Truth Tables

Binary Logic

What do we know up to now?

- We know how to derive an output binary expression from a given …
- … Logic Circuit.

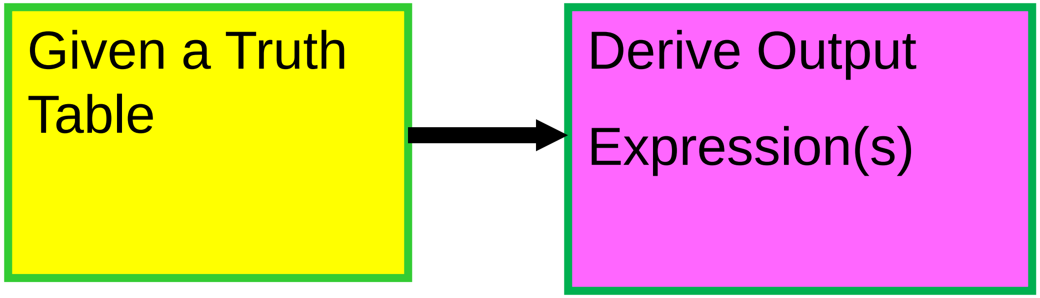
Today …

- We will learn how to derive an output binary expression from …
- … a Truth Table.

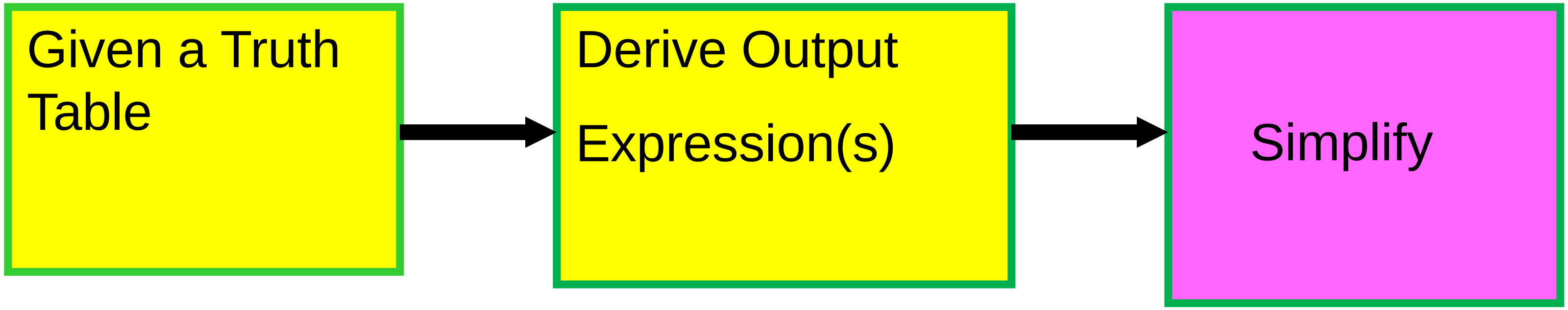
Truth Table

Given a Truth Table

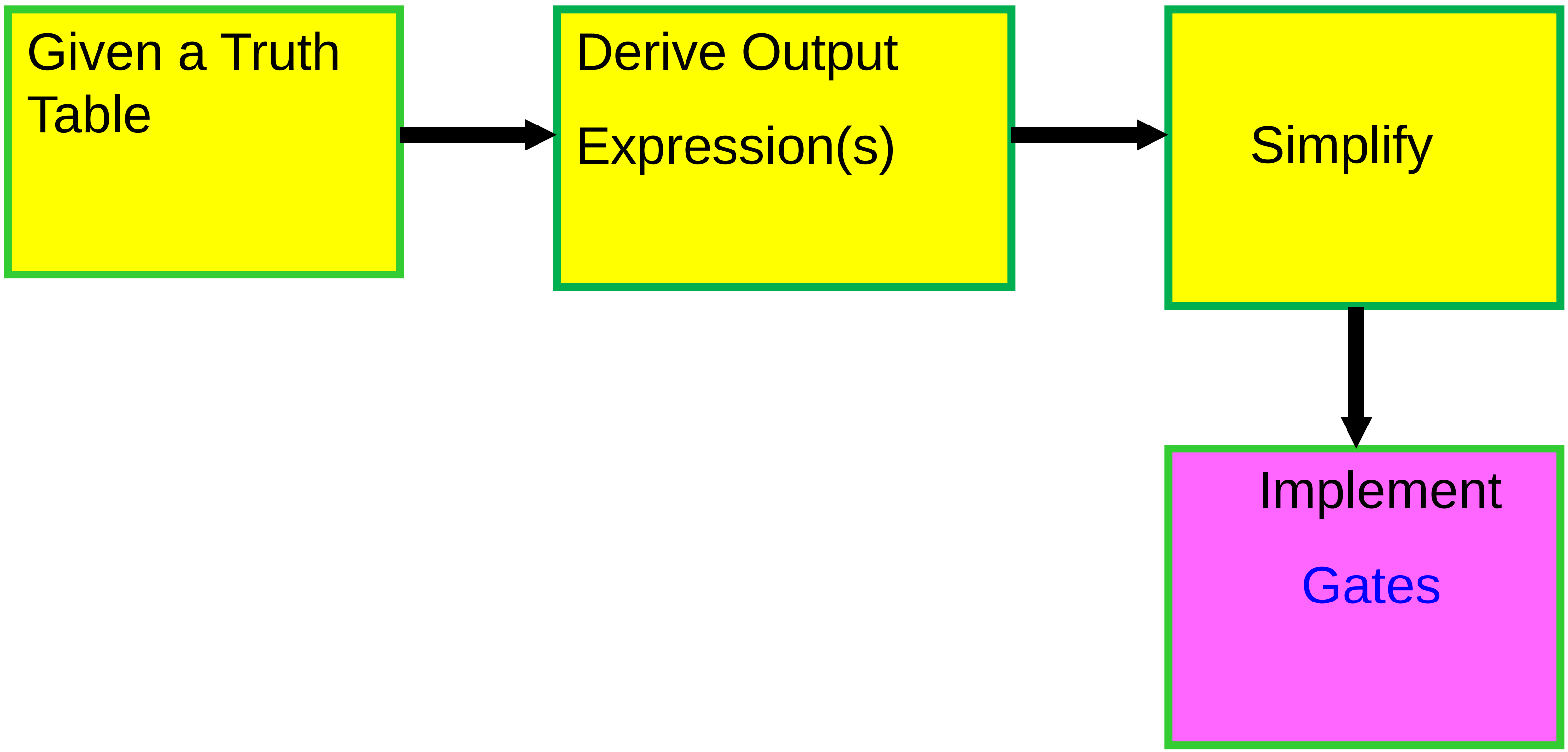
Output expressions …



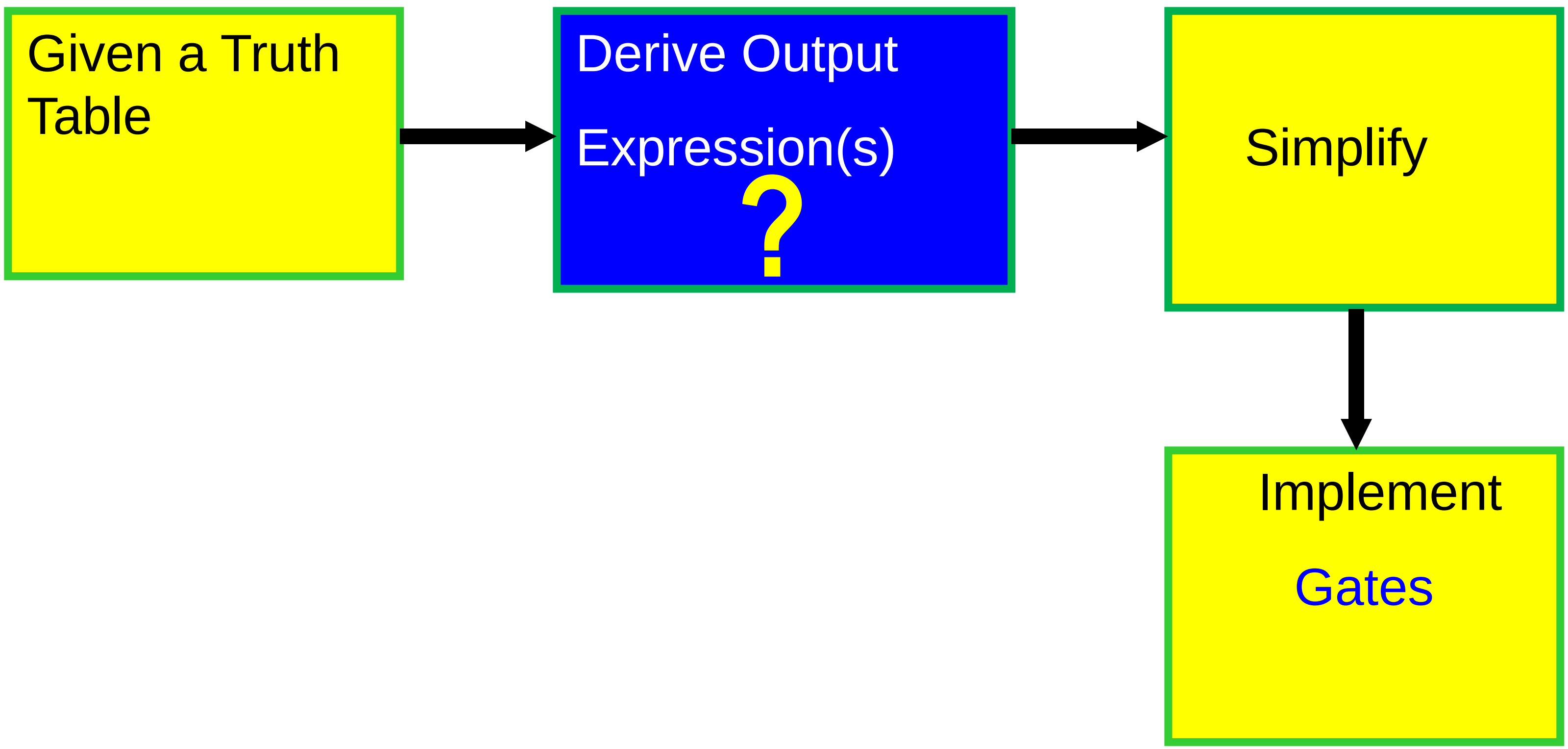
Simplify



Gates


Given a Truth Table
Derive Output Expression(s)
Simplify
Implement Gates

Truth Table → Simplified Circuit



How can we derive an output expression from a Truth Table?

Truth Table → Output logic expression(s)

Algorithm:

1. Write an AND term (Boolean expression) for each case in the truth table the output is logic 1
2. All the AND terms are then ORed together to produce the final output expression.

Example: Derive the Truth Table

Word Problem:

For a three-input (A,B,C) binary system. If we have more than one high(1) inputs the output (X) is 1, otherwise it is zero(0).

Example: Truth Table

A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

Word Problem:

For a three-input (A,B,C) binary system. If we have more than one high(1) inputs the output (X) is 1, otherwise it is zero(0).

Example: Truth Table: *Done*

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

Word Problem:
For a three-input (A,B,C) binary system. If we have more than one high(1) inputs the output (X) is 1, otherwise it is zero(0).

Example: Write Terms for X = 1

A	B	C	X	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	1	$\overline{A}\,B\,C$
1	0	0	0	
1	0	1	1	$A\,\overline{B}\,C$
1	1	0	1	$A\,B\,\overline{C}$
1	1	1	1	$A\,B\,C$

Example: Output expression

$$X = \overline{A}\,B\,C + A\,\overline{B}\,C + A\,B\,\overline{C} + A\,B\,C$$

A	B	C	X	
0	0	0	0	
0	0	1	0	
0	1	0	0	
0	1	1	1	$\overline{A}\,B\,C$
1	0	0	0	
1	0	1	1	$A\,\overline{B}\,C$
1	1	0	1	$A\,B\,\overline{C}$
1	1	1	1	$A\,B\,C$

SOP = Sum-Of-Products

Example: Simplify

$$X = \overline{A}\,B\,C + A\,\overline{B}\,C + A\,B\,\overline{C} + A\,B\,C$$

Lets simplify…

5 Minutes…

Simplification using Boolean Theorems

$$X = \overline{A}\,B\,C + A\,\overline{B}\,C + A\,B\,\overline{C} + A\,B\,C$$

$$= \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC + ABC + ABC$$

Note// $ABC = ABC + ABC + ABC$

Simplification using Boolean Theorems

$$X = \overline{A}\,B\,C + A\,\overline{B}\,C + A\,B\,\overline{C} + A\,B\,C$$

$$= \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC + ABC + ABC$$

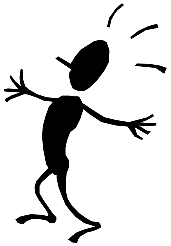
Result

$$X = \overline{A}\,B\,C + A\,\overline{B}\,C + A\,B\,\overline{C} + A\,B\,C$$

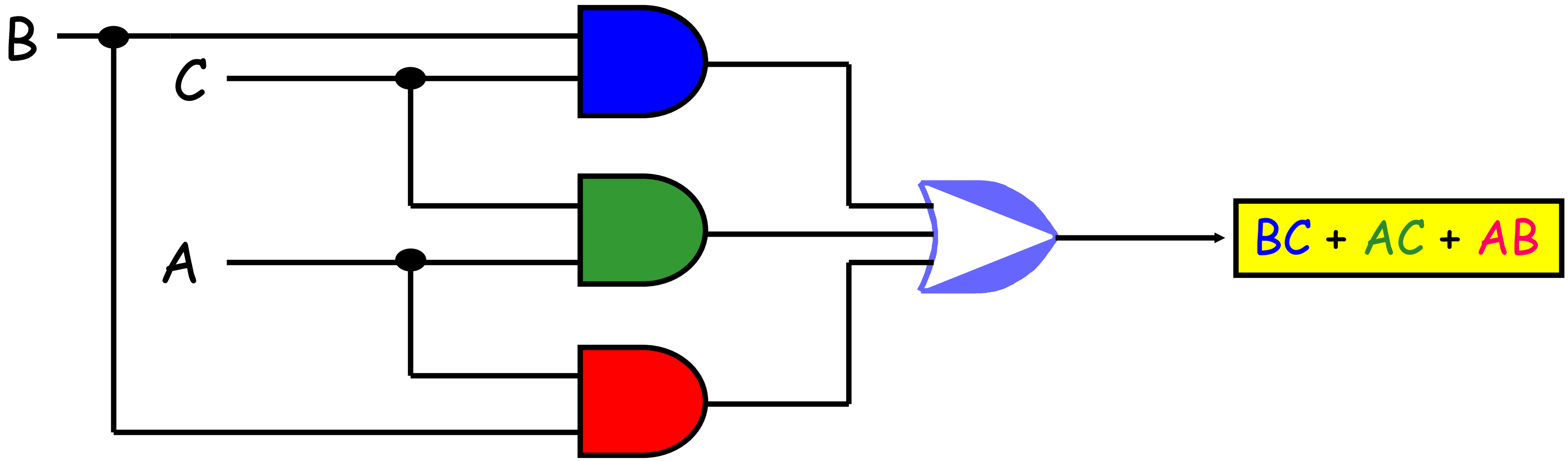
$$= \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC + ABC + ABC$$

$$= BC(\overline{A}+A) + AC(\overline{B}+B) + AB(\overline{C}+C)$$

$$= BC + AC + AB$$



Implementation: Logic Circuit



Conclusion

- The algebraic simplification procedure is very unsystematic … not easy to be implemented using a programming language

- Next a more systematic simplification procedure is presented.

END