

## Tutorial 1: Boolean Algebra

1. On my last visit to the National Film theatre I noticed that my ticket had the following instruction printed on it:

*” Enter through door 1 and door 3 ”*

As I was unable to carry out this instruction I spent the evening in the lobby and missed the film. However, it didn't matter since it was a Woody Allen production.

What should the instruction have said?

2. Prove de Morgan's Theorem for three variables:  $(A + B + C)' = A' \cdot B' \cdot C'$ , by filling up the following truth table.

$ABC$	$A + B + C$	$(A + B + C)'$	$A'$	$B'$	$C'$	$A' \cdot B' \cdot C'$
000						
001						
010						
011						
100						
101						
110						
111						

3. Given that you know that two variables A and B can only take the values 0 and 1, it is possible to write expressions using the normal arithmetic operators (plus, minus, multiply) which are equivalent to Boolean expressions. For example the arithmetic expression  $A \times B$  is equivalent to the Boolean expression  $A \cdot B$ . Find arithmetic expressions for:

$$A \cdot B'$$

$$A + B$$

$$A' + B'$$

$$A \oplus B$$

where  $\oplus$  means exclusive or and is defined by the following truth table:

$A \setminus B$	0	1
0	0	1
1	1	0

4. The a la carte menu in a well known restaurant offers the following choices for desert:

*Coffee with either biscuits and either cheese or ice cream or fresh fruit or apple pie*

Clarify the meaning by formalising the statement into a proposition. Simplify it and put it back into words. (Your neighbour may not agree with your interpretation)

5. Prove de Morgan's theorem for any number of variables.