Truth Tables

Binary Logic

What do we know up to now?

- We know how to derive the output expression from a given …
- … Logic Circuit

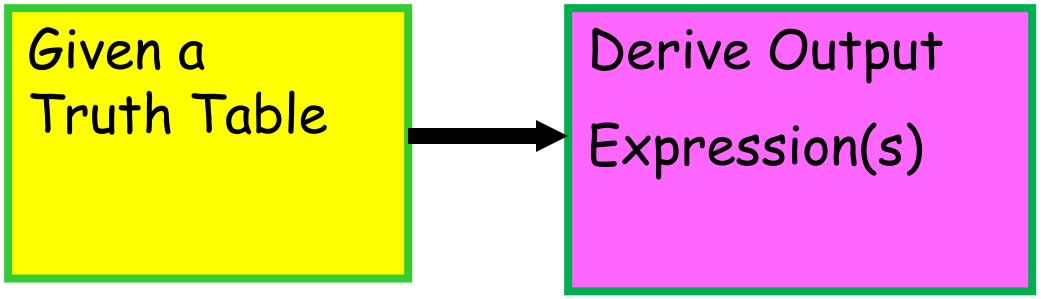
Today …

- We will learn how to derive the output expression from …
- … a Truth Table

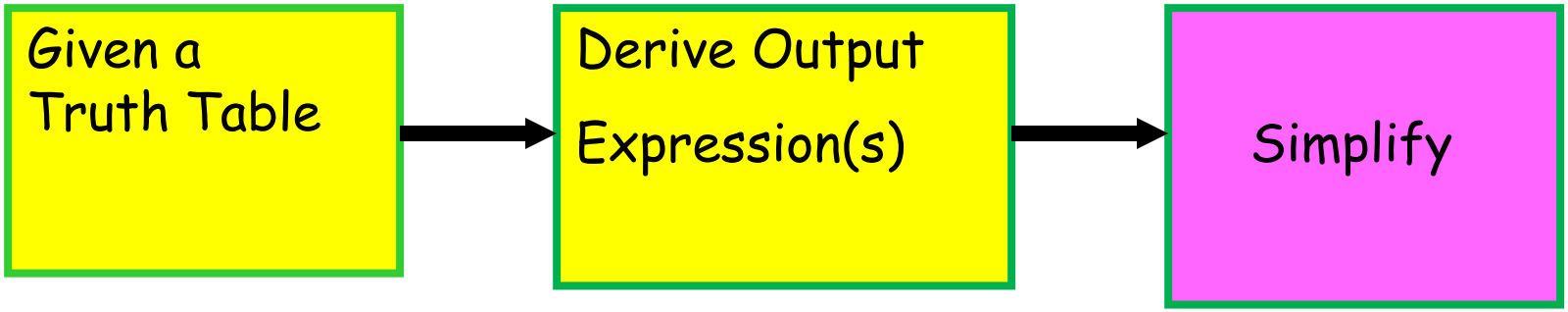
Truth Table

Given a
Truth Table

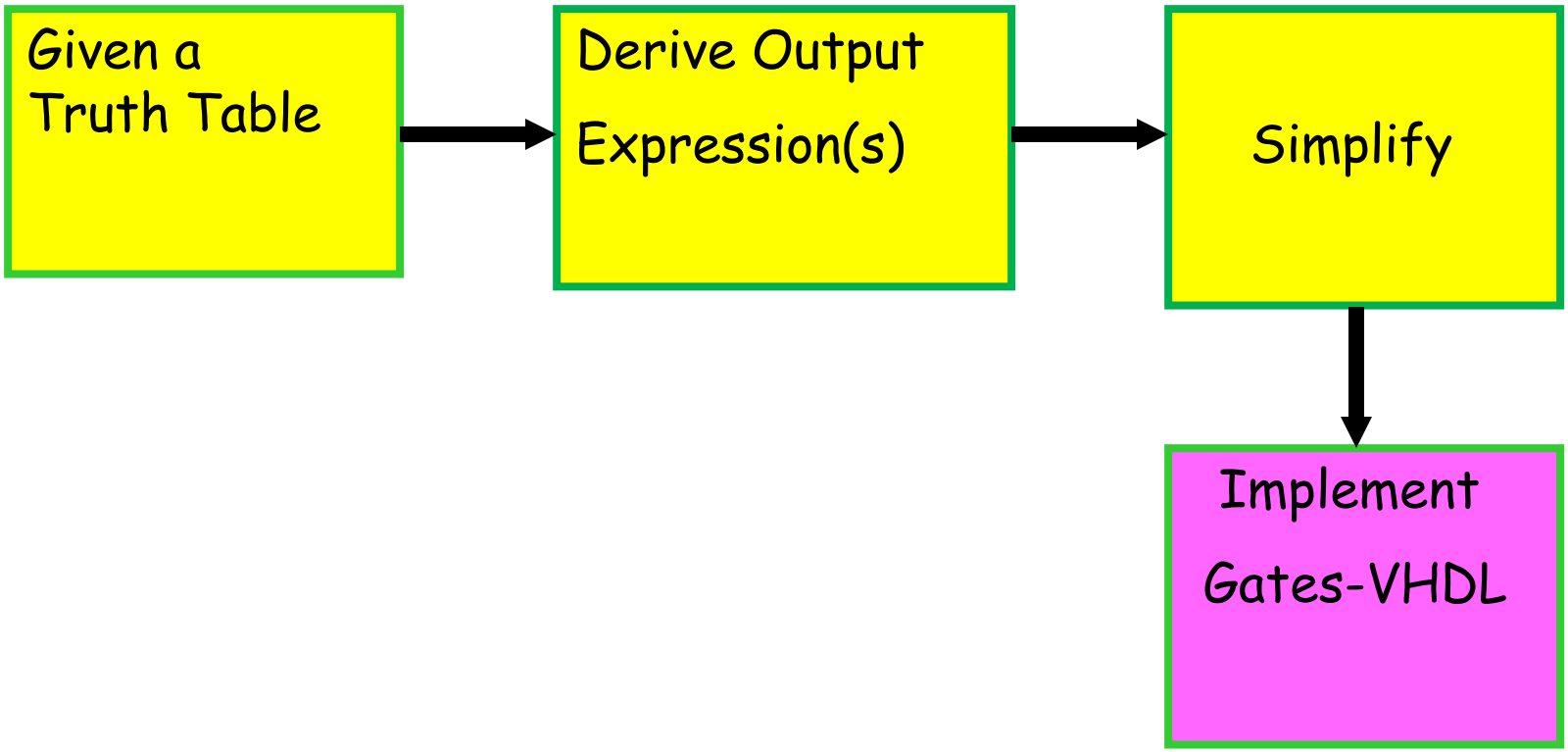
Output expressions …



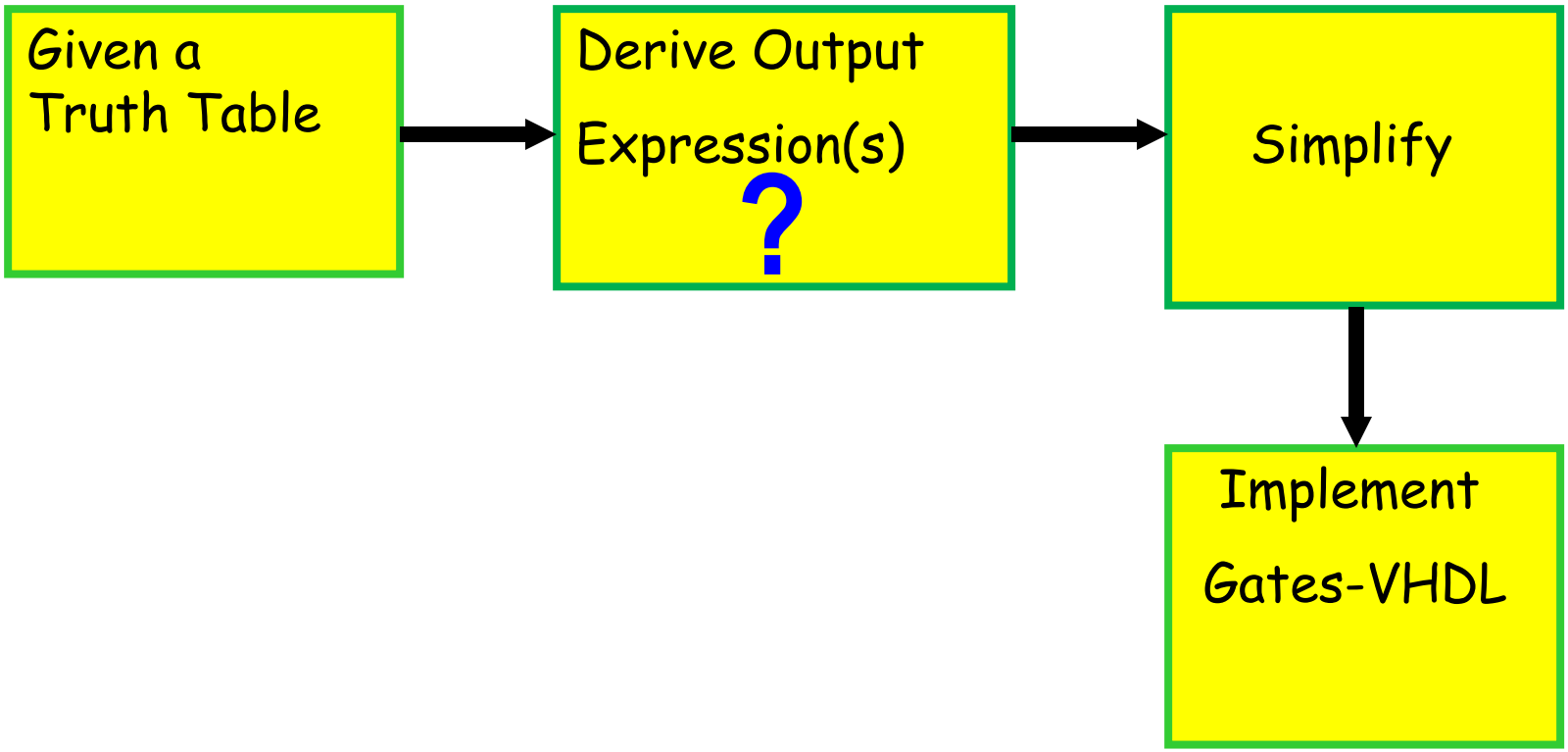
Simplify



Gates and VHDL



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

Derive the Truth Table; Word Problem

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 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 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 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

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

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

$\overline{A}\,B\,C$

$A\,\overline{B}\,C$

$A\,B\,\overline{C}$

$A\,B\,C$

Example: Sum-of-Product (SOP)

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

SOP = Sum-Of-Products

Let us simplify the above expression …

Example: Simplify

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

5 Minutes …

Simplification using Boolean Theorems

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

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

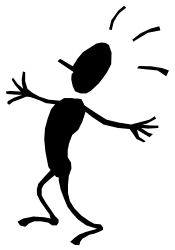
Result

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

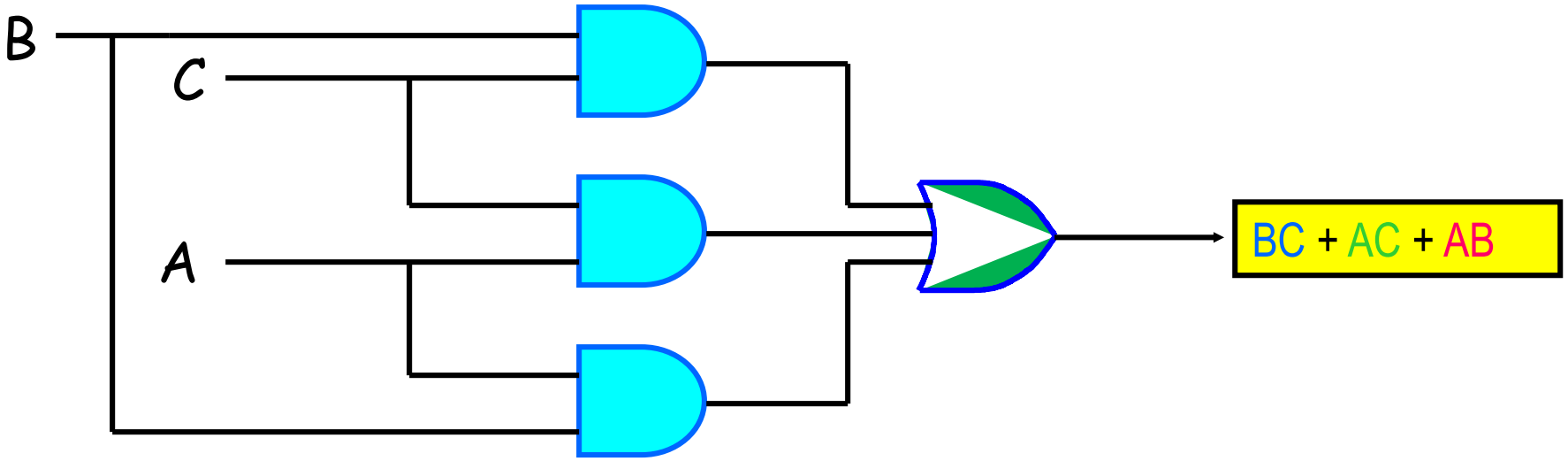
$$= \overline{A}BC + A\overline{B}C + AB\overline{C} + ABC + ABC + ABC$$

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

$$= BC + AC + AB$$



Implementation: Logic Circuit



Conclusion

- The algebraic simplification procedure is very unsystematic …
- A systematic method will be studied next semester (CMPT281)

END