Date

Introduction to Computer Science   Sheet # 07

Problem 7.1:

• Using not-or ($\bar{\vee}$) to prove $\wedge$ (AND)

For a classical AND ($\wedge$) gate we see that:

A	B	$A \wedge B$
1	1	1
0	1	0
1	0	0
0	0	0

Similarly this can be done as the following:

$$X = (A \bar{\vee} A) \bar{\vee} (B \bar{\vee} B)$$

A	B	$A \bar{\vee} A$	$B \bar{\vee} B$	X
1	1	0	0	1
0	1	1	0	0
1	0	0	1	0
0	0	1	1	0

Hence, as the outputs are exactly the same we can say that

$$A \wedge B = (A \bar{\vee} A) \bar{\vee} (B \bar{\vee} B)$$

• Using not-or ($\bar{\vee}$) to prove $\vee$ (OR)

For a classical ($\vee$) OR gate we see that:

A	B	$A \vee B$
1	1	1
0	1	1
1	0	1
0	0	0

Similary with not-or ($\bar{\vee}$):

$$X = (A \bar{\vee} B) \bar{\vee} (A \bar{\vee} B)$$

A	B	$A \bar{\vee} B$	$A \bar{\vee} B$	X
1	1	0	0	1
0	1	0	0	1
1	0	0	0	1
0	0	1	1	0

Date

Hence, as the outputs are the same we can say that:

$$A \vee B = (A \bar{\vee} B) \bar{\vee} (A \bar{\vee} B)$$

- Using not-or ($\bar{\vee}$) to prove $\neg$ (not) gate:

For a classical $\neg$ (not) gate:

A	$\neg A$
1	0
0	1

Similarly, the not-or ($\bar{\vee}$) gate can be used:

$$X = (A \bar{\vee} A)$$

A	$A \bar{\vee} A$
1	0
0	1

Hence we can say that:

$$\neg A = A \bar{\vee} A$$

Problem 7.2:

$$F(X,Y,Z) = (((X \wedge Y) \vee (X \wedge \neg Z)) \vee (Z \wedge \neg 0))$$

$$= (((X \wedge Y) \vee (X \wedge \neg Z)) \vee (Z \wedge \neg 0)$$

Since $\neg 0 = 1$,

Applying Identity law i.e $x \wedge 1 = x$,

$$= (((X \wedge Y) \vee (X \wedge \neg Z)) \vee (Z))$$

~~Applying distributivity law i.e $(x \wedge (y \vee z)) = ((x \wedge y) \vee (x \wedge z))$~~

~~$= ((X \wedge (Y \vee \neg Z)) \vee (Z))$~~

Date

$= (X \wedge Y) \vee (X \wedge \neg Z) \vee Z$

Applying absorption law i.e $(x \wedge \neg y) \vee y = x \vee y$,

$= (X \wedge Y) \vee X \vee Z$

Applying absorption law again, i.e $(x \wedge (x \vee y)) = x$

$= (X \vee Z)$ //

hence proven that by using boolean equivalence laws F can be formed into the expression $G(X,Y,Z) = (X \vee Z)$.