Analog and Digital Electronics (EC13103)
IT-B
Lecture-3
(1's and 2's Complement Arithmetic and Boolean Algebra)

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1's Complement Arithmetic

- In 1's comp. subtraction, add the 1's comp of the subtrahend to the minuend.
  - If there is carryout , bring the carry around & add it to the LSB called the **end around carry.**
  - Look at the sign bit (MSB).
    - If this is a 0, the result is +ve & is in true binary.
    - If the MSB is a 1 (carry or no carry), the result is –ve & is in its is comp form .Take its 1's comp to get the magnitude in binary.

Example: $(25)_{10} - (14)_{10}$

$+14 - \quad 00001110$
$-14 - \quad 11110001$
$+25 - \quad 00011001$

+25-14 - 00011001+11110001= **1** 00001010

+1

00001011

2's Complement Arithmetic

- In 2's complement subtraction, add the 2's complement of the subtrahend to the minuend.
  - If there is carryout , ignore it.
  - Look at the sign bit (MSB).
    - If this is a 0, the result is +ve & is in true binary.
    - If the MSB is a 1 (carry or no carry), the result is –ve & is in its is comp form .Take its 2's comp to get the magnitude in binary.

Example: $(46)_{10} - (14)_{10}$

$+14 -$ 00001110
$-14 -$ 11110001
+1
11110010 → **Ignore it**
$+46 -$ 00101110

+46-14 - 00101110+11110010= **1** 00100000 → **True Binary Form**

Cont….

Example: $(26)_{10} - (75)_{10}$

$+75 -$ 01001011

$-75 -$ 10110100

+1

10110101

$+26 -$ 00011010

+26-75 - 00011010

+10110101

11001111

MSB=1, Result= -ve

Take 2's complement of the result:

00110000+1=00110001= -49

For Practice

- Express -45 in 8-bit 2’s complement form

- Subtract 27.50 from 68.75 using 12 bit 1’s complement method.

- Add +27.125 and -79.625 using 12 bit 2’s complement arithmetic.

Boolean Algebra

- Also known as Switching Algebra
  - Invented by mathematician George Boole in1849
  - Used by Claude Shannon at Bell Labs in1938
- It is described as an algebra of logic or an algebra of two values i.e. true or false.
- It is used in digital computers to perform the logical operations.
- Logical operations are performed by different logical operators

AND
OR
NOT
} Fundamental Logical Operator

Cont….

AND Operator:

- Logical Multiplication; denoted by dot (.)

X	Y	X.Y
0	0	0
0	1	0
1	0	0
1	1	1

OR Operator:

- Logical Addition; denoted by dot (+)

X	Y	X+Y
0	0	0
0	1	1
1	0	1
1	1	1

Cont….

NOT Operator:

- Perform complement operation; denoted by bar over the symbol ($\bar{A}$)

X	$\bar{X}$
0	1
1	0

Truth Table:

- It is the table that contains all possible value of the logical variables/statement in the Boolean Expression.
  - No. of possible combination: 2^n; where, 'n' is the number of variables

Example: $F = \bar{A}B + \bar{B}A$

In this Boolean function, n=2; so possible combination is 4

A	B	$\bar{A}B$	$\bar{B}A$	F
0	0	0	0	0
0	1	1	0	1
1	0	0	1	1
1	1	0	0	0

Cont….

Boolean Algebra Attributes

Variable: Variables are the different symbols in a Boolean expression

Literal: Each occurrence of a variable or its complement is called a literal

Term: A term is the expression formed by literals and operations at one level

Example: $F = \overline{A} + A.B + A.\overline{C} + \overline{A}.B.C$

No. of variable: 03

No. of Literal: 08

No. of Terms: 04