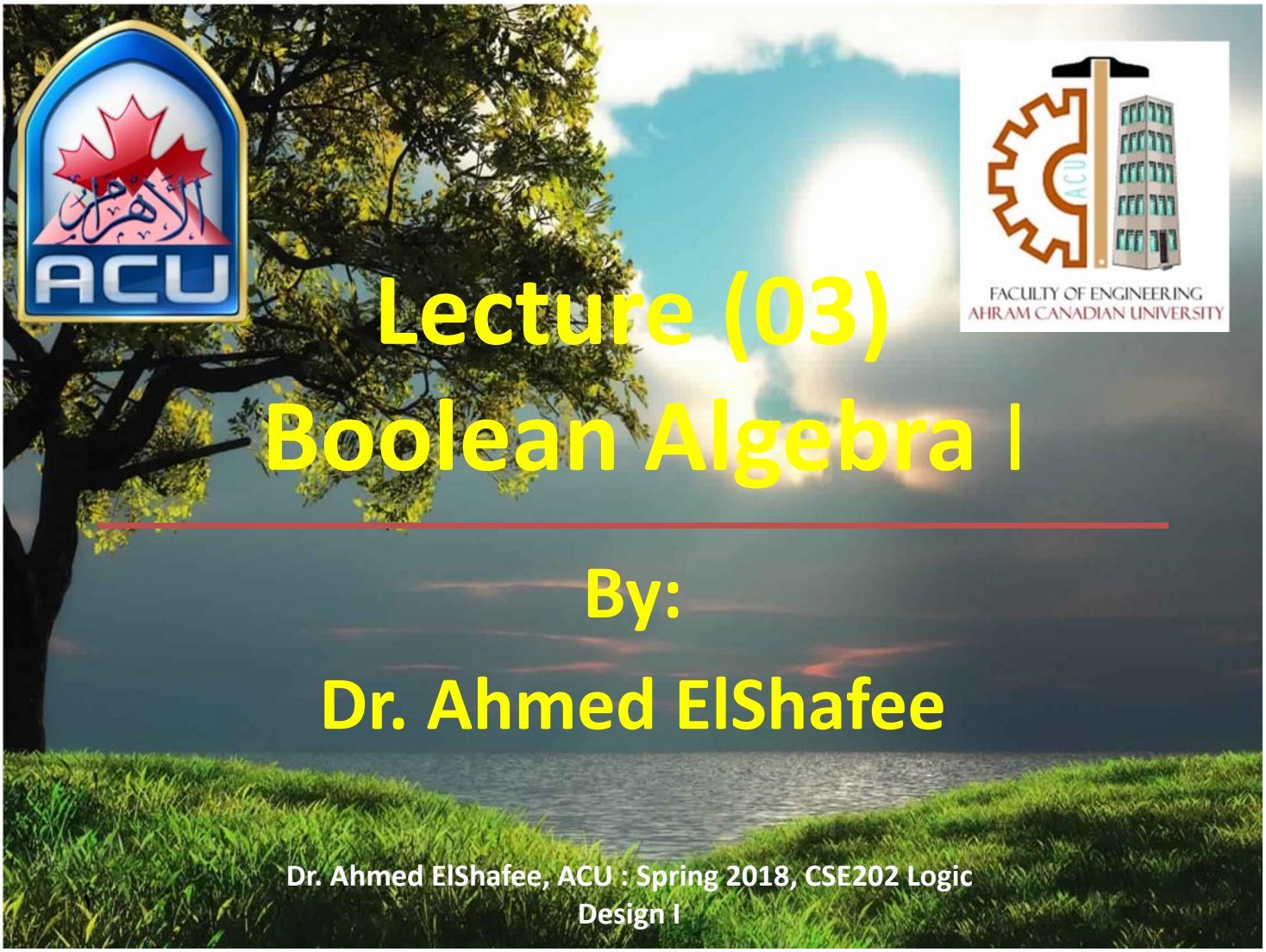


objectives

- Security system installed in a house; consists of
  - Door sensor (D) : 0 = closed; 1= opened
  - Light sensor (L): 0 = night; 1 = day
  - Alarm (A) : 0 = no alarm; 1 = Alarm
- System is designed to protect home at night, that if door is opened during day light; alarm will not activated, if door is open during night; alarm will be activated.

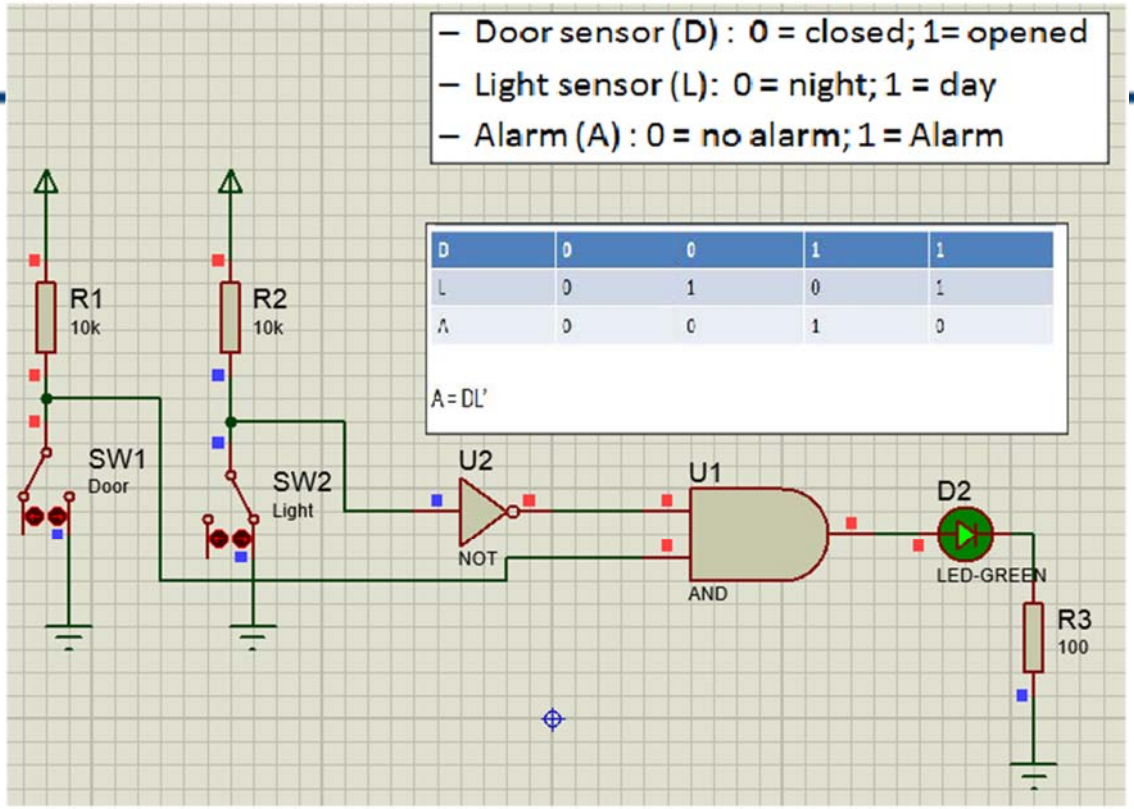
- Door sensor (D) : 0 = closed; 1= opened
- Light sensor (L): 0 = night; 1 = day
- Alarm (A) : 0 = no alarm; 1 = Alarm

```
If((D==0))
    {
        A=0;
    }
    Else if((D==1)&&(L==1))
    {
        A=0;
    {
    Else if((D==1)&&(L==0))
    {
        A=1;
    }
```


- Door sensor (D) : 0 = closed; 1= opened
- Light sensor (L): 0 = night; 1 = day
- Alarm (A) : 0 = no alarm; 1 = Alarm

D	L	A
0	0	0
0	1	0
1	0	1
1	1	0

A = DL'

- 

objectives

- Security system installed in a house; consists of
  - Door sensor (D) : 0 = closed; 1= opened
  - Light sensor (L): 0 = night; 1 = day
  - Windows (w) : 0: closed; 1 = opened
  - Alarm (A) : 0 = no alarm; 1 = Alarm
- System is designed to protect home at day and night, that if
  - door is opened during day light; alarm will not be activated, if door is open during night; alarm will be activated.
  - If window is opened during day light; alarm will not be activated, if door is open during night; alarm will be activated.

- Door sensor (D) : 0 = closed; 1= opened
- Light sensor (L): 0 = night; 1 = day
- Windows (w) : 0: closed; 1 = opened
- Alarm (A) : 0 = no alarm; 1 = Alarm

```
If((D==0) && (W==0))
    {
        A=0;
    }
    Else if(L==1)
    {
        A=0;
    {
    Else if((L==0)&&(D==1))
    {
        A=1;
    }
```

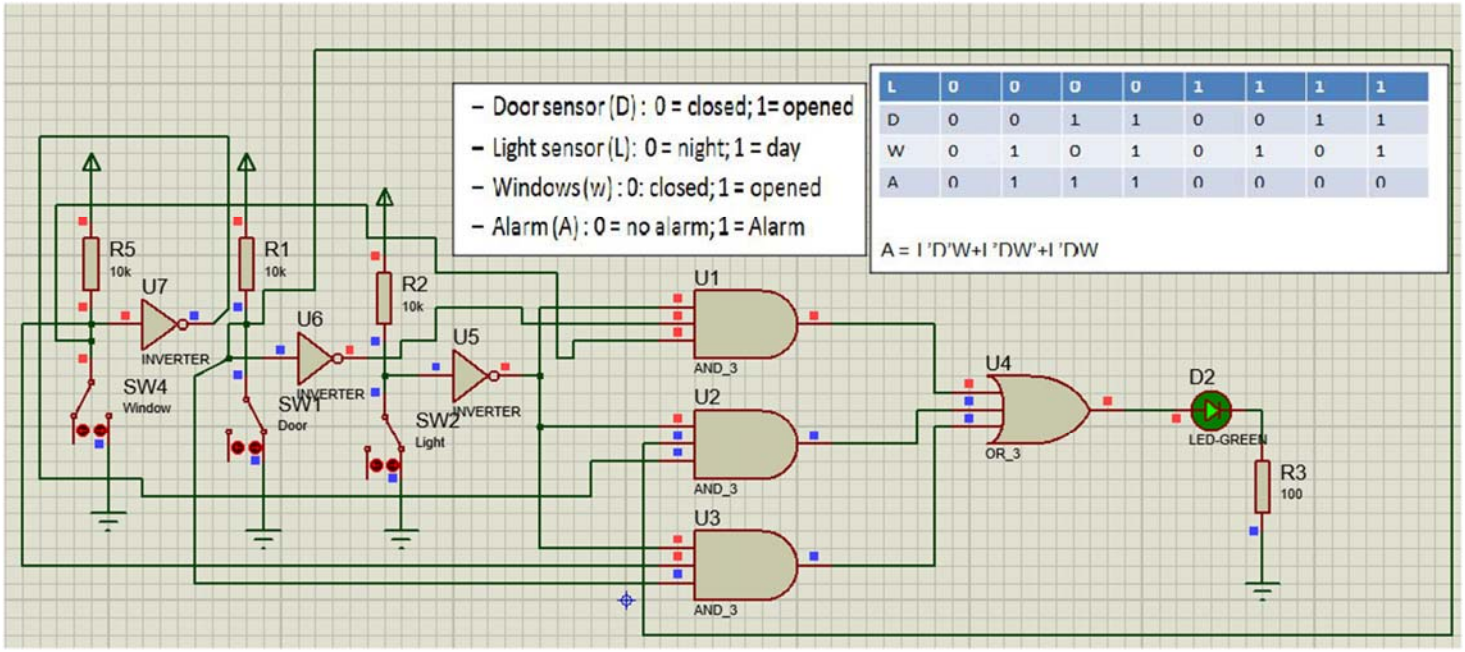
```
    Else if((L==0)&&(W==1))
    {
        A=1;
    }
    Else if((L==0)&&(W==1)&&(D==1))
    {
        A=1;
    }
    Else
    {
    A=0;
    }
```


- Door sensor (D) : 0 = closed; 1= opened
- Light sensor (L): 0 = night; 1 = day
- Windows (w) : 0: closed; 1 = opened
- Alarm (A) : 0 = no alarm; 1 = Alarm

-

L	D	W	A
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

A = L'D'W+L'DW'+L'DW



Introduction

- George Boole developed Boolean algebra in 1847 and used it to solve problems in mathematical logic.

Boolean Algebra

- is an *algebra* **(B; . , + ,' ;0, 1)** consisting of a set **B** (which contains at least two elements **0** and **1**)
- together with *three* operations,
- the **AND** (Boolean *product*) operation **.** ,
- the **OR** (Boolean *sum*) operation **+**, and
- the **NOT** (*complement*) operation **'** , defined on the set, such that

- An element of a Boolean algebra B is called a *constant* on B.
- e.g. 0,a,b,1 in B4.

- A symbol that may represent any one of element of B is called a (Boolean) *variable* on B.
- e.g. x,y,z,…

- A *Boolean expression* over an algebra system (B; . ,+, ’ ; 0,1) is defined as follows:

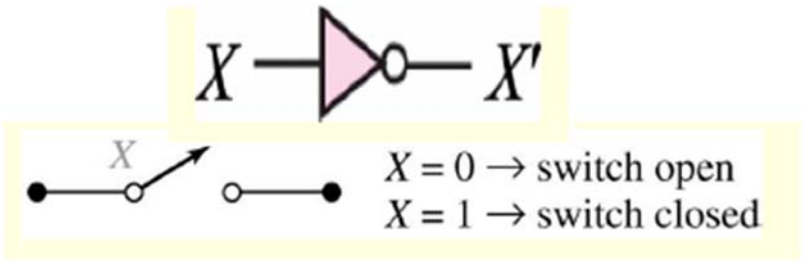
1. Any element of B (constant) is a Boolean expression.
2. Any variable name is a Boolean expression.
3. If e_1 and e_2 are Boolean expression, then e_1’, e_2’, e_1+e_2, e_1.e_2 are Boolean expressions.
4. Any expression that can be constructed by a finite number of applications of the above rules, and only such a expression is a Boolean expression.

Boolean Operations

- The basic operations of Boolean algebra are AND, OR, and NOT (complement, or inverse).
- NOT (Complement)

$$0' = 1 \qquad 1' = 0$$
$$X' = 1 \text{ if } X = 0 \text{ and } X' = 0 \text{ if } X = 1$$

- Inverter



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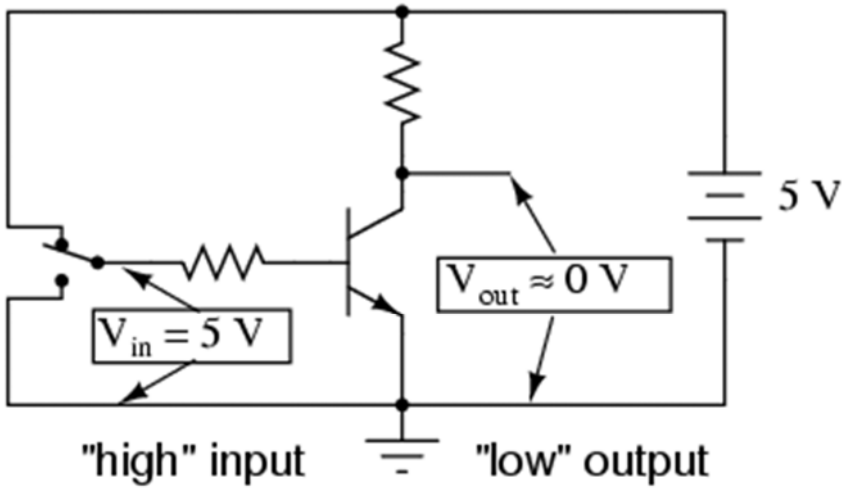
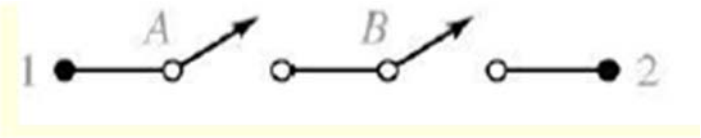


0 V = "low" logic level (0)

5 V = "high" logic level (1)

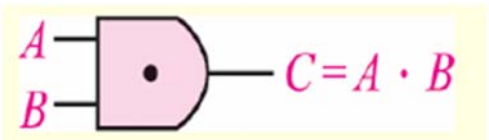
- AND Operation
- Omit the symbol “.”, A . B=AB



$T = 0 \rightarrow$ open circuit between terminals 1 and 2
$T = 1 \rightarrow$ closed circuit between terminals 1 and 2

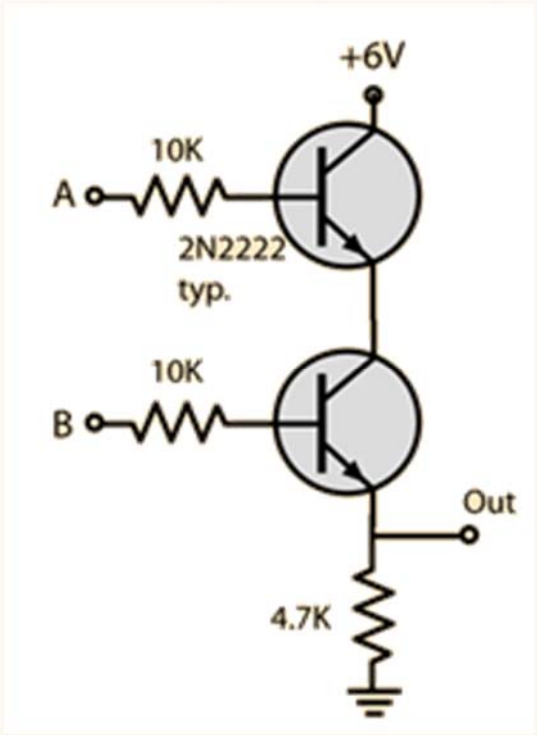
-

A	B	$C = A \cdot B$
0	0	0
0	1	0
1	0	0
1	1	1

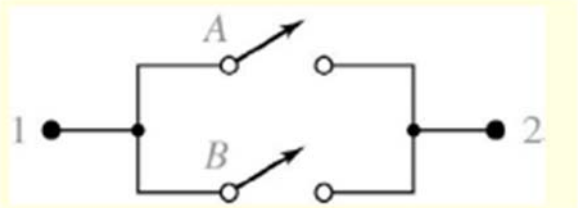


AND Gate

•



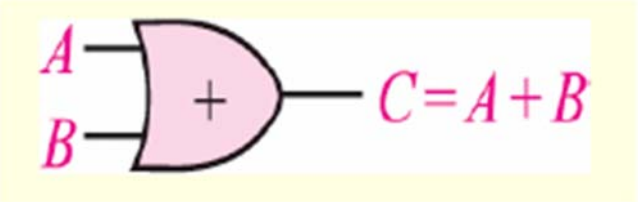
• OR operation



$$0+0=0 \quad 0+1=1 \quad 1+0=1 \quad 1+1=1$$

-

A	B	C=A+B
0	0	0
0	1	1
1	0	1
1	1	1



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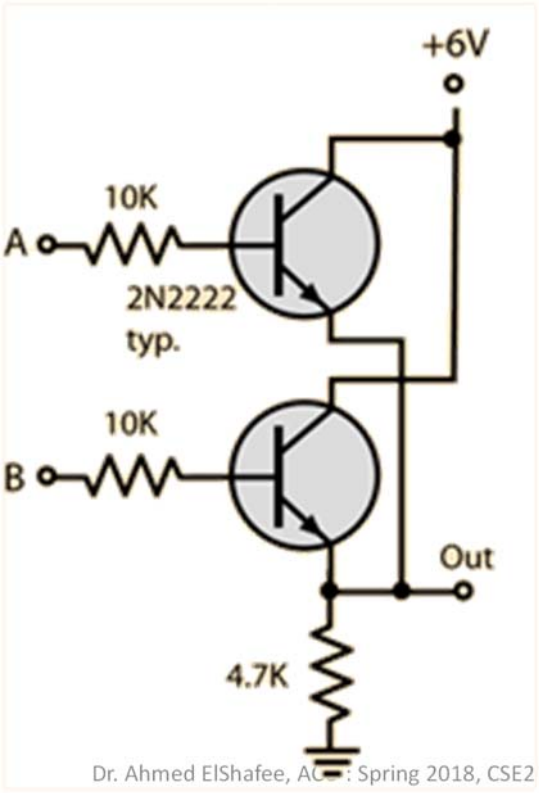


Boolean functions/expressions

- A function $f(x_1,x_2,\ldots,x_n),\ f : B^n \rightarrow B$

is called a Boolean function if it can be specified by a Boolean expression of n variables $x_1,x_2,\ldots,x_n$.

f(a,b,c)=ab'c+a'b+b'c'

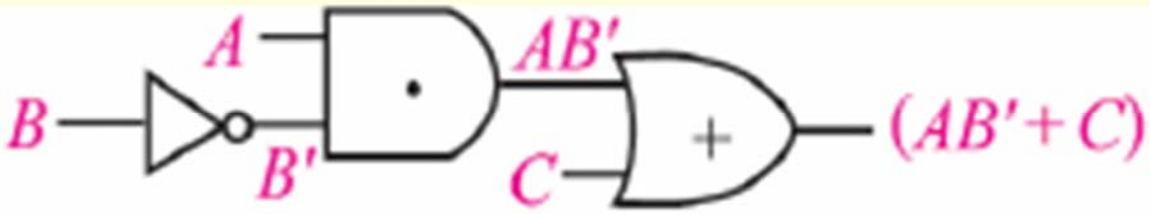
- Each appearance of a variable or its complement in an expression is referred to as a literal.

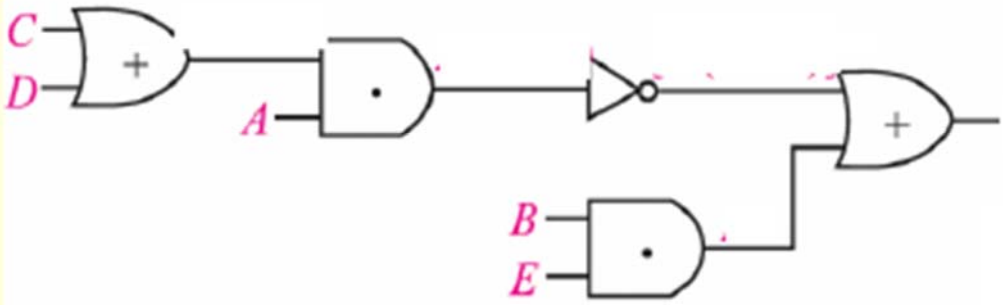
f(a,b,c)=ab'c+a'b+b'c'

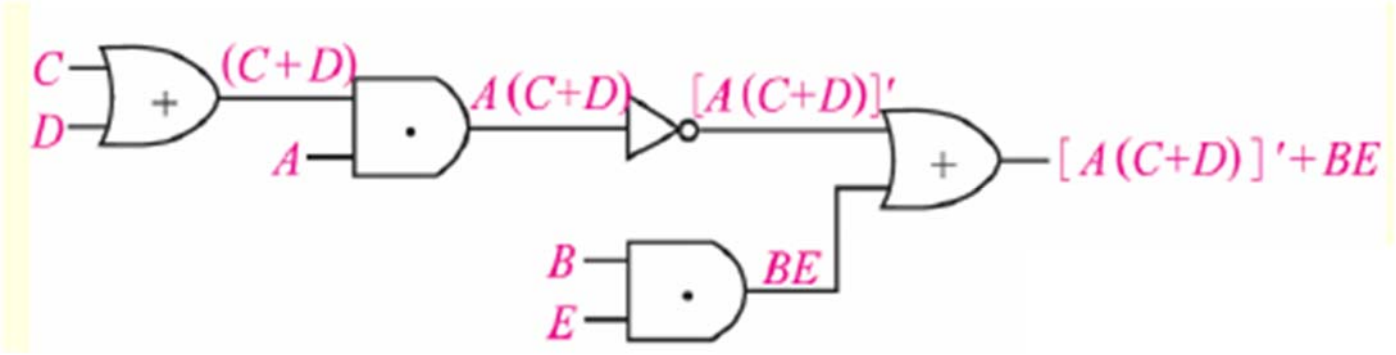
- has 3 variables, a,b, and c, 7 literals(a, b' , c, a', b, b', c').

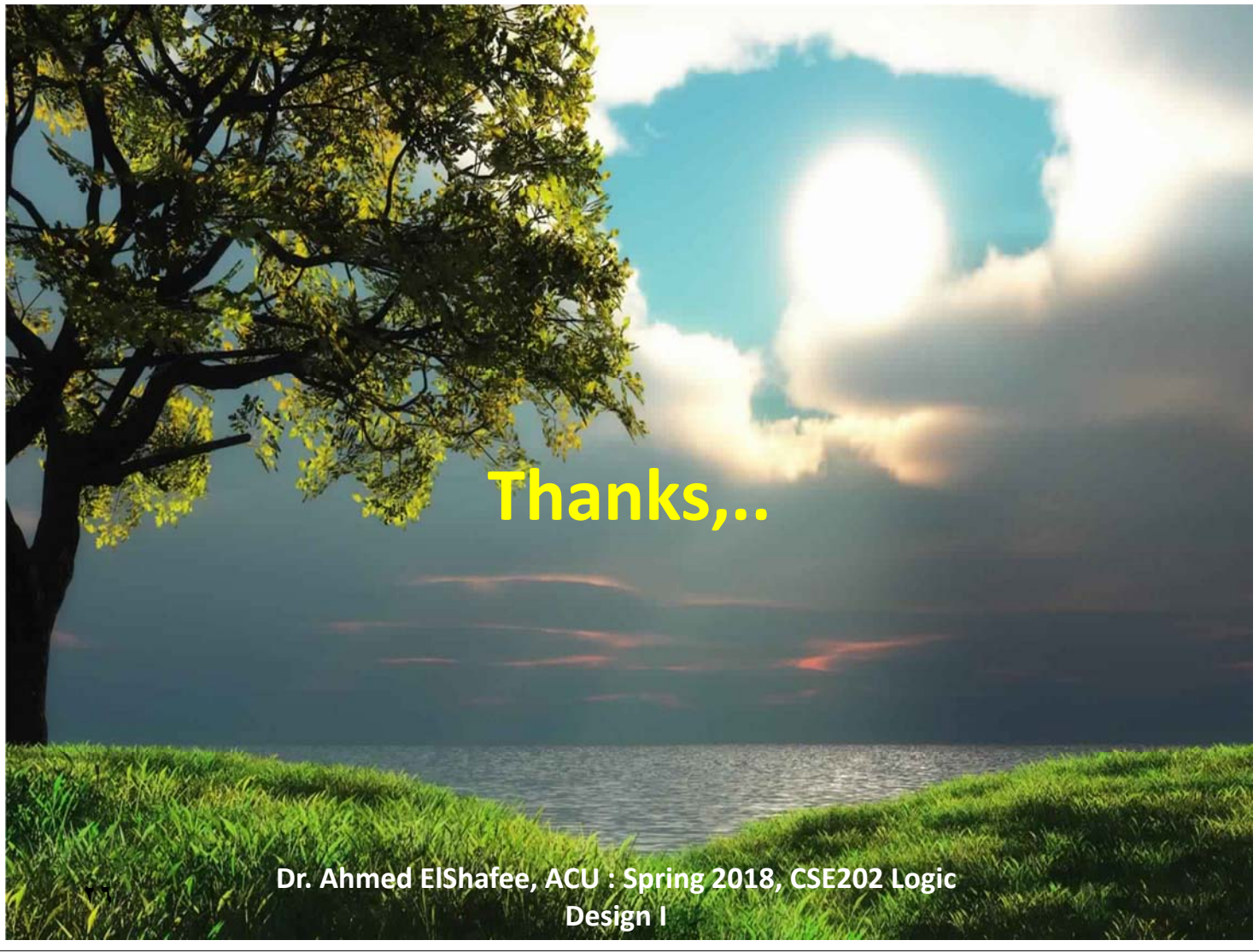
f(a,b,c)=C + (AB')

f(a,b,c)=C + (AB’)






C
D
+
(C+D)
A
·
A(C+D)
[A(C+D)]'
+
[A(C+D)]'+BE
B
E
·
BE


Thanks,..
Dr. Ahmed ElShafee, ACU : Spring 2018, CSE202 Logic Design I