

Foundations of Computer Science

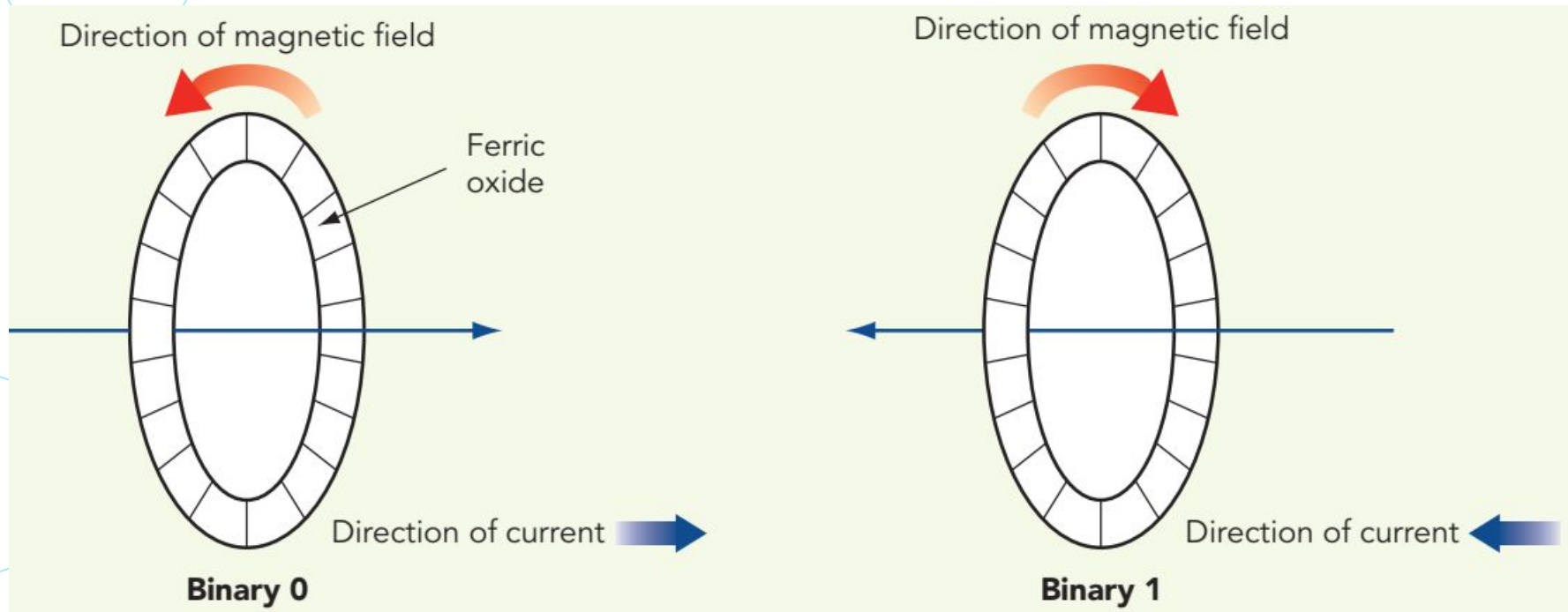
Hardware World

ONE LOVE. ONE FUTURE.

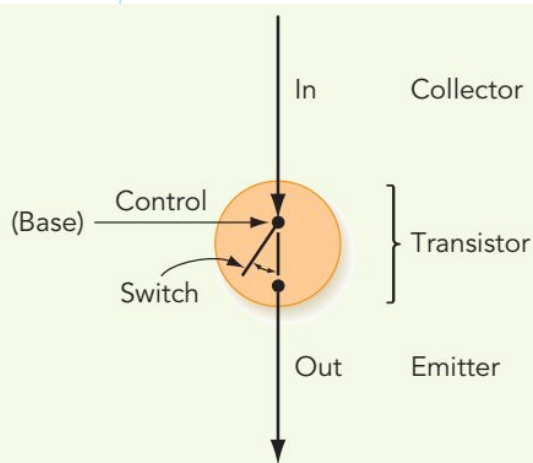
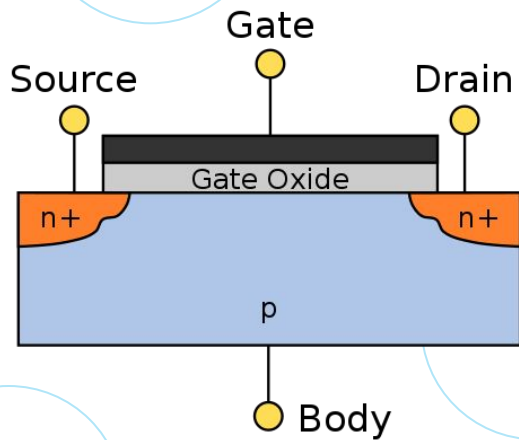
Contents

- Binary Storage
- Boolean Logic
- Logic Gates
- Computer Circuit

HUST



Transistor



Power supply (+5 V)

1
(switch closed)

Measuring device

ON state
Binary 1

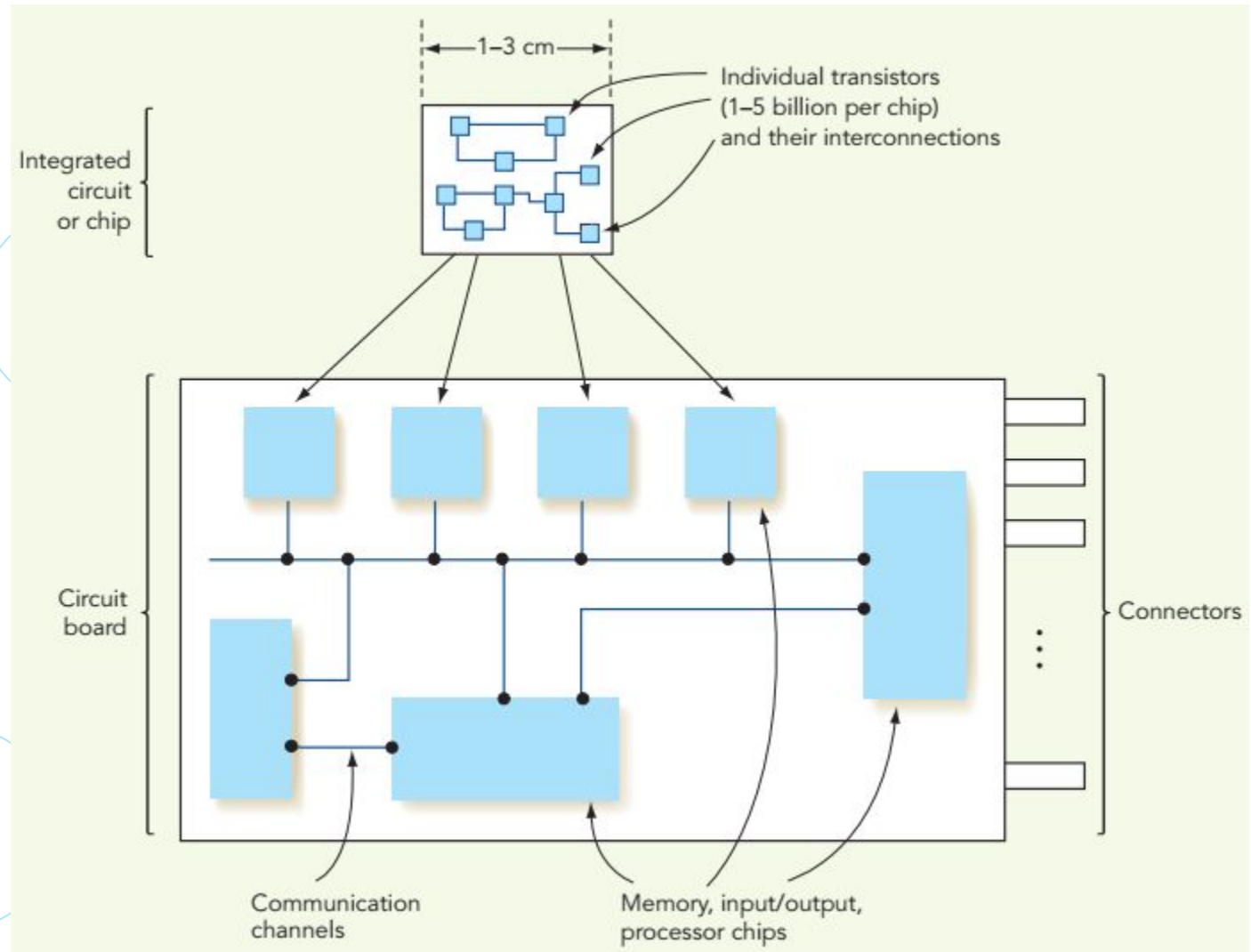
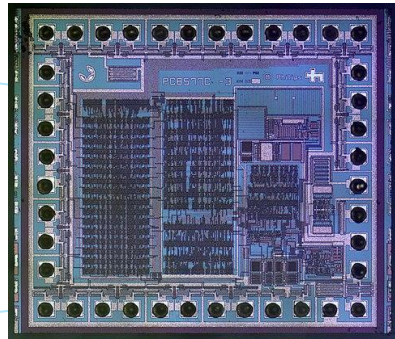
Power supply (+5 V)

0
(switch open)

Measuring device

OFF state
Binary 0

Integrated Circuit



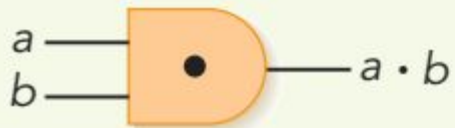
Processor	Transistor Count	Date
Intel 404	2,300	1971
Intel 8080	4,500	1974
Intel 8088	29,000	1979
Intel 80286	134,000	1982
Intel 80386	275,000	1985
Intel 80486	1,200,000	1989
Pentium	3,100,000	1993
Pentium II	7,500,000	1997
Pentium 4	42,000,000	2000
Itanium 2	220,000,000	2003
Dual-Core Itanium 2	1,400,000,000	2006
Quad-Core Itanium Tukwila	2,000,000,000	2008
nVidia GeForce 6800 Ultra	3,000,000,000	2011
62-core Xeon Phi	5,000,000,000	2015

Inputs		Output $a \text{ AND } b$ (also written $a \cdot b$)
a	b	
False	False	False
False	True	False
True	False	False
True	True	True

Inputs		Output $a \text{ OR } b$ (also written $a + b$)
a	b	
False	False	False
False	True	True
True	False	True
True	True	True

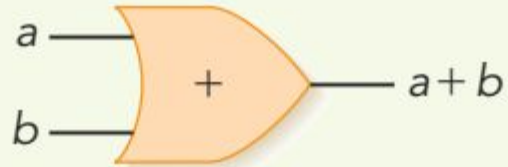
Input a	Output $\text{NOT } a$ (also written $\bar{a}$)
False	True
True	False

AND gate



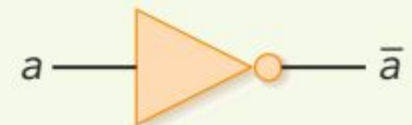
a	b	$a \cdot b$
0	0	0
0	1	0
1	0	0
1	1	1

OR gate



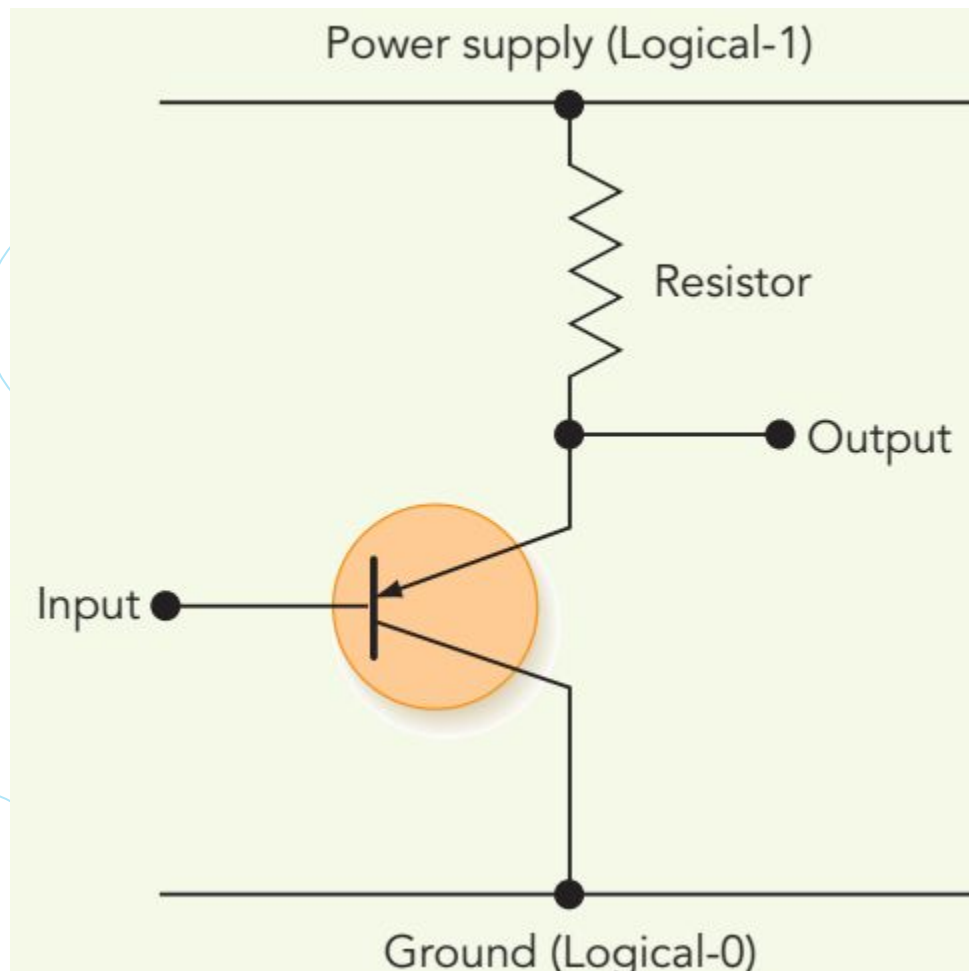
a	b	$a + b$
0	0	0
0	1	1
1	0	1
1	1	1

NOT gate

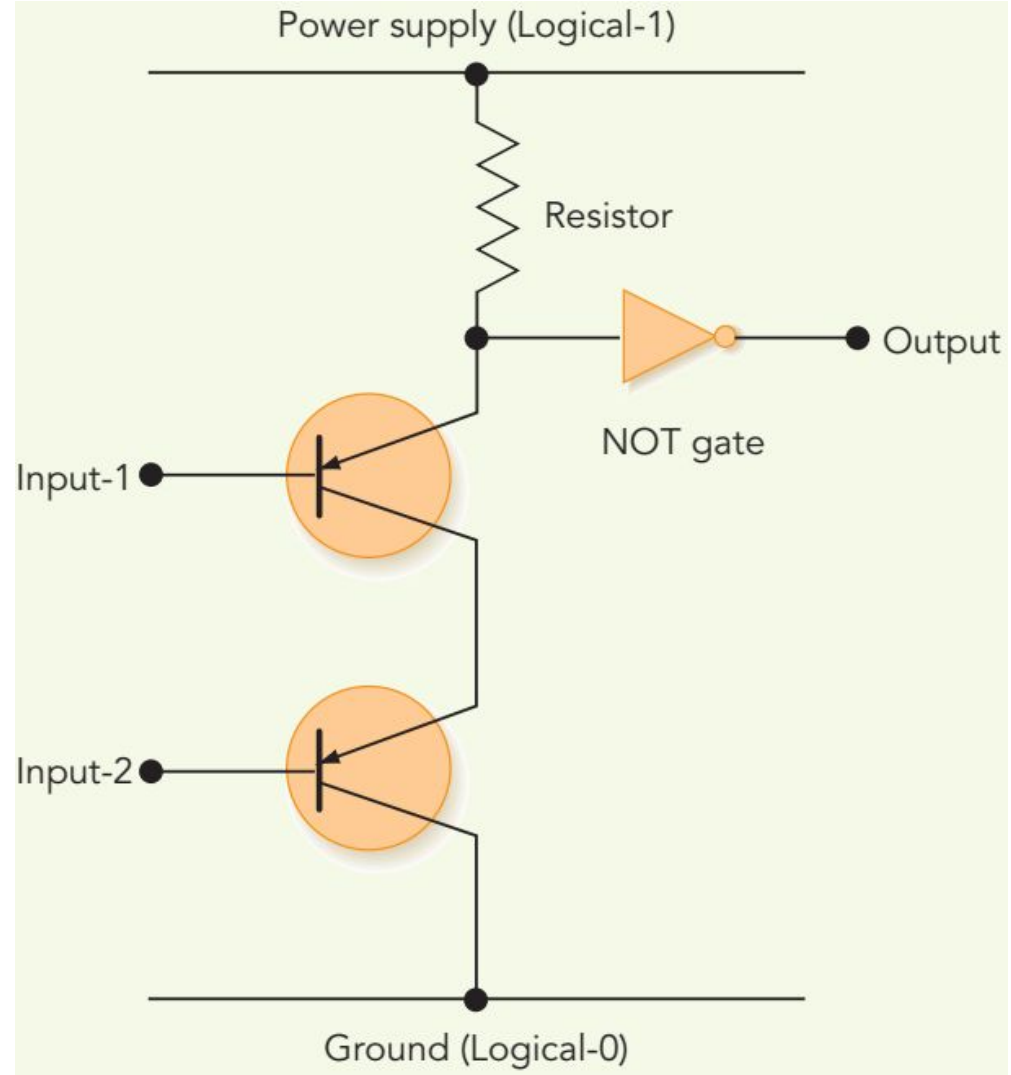
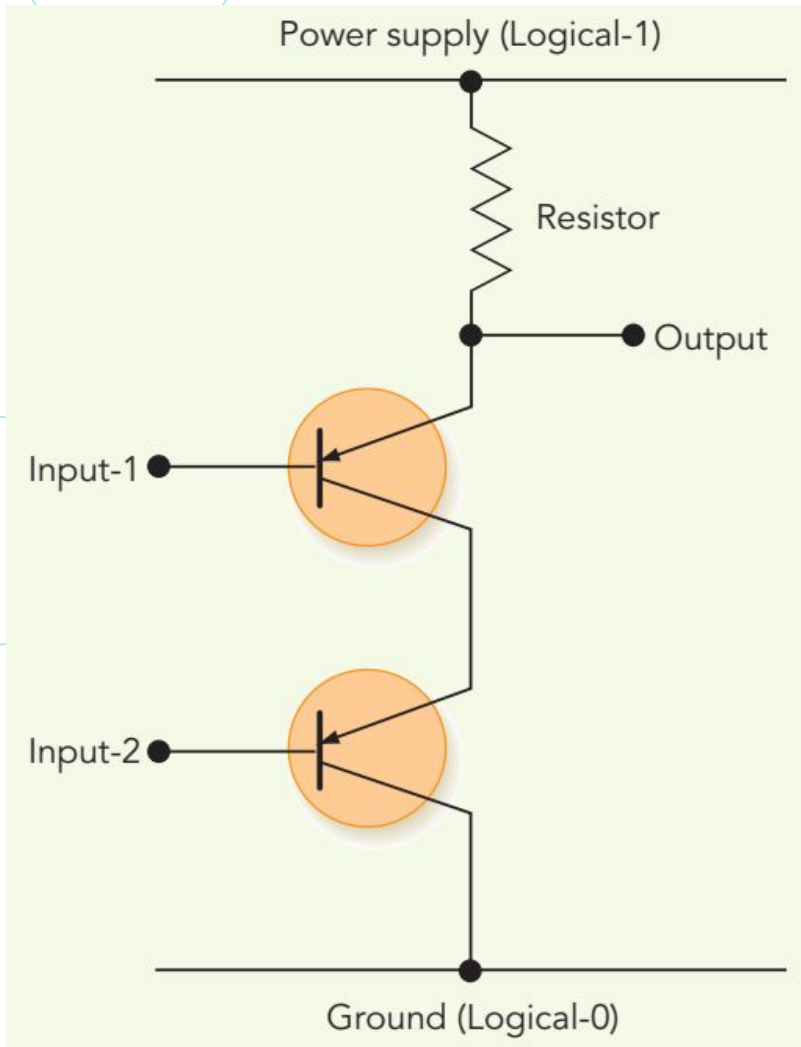


a	$\bar{a}$
0	1
1	0

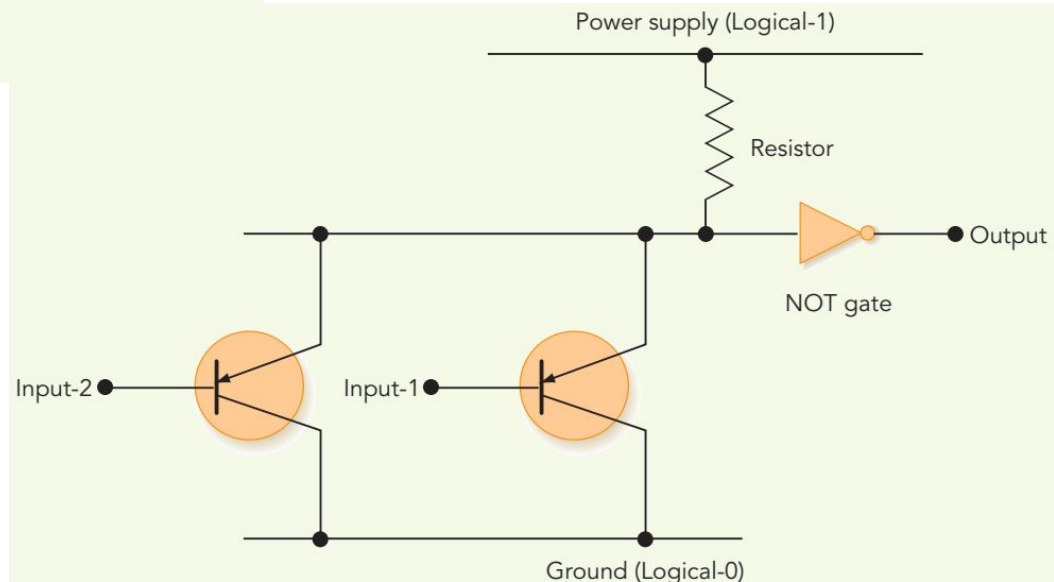
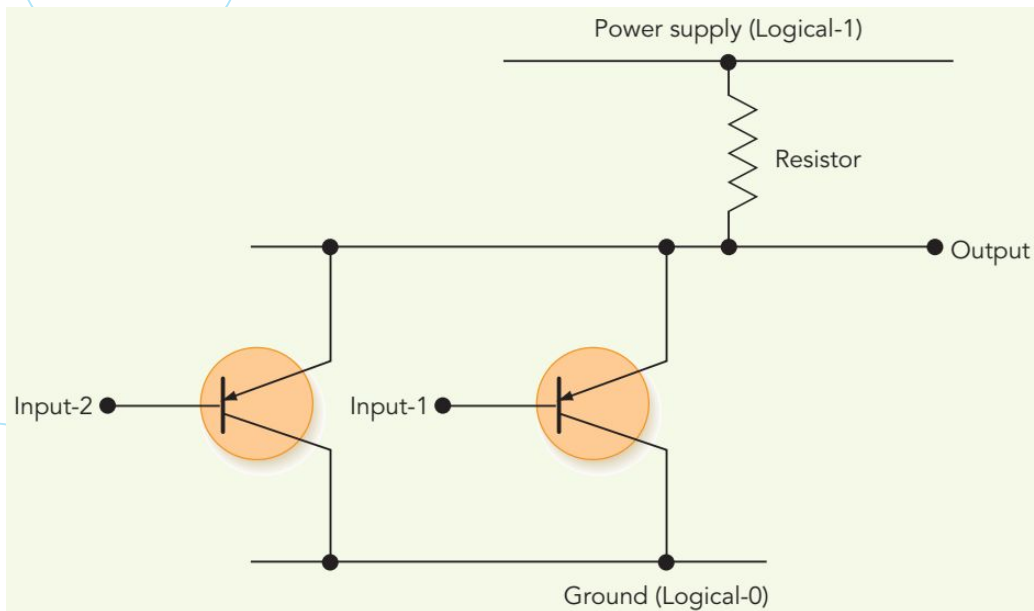
NOT Gate

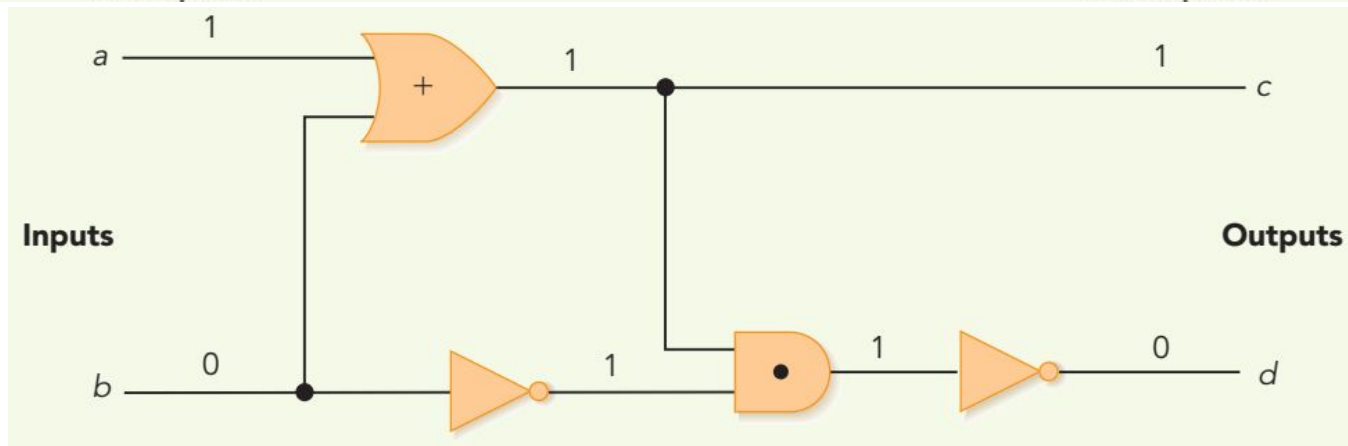
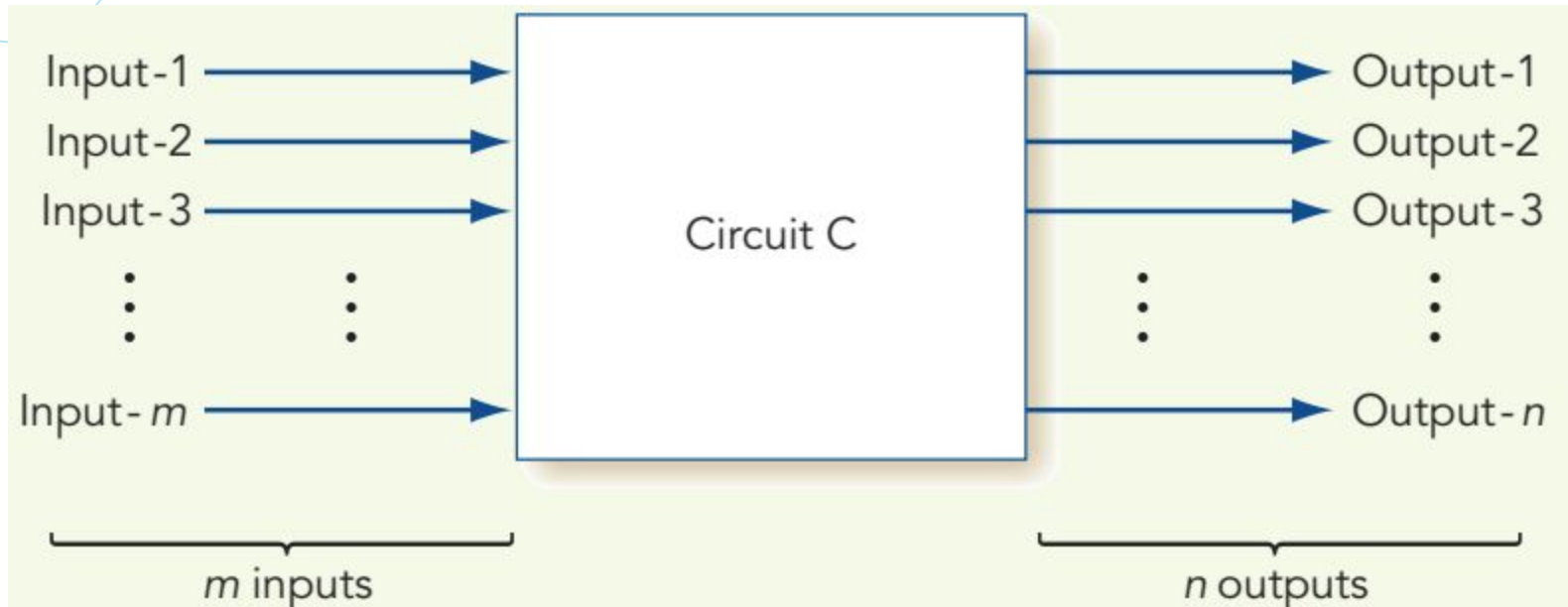


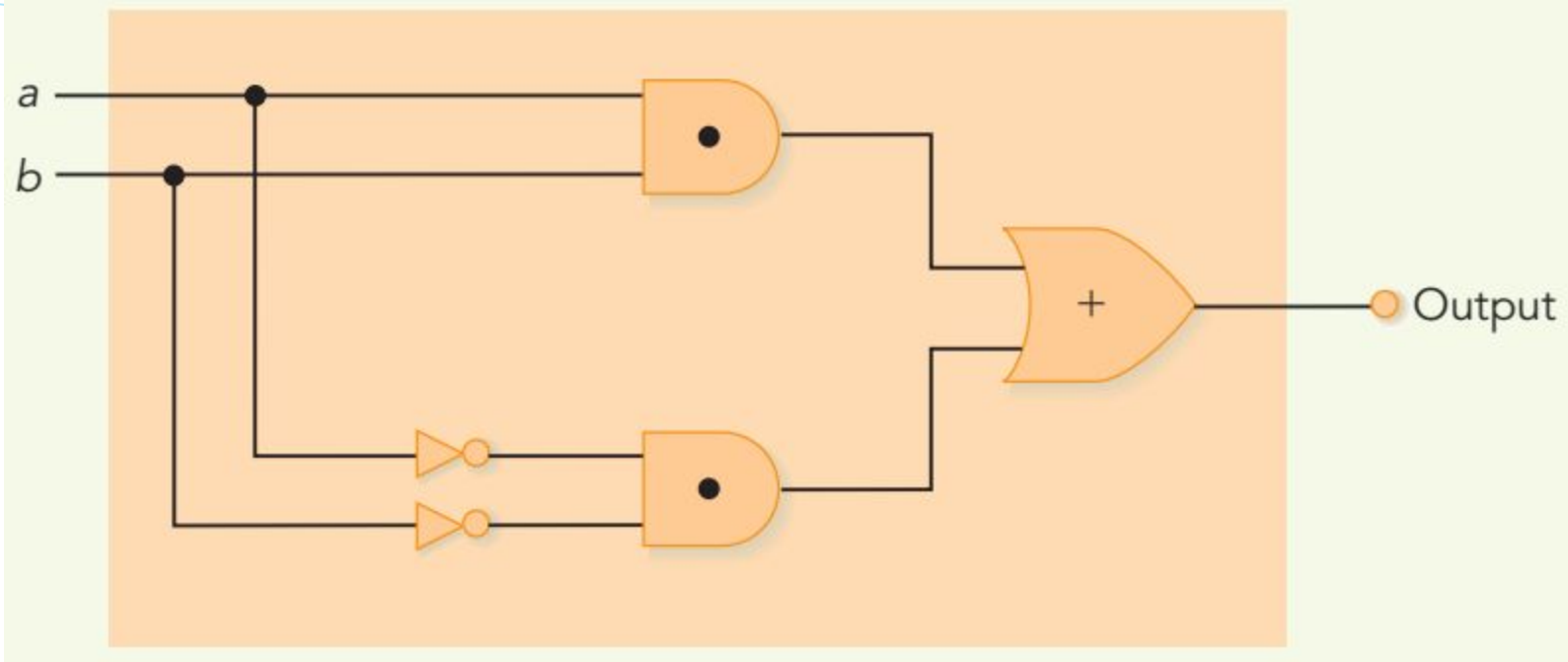
NAND Gate and AND Gate

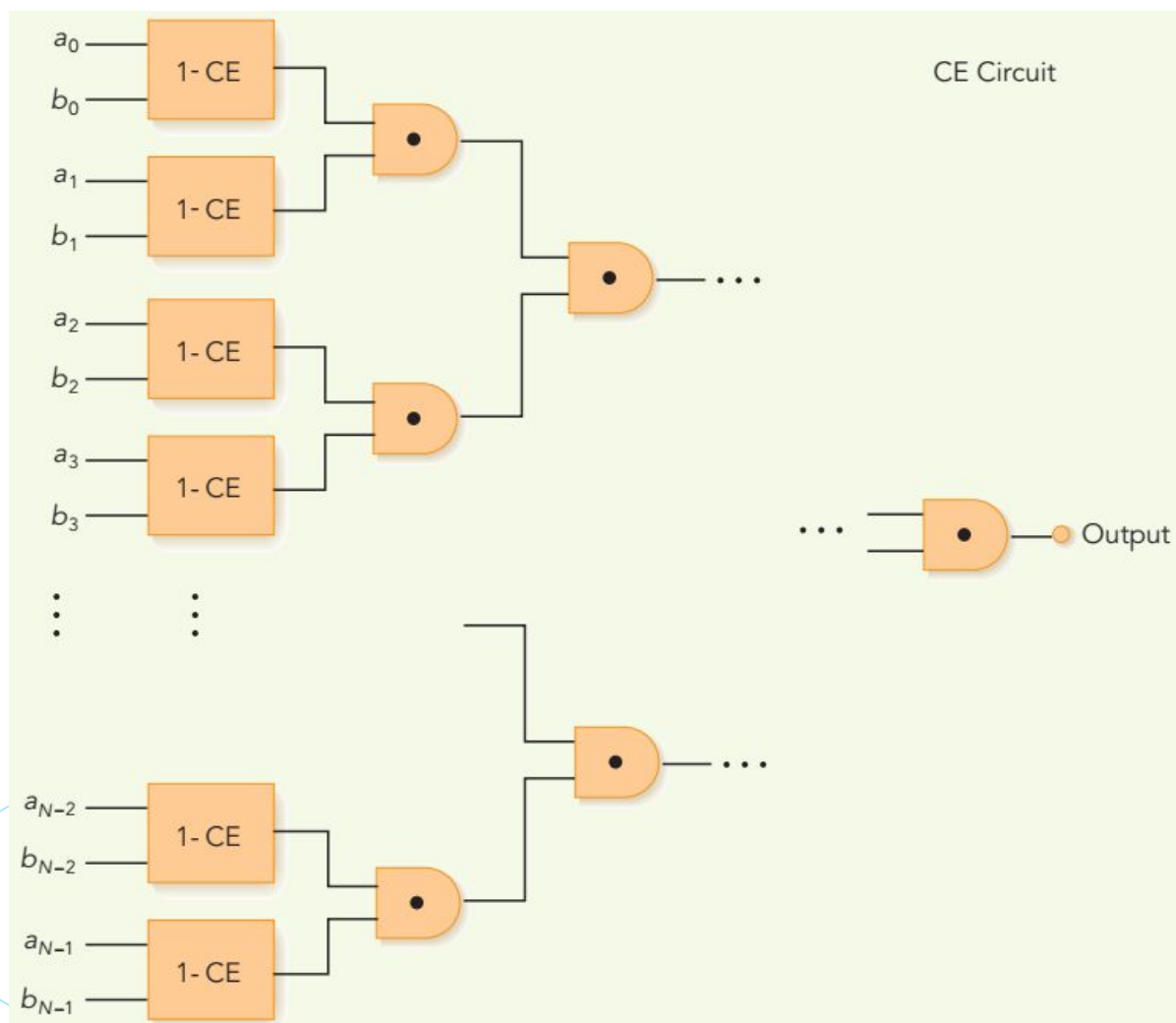


NOR Gate and OR Gate

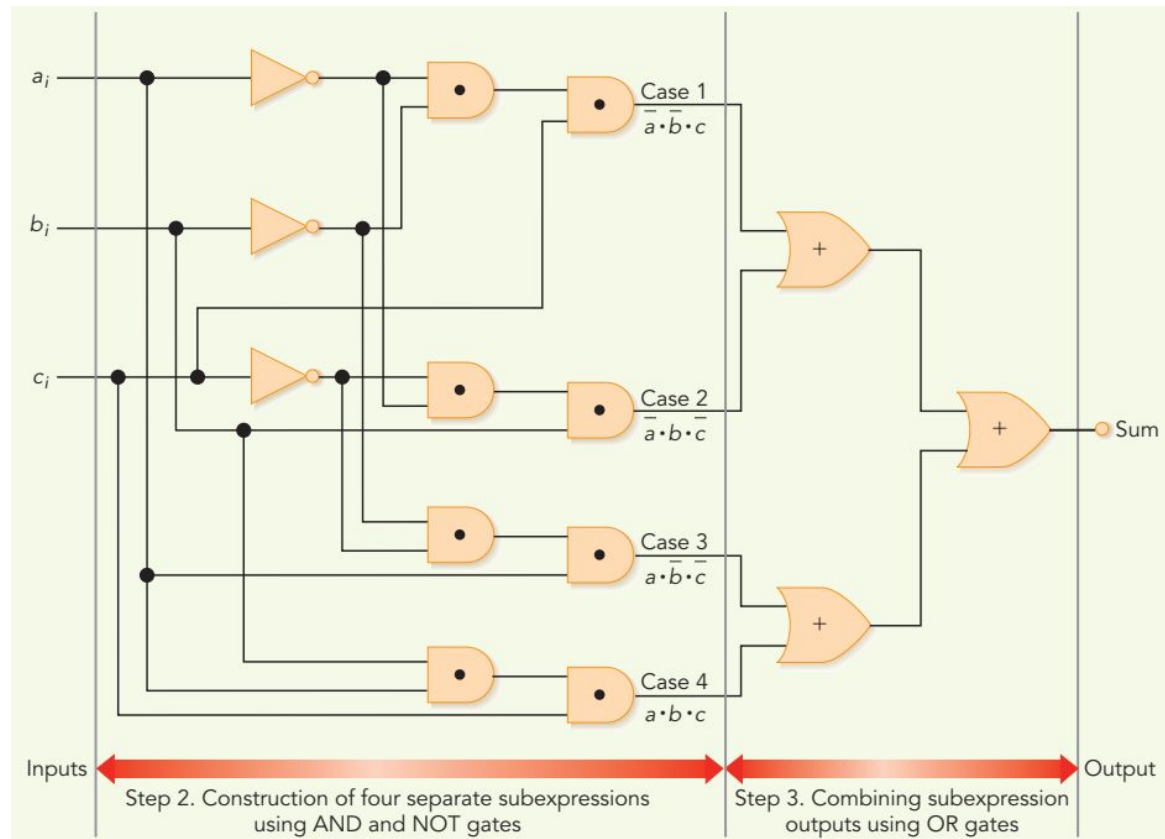
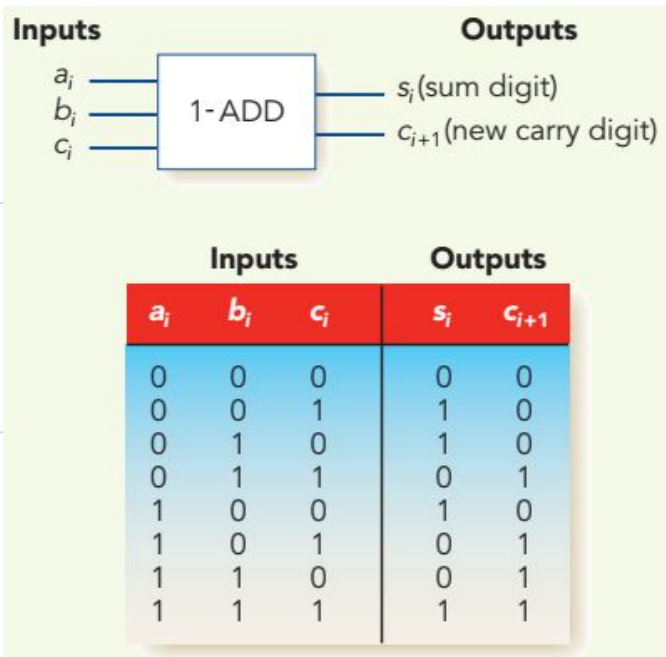






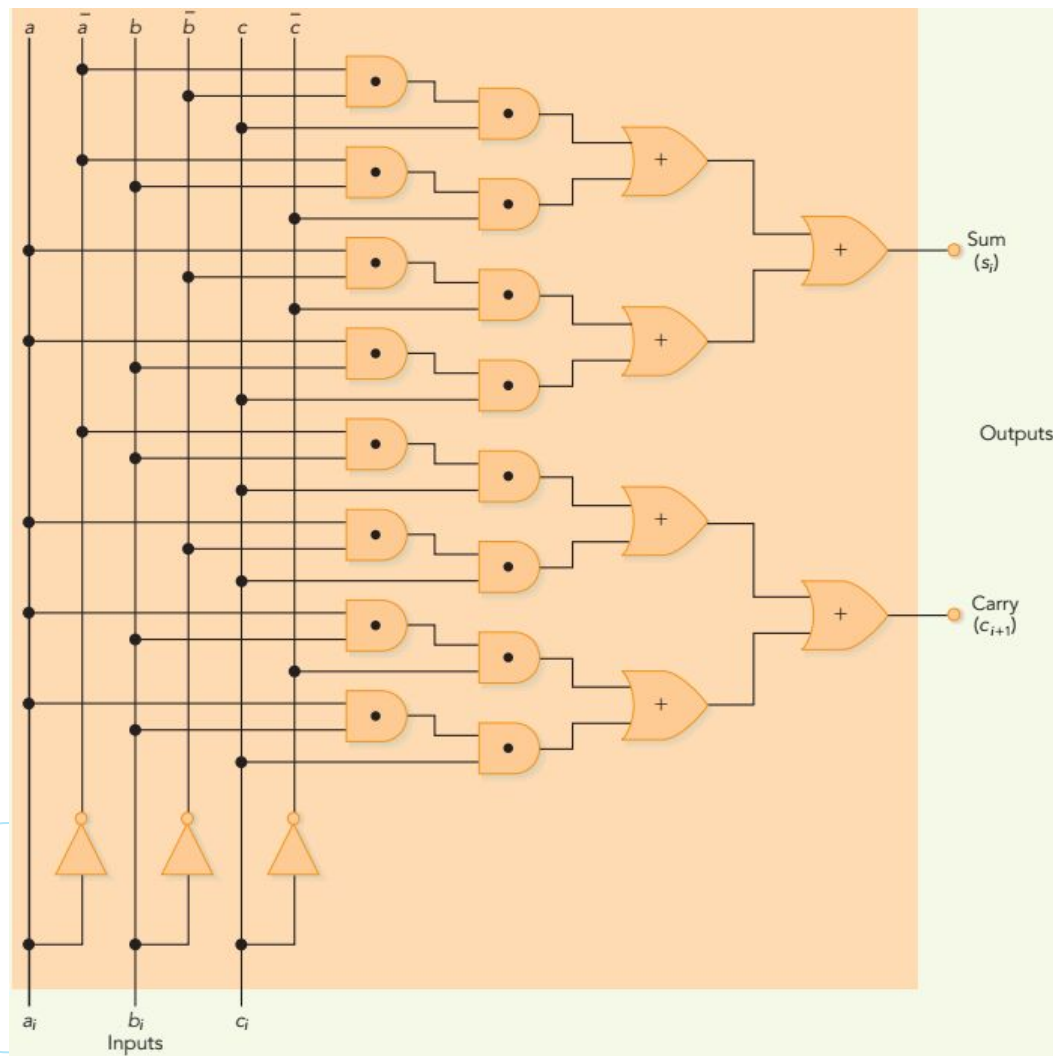


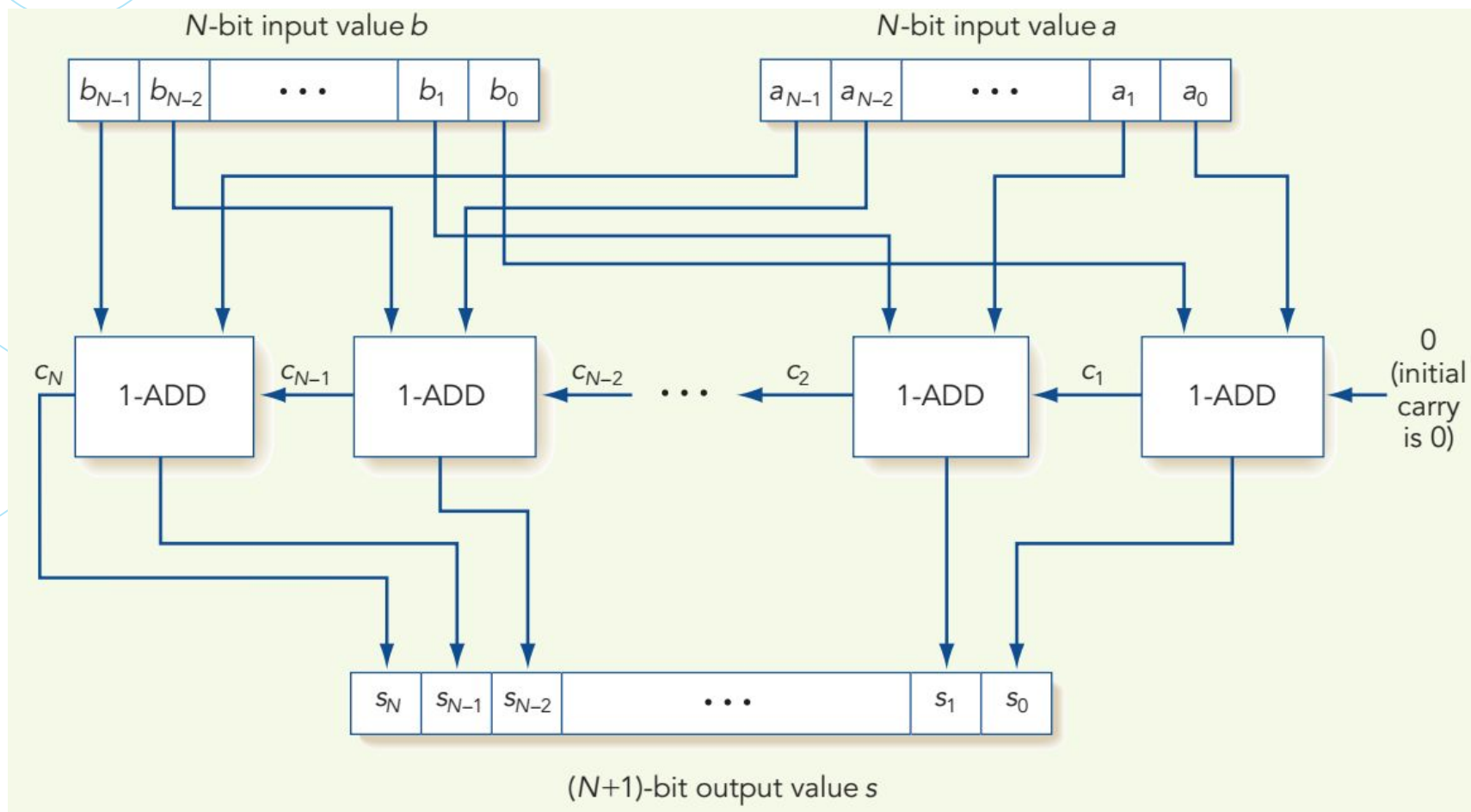
Bit Add Circuit



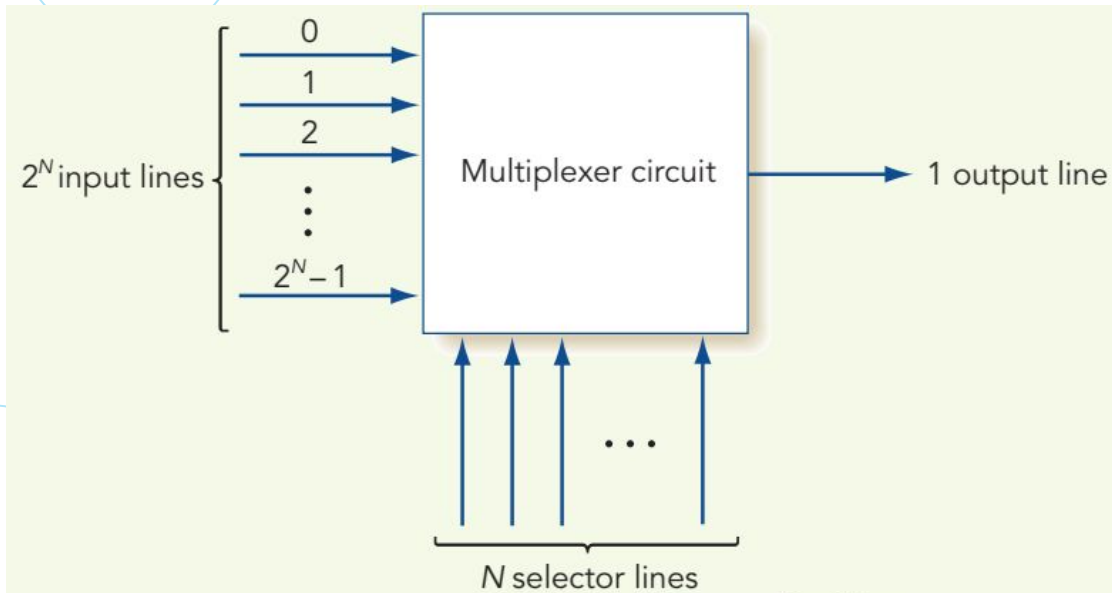
1. Construct the truth table describing the behavior of the desired circuit
2. While there is still an output column in the truth table, do Steps 3 through 6
3. Select an output column
4. Subexpression construction using AND and NOT gates
5. Subexpression combination using OR gates
6. Circuit diagram production
7. Done

Full 1-Add Circuit

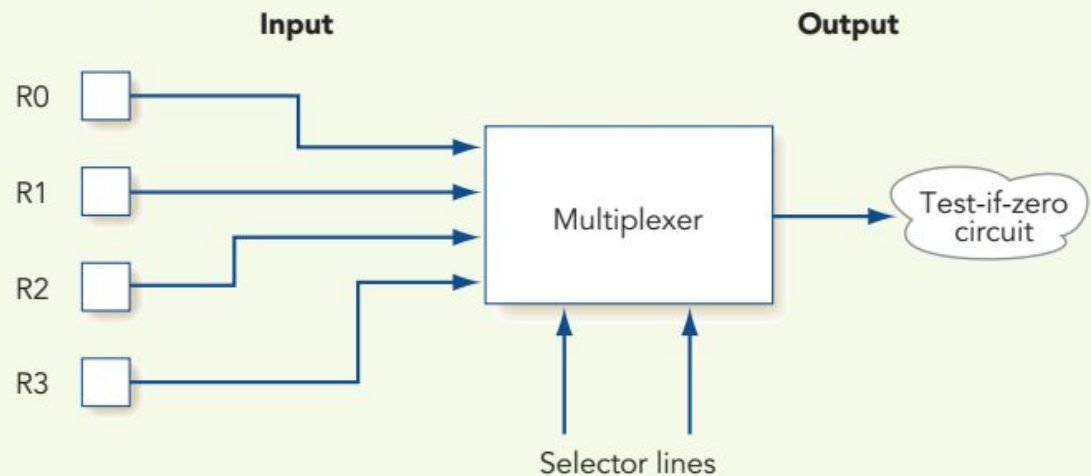


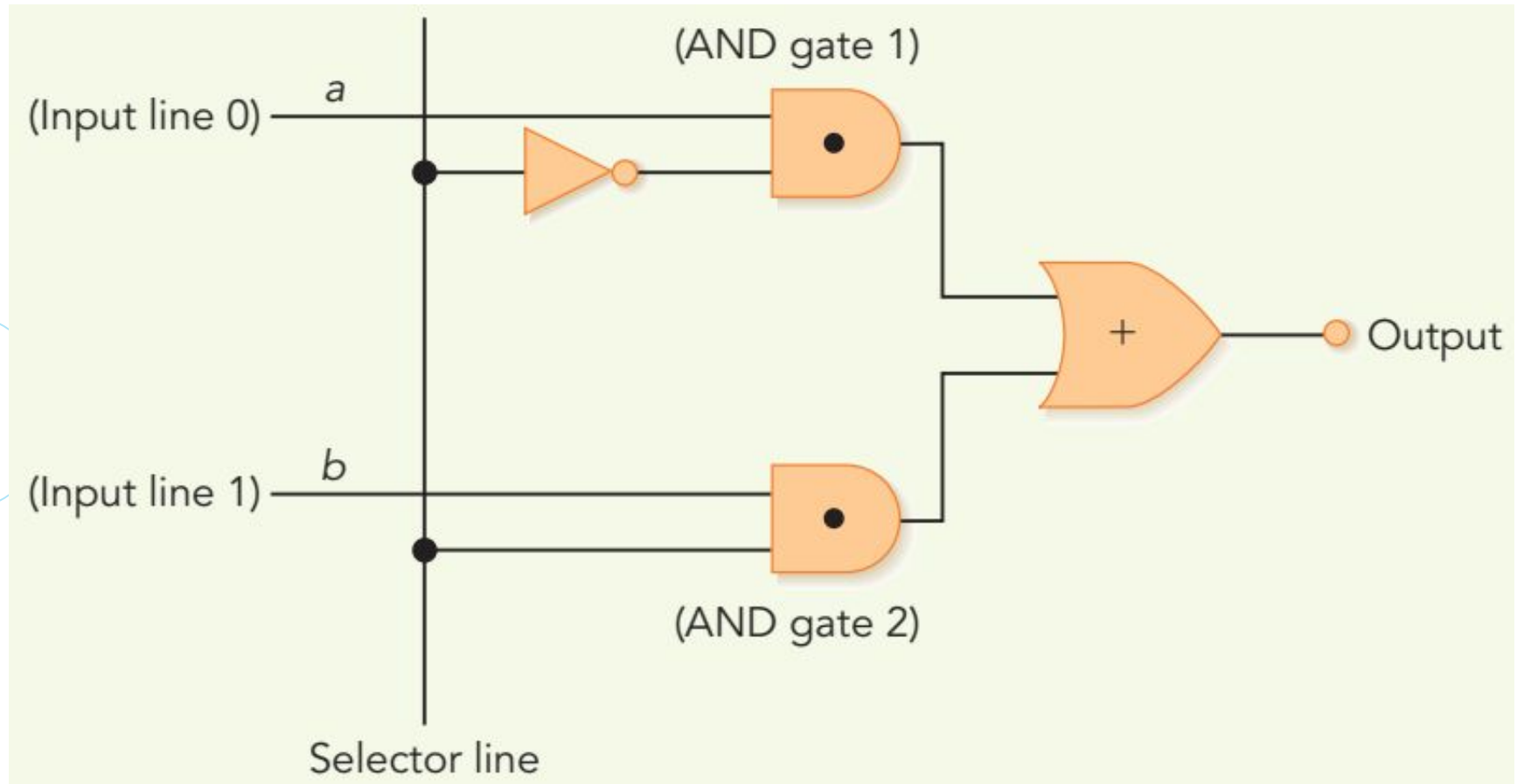


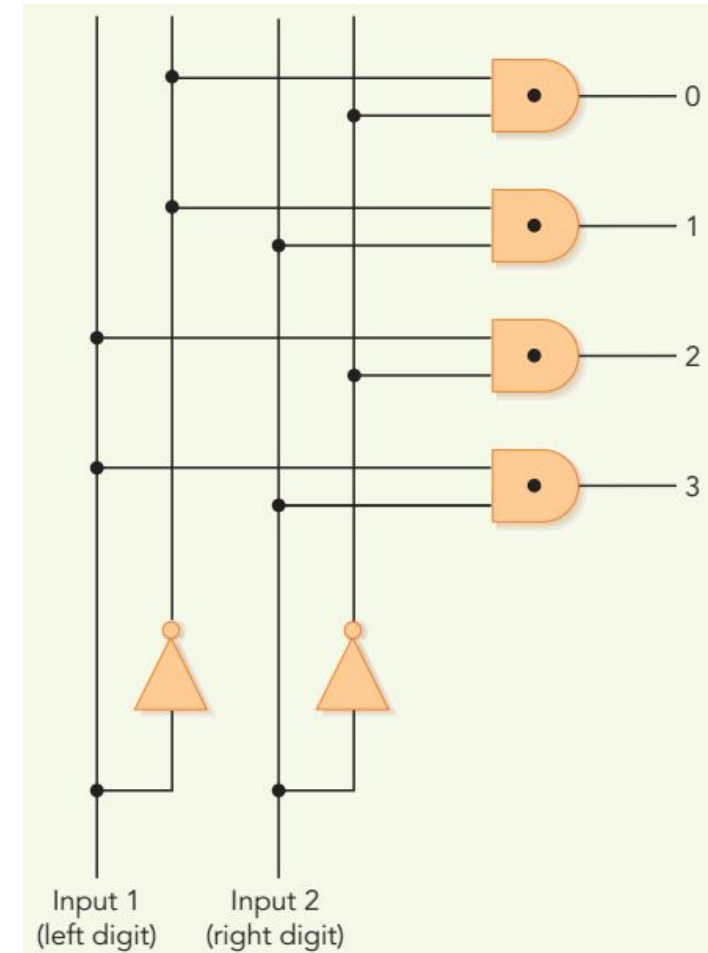
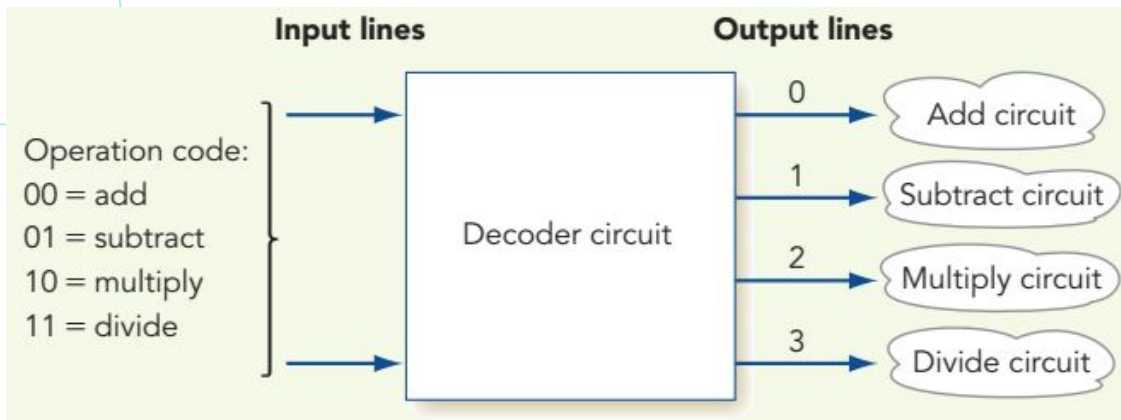
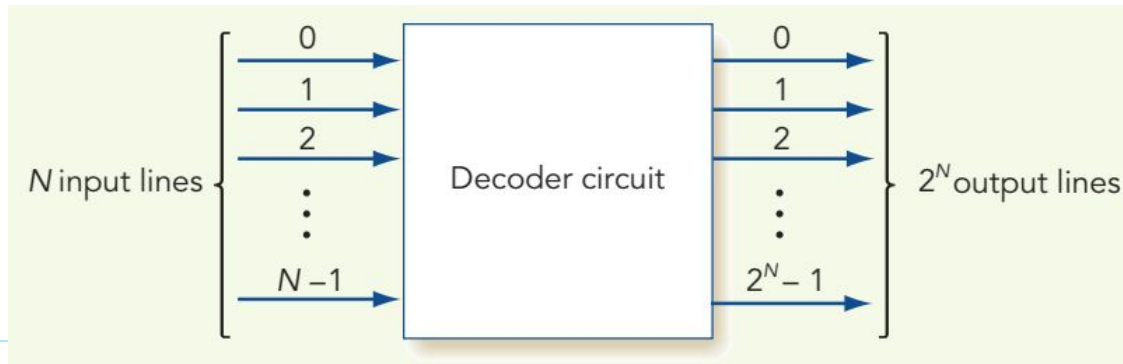
Multiplexer



Registers







HUST

