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CSC 28 - Section 05

Real Number Representation:

1) Represent the number 263.3 in 32-bit floating point representation.

0 10000111 00000111010011001100110

2) Represent the number -17.625 in 32-bit floating point representation.

1 10000011 00011010000000000000000

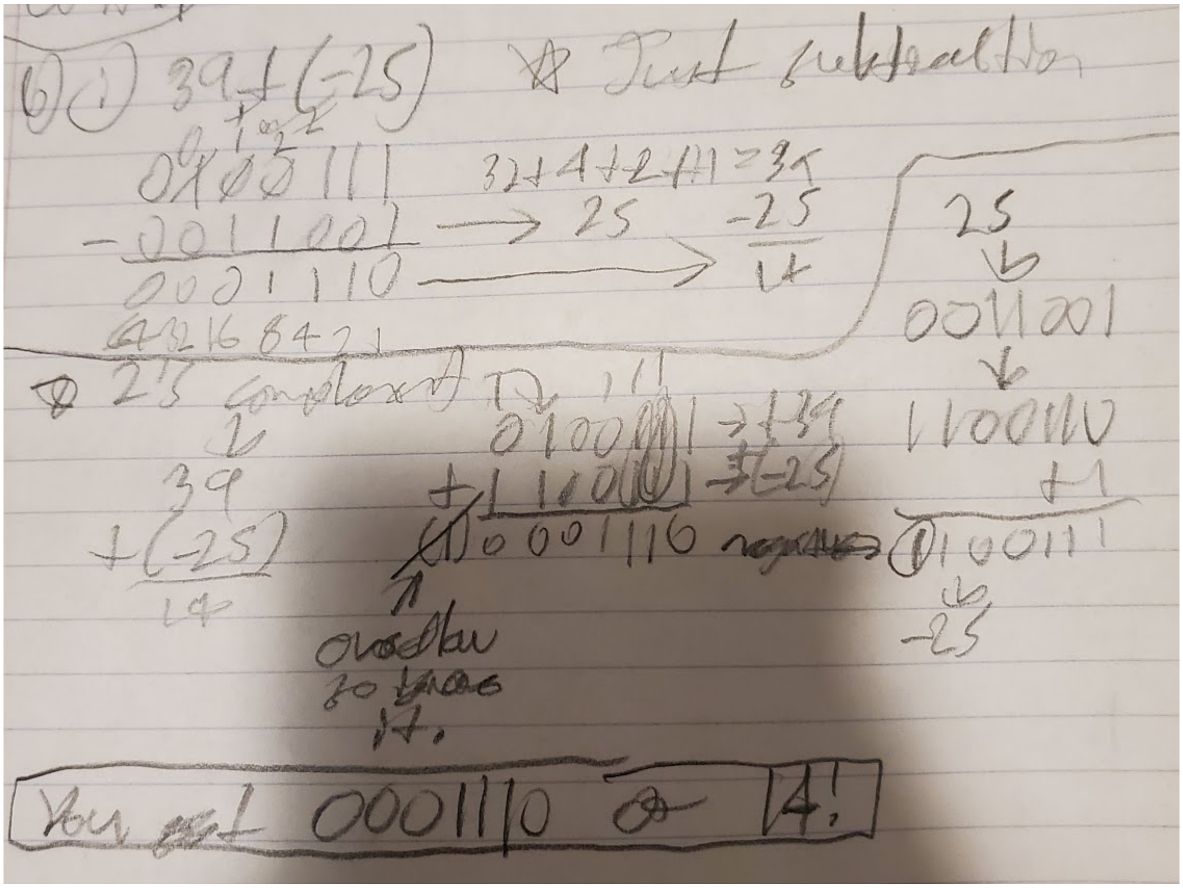
3) (a) Using the 2's complement method, express the following negative numbers in binary (use 5-bit binary system) -7, -12.

-7 = 01001

-12 = 10100

(b) Using the 2's complement method, find the value of the following:

(i) 39 + (-25)


(b)(i) 39 + (-25) ☆ Just subtraction

0100111 → 32+4+2+1=39
-0011001 → 25 → -25
0001110 → 14
64 32 16 8 4 2 1

☆ 2's complement

39
+(-25)
14

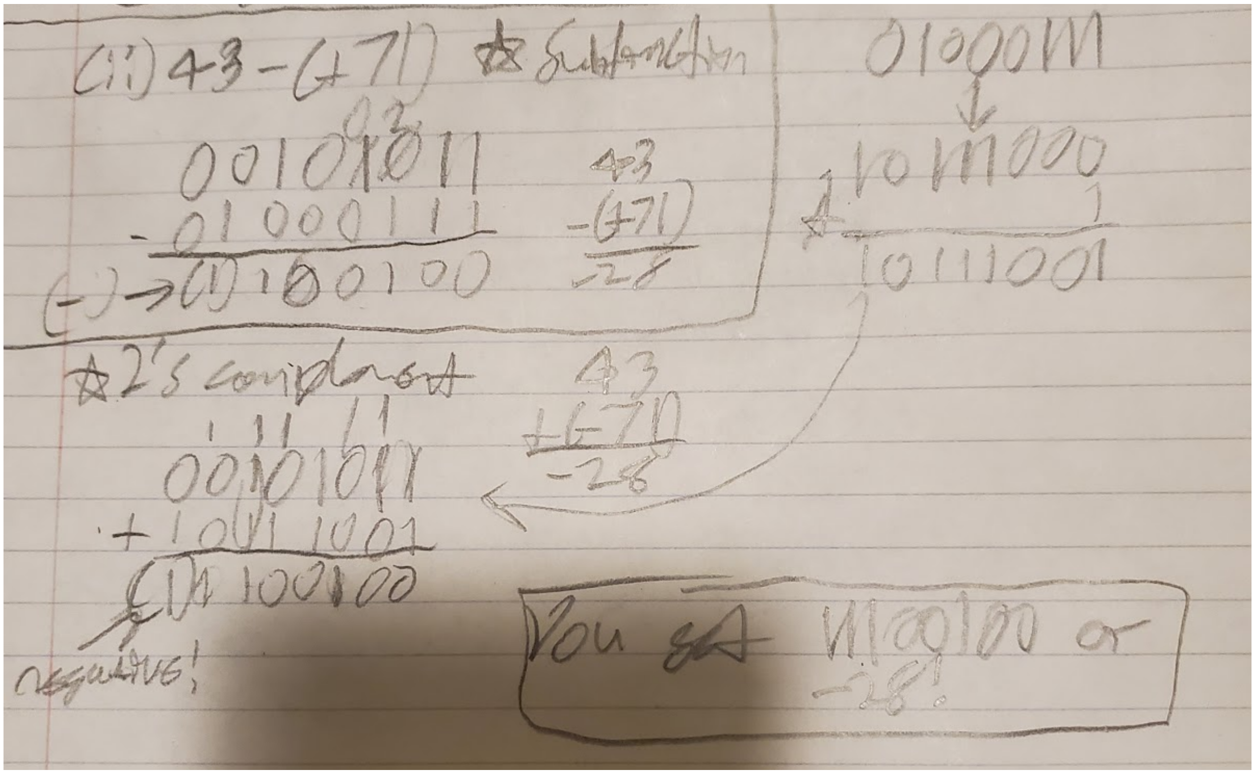
0100111 → +39
+1100111 → (-25)
(1)0001110

overflow so ignore it.

25 → 0011001 → 1100110 +1 → 1100111 → -25

You get 0001110 or 14!

(ii) 43 - (+71)



*I meant 11100100 or -28. I don't know how well you can see that.

Boolean Algebra, Logic Gates, Karnaugh Maps:

4) Simplify the following Boolean Expression using Boolean laws:

$$F_1 = A.B.C + \bar{A} + A.\bar{B}.C$$

$$F_2 = \bar{A}.\bar{B}.\bar{C} + \bar{A}.\bar{B}.C + \bar{A}.\bar{C}$$

$$F_3 = (A.\bar{B}.(C + B.D) + \bar{A}.\bar{B}).C$$

(mention which laws you are using in which step)

$F_1 = A\cdot B\cdot C + \overline{A} + A\cdot \overline{B}\cdot C \leftarrow$ Distributive law $A(B+C) = AB+AC$

$F_1 = A\cdot C(B+\overline{B}) + \overline{A} \leftarrow$ Addition Identity law $(A+\overline{A}=1)$

$F_1 = A\cdot C(1) + \overline{A} \leftarrow$ Multiplication Identity Law $A\cdot 1 = A$

$F_1 = A\cdot C + \overline{A} \leftarrow A+\overline{A}\cdot B = A+B$

$\boxed{F_1 = \overline{A} + C}$

$F_2 = \overline{A}\cdot\overline{B}\cdot\overline{C} + \overline{A}\cdot\overline{B}\cdot C + A\cdot\overline{C} \leftarrow$ Distributive law $AB+AC = A(B+C)$

$F_2 = \overline{A}\cdot\overline{B}(\overline{C}+C) + A\cdot\overline{C} \leftarrow$ Addition Identity Law $(A+\overline{A}=1)$

$F_2 = \overline{A}\cdot\overline{B}(1) + \overline{A}\cdot\overline{C} \leftarrow$ Multiplication Identity Law $(A\cdot 1=A)$

$F_2 = \overline{A}\cdot\overline{B} + \overline{A}\cdot\overline{C} \leftarrow$ Distributive Law $AB+AC = A(B+C)$

$F_2 = \overline{A}(\overline{B}+\overline{C}) \leftarrow$ De Morgan's Law $\overline{U\cdot V} = \overline{U}+\overline{V}$

$F_2 = \overline{A}(\overline{BC}) \leftarrow$ De Morgan's Law $\overline{(U+V)} = \overline{U}\cdot\overline{V}$

$\boxed{F_2 = \overline{A+BC}}$

$F_3 = (A\cdot\bar{B}(C + B\cdot D) + \bar{A}\cdot\bar{B})C \leftarrow$ Distributive Law $A(B+C) = AB+AC$

$F_3 = (A\cdot\bar{B}\cdot C + A\cdot\bar{B}\cdot B\cdot D + \bar{A}\cdot\bar{B})C \leftarrow$ Multiplication Identity Law $(A\cdot\bar{A}=0)$

$F_3 = (A\cdot\bar{B}C + A\cdot 0\cdot D + \bar{A}\cdot\bar{B})C \leftarrow$ Multiplication identity law $(A\cdot 0=0)$

$F_3 = (A\cdot\bar{B}\cdot C + 0 + \bar{A}\cdot\bar{B})C \leftarrow$ Addition Identity Law $(A+0=A)$

$F_3 = (A\cdot\bar{B}\cdot C + \bar{A}\cdot\bar{B})C \leftarrow$ Distributive Law $A(B+C)=AB+AC$

$F_3 = A\cdot\bar{B}\cdot C\cdot C + \bar{A}\cdot\bar{B}\cdot C \leftarrow$ Multiplication Identity law $(A\cdot A=A)$

$F_3 = A\cdot\bar{B}\cdot C + \bar{A}\cdot\bar{B}\cdot C \leftarrow$ Distributive Law $A(B+C)=AB+AC$

$F_3 = (A+\bar{A})\bar{B}\cdot C \leftarrow$ Addition Identity law $(A+\bar{A}=1)$

$F_3 = (1)\bar{B}\cdot C \leftarrow$ Multiplication Identity law $(A\cdot 1=A)$

$\boxed{F_3 = \bar{B}\cdot C}$

5) Given the Boolean function:

$$F = AB'C + A'B'C + D'AB + DA'B + DAB$$

find the following:

(a) Obtain the truth table of the function.

$F = AB'C + A'B'C + D'AB + DA'B + DAB \quad + = \text{or} \quad * = \text{And}$ (a)

A	B	C	D	A'	B'	D'	AB'C	A'B'C	D'AB	DA'B	DAB	AB'C+A'B'C+D'AB+DA'B+DAB
1	1	1	1	0	0	0	0	0	0	0	1	1
1	1	1	0	0	0	1	0	0	1	0	0	1
1	1	0	1	0	0	0	0	0	0	0	1	1
1	1	0	0	0	0	1	0	0	1	0	0	1
1	0	1	1	0	1	0	1	0	0	0	0	1
1	0	1	0	0	1	1	1	0	0	0	0	1
1	0	0	1	0	1	0	0	0	0	0	0	0
1	0	0	0	0	1	1	0	0	0	0	0	0
0	1	1	1	1	0	0	0	0	0	1	0	1
0	1	1	0	1	0	1	0	0	0	0	0	0
0	1	0	1	1	0	0	0	0	0	1	0	1
0	1	0	0	1	0	1	0	0	0	0	0	0
0	0	1	1	1	1	0	0	1	0	0	0	1
0	0	1	0	1	1	1	0	1	0	0	0	1
0	0	0	1	1	1	0	0	0	0	0	0	0
0	0	0	0	1	1	1	0	0	0	0	0	0

(b) Simplify the function to a minimum number of laterals using Boolean algebra.

b) Simplify the function using Boolean algebra

$F = AB'C + A'B'C + D'AB + DA'B + DAB$

$F = B'(AC \overset{or}{+} A'C) \overset{or}{+} D'AB \overset{or}{+} DA'B \overset{or}{+} DAB$

$F = B'(AC \overset{or}{+} A'C) + B(D'A + DA' + DA)$

$F = B'(C(\overset{1}{A + A'})) + B(D'A + DA' + DA)$

$F = B'(C(1)) + B(D'A + DA' + DA)$

$F = B'C + B(D'A + D(A' + A))$

$F = B'C + B(D'A + D(1))$

$F = B'C + B(D + A)$

$\boxed{F = B'C + BD + AB}$

(c) Obtain the truth table of the function using the simplified expression.

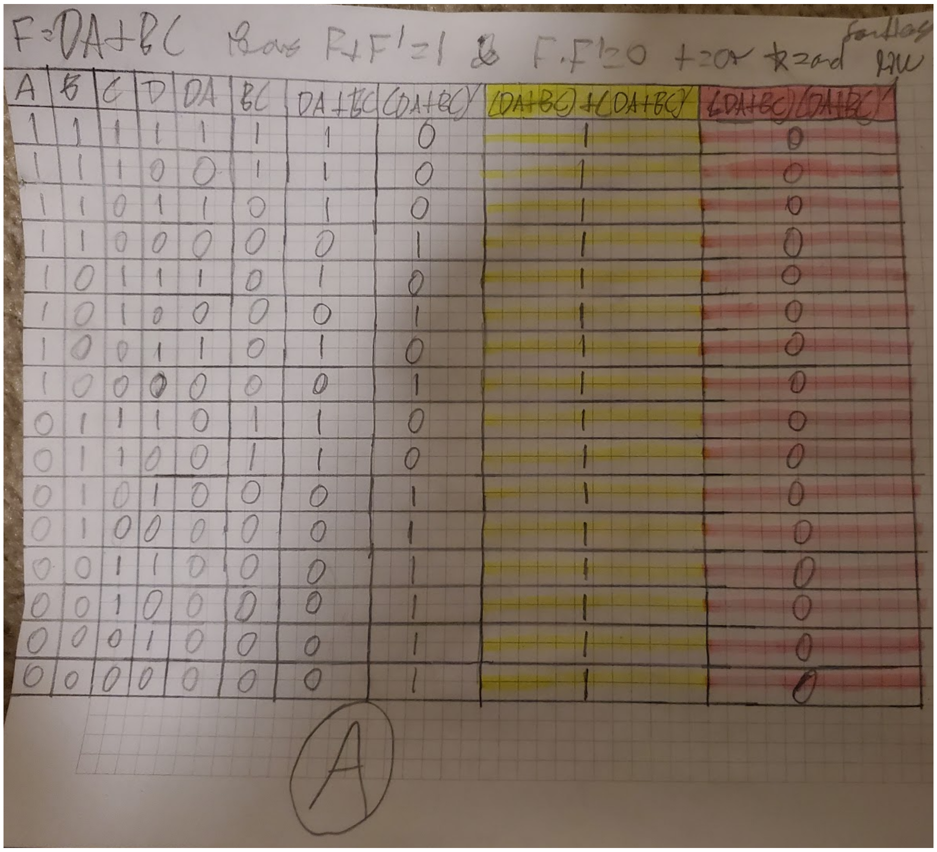
F=B'C+BD+AB   + = or   ☆ = and

A	B	C	D	B'	AB	BD	B'C	B'C+BD+AB
1	1	1	1	0	1	1	0	1
1	1	1	0	0	1	0	0	1
1	1	0	1	0	1	1	0	1
1	1	0	0	0	1	0	0	1
1	0	1	1	1	0	0	1	1
1	0	1	0	1	0	0	1	1
1	0	0	1	1	0	0	0	0
1	0	0	0	1	0	0	0	0
0	1	1	1	0	0	1	0	1
0	1	1	0	0	0	0	0	0
0	1	0	1	0	0	1	0	1
0	1	0	0	0	0	0	0	0
0	0	1	1	1	0	0	1	1
0	0	1	0	1	0	0	1	1
0	0	0	1	1	0	0	0	0
0	0	0	0	1	0	0	0	0

6) For the following function:

(a) $F = DA + BC$
(b) $F = A + BC$

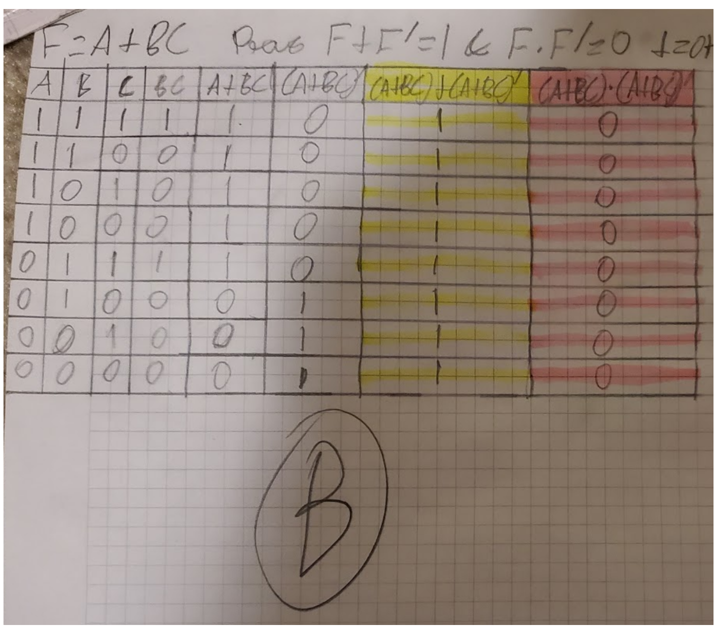
Prove $F + F' = 1$ &
$F \cdot F' = 0$



F=DA+BC Prove F+F'=1 & F.F'=0 +=or *=and for the HW

A	B	C	D	DA	BC	DA+BC	(DA+BC)'	(DA+BC)+(DA+BC)'	(DA+BC)(DA+BC)'
1	1	1	1	1	1	1	0	1	0
1	1	1	0	0	1	1	0	1	0
1	1	0	1	1	0	1	0	1	0
1	1	0	0	0	0	0	1	1	0
1	0	1	1	1	0	1	0	1	0
1	0	1	0	0	0	0	1	1	0
1	0	0	1	1	0	1	0	1	0
1	0	0	0	0	0	0	1	1	0
0	1	1	1	0	1	1	0	1	0
0	1	1	0	0	1	1	0	1	0
0	1	0	1	0	0	0	1	1	0
0	1	0	0	0	0	0	1	1	0
0	0	1	1	0	0	0	1	1	0
0	0	1	0	0	0	0	1	1	0
0	0	0	1	0	0	0	1	1	0
0	0	0	0	0	0	0	1	1	0

A



F=A+BC Prove F+F'=1 & F.F'=0 +=or

A	B	C	BC	A+BC	(A+BC)'	(A+BC)+(A+BC)'	(A+BC)·(A+BC)'
1	1	1	1	1	0	1	0
1	1	0	0	1	0	1	0
1	0	1	0	1	0	1	0
1	0	0	0	1	0	1	0
0	1	1	1	1	0	1	0
0	1	0	0	0	1	1	0
0	0	1	0	0	1	1	0
0	0	0	0	0	1	1	0

B

7) Demonstrate by means of truth tables the validity of the following identities:

(a) De-Morgan’s theorem for three variables: (A+B+C)’ = A’B’C’ and (ABC)’=A’+B’+C’

(A+B+C)' = A'B'C' and (ABC)' = A'+B'+C'   + = or   * = and

A	B	C	A'	B'	C'	A+B+C	(A+B+C)'	A'B'C'	ABC	(ABC)'	A'+B'+C'
1	1	1	0	0	0	1	0	0	1	0	0
1	1	0	0	0	1	1	0	0	0	1	1
1	0	1	0	1	0	1	0	0	0	1	1
1	0	0	0	1	1	1	0	0	0	1	1
0	1	1	1	0	0	1	0	0	0	1	1
0	1	0	1	0	1	1	0	0	0	1	1
0	0	1	1	1	0	1	0	0	0	1	1
0	0	0	1	1	1	0	1	1	0	1	1

De Morgan's Theorem is valid in both cases!

(b) The distributive law: A+BC = (A+B) (A+C)

$A+BC=(A+B)(A+C)$ $f=($

A	B	C	BC	A+BC	A+B	A+C	(A+B)(A+C)
1	1	1	1	1	1	1	1
1	1	0	0	1	1	1	1
1	0	1	0	1	1	1	1
1	0	0	0	1	1	1	1
0	1	1	1	1	1	1	1
0	1	0	0	0	1	0	0
0	0	1	0	0	0	1	0
0	0	0	0	0	0	0	0

* $A+BC=(A+B)(A+C)$ is valid!

8) Reduce the following Boolean expressions to the indicated number of literals (using laws and mention names of laws you are using in which step):

(a) $R'T' + RST + RT'$ **to three literals**

(b) $(R'S' + T)' + T + RS + UT$ **to three literals**

(c) $R'S(U' + T'U) + S(R + R'TU)$ **to one literals**

(d) $(R' + T)(R' + T')(R + S + T'U)$ **to four literals**

8. a) $R'T' + RST + RT'$ ← Distributive Law
$A(B+C) = AB + AC$

$T'(R'+R) + RST$ ← Addition Identity Law
$(A+A=1)$

$T'(1) + RST$ ← Multiplication Identity Law
$A \cdot 1 = A$

$T' + RST$ ← Distributive Law
$A+BC = (A+B)(A+C)$

$(T'+T)(T'+RS)$ ← Addition Identity Law
$(A+A=1)$

$(1)(T'+RS)$ ← Multiplication Identity Law
$A \cdot 1 = A$

$\boxed{T'+RS}$

9

b) $(R'S'+T)' + T + RS + UT$ to 3 literals

$(R'S')' T' + T + RS + UT$ ← Distributive Law

$(R+S) T' + T + RS + UT$ ← Associative Law

$((R+S)T' + T) + RS + UT$ ← Distributive Law
$A+BC = (A+B)(A+C)$

$(R+S+T)(T'+T) + RS + UT$ ← Addition Identity Law
$(A+A'=1)$

$(R+S+T)(1) + RS + UT$ ← Multiplication Identity Law
$A \cdot 1 = A$

$R+S+T+RS+UT$ ← Distributive Law
$A+BC = (A+B)(A+C)$

$R(1+S) + S + T + UT$ ← Distributive Law
$A+BC = (A+B)(A+C)$

$R(1+S) + S + T(1+U)$ ← Addition Identity Law
$A+1=1$

$R(1) + S + T(1)$ ← Multiplication Identity Law
$A \cdot 1 = A$

$\boxed{R+S+T}$

B

c) $R'S(U'+T'U)+S(R+R'TU)$ ← Distributive law $A(B+C)=AB+AC$

$S(R'U'+R'T'U)+S(R+R'TU)$ ← Distributive Law $AB+AC=A(B+C)$

$S\{R'U'+R'T'U+R+R'TU\}$ ← Distributive Law $AB+AC=A(B+C)$

$S\{R'U'+R+R'U(T'+T)\}$ ← Addition Identity Law $A+A'=1$

$S\{R'U'+R+R'U(1)\}$ ← Multiplication identity Law $A\cdot 1=A$

$S\{R'U'+R+R'U\}$ ← Distributive Law $AB+AC=A(B+C)$

$S\{R'(U'+U)+R\}$ ← Addition identity law $(A+A'=1)$

$S\{R'(1)+R\}$ ← Multiplication identity law $A\cdot 1=A$

$S(R'+R)$ ← Addition identity law $A+A'=1$

$S(1)$ ← Multiplication identity law $A\cdot 1=A$

$\boxed{S}$

C

1) $(R'+T)(R'+T')(R+S+T'U) \leftarrow$ Distributive Law
$A(B+C) = AB+AC$

$(R'R'+R'T+R'T'+TT')(R+S+T'U) \leftarrow$ Multiplication Identity Law

$(R'+R'T+R'T'+0)(R+S+T'U) \leftarrow$ Addition Identity Law
$A+0=A$

$(R'+R'T+R'T')(R+S+T'U) \leftarrow$ Distributive law

$\underline{R'R}+R'S+R'T'U+\underline{R'TR}+R'T'S+\underline{R'T'T'U}$ ....
.... $R'TR+R'TS+\underline{R'TT'U}$

Multiplication Identity laws, Addition Identity law
$A \cdot A'=0,\ A \cdot A = A,\quad A+A=A$

$R'T'U+R'S+R'T'S+R'TS \leftarrow$ Distributive Law
$AB+AC = A(B+C)$

$R'T'U+R'S(1+T')+R'TS \leftarrow$ Distributive law

$R'T'U+R'S(1+T) \leftarrow$ Addition Identity law
$A+1=1$

$R'T'U+R'S \leftarrow$ Distributive law
$AB+AC=A(B+C)$

$\boxed{R'(T'U+S)}$

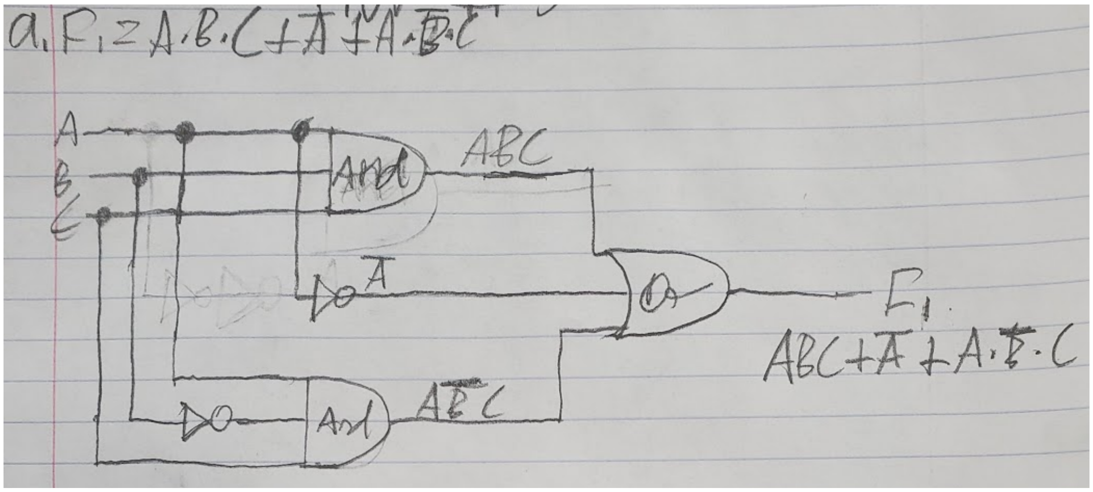
D

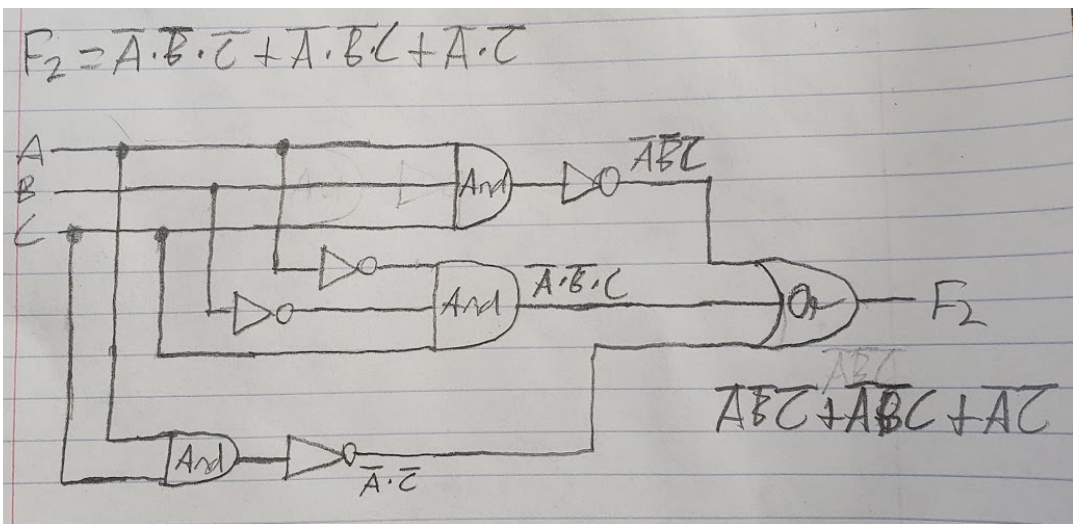
9)Using only minimum gates, draw a logic gate diagram for the following expressions:

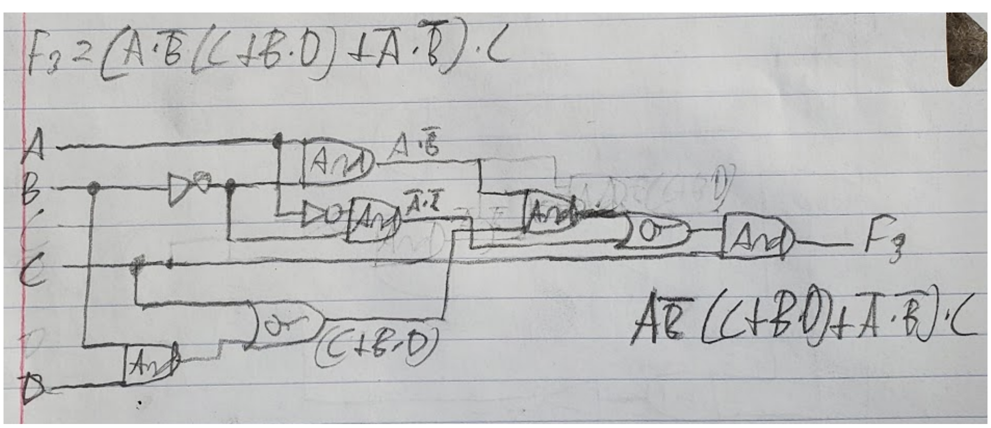
$$F_1 = A.B.C + \bar{A} + A.\bar{B}.C$$

$$F_2 = \bar{A}.\bar{B}.\bar{C} + \bar{A}.\bar{B}.C + \bar{A}.\bar{C}$$

$$F_3 = (A.\bar{B}.(C + B.D) + \bar{A}.\bar{B}).C$$







Karnaugh Maps:

10) Simply the following functions using 3 variable maps:

(a) $F(x,y,z) = \sum(0,2,6,7)$ (b) $F(x,y,z) = \sum(0,2,3,4,6)$

(c) $F(x,y,z) = \sum(0,1,2,3,7)$ (d) $F(x,y,z) = \sum(3,5,6,7)$

10. a) $F(x,y,z) = \sum(0,2,6,7)$

$0 = 000$ $6 = 110$
$2 = 010$ $7 = 111$

$0 = \bar{x}\bar{y}\bar{z}$

$2 = \bar{x}y\bar{z}$

x	y	z	
0	0	0	0
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	6
1	1	1	7

	$\bar{y}\bar{z}$	$\bar{y}z$	$y\bar{z}$	yz
$\bar{x}$	0	1	2	3
x	4	5	6	7

	$\bar{y}\bar{z}$	$\bar{y}z$	$y\bar{z}$	yz
$\bar{x}$	1	0	1	0
x	0	0	1	1

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	1	3	2
x	4	5	7	6

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	0	0	1
x	0	0	1	1

$(\bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z}) + (\bar{x}y\bar{z} + xy\bar{z})$

$\bar{x}\bar{z}\underbrace{(y+\bar{y})}_{1} + y\bar{z}\underbrace{(\bar{x}+x)}_{1}$

$\bar{x}\bar{z} + y\bar{z}$

$\boxed{\bar{z}(\bar{x}+y)}$ a

b) $F(x,y,z) = \Sigma(0,2,3,4,6)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	1	3	2
x	4	5	7	6

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	0	1	1
x	1	0	0	1

$(\bar{x}\bar{y}\bar{z} + \bar{x}yz + \bar{x}y\bar{z}) + (\bar{x}y\bar{z} + xy\bar{z}) + (\bar{x}\bar{y}\bar{z} + x\bar{y}\bar{z})$

$\bar{x}(\bar{y}\bar{z} + yz + y\bar{z}) + y\bar{z}\underbrace{(\bar{x}+x)}_{1} + \bar{y}\bar{z}\underbrace{(\bar{x}+x)}_{1}$

$\bar{x}(\bar{z}\underbrace{(\bar{y}+y)}_{1} + yz) + y\bar{z} + \bar{y}\bar{z}$

$\bar{x}(\bar{z} + yz) + \bar{z}\underbrace{(y+\bar{y})}_{1}$

$\bar{x}(\bar{z} + yz) + \bar{z}$

$\bar{x}(\bar{z} + y) + \bar{z}$

$\bar{x}\bar{z} + \bar{x}y + \bar{z}$

$\bar{x}\bar{z} + \bar{z} + \bar{x}y$

b

$\boxed{\bar{z} + \bar{x}y}$

Q) $F(x,y,z) = \Sigma(0,1,2,3,7)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	1	3	2
x	4	5	7	6

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1	1	1
x	0	0	1	0

$\bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + \bar{x}yz + \bar{x}y\bar{z}) + (\bar{x}yz + xyz)$

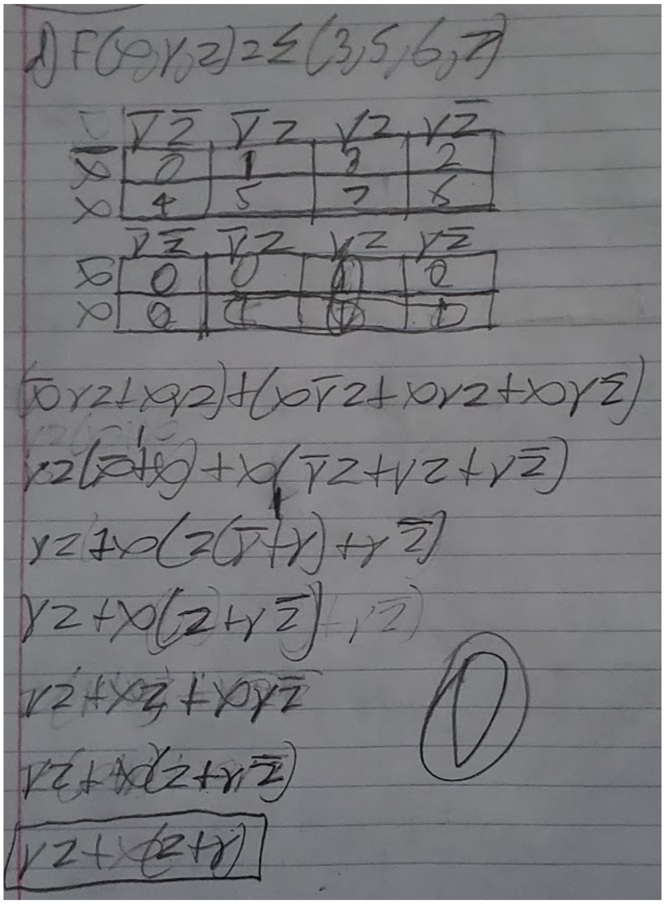
$\bar{x}(\bar{y}\bar{z} + \bar{y}z + yz + y\bar{z}) + yz(\bar{x} + x)$

$\bar{x}(\bar{y}(\bar{z}+z) + y(z+\bar{z})) + yz$

$\bar{x}(\bar{y}+y) + yz$

$\boxed{\bar{x} + yz}$

C



d) $F(x,y,z) = \Sigma(3,5,6,7)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	1	3	2
x	4	5	7	6

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	0	1	0
x	0	1	1	1

$(\bar{x}yz + xyz) + (x\bar{y}z + xyz + xy\bar{z})$

$yz(\bar{x}+x) + x(\bar{y}z + yz + y\bar{z})$

$yz + x(z(\bar{y}+y) + y\bar{z})$

$yz + x(z + y\bar{z})$

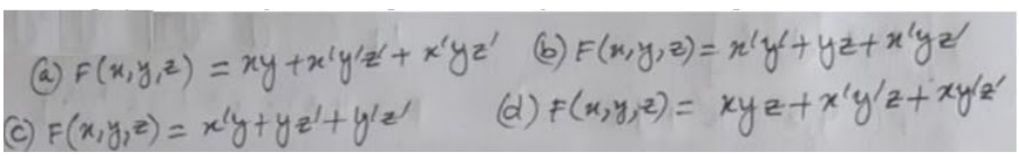
$yz + xz + xy\bar{z}$

$yz + x(z + y\bar{z})$

$\boxed{yz + x(z+y)}$

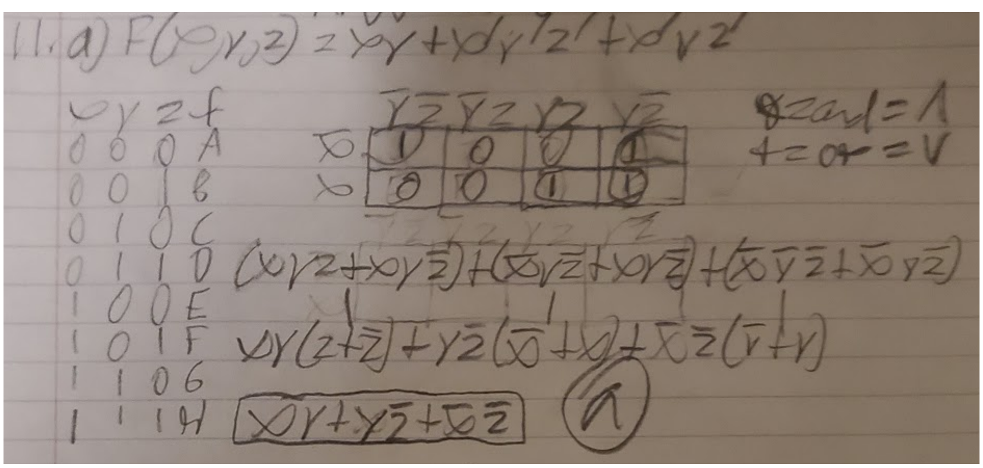
d

11) Simplify the following Boolean expressions, using three-variable maps:



(a) $F(x,y,z) = xy + x'y'z' + x'yz'$ (b) $F(x,y,z) = x'y' + yz + x'yz'$

(c) $F(x,y,z) = x'y + yz' + y'z'$ (d) $F(x,y,z) = xyz + x'y'z + xy'z'$



11. a) $F(x,y,z) = xy + x'y'z' + x'yz'$

x	y	z	f
0	0	0	A
0	0	1	B
0	1	0	C
0	1	1	D
1	0	0	E
1	0	1	F
1	1	0	G
1	1	1	H

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	0	0	1
x	0	0	1	1

and $= \wedge$

$+ =$ or $= \vee$

$(xyz + xy\bar{z}) + (\bar{x}y\bar{z} + xy\bar{z}) + (\bar{x}\bar{y}\bar{z} + \bar{x}y\bar{z})$

$xy(z+\bar{z}) + y\bar{z}(\bar{x}+x) + \bar{x}\bar{z}(\bar{y}+y)$

$\boxed{xy + y\bar{z} + \bar{x}\bar{z}}$ a

b) $F(x,y,z) = x'y' + yz + x'yz'$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	1	1	1
x	0	0	1	0

$(xyz + \bar{x}yz) + (\bar{x}\bar{y}\bar{z} + \bar{x}\bar{y}z + \bar{x}yz + \bar{x}y\bar{z})$

$yz(x + \bar{x}) + \bar{x}(\bar{y}\bar{z} + \bar{y}z + yz + y\bar{z})$

$yz + \bar{x}(\bar{y}(\bar{z} + z) + y(z + \bar{z}))$

$yz + \bar{x}(\bar{y} + y)$

$\boxed{yz + \bar{x}}$

(b)

c) $F(x,y,z) = x'y + yz' + y'z'$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	0	1	1
x	1	0	0	1

$(\bar{x}\bar{y}\bar{z} + x\bar{y}\bar{z}) + (\bar{x}yz + \bar{x}y\bar{z}) + (\bar{x}y\bar{z} + xy\bar{z}) + (xy\bar{z} + x\bar{y}\bar{z})$

$\bar{y}\bar{z}(\bar{x} + x) + \bar{x}y(z + \bar{z}) + y\bar{z}(\bar{x} + x) + x\bar{z}(y + \bar{y})$

$\bar{y}\bar{z} + \bar{x}y + y\bar{z} + x\bar{z}$

$\bar{z}(\bar{y} + y) + \bar{x}y + x\bar{z}$

$\boxed{\bar{z} + \bar{x}y + x\bar{z}}$

(c)

d) $F(x,y,z) = xyz + x'y'z + xy'z'$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	1	0	0
x	1	0	1	0

We cannot make any loops because there are no adjacent "true" values. As such, the expression cannot really be simplified!

$\boxed{x(yz+y'z') + x'y'z}$

D

Induction and Recursion:

12) Prove by induction the recursive formula for the Fibonacci numbers:

F1 = 1

F2 = F1

F3 = F1+F2

F4 = F2+F3

F5 = F3+F4

12. Prove by induction the recursive formula for the Fibonacci numbers:

$F_0=0$ $F_1=1$ $\quad F_1=1$ $\quad F_n = F_{n-1} + F_{n-2}$ $(n \geq 2)$

$F_2 = F_1$ $\quad F_2 = 1$

$F_3 = F_1 + F_2$ $\quad F_3 = 1+1=2$ $\quad F_n = F_{n-2} + F_{n-1}$

$F_4 = F_2 + F_3$ $\quad F_4 = 1+2=3$

$F_5 = F_3 + F_4$ $\quad F_5 = 2+3=5$

Base case: $n=2$ $\quad n=2$

$F_2 = F_0 + F_1$ $\quad F_2 = F_0 + F_1$

$1 = 0+1$ ✓ Base case holds $\quad 1 = 0+1$

$1 = 1$ ✓

Cont'd

Cont'd

Inductive step: Suppose the function holds for $k+1$ (IH: $F_{k+1} = F_k + F_{k-1}$) $\quad k+2 \quad F_{k+2} = F_{k+1}$

We show that it holds for $n = k+2$

$F_{k+2} = F_{k+1} + F_k \quad F_{k+1} = F_k + F_{k-1}$

$F_{k+1} + F_k + F_{k+2} = F_{k+1} + F_k$

$\boxed{F_{k+1} + F_k = F_{k+1} + F_k}$ QED!

Define the two Recursive Formula Rules, with the basic rule and the recursive rule.

Basic rule:

$$F_n = \frac{1}{\sqrt{5}}\left(\frac{1+\sqrt{5}}{2}\right)^n - \frac{1}{\sqrt{5}}\left(\frac{1-\sqrt{5}}{2}\right)^n$$

Recursive rule:

$$F_n = F_{n-1} + F_{n-2}$$

Then, using the below information, validate the formula for Fn.

n = 1 2 3 4 5 6 7 8 9 10 11 12...

n =	1	2	3	4	5	6	7	8	9	10
fn =	1	1	2	3	5	8	13	21	34	55
sum fn =	1	2	4	7	12	20	33	54		

Notice from the table it appears that the sum of the first n terms is the (nth+2) term minus 1

Let P(n) be the statement f1+f2+f3+...fn=f(n+2) – 1

Prove P(n), for all n

Base case: $n=1$

$F_1 = F(1+2)-1$

$F(3)-1$

F_2

$1 = 1$ ✓

Inductive step: Suppose the function holds for k

(IH: $F_k = F(k+2)-1$)

We show that it holds for $n=k+1$

$F_k = F(k+2)-1 \quad | \; F_{k+1} = F((k+2)+1)-1$

$F(k+2)-1 + F_{k+1} = F((k+2)+1)-1$

~~$F_{k+3}-1 \neq F_{k+3}-1+F_1$~~

$\boxed{F_{k+2} = F_{k+2}}$ QED!

***I'll admit that I likely got this problem wrong. I would love to take the time to solve it properly, but I just don't have the time right now. I've got other courses to worry about and I really hate when I feel like I am forced to choose between them. I hate having to feel like I should decide which course to do well in and which course I shouldn't do well in. I learned a lot, however. I appreciate being able to do that much. If only I was better at it...**