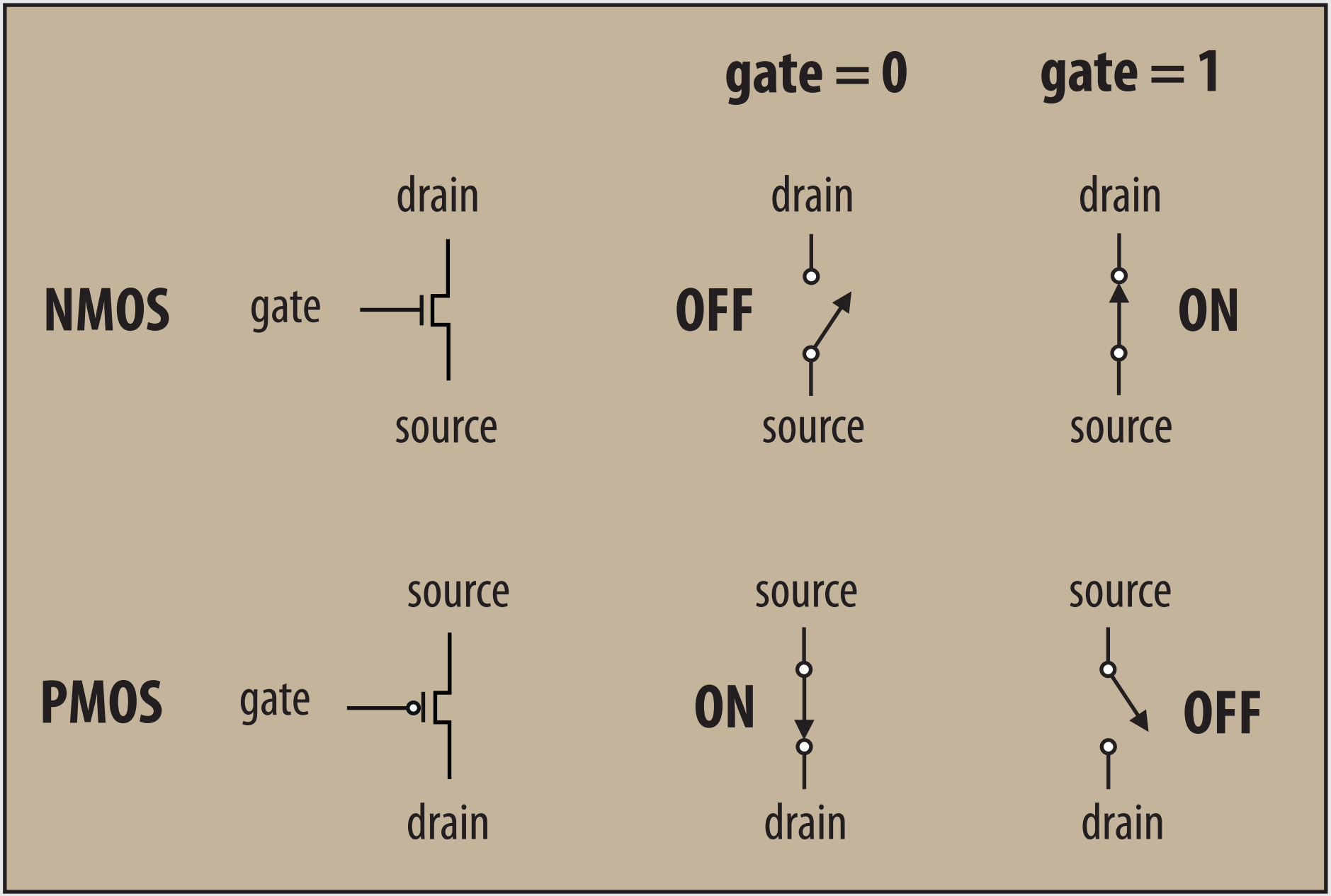
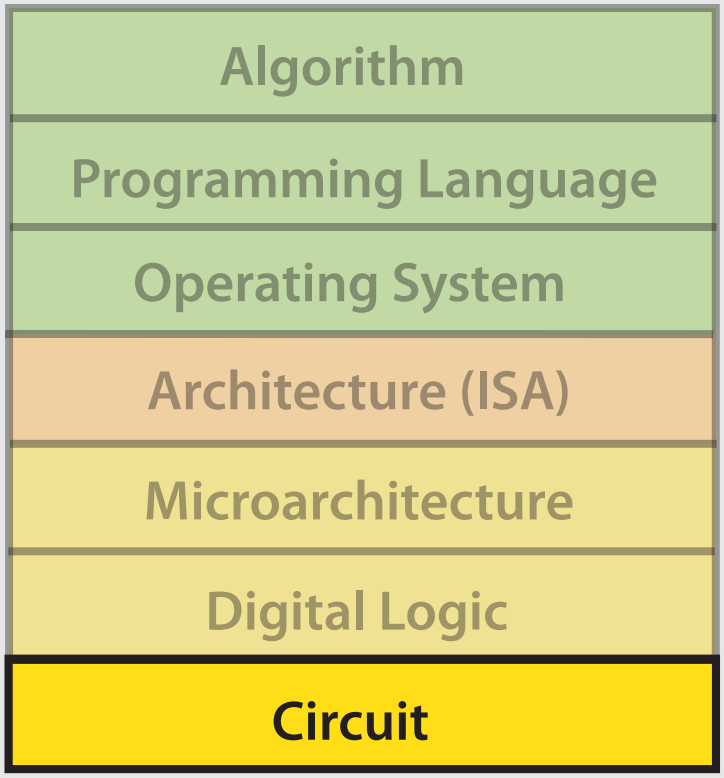
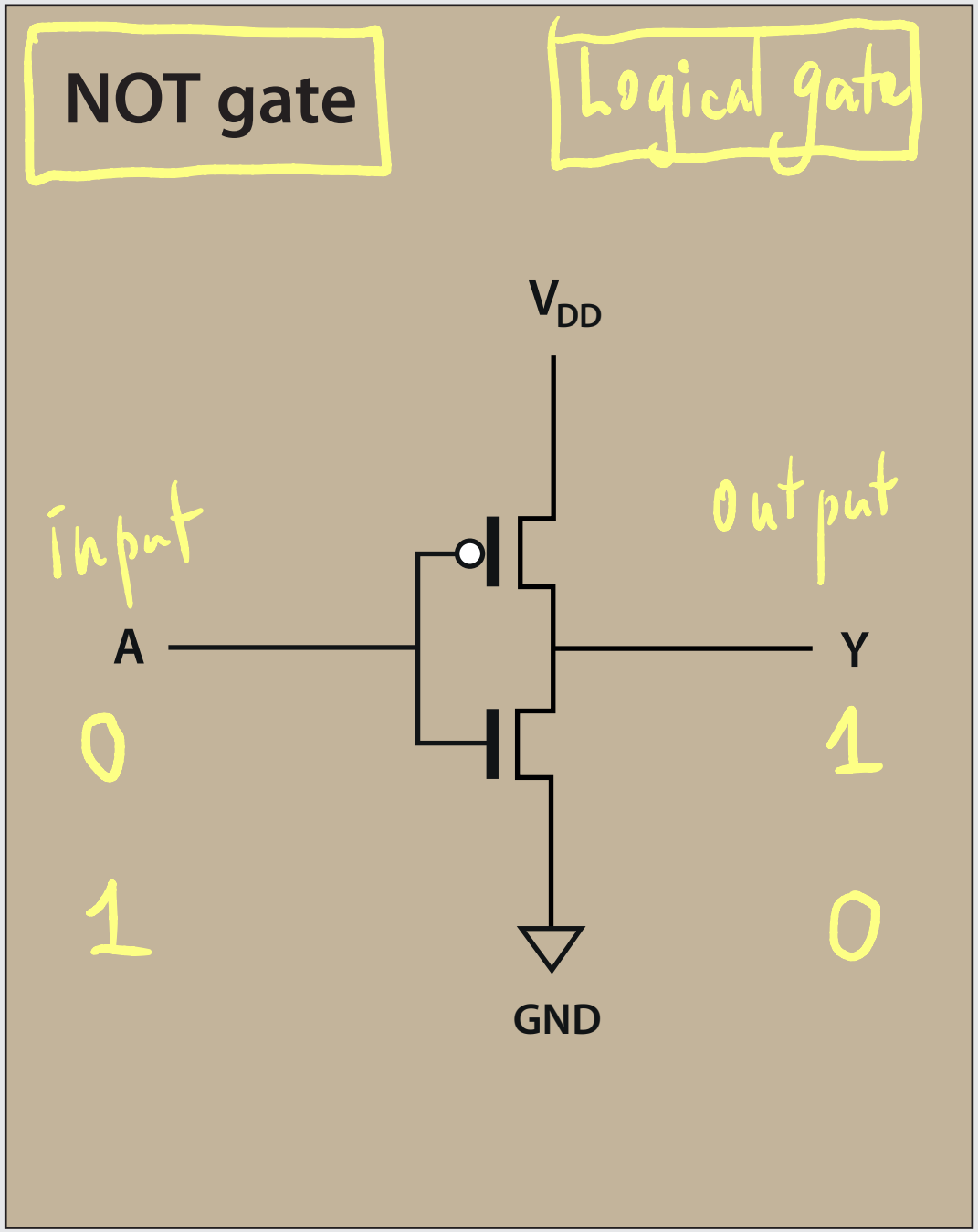
Key idea : transistors are switches !



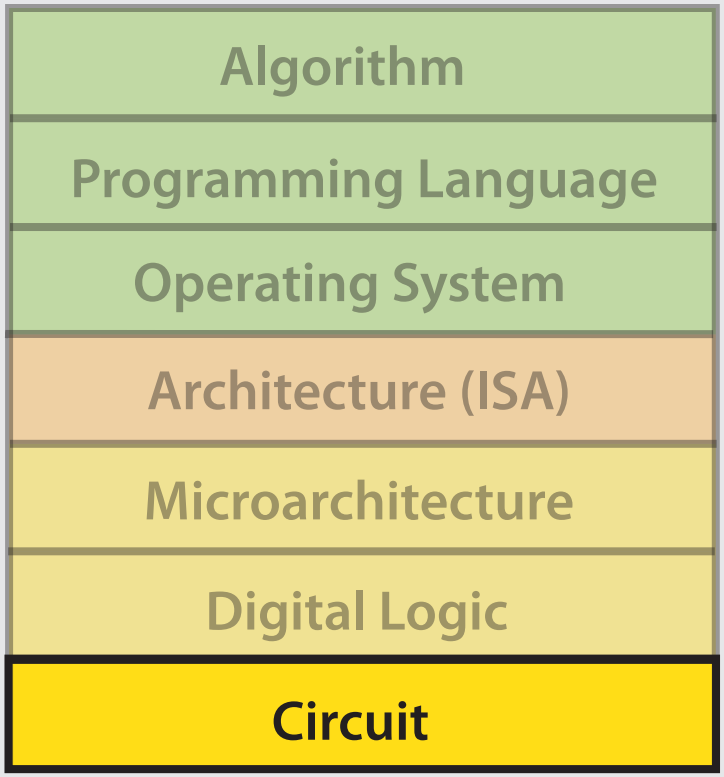


$0 \longmapsto 1$

$1 \longmapsto 0$



Not AND gate


Algorithm
Programming Language
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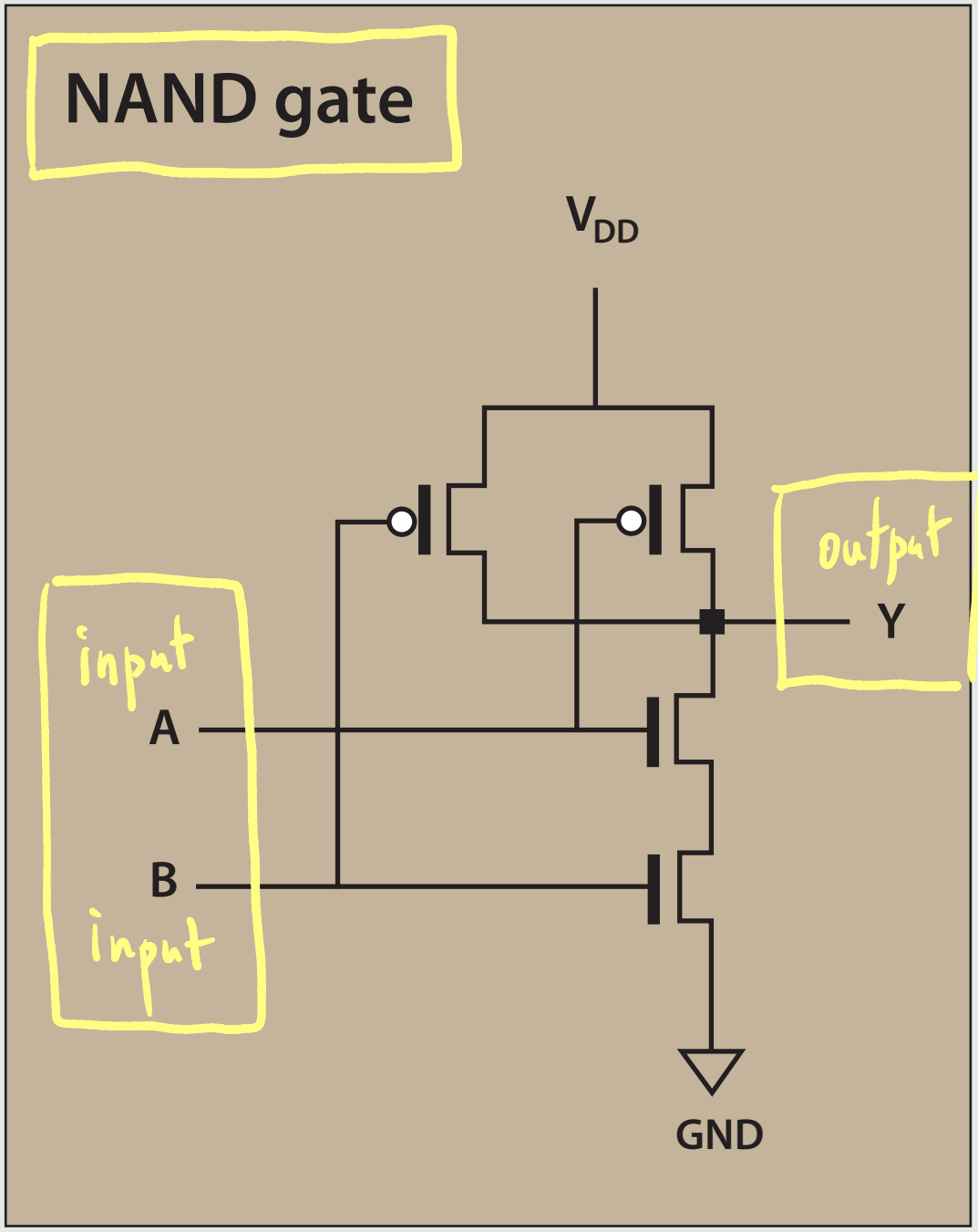
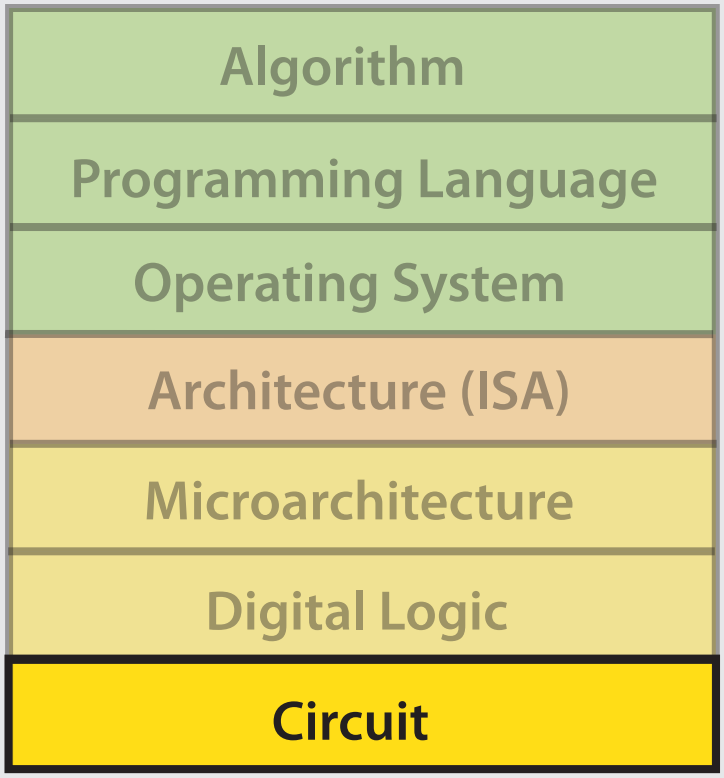
Architecture (ISA)
Microarchitecture
Digital Logic
Circuit


NAND gate
V_{DD}
output
Y
input
A
B
input
GND

Not OR gate


Algorithm
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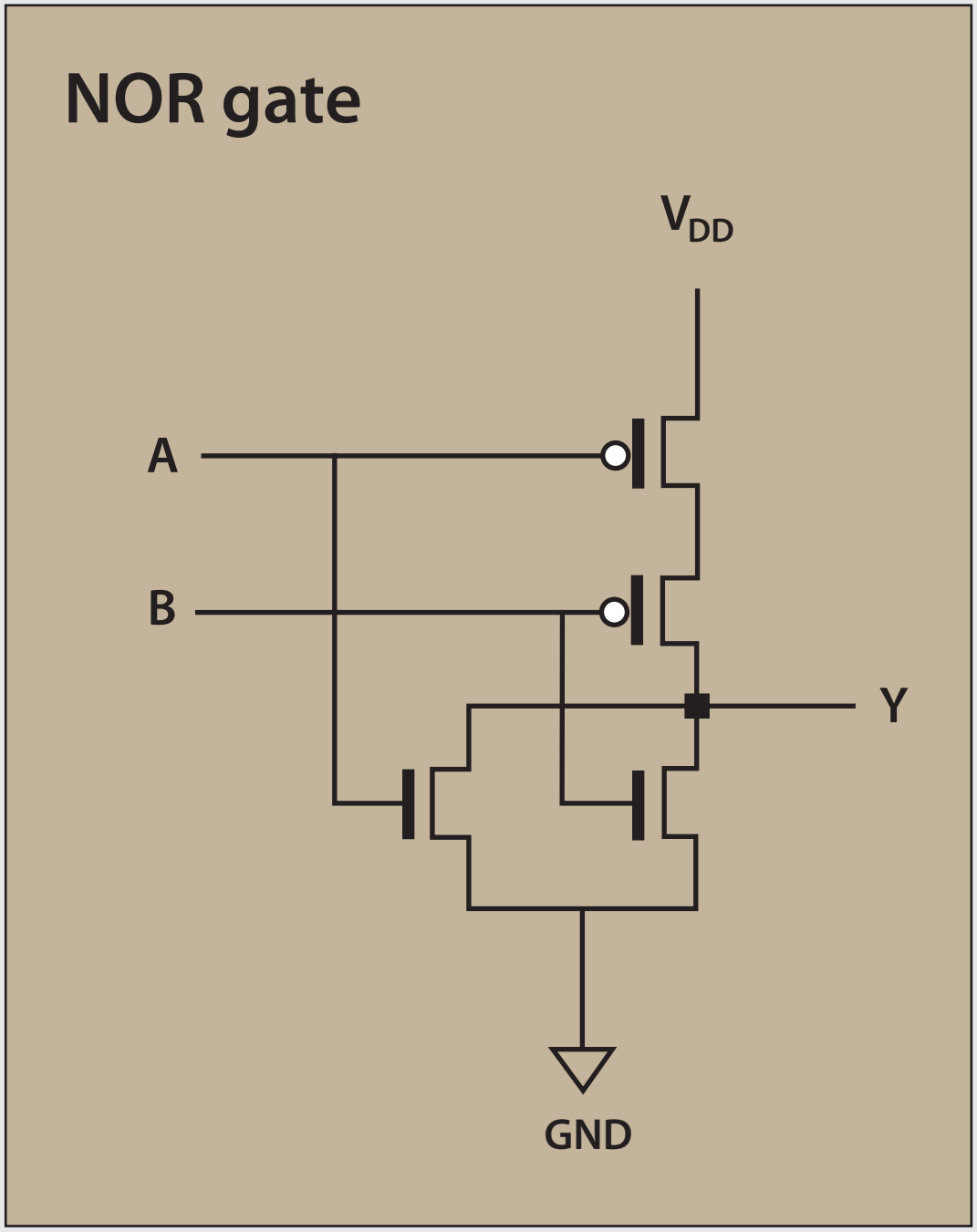

NOR gate
V_{DD}
A
B
Y
GND

Illustration : the inverter

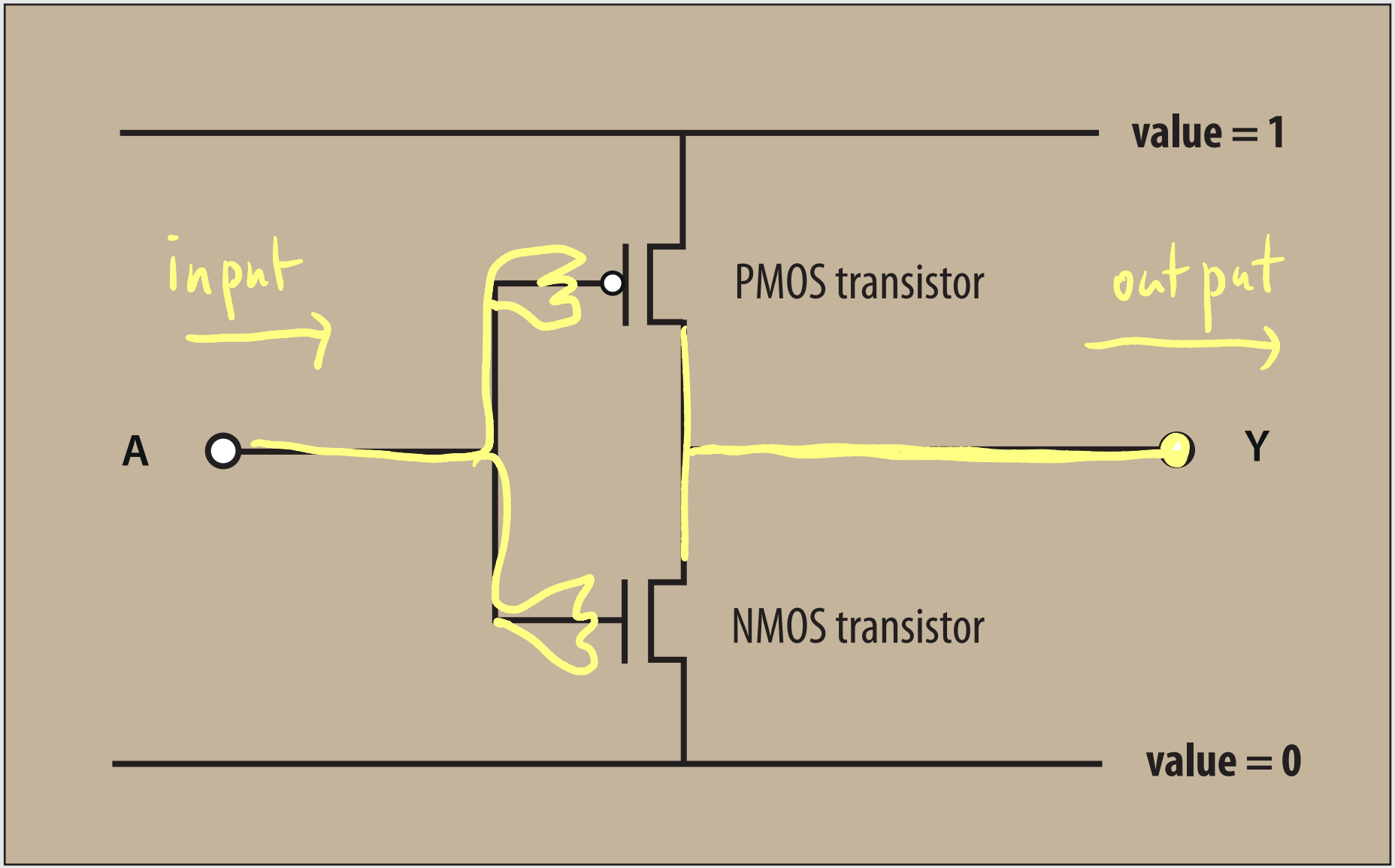


Illustration : the inverter

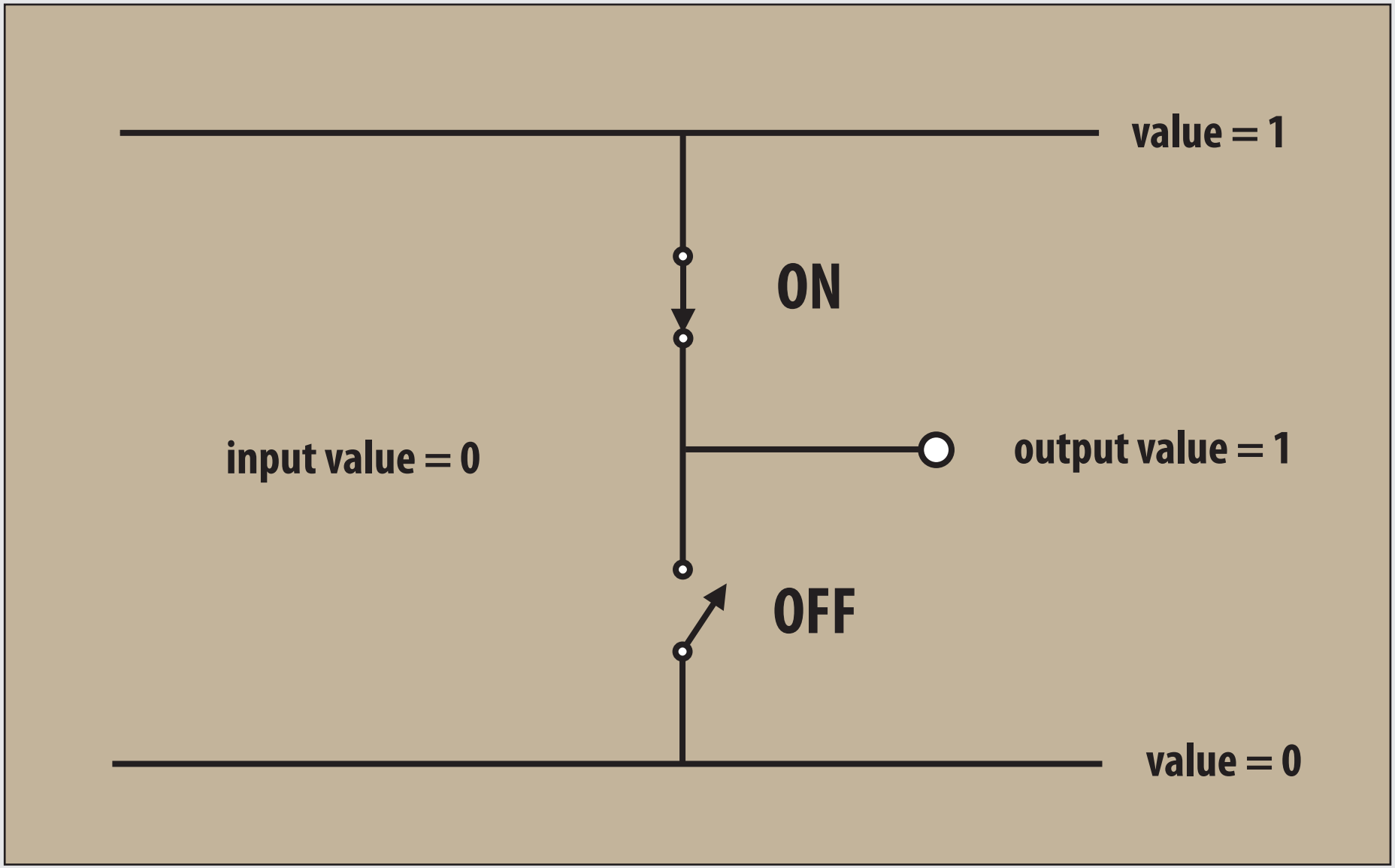
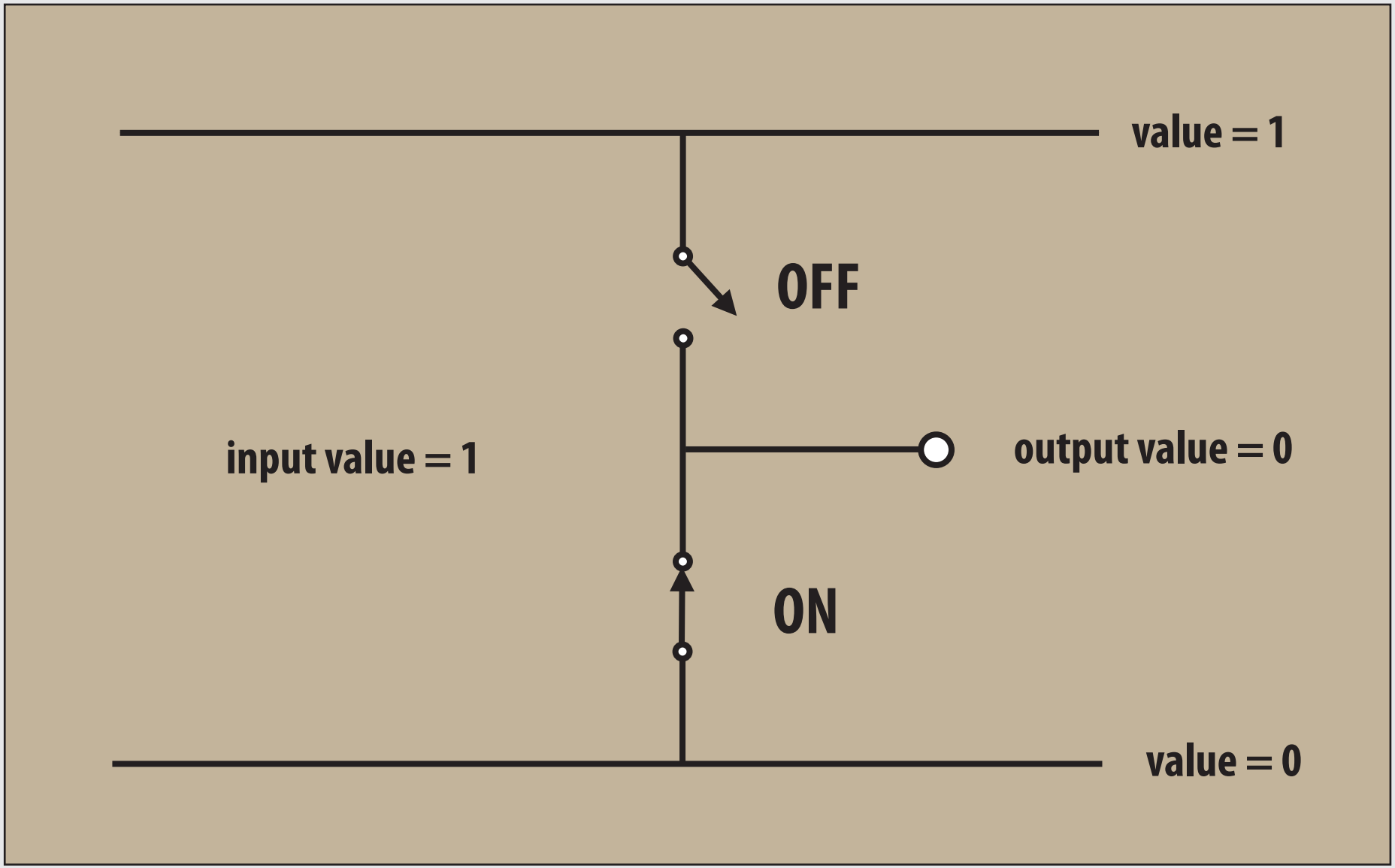
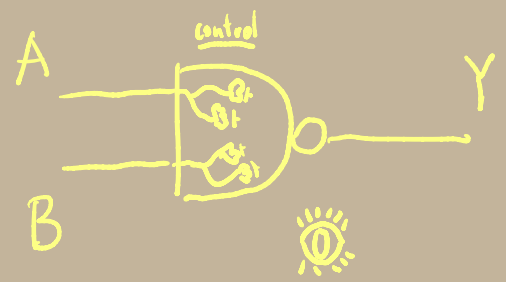


Illustration : the inverter



NAND gate



value = 1

value = 1

gate

gate

Y

A

gate

B

gate

value = 0

value = 0

AND

0 = false

1 = true (1)

numbers logic

Boole

true AND true = true

false AND true = false

true AND false = false

false AND false = false

truth table

AND	0	1
0	0	0
1	0	1

← left component x

x AND y

right component → y

AND	false	true
false	false	false
true	false	true

NAND = Negation of AND

true NAND true = false

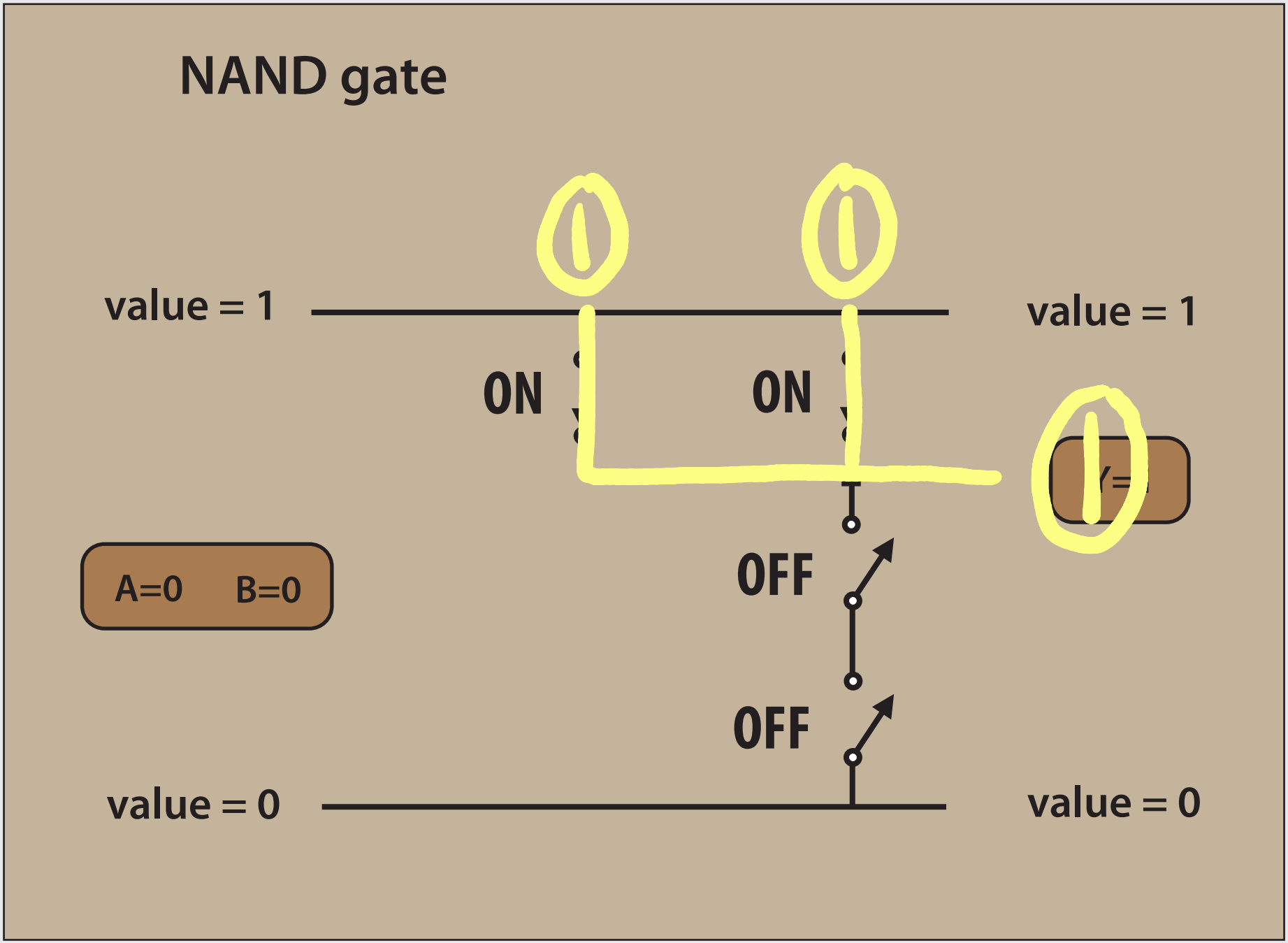
false NAND true = true

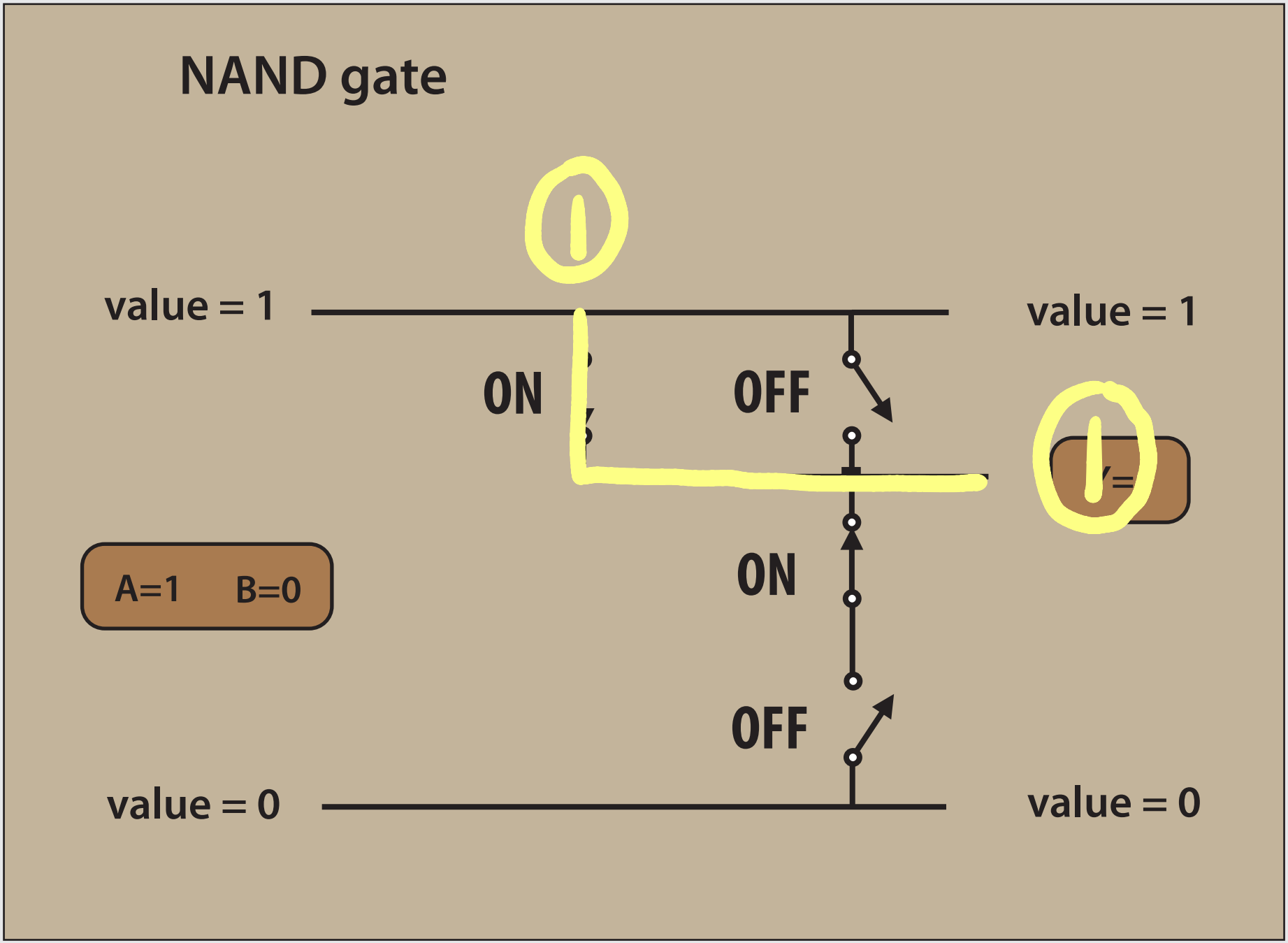
true NAND false = true

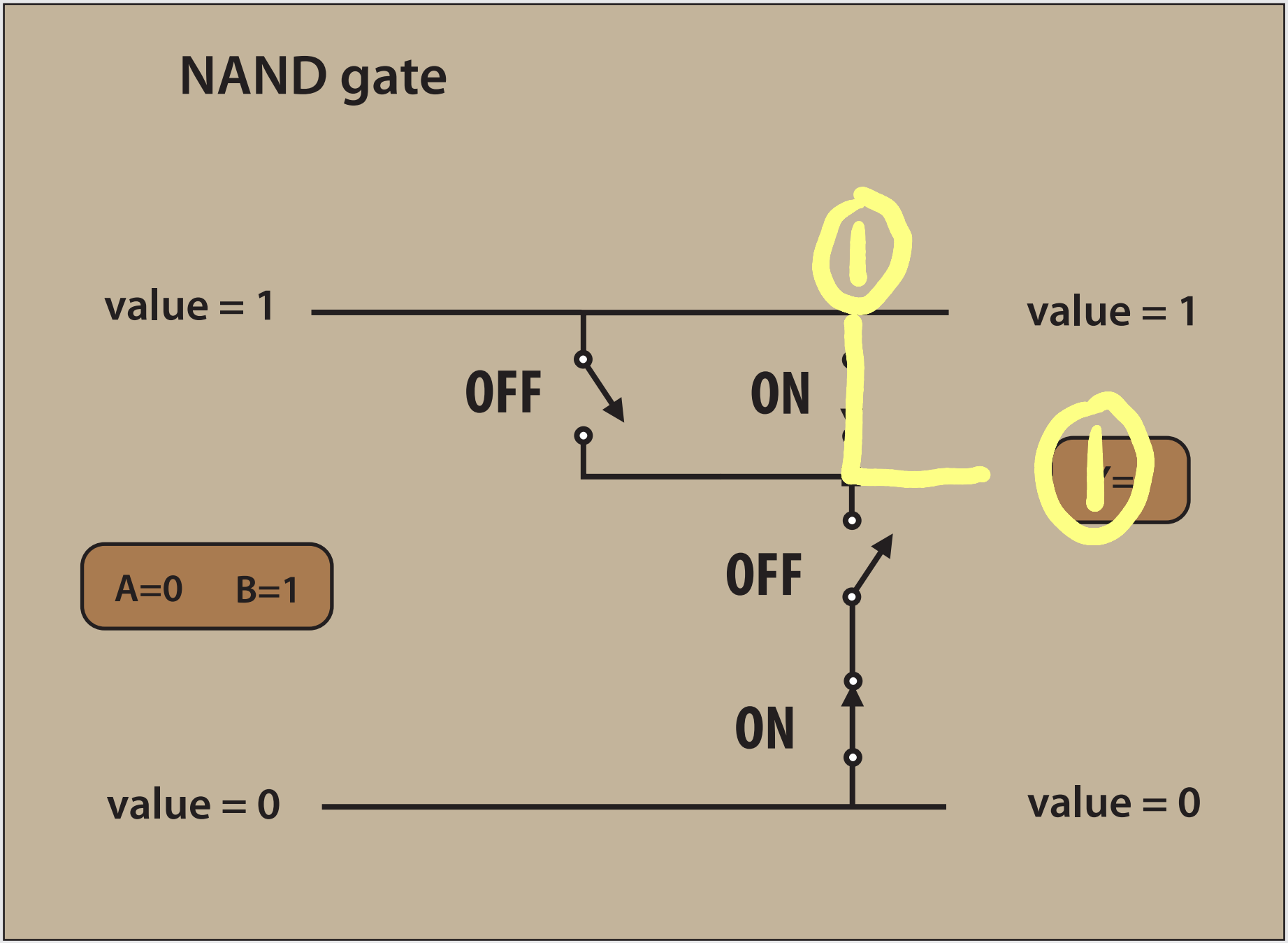
false NAND false = true

truth table of NAND

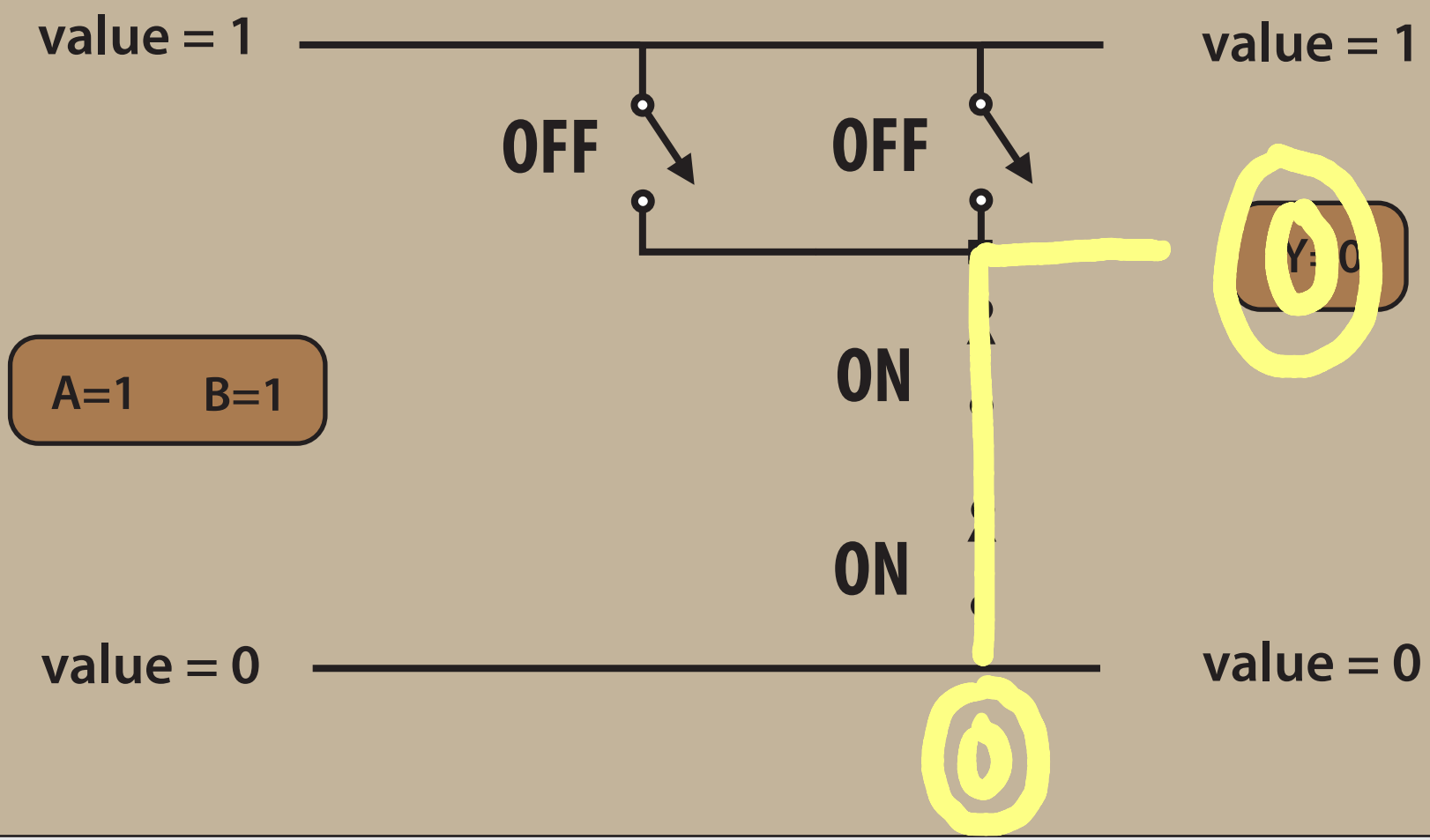
NAND	0	1
0	1	1
1	1	0

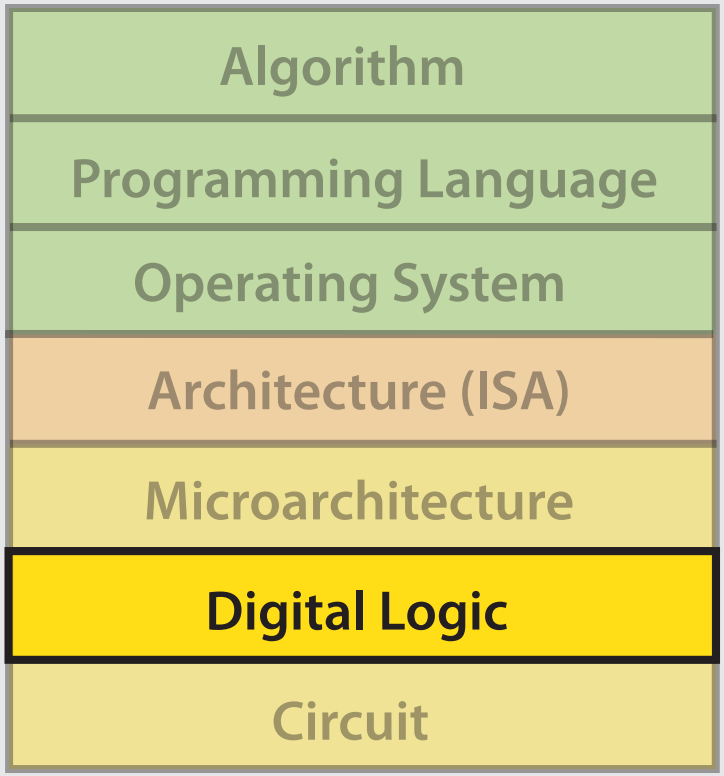

NAND gate
value = 1
value = 1
ON
ON
A=0 B=0
OFF
OFF
value = 0
value = 0


NAND gate
value = 1
value = 1
ON
OFF
A=1 B=0
ON
OFF
value = 0
value = 0

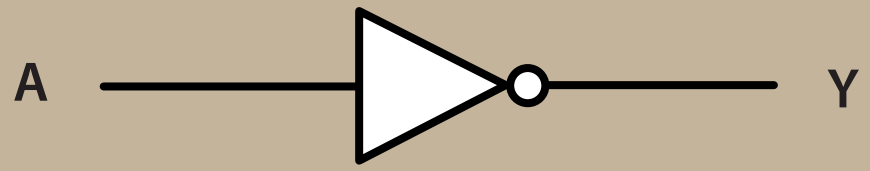

NAND gate
value = 1
value = 1
OFF
ON
A=0 B=1
OFF
ON
value = 0
value = 0

NAND gate

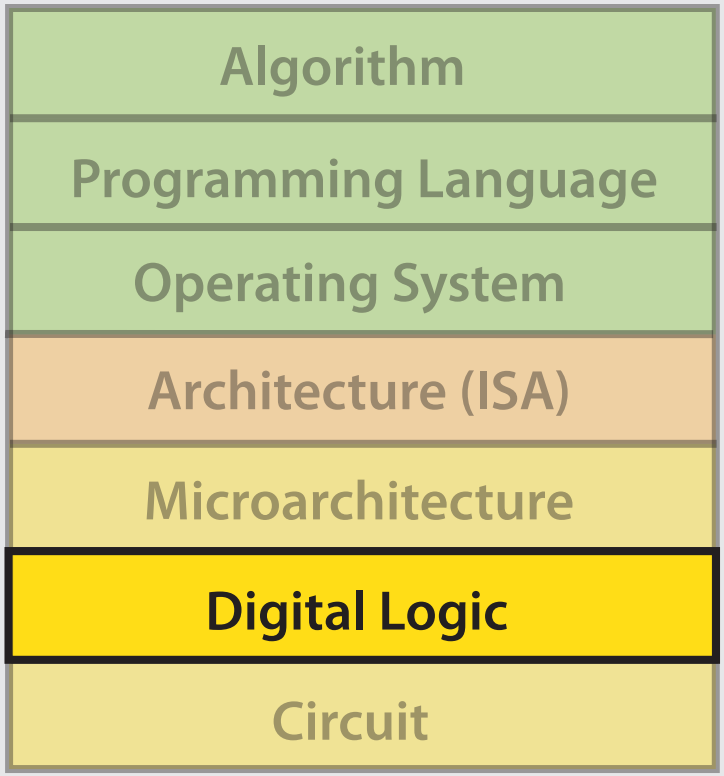




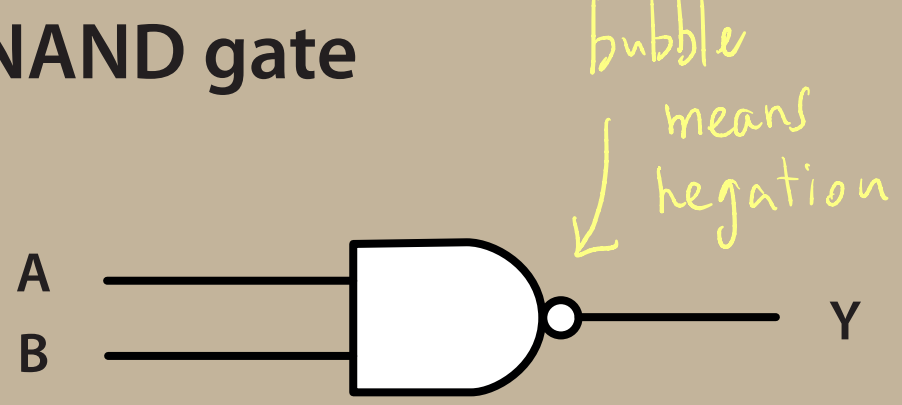
NOT gate



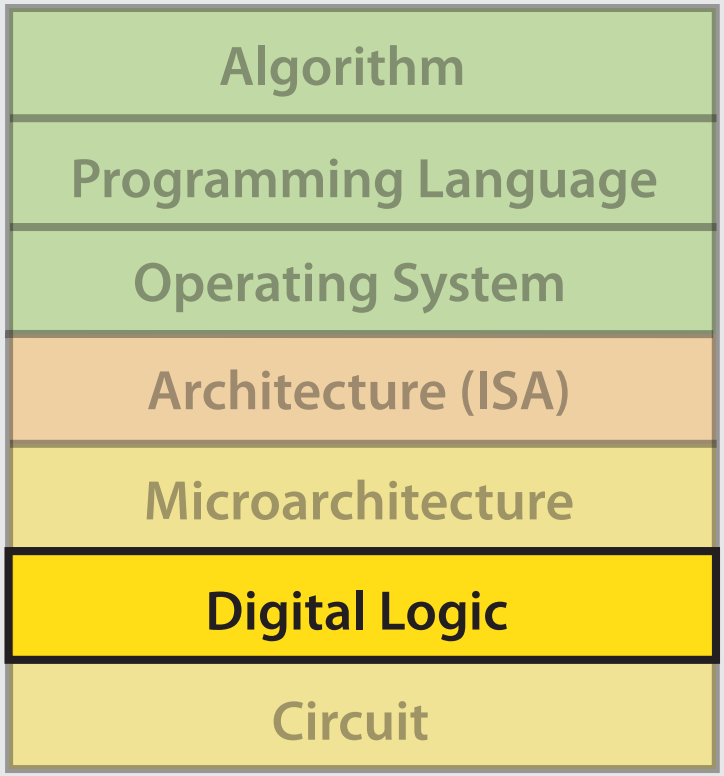
A	Y
0	1
1	0



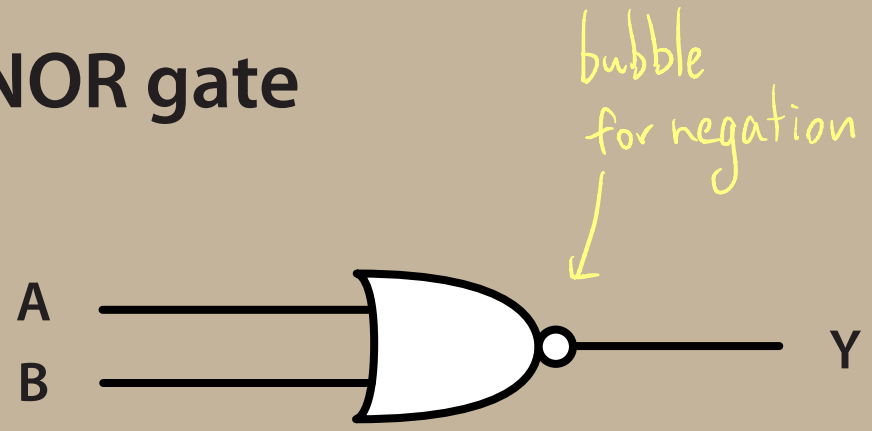
NAND gate



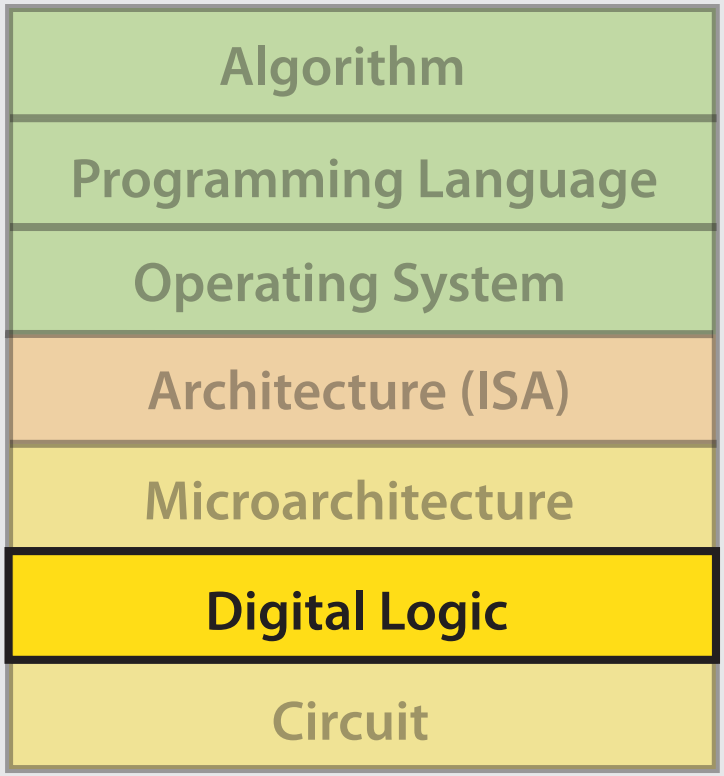
A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0



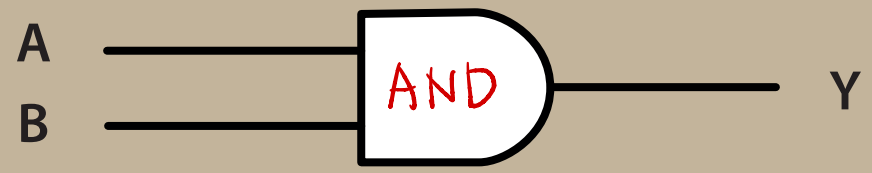
NOR gate



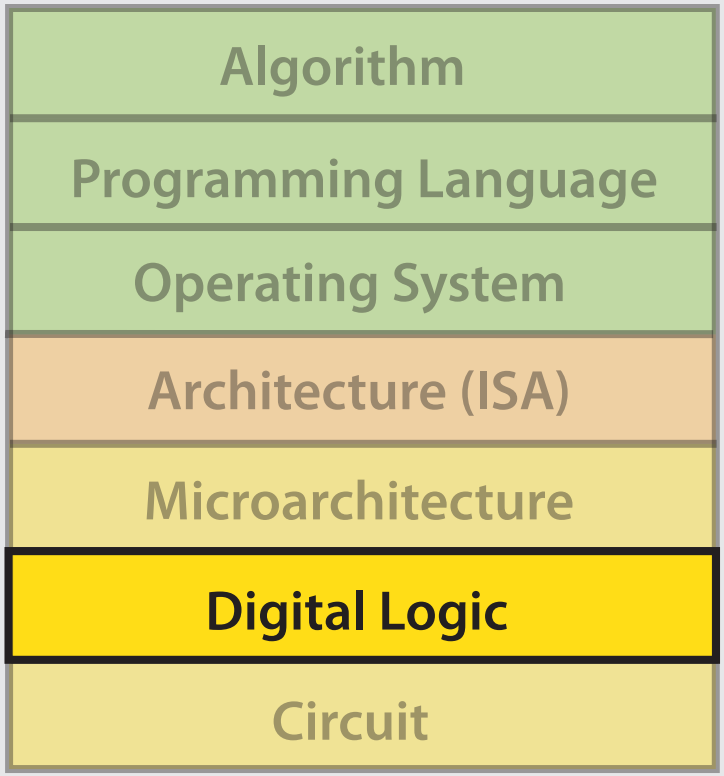
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0



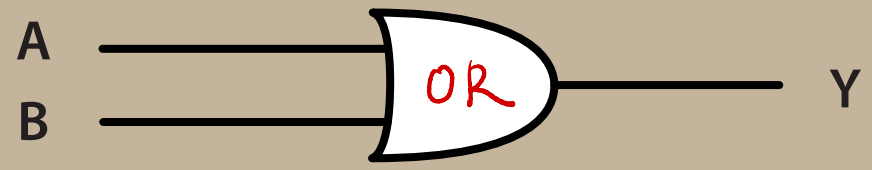
AND gate



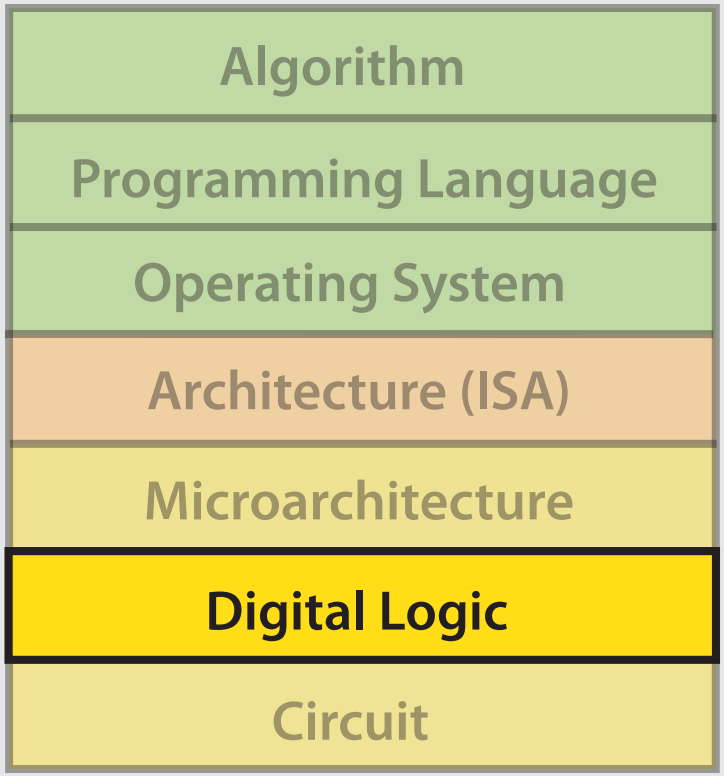
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1



OR gate

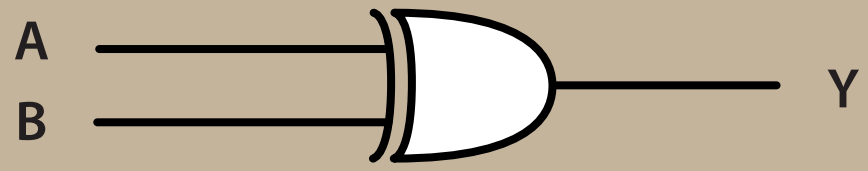


A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1



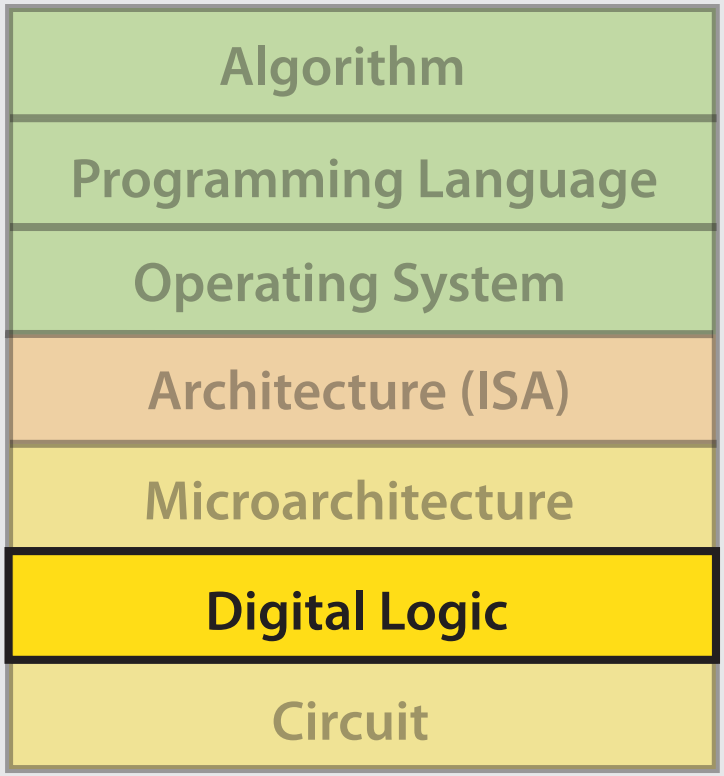
XOR gate

Exclusive Or



A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

if then else

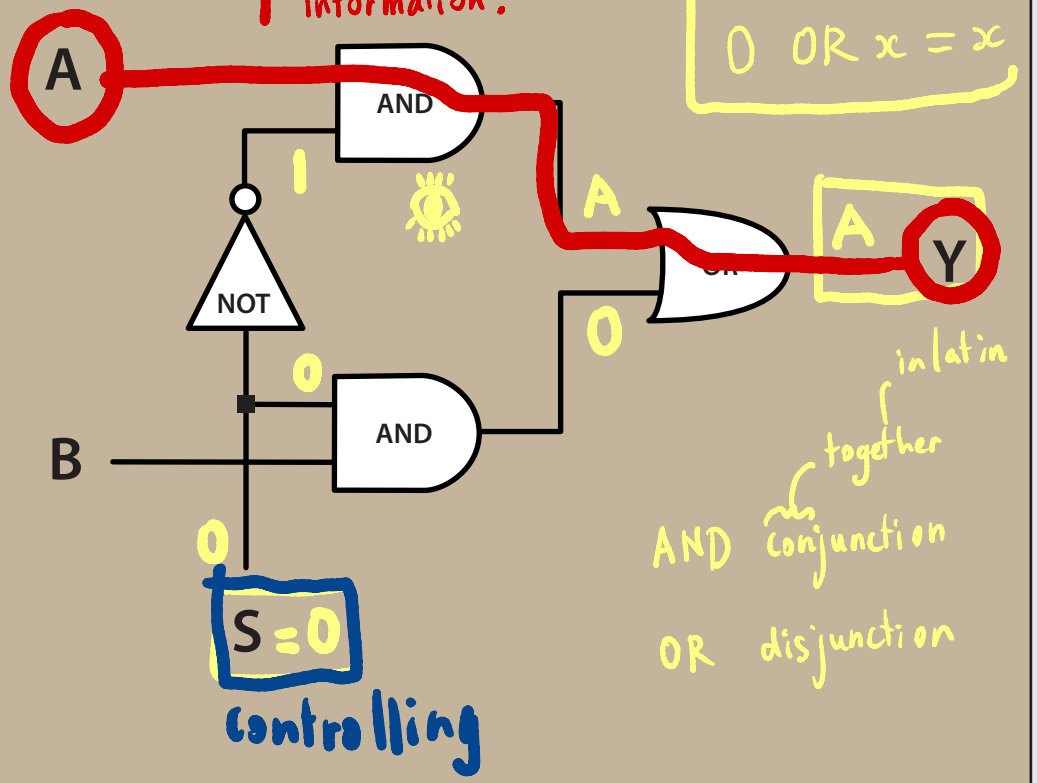


if S then B
else A

Multiplexor (mux)

1 AND x = x
0 AND x = 0
0 OR x = x

processing information!



in latin
together
AND conjunction
OR disjunction

S	Y
0	A
1	B

in algebra:

$$1 \text{ AND } x = x$$

means that 1

is a neutral element

for AND

Algorithm

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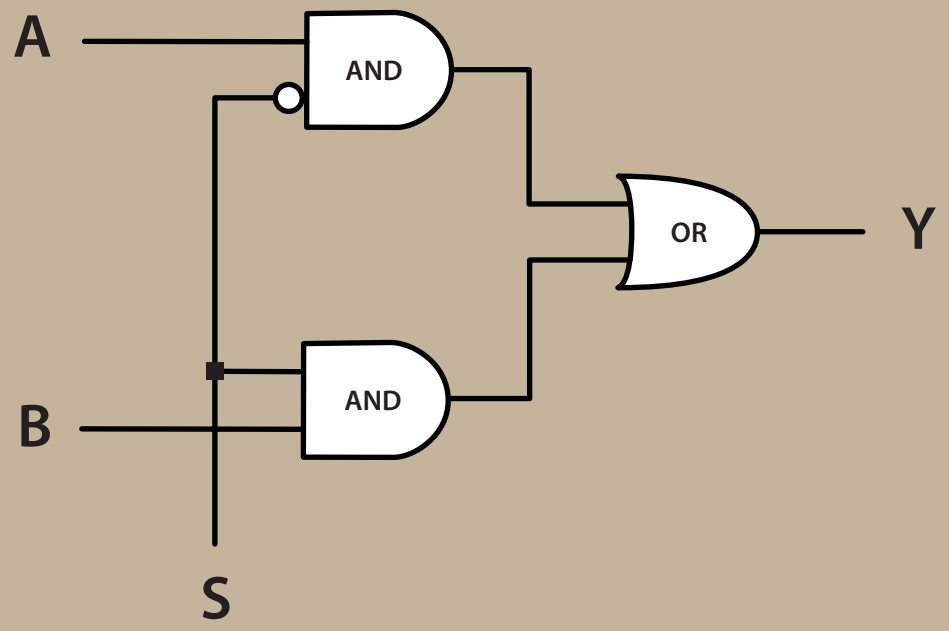
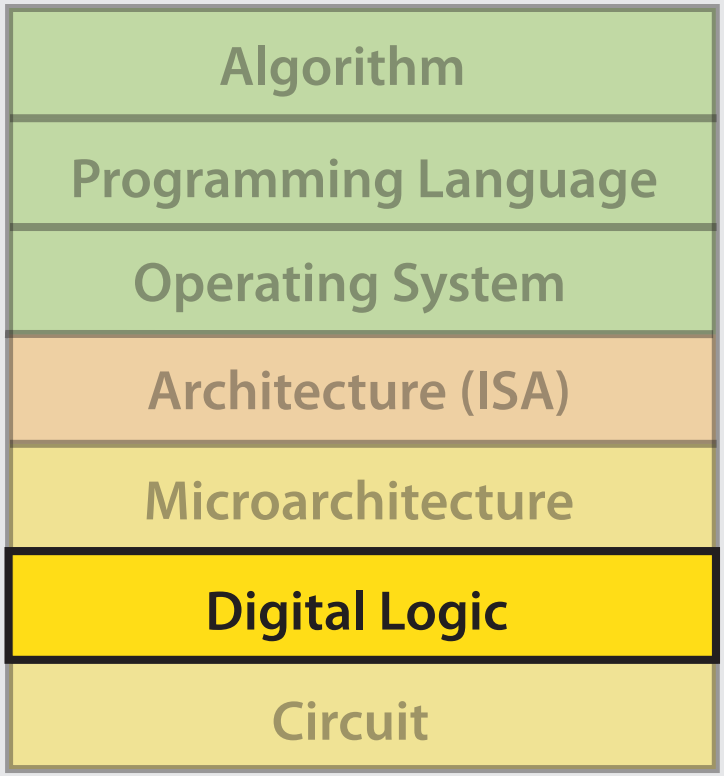
Multiplexor (mux)

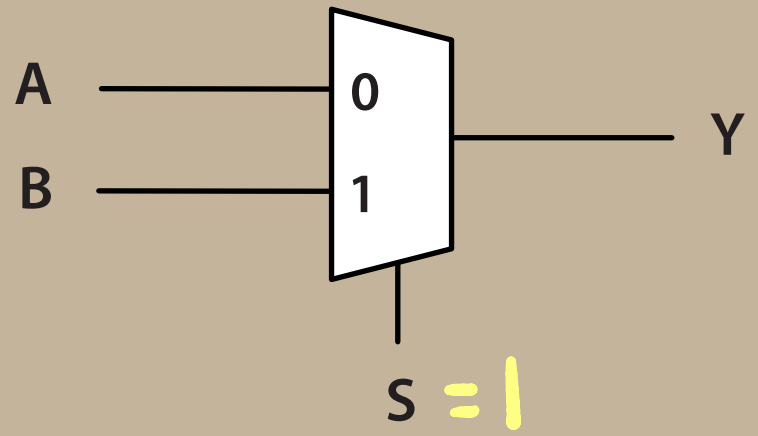


S	Y
0	A
1	B



Multiplexor (mux)

if S=0 then A or 1



S	Y
0	A
1	B

true OR A = true

NOR = negation of (OR)

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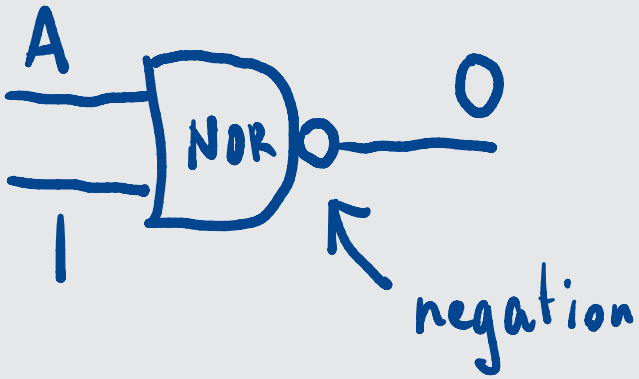
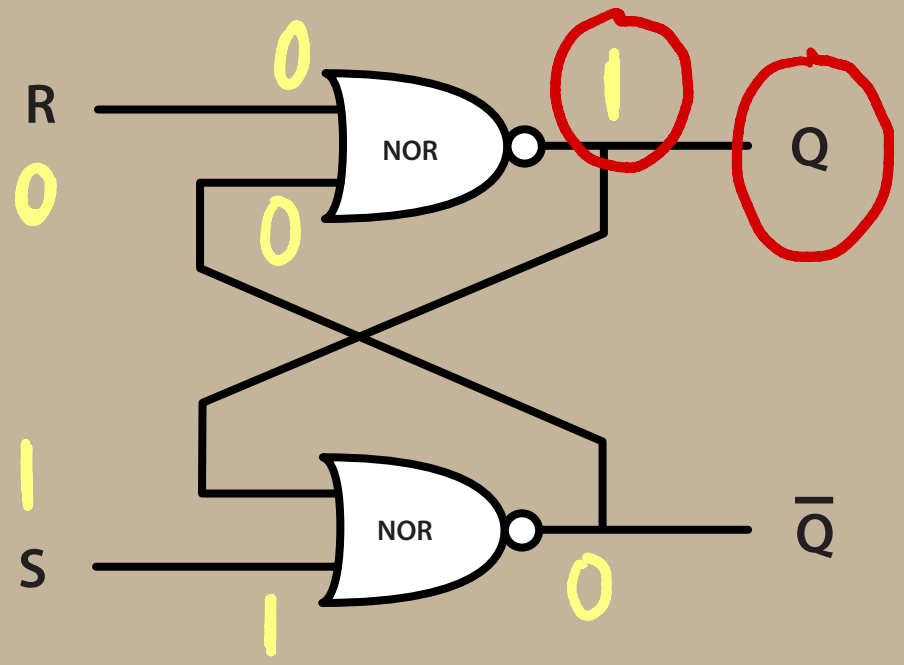
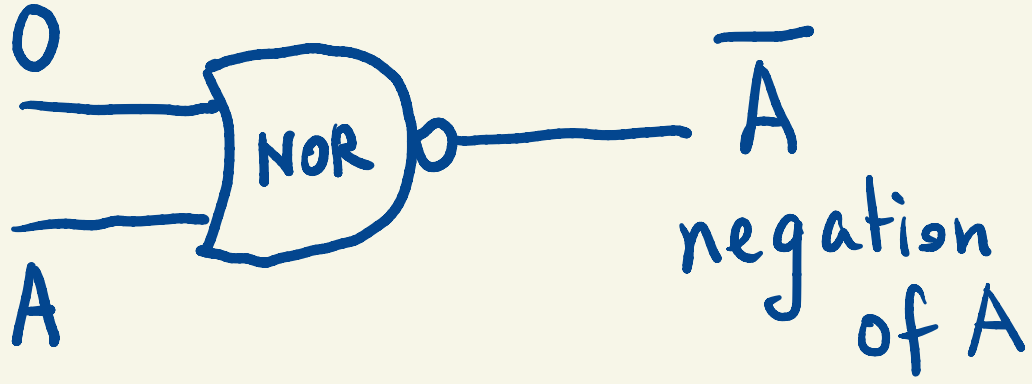


Set and Reset

SR-latch (static memory)

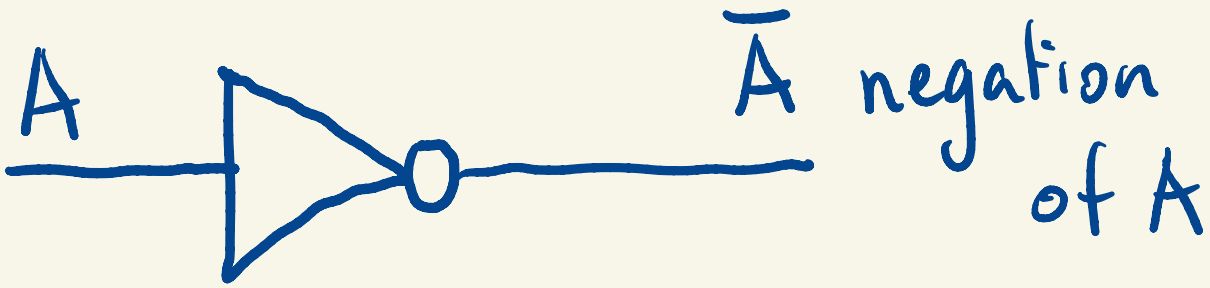


S	R	Q	$\overline{Q}$
0	0	mem	$\overline{mem}$
0	1	0	1
1	0	1	0
1	1	0	0

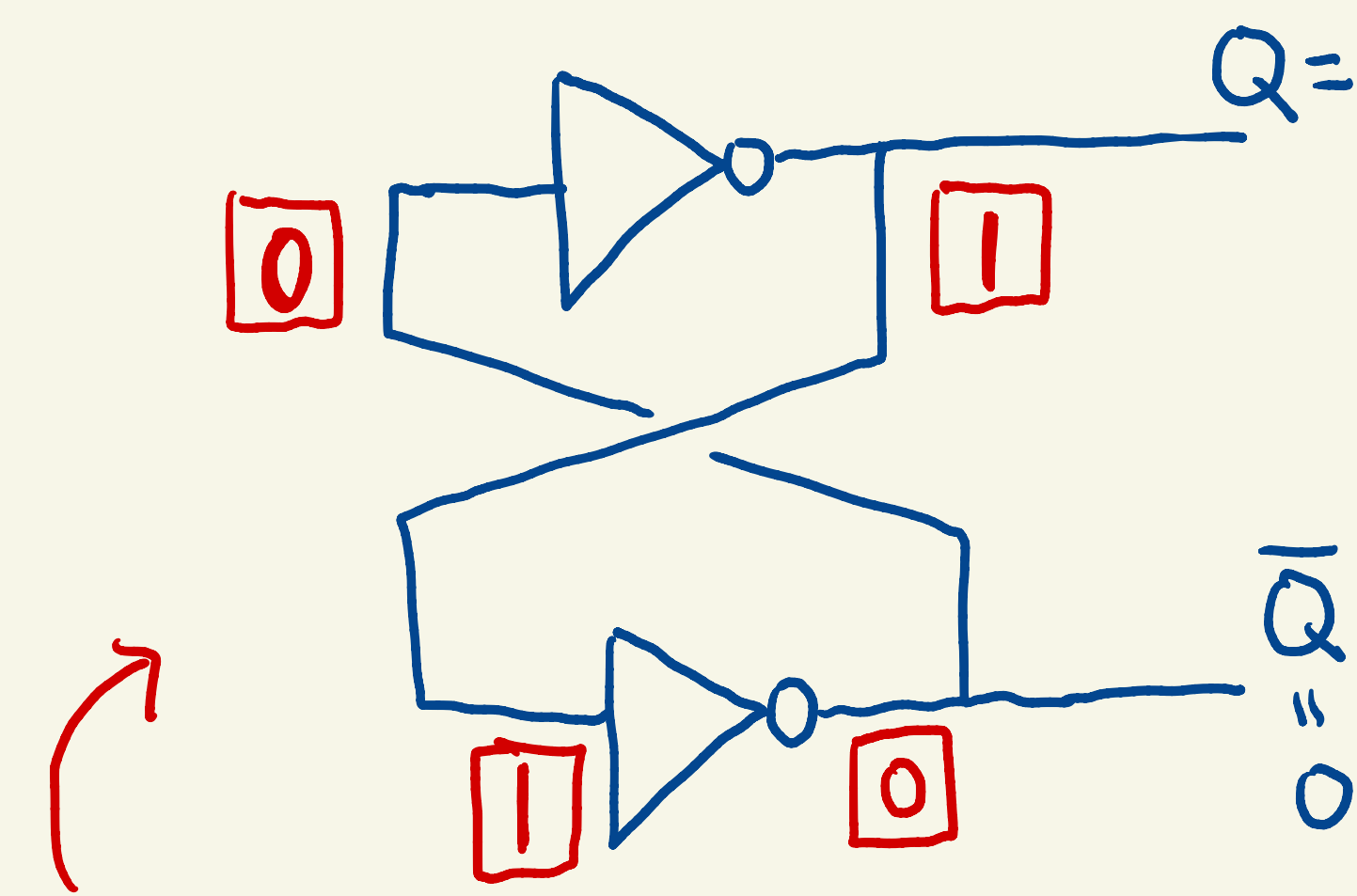


$$\begin{cases} 0 \text{ OR } A = A \\ \text{FALSE OR } A = A \end{cases}$$

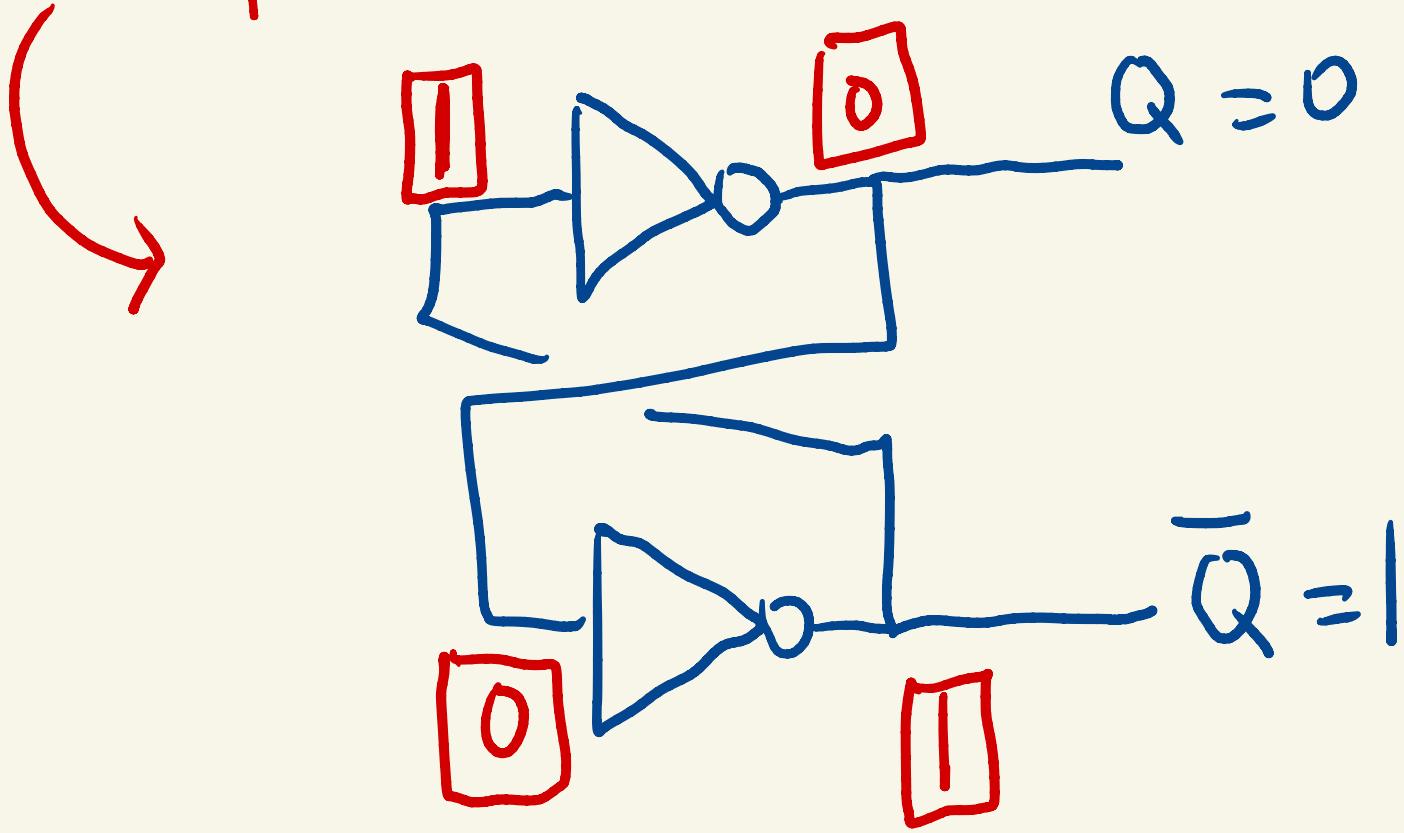
$$\text{NEG}\left(\text{FALSE OR } A\right) = \text{NEG } A$$



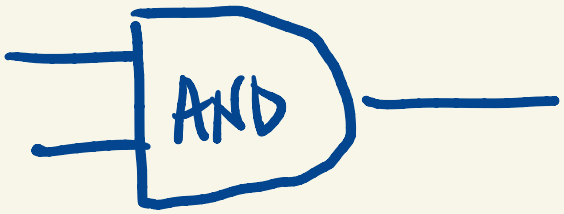
two inverters plugged like this:

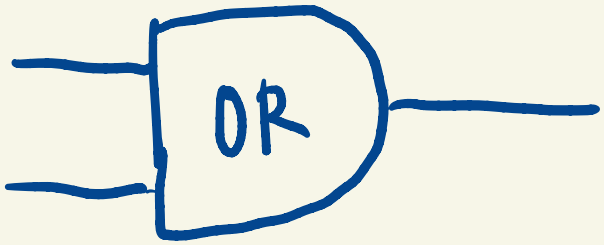


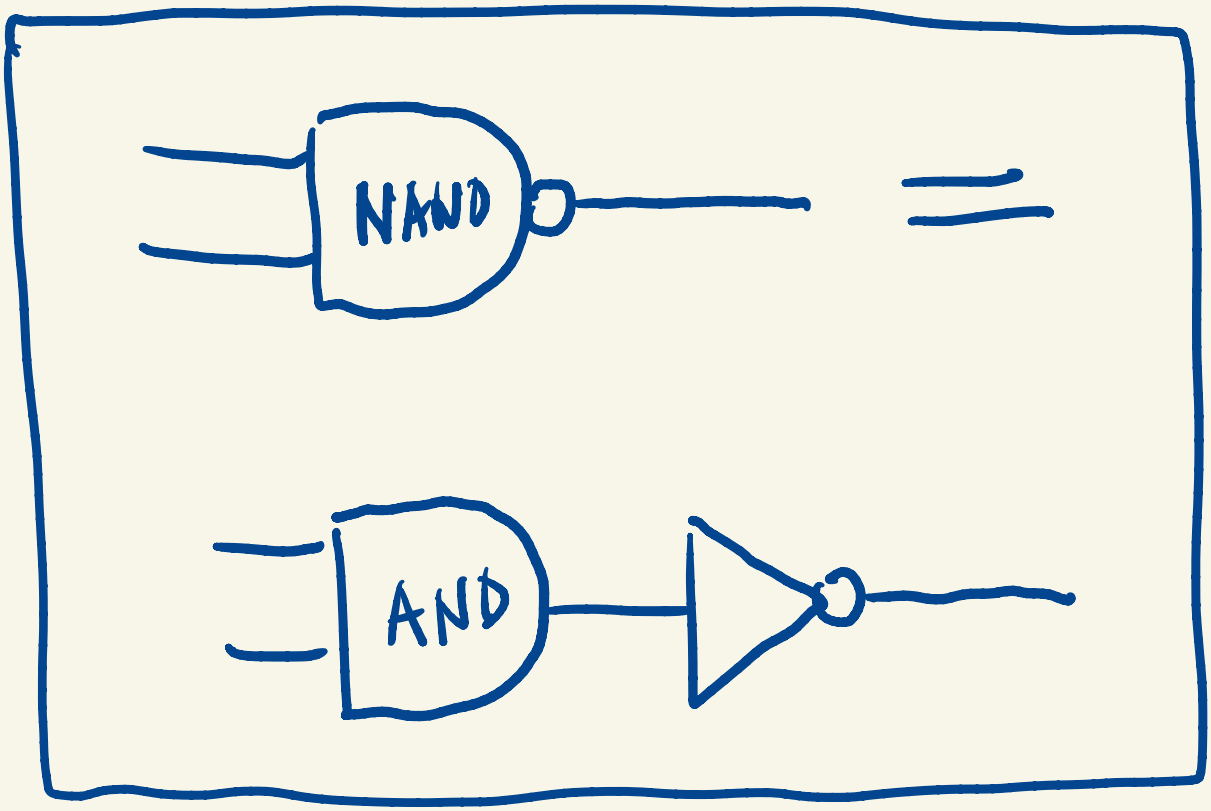
two possible internal states



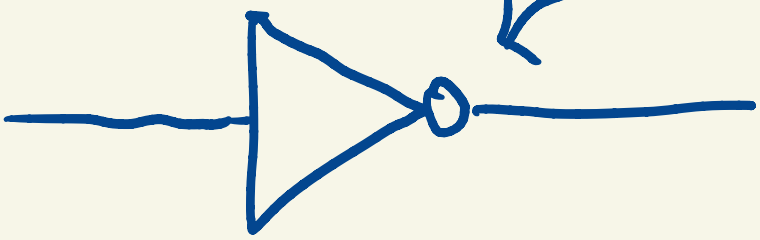
A word about the notation







An inverter is represented as



bubble which negates.

a triangle which does "nothing"

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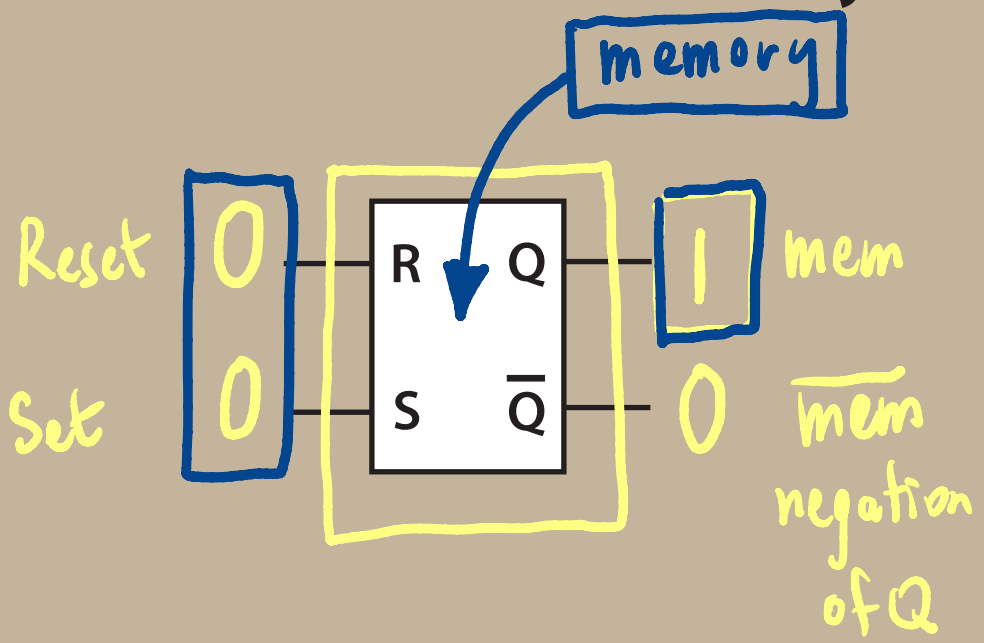
SR-latch (static memory)



S	R	Q	$\overline{Q}$
0	0	mem	$\overline{mem}$
0	1	0	1
1	0	1	0
1	1	0	0

Algorithm

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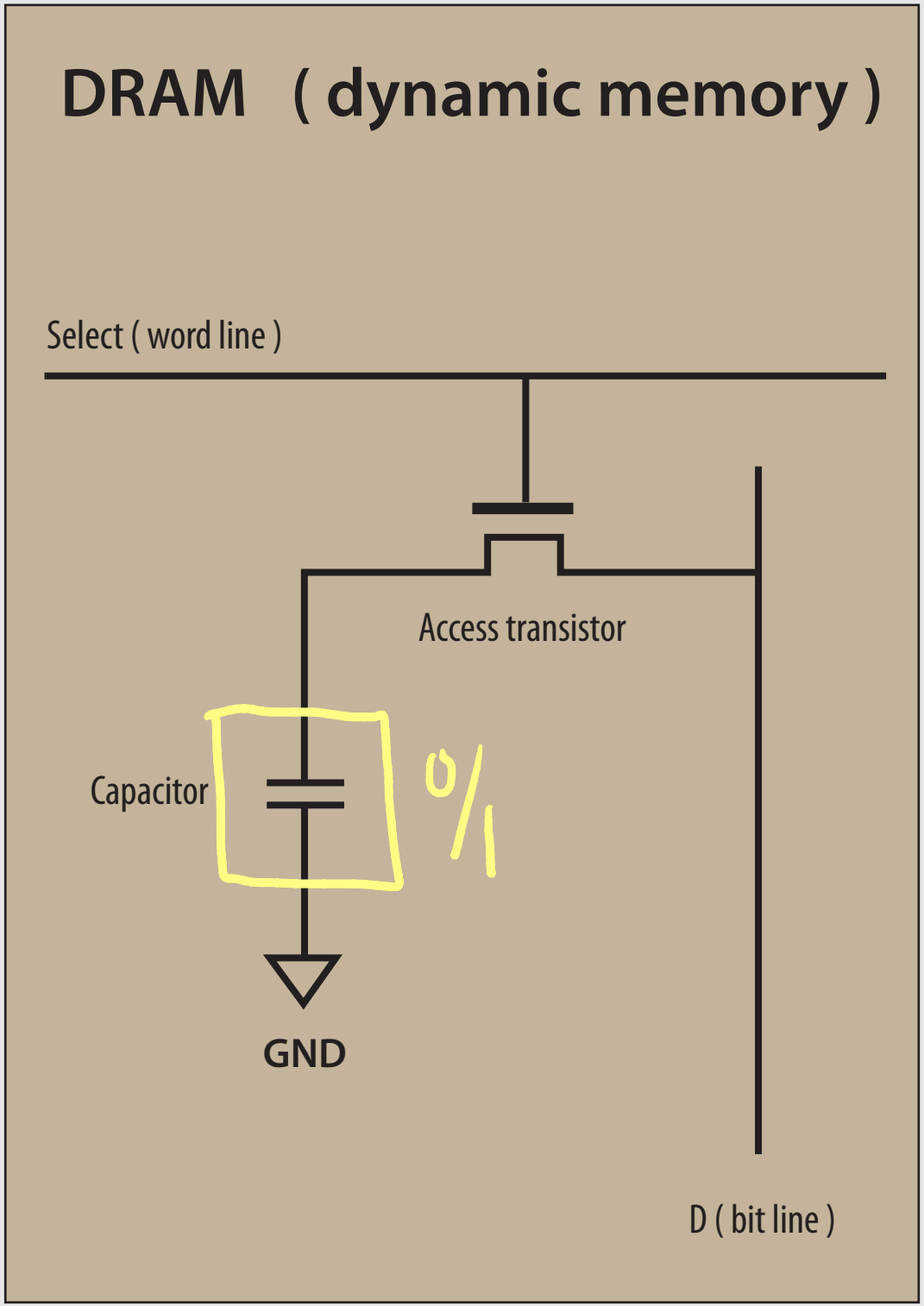
Circuit