CSE 370 Fall 99
Solution for Assignment 3
10/18/99

2.

Leap	A	B	C	D	**28**	**29**	**30**	**31**
-	0	0	0	0	**X**	**X**	**X**	**X**
-	0	0	0	1	**0**	**0**	**0**	**1**
0	0	0	1	0	**1**	**0**	**0**	**0**
1	0	0	1	0	**0**	**1**	**0**	**0**
-	0	0	1	1	**0**	**0**	**0**	**1**
-	0	1	0	0	**0**	**0**	**1**	**0**
-	0	1	0	1	**0**	**0**	**0**	**1**
-	0	1	1	0	**0**	**0**	**1**	**0**
-	0	1	1	1	**0**	**0**	**0**	**1**
-	1	0	0	0	**0**	**0**	**0**	**1**
-	1	0	0	1	**0**	**0**	**1**	**0**
-	1	0	1	0	**0**	**0**	**0**	**1**
-	1	0	1	1	**0**	**0**	**1**	**0**
-	1	1	0	0	**0**	**0**	**0**	**1**
-	1	1	0	1	**X**	**X**	**X**	**X**
-	1	1	1	0	**X**	**X**	**X**	**X**
-	1	1	1	1	**X**	**X**	**X**	**X**

a)

$28(leap,a,b,c,d)=m2+\Sigma d(0,13,14,15,16,29,30,31)$
$29(leap,a,b,c,d)=m18+\Sigma d(0,13,14,15,16,29,30,31)$
$30(a,b,c,d)=\Sigma m(4,6,9,11)+\Sigma d(0,13,14,15)$
$31(a,b,c,d)=\Sigma m(1,3,5,7,8,10,12)+\Sigma d(0,13,14,15)$

b)

Reading from the schematic

$28=(leap)'a'b'cd'=m2$
which trivially matches with a) by putting all the don't-cares to `0'
$29=(leap)a'b'cd'=m18$
ditto
$31= a \text{ XOR } d = a'd+ad' = (a'd+ad')(b'c'+b'c+bc'+bc)$
$=(a'b'c'd+a'b'cd+a'bc'd+a'bcd+ab'c'd'+ab'cd'+abc'd'+abcd')$
$= \Sigma m(1,3,5,7,8,10,12,14)$
which is same as 31 above if *only* d14 is taken as `1' (so add a term m14) and rest as `0'.
$30= (a \text{ XOR } d)'(a'b'cd')' = (a'd+ad')'(a'b'cd')'$

<u>solution 1</u>
$a \text{ XOR } d = \Sigma m(1,3,5,7,8,10,12,14)$
so $(a \text{ XOR } d)' = \Sigma m(0,2,4,6,9,11,13,15)$

(all the terms NOT present on the previous line)

similarly (a'b'cd')'= Σm(0,1,3,4,5,6,7,8,9,10,11,12,13,14,15)

so their AND will have only THOSE minterms which are common (why ??)

so as implemented

30(a,b,c,d)=Σm(0,4,6,9,11,13,15)

which is same as a) if we let d(0,13,15) =1.

solution 2

basically similar as above

X' and Y' = [(X' and Y')']' = (X + Y)'

So putting X as "a XOR d" and Y as "a'b'cd'"

30(a,b,c,d)= NOT(a'b'cd'+a XOR d) = NOT[m2+Σm(1,3,5,7,8,10,12,14)]

= NOT(Σm(1,2,3,5,7,8,10,12,14)) = Σm(0,4,6,9,11,13,15)

which is same as above in *solution 1*

3.

R0	R1	C0	C1	**S0**	**S1**
0	0	0	0	**0**	**0**
0	0	0	1	**0**	**0**
0	0	1	0	**0**	**0**
0	0	1	1	**0**	**0**
0	1	0	0	**0**	**0**
0	1	0	1	**1**	**1**
0	1	1	0	**0**	**1**
0	1	1	1	**1**	**0**
1	0	0	0	**1**	**1**
1	0	0	1	**0**	**0**
1	0	1	0	**1**	**0**
1	0	1	1	**0**	**1**
1	1	0	0	**1**	**1**
1	1	0	1	**1**	**1**
1	1	1	0	**1**	**1**
1	1	1	1	**1**	**1**

S0 = Σm(5,7,8,10,12,13,14,15)

= ΠM(0,1,2,3,4,6,9,11)

S1 = Σm(5,6,8,11,12,13,14,15)

= ΠM(0,1,2,3,4,7,9,10)

b)

S0= Σm(5,7,13,15)+Σm(8,10,12,14)

$= \Sigma m(-1-1)+\Sigma m(1--0)$ (using the Unifying Theorem)
$= R1C1+R0C1'$

$S1= \Sigma m(5,13)+\Sigma m(6,14)+\Sigma m(8,12)+\Sigma m(11,15)$
$= \Sigma m(-101)+\Sigma m(-110)+\Sigma m(1-00)+\Sigma m(1-11)$ (using the Unifying Theorem)
$= R1C0'C1+R1C0C1'+R0C0'C1'+R0C0C1$
$= R1(C0'C1+C0C1') + R0(C0'C1+C0C1)$
$= R1(C0 \text{ xor } C1) + R0(C0 \text{ xor } C1)'$ (*optional*)

4.

a) $f(X,Y)=XY+XY'$
$=X(Y+Y')$
$=X*1$
$=X$

b) $f(X,Y)=(X+Y)(X+Y')$
$=XX+XY'+YX+YY'$
$=X+XY'+XY+0$
$=X+X(Y+Y')$
$=X+X$
$=X$

c) $f(X,Y,Z)=YZ'+X'YZ+XYZ$
$=YZ'+YZ(X+X')$
$=YZ'+YZ$
$=Y(Z+Z')$
$=Y$

d) $f(X,Y,Z)=(X+Y)(X'+Y+Z)(X'+Y+Z')$

Let $A=X'+Y$. Now,
$(X'+Y+Z)(X'+Y+Z') = (A+Z)(A+Z')$
$=AA+AZ'+ZA+ZZ'$
$=A+A(Z+Z')+0$
$=A+A$
$=A$

So
$F(X,Y,Z)=(X+Y)A$
$=(X+Y)(X'+Y)$
$=XX'+XY+YX'+YY$
$=0+Y(X+X')+Y$
$=Y+Y$
$=Y$

e) $f(X,Y,Z,W)=X+XYZ+X'YZ+X'Y+WX+W'X$

$=X(1+YZ)+X'Y(Z+1)+X(W+W')$
$=X+X'Y+X$
$=X+XY+X'Y+X$
$=X+X+Y(X+X')$
$=X+Y$

5.

a)$\Sigma m(0,1,2,7,8,9,10,15)=$
$=A'B'C'D'+A'B'C'D+A'B'CD'+A'BCD+AB'C'D'+AB'C'D+AB'CD'+ABCD$

b)$\Pi M(3,4,5,6,11,12,13,14)=$
$=(A+B+C'+D')(A+B'+C+D)(A+B'+C+D')(A+B'+C'+D)$
$(A'+B+C'+D')(A'+B'+C+D)(A'+B'+C+D')(A'+B'+C'+D)$

c)$f'=\Sigma m(3,4,5,6,11,12,13,14)$
$=A'B'CD+A'BC'D'+A'BC'D+A'BCD'+AB'CD+ABC'D'+ABC'D+ABCD'$

d)$f'=\Pi M(0,1,2,7,8,9,10,15)$
$=(A+B+C+D)(A+B+C+D')(A+B+C'+D)(A+B'+C'+D')$
$(A'+B+C+D)(A'+B+C+D')(A'+B+C'+D)(A'+B'+C'+D')$