1  0];
7  B=[1  0;
8     0  0;
9     1  1;
10    1  1];
11 C=[0  1  0  1;
12    1  1  1  0];
13 D=[1  0;
14    0  1];
15 K=[C;C*A;C*(A*A)];
16 K=modulo(K,2);
17 T=K(1:3,:);
18 Q=K(1:3,1:3);
19 Q_inv=inv(Q);
20 Q_inv=abs(modulo(Q_inv,2));
21 R=[Q_inv;[0 0 0]];
22 disp("Reduced matrix A is");
23 disp(A_red=T*A*R);
24 disp("Reduced matrix B is");
25 disp(B_red=T*B);
26 disp("Reduced matrix C is");
27 disp(C_red=C*R);
28 disp("Reduced matrix D is");
29 disp(D_red=D);
```

Scilab code Exa 15.15 Commutative ring

```
clc;
clear;
n=4;
for i=1:4
    for j=1:4
        p(i,j)=modulo(i+j-2,4);
    end
end
disp("modulo 4 Addition");
disp(p);
for i=1:4
    for j=1:4
        p(i,j)=modulo((i-1)*(j-1),4);
    end
end
disp("modulo 4 Multiplication");
disp(p);
```

Scilab code Exa 15.16 Identifying Whether the Ring is a Field Or not

```
clc;
clear;
n=4;
a=zeros(1,n);
for i=1:n
    for j=1:n
        pad(i,j)=modulo(i+j-2,4);
    end
end
for i=1:n
```

```
11      for j=1:n
12          pmu(i,j)=modulo((i-1)*(j-1),4);
13      end
14  end
15  t=0;
16  for i=1:n
17      for j=1:n
18          if(pad(i,j)==1)
19              t=1;
20              break;
21          end
22       end
23  end
24  if(t==0)
25      disp("Modulo 4 ring is not a field");
26  end
27  for i=0:3
28      for j=0:3
29          if(modulo(i*j,4)==1)
30              a(i)=1;
31          end
32      end
33  end
34  res=0;
35  for i=1:max(size(a))
36     if(a(i)==1)
37        res=res+1;
38      end
39  end
40  if(res==4)
41      disp("Modulo 4 ring is a field");
42  else
43      disp("Modulo 4 ring is not a field");
44  end
```

Scilab code Exa 15.17 Finite Field

```
clc;
clear;
n=3;
for i=1:n
    for j=1:n
        p(i,j)=modulo(i+j-2,3);
    end
end
disp("modulo 3 Addition");
disp(p);
for i=1:n
    for j=1:n
        p(i,j)=modulo((i-1)*(j-1),3);
    end
end
disp("modulo 3 Multiplication");
disp(p);
```

Chapter 16

Finite State Recognizers

Scilab code Exa 16.2 Prove the identity

```
1 clc;
2 clear;
3 disp("R1=  +1*(011)*(1*(011)*)*");
4 //from the identity  +RR*=R*  where R=1*(011)*
5 disp("R2=(1+011)*");
6 //from the identity (P+Q)*=(P*Q*)*
7 disp("R1=  +1*(011)*(1*(011)*)*");
8 disp("(1*(011)*)*");
9 disp("(1+011)*=R2");
```

Scilab code Exa 16.3 Prove the identity 2

```
1 clc;
2 clear;
3 disp("(1+00*1)+(1+00*1)(0+10*1)*(0+10*1)=0*1(0+10*1)
    *");
4 disp("(1+00*1)+(1+00*1)(0+10*1)*(0+10*1)");
5 //by taking (1+00*1) as common
```

```
6 disp("=(1+00*1)[    +(0+10*1)*(0+10*1)]");
7 disp("[(    +00*)1][    +(0+10*1)*(0+10*1)]");
8 //from the identity    +RR*=R*
9 disp("[0*1(0+10*1)*]");
```

Appendix

Scilab code AP 1 Kmap Solver with out Dontcares

```
function []=karmap(k)
    n=4;
    k(:,:,2)=zeros(n,n);
    var=['y' 'z' 'w' 'x'];
    //var=['w' 'x' 'y' 'z'];
    p1=['y''z''' 'y''z' 'yz' 'yz''''];
    p2=['w''x''';'w''x';'wx';'wx''''];
    cmn4=4;
    cmn2=2;
    temp=1;
    //16 cells
    for i=1:n
        for j=1:n
            if(k(i,j)~=1)
                temp=0;
                break;
             end
        end
    end
    if(temp==1)
        printf("1");
        abort;
    end
    //8 cells
    z1=ones(2,4);
    z2=ones(4,2);
```

```
27      temp1=['00' '01' '11' '10'];
28      temp2=temp1';
29      for i=1:n
30              if(i==4)
31                  t=1;
32              else
33                  t=i+1;
34              end
35              z=[k(i,:,1);k(t,:,1)];
36              if(z==z1)
37                  k(i,:,2)=[1 1 1 1];
38                  k(t,:,2)=[1 1 1 1];
39                  a=strsplit(temp2(i,1));
40                  b=strsplit(temp2(t,1));
41                  c=strcmp(a,b);
42                  for in=1:max(size(c))
43                      if(c(in)==0 & a(in)=='0')
44                          printf('%s''',var(in));
45                          disp("");
46                          break;
47                       else
48                           if(c(in)==0 & a(in)=='1')
49                              printf(var(in));
50                              disp("");
51                              break;
52                            end
53                       end
54                  end
55              end
56      end
57      for j=1:n
58          if(j==4)
59              t=1;
60          else
61              t=j+1;
62          end
63          z=[k(:,j,1) k(:,t,1)];
64          if(z==z2)
```

```
65              k(:,j,2)=[1;1;1;1];
66              k(:,t,2)=[1;1;1;1];
67              a=strsplit(temp1(1,j));
68              b=strsplit(temp1(1,t));
69              c=strcmp(a,b);
70              for in=1:max(size(c))
71                  if(c(in)==0 & a(in)=='0')
72                      printf('%s''',var(2+in));
73                      disp("");
74                      break;
75                   else
76                       if(c(in)==0 & a(in)=='1')
77                           printf(var(2+in));
78                           disp("");
79                           break;
80                       end
81                   end
82              end
83          end
84      end
85      //4 cells
86      z1=ones(1,4);
87      z2=ones(4,1);
88      z3=ones(2,2);
89      temp1=['00' '01' '11' '10'];
90      temp2=temp1';
91      for t=1:n
92              z=k(t,:,1);
93              no=number_of(k(t,:,2),1);
94              if(z==z1 & no<cmn4)
95                  k(t,:,2)=z1;
96                  a=strsplit(temp1(1,t));
97                  for in=1:max(size(a))
98                      if(a(in)=='0')
99                          printf('%s''',var(in));
100                     end
101                     if(a(in)=='1')
102                         printf(var(in));
```

```
103                     end
104                 end
105                 disp("");
106             end
107     end
108     for t=1:n
109         z=k(:,t,1);
110         no=number_of(k(:,t,2),1);
111         if(z==z2 & no<cmn4)
112             k(:,t,2)=z2;
113             a=strsplit(temp2(t,1));
114             for in=1:max(size(a))
115                 if(a(in)=='0')
116                     printf('%s''',var(2+in));
117                 end
118                 if(a(in)=='1')
119                     printf(var(2+in));
120                 end
121             end
122                 disp("");
123         end
124     end
125     for i=1:n
126         for j=1:n
127            if(i==n)
128                 t1=1;
129             else
130                 t1=i+1;
131             end
132            if(j==n)
133                 t2=1;
134             else
135                 t2=j+1;
136             end
137             z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2
                   ,1)];
138             z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2
                   ,2)];
```

```
139             no=number_of(z5,1);
140             if(z4==z3 & no<cmn4)
141                 k(i,j,2)=1;
142                 k(i,t2,2)=1;
143                 k(t1,j,2)=1;
144                 k(t1,t2,2)=1;
145                 a=strsplit(temp2(i,1));
146                 b=strsplit(temp2(t1,1));
147                 c=strcmp(a,b);
148                 for in=1:max(size(c))
149                     if(c(in)==0 & a(in)=='0')
150                         printf('%s'',var(in));
151                      end
152                      if(c(in)==0 & a(in)=='1')
153                          printf(var(in));
154                      end
155                  end
156                 a=strsplit(temp1(1,j));
157                 b=strsplit(temp1(1,t2));
158                 c=strcmp(a,b);
159                 for in=1:max(size(c))
160                     if(c(in)==0 & a(in)=='0')
161                         printf('%s'',var(2+in));
162                      end
163                      if(c(in)==0 & a(in)=='1')
164                          printf(var(2+in));
165                      end
166                  end
167                  disp("");
168             end
169         end
170     end
171     //2 cells
172     z6=[1 1];
173     z7=z6';
174     for i=1:n
175         for j=1:n
176             if(i==n)
```

```
177                 t1=1;
178              else
179                 t1=i+1;
180              end
181             if(j==n)
182                 t2=1;
183              else
184                 t2=j+1;
185              end
186              z8=[k(i,j,1) k(i,t2,1)];
187              z9=[k(i,j,2) k(i,t2,2)];
188              no1=number_of(z9,1);
189              if(z8==z6 & no1<cmn2 & i+j~=2)
190                k(i,j,2)=1;
191                k(i,t2,2)=1;
192                a=strsplit(temp1(1,j));
193                b=strsplit(temp1(1,t2));
194                c=strcmp(a,b);
195                  for in=1:max(size(c))
196                      if(c(in)==0 & a(in)=='0')
197                          printf(p1(1,i));
198                          printf('%s'',var(2+in));
199                          disp("");
200                       end
201                       if(c(in)==0 & a(in)=='1')
202                           printf(p1(1,i));
203                           printf(var(2+in));
204                           disp("");
205                       end
206                   end
207              end
208          end
209      end
210      for i=1:n
211          for j=1:n
212              if(i==n)
213                  t1=1;
214              else
```

```
                t1=i+1;
            end
           if(j==n)
                t2=1;
            else
                t2=j+1;
            end
            z10=[k(i,j,1);k(t1,j,1)];
            z11=[k(i,j,2);k(t1,j,2)];
            no2=number_of(z11,1);
            if(z10==z7 & no2<cmn2)
              k(i,j,2)=1;
              k(t1,j,2)=1;
              a=strsplit(temp2(i,1));
              b=strsplit(temp2(t1,1));
              c=strcmp(a,b);
                for in=1:max(size(c))
                    if(c(in)==0 & a(in)=='0')
                        printf(p2(j,1));
                        printf('%s'',var(in));
                        disp("");
                     end
                     if(c(in)==0 & a(in)=='1')
                         printf(p2(j,1));
                         printf(var(in));
                         disp("");
                     end
                 end
            end
        end
    end
    //single cell
    for i=1:n
        for j=1:n
            if(k(i,j,2)==0 & k(i,j,1)==1)
                a=strsplit(temp1(1,j));
                b=strsplit(temp2(i,1));
                for in=1:max(size(a(:,1)))
```

```
253                         if(a(in,1)=='1')
254                             printf(var(in+2));
255                         else
256                             if(a(in,1)=='0')
257                                 printf('%s'',var(2+in))
                                        ;
258                             end
259                          end
260                     end
261                     for in=1:max(size(b(:,1)))
262                         if(b(in,1)=='1')
263                             printf(var(in));
264                         else
265                             if(b(in,1)=='0')
266                                 printf('%s'',var(in));
267                             end
268                          end
269                     end
270                     if(i~=4 & j~=4)
271                         disp("");
272                     end
273                 end
274             end
275         end
276 endfunction
```

Scilab code AP 2 No.of

```
1  //finds the number of z's in the matrix A
2  function res=number_of(a,z)
3      res=0;
4      for i=1:max(size(a(:,1)))
5          for j=1:max(size(a(1,:)))
6              if(a(i,j)==z)
7                  res=res+1;
8              end
9          end
10     end
```

```
11 endfunction
```

Scilab code AP 3 Kmap Solver with out Dontcares

```
1  function []=karmap1(k)
2      n=4;
3      k(:,:,2)=zeros(n,n);
4      var=['y' 'z' 'w' 'x'];
5      p1=['y''z''' 'y''z' 'yz' 'yz''''];
6      p2=['w''x''';'w''x';'wx';'wx''''];
7      cmn4=1;
8      cmn2=1;
9      temp=1;
10     //16 cells
11     for i=1:n
12         for j=1:n
13             if(k(i,j)~=1)
14                 temp=0;
15                 break;
16              end
17         end
18     end
19     if(temp==1)
20         printf("1");
21         abort;
22     end
23     //8 cells
24     z1=ones(2,4);
25     z2=ones(4,2);
26     temp1=['00' '01' '11' '10'];
27     temp2=temp1';
28     for i=1:n
29             if(i==4)
30                 t=1;
31             else
32                 t=i+1;
33             end
34             z=[k(i,:,1);k(t,:,1)];
```

```
35              if(z==z1)
36                  k(i,:,2)=[1 1 1 1];
37                  k(t,:,2)=[1 1 1 1];
38                  a=strsplit(temp2(i,1));
39                  b=strsplit(temp2(t,1));
40                  c=strcmp(a,b);
41                  for in=1:max(size(c))
42                      if(c(in)==0 & a(in)=='0')
43                          printf('%s''',var(in));
44                          disp("");
45                          break;
46                       else
47                           if(c(in)==0 & a(in)=='1')
48                              printf(var(in));
49                              disp("");
50                              break;
51                            end
52                       end
53                  end
54              end
55      end
56      for j=1:n
57          if(j==4)
58              t=1;
59          else
60              t=j+1;
61          end
62          z=[k(:,j,1) k(:,t,1)];
63          if(z==z2)
64              k(:,j,2)=[1;1;1;1];
65              k(:,t,2)=[1;1;1;1];
66              a=strsplit(temp1(1,j));
67              b=strsplit(temp1(1,t));
68              c=strcmp(a,b);
69              for in=1:max(size(c))
70                  if(c(in)==0 & a(in)=='0')
71                      printf('%s''',var(2+in));
72                      disp("");
```

```
73                      break;
74                  else
75                      if(c(in)==0 & a(in)=='1')
76                          printf(var(2+in));
77                          disp("");
78                          break;
79                      end
80                  end
81              end
82          end
83      end
84      //4 cells
85      z1=ones(1,4);
86      z2=ones(4,1);
87      z3=ones(2,2);
88      temp1=['00' '01' '11' '10'];
89      temp2=temp1';
90      for t=1:n
91              z=k(t,:,1);
92              no=number_of(k(t,:,2),1);
93              if(z==z1 & no<cmn4)
94                  k(t,:,2)=z1;
95                  a=strsplit(temp1(1,t));
96                  for in=1:max(size(a))
97                      if(a(in)=='0')
98                          printf('%s''',var(in));
99                      end
100                     if(a(in)=='1')
101                         printf(var(in));
102                     end
103                 end
104                     disp("");
105             end
106     end
107     for t=1:n
108         z=k(:,t,1);
109         no=number_of(k(:,t,2),1);
110         if(z==z2 & no<cmn4)
```

```
111                 k(:,t,2)=z2;
112                 a=strsplit(temp2(t,1));
113                 for in=1:max(size(a))
114                     if(a(in)=='0')
115                         printf('%s''',var(2+in));
116                      end
117                      if(a(in)=='1')
118                          printf(var(2+in));
119                      end
120                 end
121                         disp("");
122             end
123         end
124         for i=1:n
125             for j=1:n
126                if(i==n)
127                     t1=1;
128                 else
129                     t1=i+1;
130                 end
131                if(j==n)
132                     t2=1;
133                 else
134                     t2=j+1;
135                 end
136                 z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2
                       ,1)];
137                 z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2
                       ,2)];
138                 no=number_of(z5,1);
139                 if(z4==z3 & no<cmn4)
140                     k(i,j,2)=1;
141                     k(i,t2,2)=1;
142                     k(t1,j,2)=1;
143                     k(t1,t2,2)=1;
144                     a=strsplit(temp2(i,1));
145                     b=strsplit(temp2(t1,1));
146                     c=strcmp(a,b);
```

```
147                 for in=1:max(size(c))
148                     if(c(in)==0 & a(in)=='0')
149                         printf('%s''',var(in));
150                      end
151                      if(c(in)==0 & a(in)=='1')
152                          printf(var(in));
153                      end
154                  end
155                 a=strsplit(temp1(1,j));
156                 b=strsplit(temp1(1,t2));
157                 c=strcmp(a,b);
158                 for in=1:max(size(c))
159                     if(c(in)==0 & a(in)=='0')
160                         printf('%s''',var(2+in));
161                      end
162                      if(c(in)==0 & a(in)=='1')
163                          printf(var(2+in));
164                      end
165                  end
166                     disp("");
167             end
168         end
169     end
170     //2 cells
171     z6=[1 1];
172     z7=z6';
173     for i=1:n
174         for j=1:n
175             if(i==n)
176                 t1=1;
177             else
178                 t1=i+1;
179             end
180            if(j==n)
181                 t2=1;
182             else
183                 t2=j+1;
184             end
```

```
185             z8=[k(i,j,1) k(i,t2,1)];
186             z9=[k(i,j,2) k(i,t2,2)];
187             no1=number_of(z9,1);
188             if(z8==z6 & no1<cmn2)
189               k(i,j,2)=1;
190               k(i,t2,2)=1;
191               a=strsplit(temp1(1,j));
192               b=strsplit(temp1(1,t2));
193               c=strcmp(a,b);
194                 for in=1:max(size(c))
195                     if(c(in)==0 & a(in)=='0')
196                         printf(p1(1,i));
197                         printf('%s'',var(2+in));
198                         disp("");
199                      end
200                      if(c(in)==0 & a(in)=='1')
201                          printf(p1(1,i));
202                          printf(var(2+in));
203                          disp("");
204                      end
205                  end
206             end
207         end
208     end
209     for i=1:n
210         for j=1:n
211             if(i==n)
212                 t1=1;
213             else
214                 t1=i+1;
215             end
216            if(j==n)
217                 t2=1;
218             else
219                 t2=j+1;
220             end
221             z10=[k(i,j,1);k(t1,j,1)];
222             z11=[k(i,j,2);k(t1,j,2)];
```

```
223             no2=number_of(z11);
224             if(z10==z7 & no2<cmn2)
225               k(i,j,2)=1;
226               k(t1,j,2)=1;
227               a=strsplit(temp2(i,1));
228               b=strsplit(temp2(t1,1));
229               c=strcmp(a,b);
230                 for in=1:max(size(c))
231                     if(c(in)==0 & a(in)=='0')
232                         printf(p2(j,1));
233                         printf('%s''',var(in));
234                         disp("");
235                      end
236                      if(c(in)==0 & a(in)=='1')
237                          printf(p2(j,1));
238                          printf(var(in));
239                          disp("");
240                      end
241                  end
242             end
243         end
244     end
245     //single cell
246     for i=1:n
247         for j=1:n
248             if(k(i,j,2)==0 & k(i,j,1)==1)
249                 a=strsplit(temp1(1,j));
250                 b=strsplit(temp2(i,1));
251                 for in=1:max(size(a(:,1)))
252                     if(a(in,1)=='1')
253                         printf(var(in+2));
254                     else
255                         if(a(in,1)=='0')
256                             printf('%s''',var(2+in))
                                    ;
257                         end
258                      end
259                 end
```

```
                    for in=1:max(size(b(:,1)))
                        if(b(in,1)=='1')
                            printf(var(in));
                        else
                            if(b(in,1)=='0')
                                printf('%s'',var(in));
                            end
                         end
                    end
                    if(i~=4 & j~=4)
                        disp("");
                    end
                end
            end
        end
endfunction
```

Scilab code AP 4 No.of 3d matrix

```
//finds the number of z's in the 3 dimensional
   matrix A
function res=noof3(a,z)
    res=0;
    for i=1:max(size(a(:,1,1)))
        for j=1:max(size(a(1,:,1)))
            for l=1:2
                if(a(i,j,l)==z)
                    res=res+1;
                end
            end
        end
    end
endfunction
```

Scilab code AP 5 Check

```
function out= check(a,b,c,d)
    for i=1:max(size(a));
```

```
3           if(a(i,1)==b(i,1) & b(i,1)==c(i,1) & c(i,1)
               ==d(i,1))
4               out(i)=0;
5           else
6               out(i)=1;
7           end
8       end
9   endfunction
```

Scilab code AP 6 Decimal to Base 2 Converter

```
1   //dec21bin is a function whcih converts any decimal
       number given to it will output its equivalent
       binary number
2   //pass the decimal number as an argument to the
       function
3   // For eg:dec21bin(10)
4   //Will give an output of 1010
5
6   function [temp]=dec21bin(dec)
7       temp2=floor(dec);
                                              //separating
           integer part from the given number
8       temp4=modulo(dec,1);
                                            //separating
           decimal part from the given number
9
10      format('v',18);
                                                //changing
           the default precision to 18
11
12      i=1;p=0;x=1;
                                                        //flag
            bits
13
14      while(temp2>0)
           //storing each integer digit in vector for
           convenience
```

```
15          p(i)=(modulo(floor(temp2),2))
16          temp2=floor(temp2)/2;
17          i=i+1;
18      end
19
20      temp2=0;
          //clearing the temporary variable 'temp2'
21
22      for j=1:length(p)
          //multipliying the bits of integer part with
          their position values and adding
23          temp2=temp2+(p(j)*10^(j-1));
24      end
25
26      while(temp4~=0)
                                                //storing
          each integer digit in vector for convenience
27          temp4=temp4*2;
28          d(x)=floor(temp4);
29          x=x+1;
30          temp4=modulo(temp4,1);
31      end
32
33      temp5=0;
          //clearing the temporary variable 'temp2'
34
35      for j=1:x-1                                  //
          multipliying the bits of decimal part with
          their position values and adding
36          temp5=temp5+(10^(-1*j)*d(j))
37      end
38
39      temp=temp2+temp5;
                                                      //
          finally adding both the integer and decimal
          parts to get total output.
40  endfunction
```

Scilab code AP 7 Kmap with dont cares

```
function []=donkmap(k,l)
    n=4;          //four variable kmap
    k(:,:,2)=zeros(n,n);      //temporary matrix to
       know whether a element is paired or not
    //declaring notations to display output
    var=['y' 'z' 'w' 'x'];
    p1=['y''z''' 'y''z' 'yz' 'yz''''];
    p2=['w''x''';'w''x';'wx';'wx'''];
    //minimum redundant elements accepted while
       pairing
    cmn4=4;
    cmn2=2;
    temp=1;
    printf('f');
    printf('%1d',l);
    printf("=");
    //16 cells
    for i=1:n
        for j=1:n
            if(k(i,j)~=1 | k(i,j)~=2)
                temp=0;
                break;
             end
        end
    end
    if(temp==1)
        printf("1");
        abort;
    end
    //8 cells
    z1=ones(2,4);
    z2=ones(4,2);
    temp1=['00' '01' '11' '10'];
    temp2=temp1';
    for i=1:n
            if(i==4)
```

```
35                  t=1;
36              else
37                  t=i+1;
38              end
39              z=[k(i,:,1);k(t,:,1)];
40              if(number_of(z,0)==0 & number_of(z,1)>1)
41                  k(i,:,2)=[1 1 1 1];
42                  k(t,:,2)=[1 1 1 1];
43                  a=strsplit(temp2(i,1));
44                  b=strsplit(temp2(t,1));
45                  c=strcmp(a,b);
46                  for in=1:max(size(c))
47                      if(c(in)==0 & a(in)=='0')
48                          printf('%s'',var(in));
49                          printf('+');
50                          break;
51                       else
52                           if(c(in)==0 & a(in)=='1')
53                              printf(var(in));
54                              printf('+');
55                              break;
56                            end
57                       end
58                  end
59              end
60      end
61      for j=1:n
62          if(j==4)
63              t=1;
64          else
65              t=j+1;
66          end
67          z=[k(:,j,1) k(:,t,1)];
68          if(number_of(z,0)==0 & number_of(z,1)>0)
69              k(:,j,2)=[1;1;1;1];
70              k(:,t,2)=[1;1;1;1];
71              a=strsplit(temp1(1,j));
72              b=strsplit(temp1(1,t));
```

```
73              c=strcmp(a,b);
74              for in=1:max(size(c))
75                  if(c(in)==0 & a(in)=='0')
76                      printf('%s''',var(2+in));
77                      printf('+');
78                      break;
79                   else
80                       if(c(in)==0 & a(in)=='1')
81                           printf(var(2+in));
82                           printf('+');
83                           break;
84                       end
85                   end
86              end
87          end
88      end
89      //4 cells
90      z1=ones(1,4);
91      z2=ones(4,1);
92      z3=ones(2,2);
93      temp1=['00' '01' '11' '10'];
94      temp2=temp1';
95      for t=1:n
96              z=k(t,:,1);
97              no=number_of(k(t,:,2),1);
98              if(number_of(z,0)==0 & no<cmn4 &
                   number_of(z,1)>0)
99                  k(t,:,2)=z1;
100                 a=strsplit(temp1(1,t));
101                 for in=1:max(size(a))
102                     if(a(in)=='0')
103                         printf('%s''',var(in));
104                     end
105                     if(a(in)=='1')
106                         printf(var(in));
107                     end
108                 end
109                 printf("+");
```

```
110                 end
111         end
112         for t=1:n
113             z=k(:,t,1);
114             no=number_of(k(:,t,2),1);
115             if(number_of(z,0)==0 & no<cmn4 & number_of(z
                    ,1)>0)
116                 k(:,t,2)=z2;
117                 a=strsplit(temp2(t,1));
118                 for in=1:max(size(a))
119                     if(a(in)=='0')
120                         printf('%s'',var(2+in));
121                     end
122                     if(a(in)=='1')
123                         printf(var(2+in));
124                     end
125                 end
126                     printf("+");
127             end
128         end
129         for i=1:n
130             for j=1:n
131                 if(i==n)
132                     t1=1;
133                 else
134                     t1=i+1;
135                 end
136                 if(j==n)
137                     t2=1;
138                 else
139                     t2=j+1;
140                 end
141                 z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2
                        ,1)];
142                 z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2
                        ,2)];
143                 no=number_of(z5,1);
```

```
144             if(number_of(z4,0)==0 & no<cmn4 &
                   number_of(z4,1)>0)
145                 k(i,j,2)=1;
146                 k(i,t2,2)=1;
147                 k(t1,j,2)=1;
148                 k(t1,t2,2)=1;
149                 a=strsplit(temp2(i,1));
150                 b=strsplit(temp2(t1,1));
151                 c=strcmp(a,b);
152                 for in=1:max(size(c))
153                     if(c(in)==0 & a(in)=='0')
154                         printf('%s'',var(in));
155                      end
156                      if(c(in)==0 & a(in)=='1')
157                          printf(var(in));
158                      end
159                  end
160                 a=strsplit(temp1(1,j));
161                 b=strsplit(temp1(1,t2));
162                 c=strcmp(a,b);
163                 for in=1:max(size(c))
164                     if(c(in)==0 & a(in)=='0')
165                         printf('%s'',var(2+in));
166                      end
167                      if(c(in)==0 & a(in)=='1')
168                          printf(var(2+in));
169                      end
170                  end
171                  printf("+");
172             end
173         end
174     end
175     //2 cells
176     z6=[1 1];
177     z7=z6';
178     for i=1:n
179         for j=1:n
180             if(i==n)
```

```
181                 t1=1;
182              else
183                 t1=i+1;
184              end
185             if(j==n)
186                 t2=1;
187              else
188                 t2=j+1;
189              end
190              z8=[k(i,j,1) k(i,t2,1)];
191              z9=[k(i,j,2) k(i,t2,2)];
192              no1=number_of(z9,1);
193              if(number_of(z8,0)==0 & no1<cmn2 &
                    number_of(z8,1)>0)
194                k(i,j,2)=1;
195                k(i,t2,2)=1;
196                a=strsplit(temp1(1,j));
197                b=strsplit(temp1(1,t2));
198                c=strcmp(a,b);
199                  for in=1:max(size(c))
200                      if(c(in)==0 & a(in)=='0')
201                          printf(p1(1,i));
202                          printf('%s''',var(2+in));
203                          printf("+");
204                       end
205                       if(c(in)==0 & a(in)=='1')
206                           printf(p1(1,i));
207                           printf(var(2+in));
208                           printf("+");
209                       end
210                   end
211              end
212          end
213      end
214      for i=1:n
215          for j=1:n
216              if(i==n)
217                  t1=1;
```

```
218                 else
219                     t1=i+1;
220                 end
221                if(j==n)
222                     t2=1;
223                 else
224                     t2=j+1;
225                 end
226                 z10=[k(i,j,1);k(t1,j,1)];
227                 z11=[k(i,j,2);k(t1,j,2)];
228                 no2=number_of(z11,1);
229                 if(number_of(z10,0)==0 & no2<cmn2 &
                       number_of(z10,1)>0)
230                   k(i,j,2)=1;
231                   k(t1,j,2)=1;
232                   a=strsplit(temp2(i,1));
233                   b=strsplit(temp2(t1,1));
234                   c=strcmp(a,b);
235                     for in=1:max(size(c))
236                         if(c(in)==0 & a(in)=='0')
237                             printf(p2(j,1));
238                             printf('%s'',var(in));
239                             printf("+");
240                          end
241                          if(c(in)==0 & a(in)=='1')
242                              printf(p2(j,1));
243                              printf(var(in));
244                              printf("+");
245                          end
246                      end
247                 end
248             end
249         end
250         //single cell
251         for i=1:n
252             for j=1:n
253                 if(k(i,j,2)==0 & k(i,j,1)==1)
254                     a=strsplit(temp1(1,j));
```

```
255                     b=strsplit(temp2(i,1));
256                     for in=1:max(size(a(:,1)))
257                         if(a(in,1)=='1')
258                             printf(var(in+2));
259                         else
260                             if(a(in,1)=='0')
261                                 printf('%s'',var(2+in))
                                        ;
262                             end
263                          end
264                     end
265                     for in=1:max(size(b(:,1)))
266                         if(b(in,1)=='1')
267                             printf(var(in));
268                         else
269                             if(b(in,1)=='0')
270                                 printf('%s'',var(in));
271                             end
272                          end
273                     end
274                     if(i~=4 & j~=4)
275                         printf("+");
276                     end
277                 end
278             end
279         end
280         printf("0");
281         disp(" ")
282     endfunction
```

Scilab code AP 8 Kmap for 3 variables with out dontcares

```
1  function []=karmap3(k)
2      n=4;          //three variable kmap
3      m=2
4      k(:,:,2)=zeros(m,n);
5      var=['z' 'x' 'y'];
6      p1=['z'' 'z'];
```

```
7       p2=['x''y''';'x''y';'xy';'xy'''];
8       cmn4=4;
9       cmn2=3;
10      temp=1;
11      printf('The minimal ecpression of the given Kmap
            ');
12      disp(k(:,:,1));
13      disp("is :");
14      printf('f');
15      printf("=");
16      //8 cells
17      for i=1:m
18          for j=1:n
19              if(k(i,j)~=1 & k(i,j)~=2)
20                  temp=0;
21                  break;
22               end
23          end
24      end
25      if(temp==1)
26          printf("1");
27          abort;
28      end
29      //4 cells
30      z1=ones(1,4);
31      z2=ones(4,1);
32      z3=ones(2,2);
33      temp1=['0' '1'];
34      temp2=['00';'01';'11';'10'];
35      for t=1:m
36              z=k(t,:,1);
37              no=number_of(k(t,:,2),1);
38              if(number_of(z,0)==0 & no<cmn4 &
                   number_of(z,1)>0)
39                  k(t,:,2)=z1;
40                  a=strsplit(temp1(1,t));
41                  for in=1:max(size(a))
42                      if(a(in)=='0')
```

```
43                          printf('%s''',var(in));
44                      end
45                      if(a(in)=='1')
46                          printf(var(in));
47                      end
48                  end
49                  printf("+");
50              end
51      end
52      for i=1:m-1
53          for j=1:n
54             t1=i+1;
55             if(j==n)
56                  t2=1;
57              else
58                  t2=j+1;
59              end
60              z4=[k(i,j,1) k(i,t2,1);k(t1,j,1) k(t1,t2
                   ,1)];
61              z5=[k(i,j,2) k(i,t2,2);k(t1,j,2) k(t1,t2
                   ,2)];
62              no=number_of(z5);
63              if(number_of(z4,0)==0 & no<cmn4 &
                   number_of(z4,1)>0)
64                  k(i,j,2)=1;
65                  k(i,t2,2)=1;
66                  k(t1,j,2)=1;
67                  k(t1,t2,2)=1;
68                  a=strsplit(temp2(j,1));
69                  b=strsplit(temp2(t2,1));
70                  c=strcmp(a,b);
71                  for in=1:max(size(c))
72                      if(c(in)==0 & a(in)=='0')
73                          printf('%s''',var(1+in));
74                      end
75                      if(c(in)==0 & a(in)=='1')
76                          printf(var(1+in));
77                      end
```

```
78                  end
79                  printf("+");
80              end
81          end
82      end
83      //2 cells
84      z6=[1 1];
85      z7=z6';
86      for i=1:m
87          for j=1:n
88                  t1=i+1;
89                  if(j==n)
90                      t2=1;
91                  else
92                      t2=j+1;
93                  end
94              z8=[k(i,j,1) k(i,t2,1)];
95              z9=[k(i,j,2) k(i,t2,2)];
96              no1=number_of(z9,1);
97              if(number_of(z8,0)==0 & no1<cmn2 &
                   number_of(z8,1)>0)
98                k(i,j,2)=1;
99                k(i,t2,2)=1;
100               printf(p1(1,i));
101               a=strsplit(temp2(j,1));
102               b=strsplit(temp2(t2,1));
103               c=strcmp(a,b);
104                 for in=1:max(size(c))
105                     if(c(in)==0 & a(in)=='0')
106                         printf('%s'',var(1+in));
107                         printf("+");
108                     end
109                     if(c(in)==0 & a(in)=='1')
110                         printf(var(1+in));
111                         printf("+");
112                     end
113                 end
114             end
```

```
115          end
116      end
117      for i=1:m-1
118          for j=1:n
119             t1=i+1;
120             if(j==n)
121                  t2=1;
122              else
123                  t2=j+1;
124              end
125              z10=[k(i,j,1);k(t1,j,1)];
126              z11=[k(i,j,2);k(t1,j,2)];
127              no2=number_of(z11,1);
128              if(number_of(z10,0)==0 & no2<cmn2 &
                    number_of(z10,1)>0)
129                k(i,j,2)=1;
130                k(t1,j,2)=1;
131                printf(p2(j,1));
132                printf("+");
133              end
134          end
135      end
136      //single cell
137      for i=1:m
138          for j=1:n
139              if(k(i,j,2)==0 & k(i,j,1)==1)
140                  printf(p1(1,i));
141                  printf(p2(j,1));
142                  printf("+");
143              end
144          end
145      end
146      printf("0");
147      disp(" ")
148  endfunction
```

Scilab code AP 9 Binary to Decimal convertor

```
1  //bin21dec is a function whcih converts any binary
       number given to it will output its equivalent
       decimal number
2  //pass the binary number as an argument to the
       function
3  // For eg:bin21decimal(1010)
4  //Will give an output of 10
5
6  function [temp]=bin21dec(bin)
7      i=1;w=1;
8
9      temp1=floor(bin);
                                          //separating
         integer part from the given number
10     temp2=modulo(bin,1);
                                        //separating
         decimal part from the given number
11     temp2=temp2*10^3;
                                          //converting
         decimal value to interger for convenience
12
13     while(temp1>0)
         //storing each integer digit in vector for
         convenience
14         p(i)=modulo(temp1,10);
15         temp1=floor(temp1/10);
16         i=i+1;
17     end
18
19     while(temp2>0)
         //storing each integer digit in vector for
         convenience
20         q(w)=modulo(temp2,2);
21         temp2=(temp2/10);
22         temp2=floor(temp2);
23         w=w+1;
24     end
25
```

```
26      temp1=0;
          //clearing the temporary variable 'temp2'
27
28      for i=1:length(p)
          //checking whether it is binary or not.
29          if(p(i)>1) then
30              disp('not a binary number');
31              abort;
32          end
33      end
34
35      for i=1:length(p)
          //multipliying the bits of integer part with
          their position values and adding
36          temp1=temp1+(p(i)*2^(i-1));
37      end
38
39      temp2=0;
          //clearing the temporary variable 'temp2'
40
41      for z=1:w-1
          //multipliying the bits of decimal part with
          their position values and adding
42          temp2=temp2+(q(z)*2^(-1*(4-z)));
43      end
44
45      temp=temp1+temp2;
          //finally adding both the integer and decimal
           parts to get total output.
46  endfunction
```