

ACOL 215

(30th Sept.)

Combinational logic

logic circuits for digital
systems may be

Combinational

the outputs are
a function of only the
current inputs

Sequential

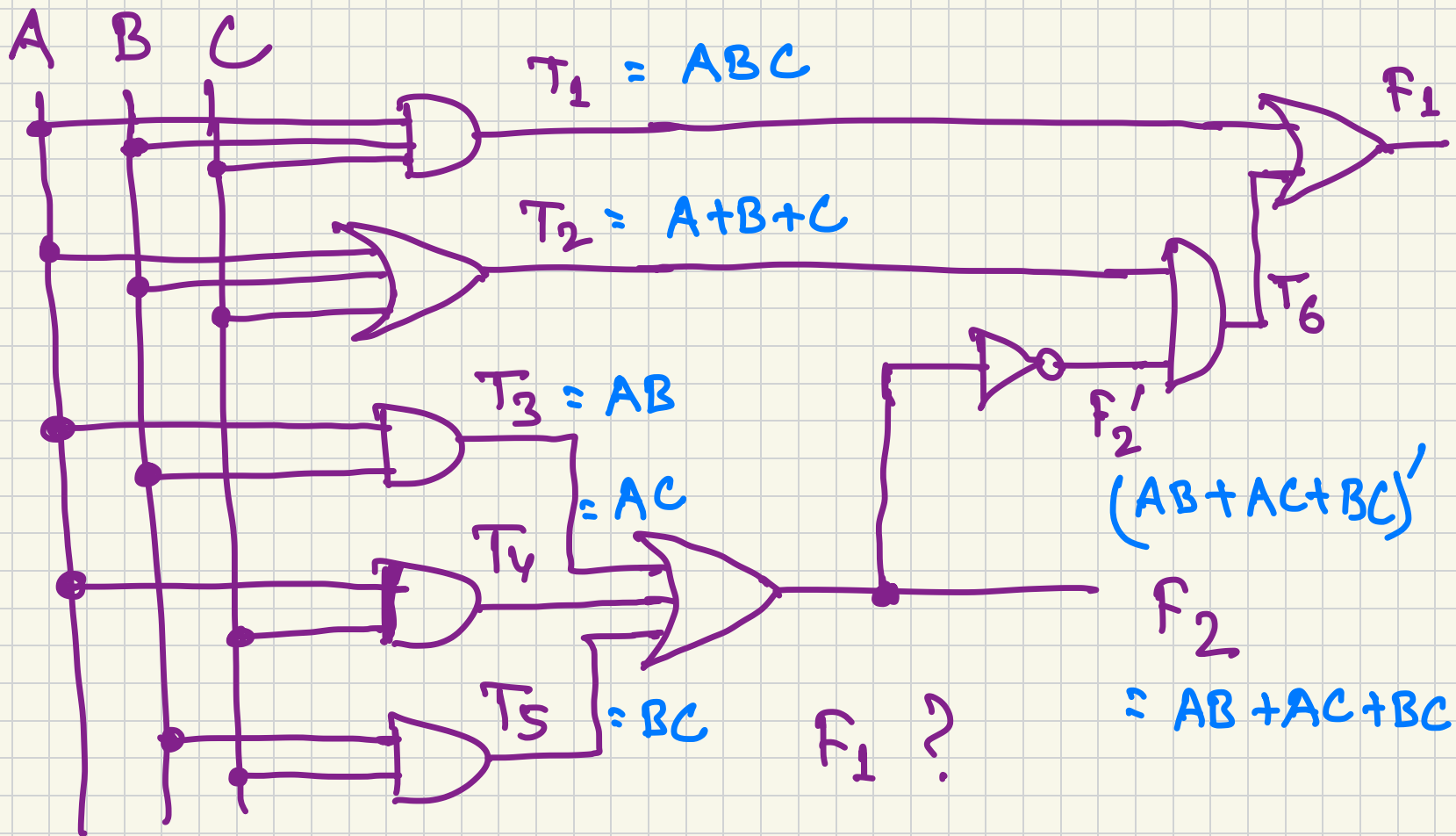
has a storage
element
so the output depends
on current as well
as previous input

We are interested in

|| 1) Analyzing the behaviour of
a given circuit

2) Synthesizing a circuit that has
(will have) a given
behaviour.

|| determining the functionality
↳ as a Boolean algebra expression
Truth table



$$\begin{aligned}
T_6 &= T_2 F_2' \\
&= (A+B+C) (AB+BC+AC)' \\
&= \underline{(A+B+C)} (\underline{(A'+B')}(B'+C')(A'+C')) \\
&= (AB' + \underline{BA' + CA' + CB'}) (\underline{B'+C'}) (A'+C') \\
&= (AB' + AB'C' + BA'C' + CA'B' + CB') (A'+C') \\
&= AB'C' + AB'C' + BA'C' + CA'B' + CA'B' \\
&= \underline{AB'C'} + A'BC' + A'B'C + \underline{+ABC} \quad F_1
\end{aligned}$$

AB C	T_3	T_4	T_5	$T_3+T_4+T_5$ F_2	F_2'	$A+B+C$ T_2	T_6	T_1	F_1
0 0 0	0	0	0	0	1	0	0	0	0
0 0 1	0	0	0	0	1	1	1	0	<u>1</u> <u>$A'B'C'$</u>
0 1 0	0	0	0	0	1	1	1	0	<u>1</u> <u>$A'BC'$</u>
0 1 1	0	0	1	1	0	1	0	0	0
1 0 0	0	0	0	0	1	1	1	0	<u>1</u> <u>$AB'C'$</u>
1 0 1	0	1	0	1	0	1	0	0	0
1 1 0	1	0	0	1	0	1	0	0	0
1 1 1	1	1	1	1	0	1	0	1	<u>1</u> <u><u><u>ABC</u></u></u>

How to design a combinational circuit?

BCD

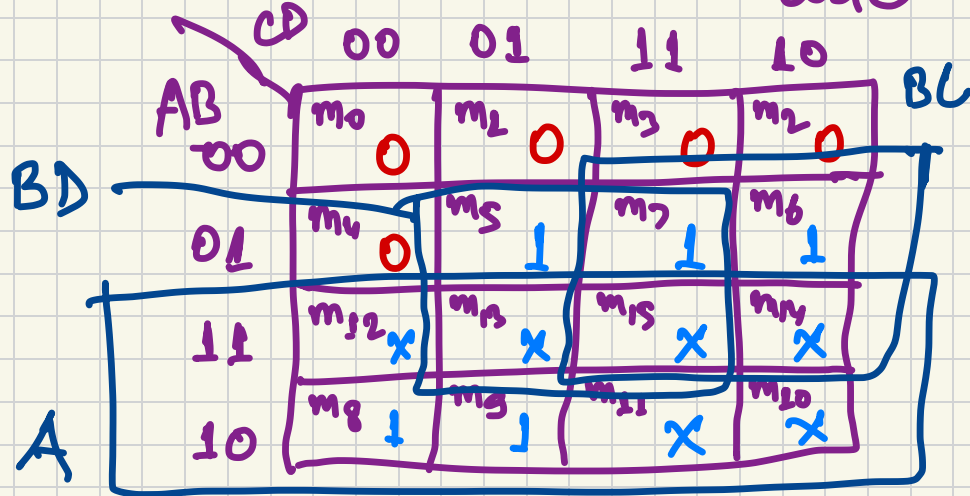
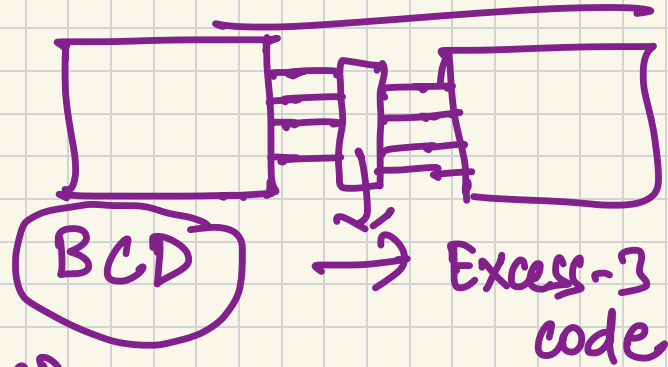
Excess-3 code

Code converter

	<u>ABCD</u>
0	0000
1	0001
2	0010
3	0011
4	0100
5	0101
6	0110
7	0111
8	1000
9	1001

	<u>wxyz</u>
	0011
	0100
	0101
	0110
	0111
	1000
	1001
	1010
	1011
	1100

$$w = A + BC + BD$$



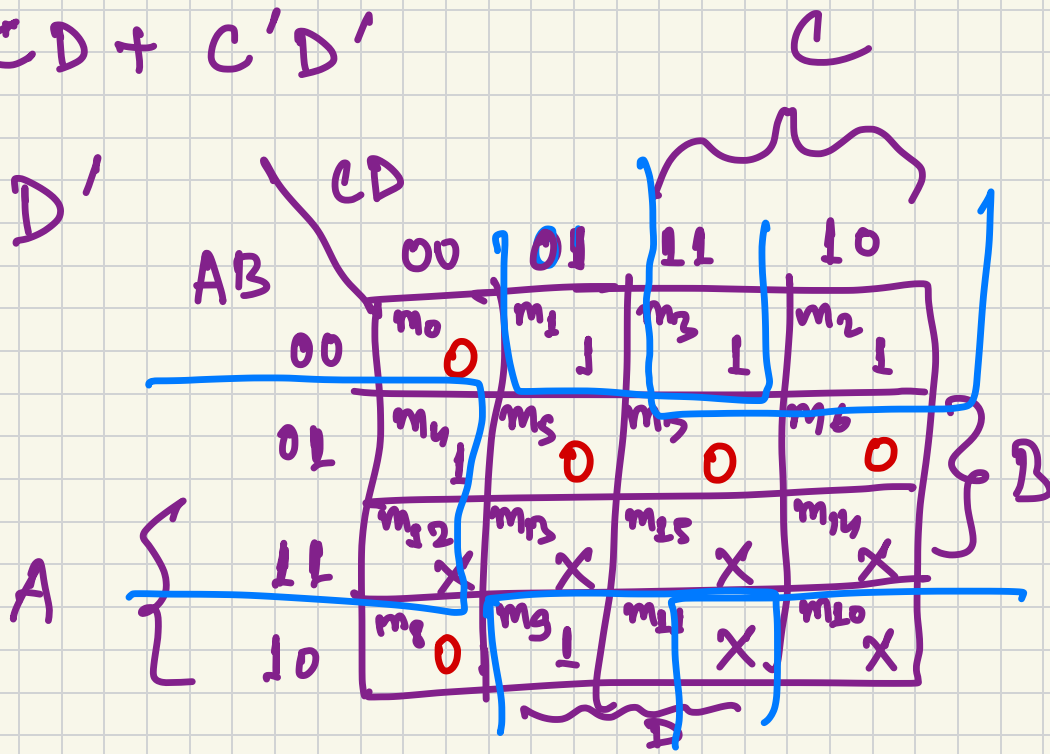
$$W = A + BC + BD$$

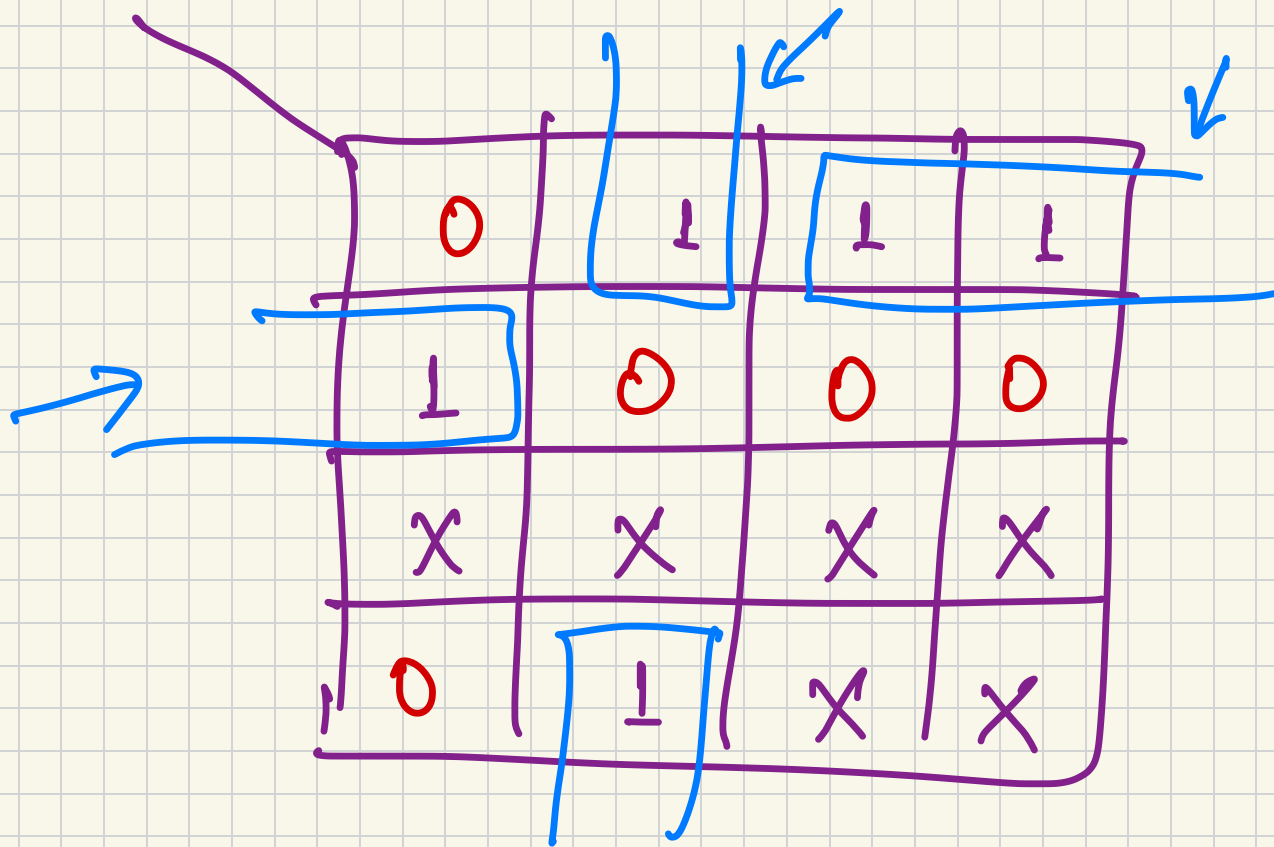
$$x = B'C + B'D + BC'D'$$

$$y = CD + C'D'$$

$$z = D'$$

$$\left. \begin{array}{l} B'D + B'C \\ + BC'D' \end{array} \right\} x$$





$$W = A + BC + BD$$

$$= A + B(C+D)$$

$$x = B'C + B'D + BC'D'$$

$$= B'(C+D) + BC'D'$$

$$y = CD + C'D'$$

$$= B'(C+D) + B(C+D)'$$

$$= CD + (C+D)'$$

$$z = D'$$

$$= D'$$

