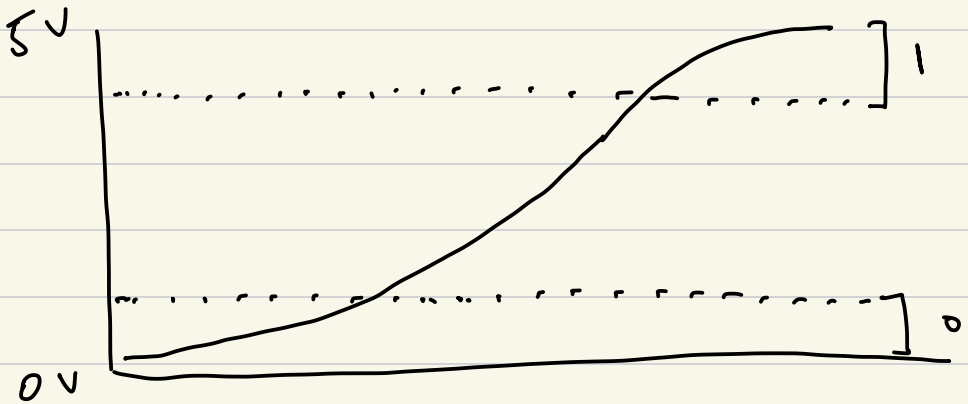
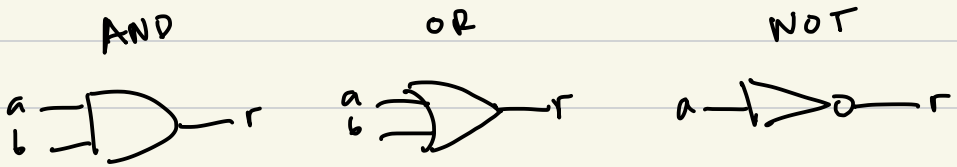
CS315.01 Lab Intro to Digital Design

Digital Design

Analog → Digital



Wires & devices → gates

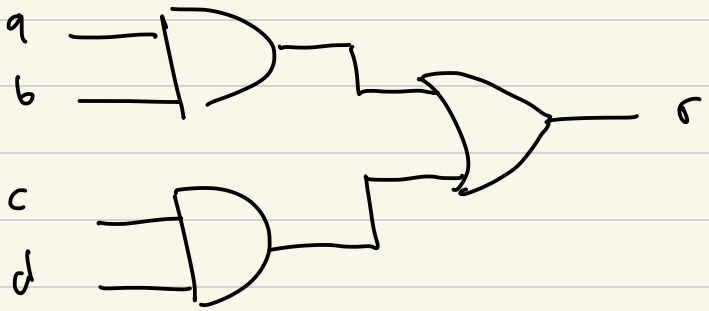


	AND	OR	NOT
C code	`r = a & b`	`r = a | b`	`r = !a`
Boolean algebra	$r = a \cdot b$	$r = a + b$	$r = \overline{a}$
Logic	$r = a \wedge b$	$r = a \vee b$	$r = \neg a$

a	b	r
0	0	0
0	1	0
1	0	0
1	1	1

a	b	r
0	0	0
0	1	1
1	0	1
1	1	1

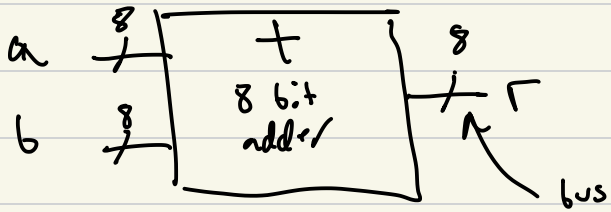
a	r
0	1
1	0



$$r = (a \cdot b) + (c \cdot d)$$

Abstraction in Digital Logic

Goal: build an 8-bit adder



Sum-of-products

Sum of two 1-bit numbers

	a	b	sum
	0	0	0
①	0	1	1
②	1	0	1
	1	1	0

XOR

$sum = a \oplus b$

$sum = (\bar{a} \cdot b) + (a \cdot \bar{b})$

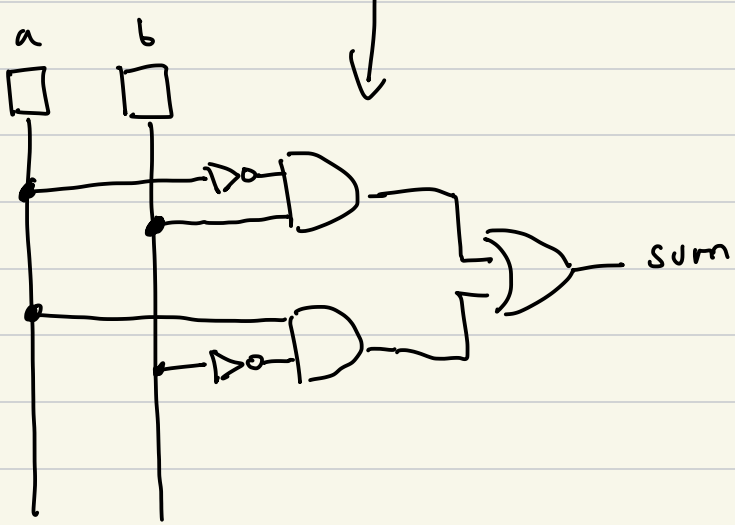
$a = 0 \quad b = 1$

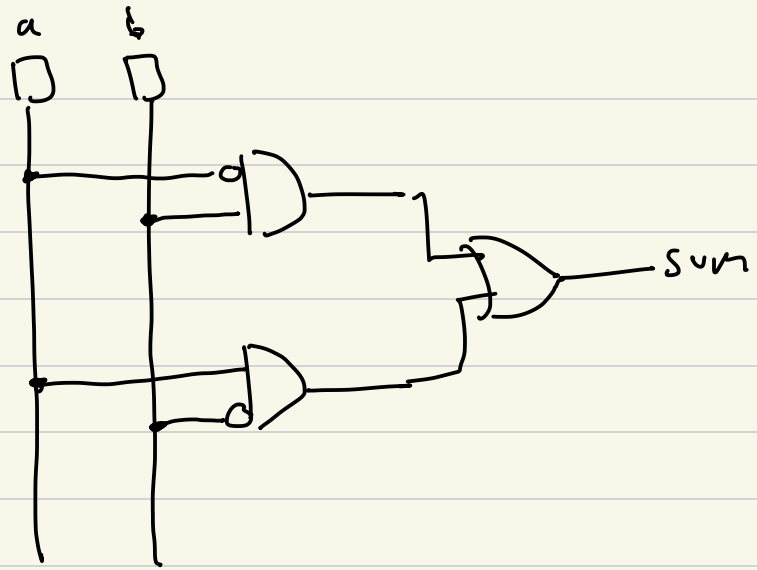
$sum = (\bar{0} \cdot 1) + (0 \cdot \bar{1})$

$= (1 \cdot 1) + (0 \cdot 0)$

$= 1 + 0$

$= 1$





Sum-of-products

1) Build a truth table for your function

For Each output

2) Identify rows with output of 1

3) Construct product (·) terms for each row
   a) If input is 1 → do not invert input var
   b) If input is 0 → invert input var

4) Sum (+) all product terms