

NAND Form

Digital Electronics

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NAND Form (1)

- Instruction
 - Convert function to DNF (Disjunctive Normal Form)
 - Create the truth table
 - Read off the DNF
 - Convert DNF to NAND form
 - Double negation
 - De Morgan
 - NAND contraction
 - NOT elimination

Disjunctive Normal Form (1)

- Instruction
 - Handle only rows with a result of 1
 - Transform these rows into minterms
 - Connect all variables by conjunctions
 - Negate variable if they are 0
 - Connect all minterms by disjunctions

Disjunctive Normal Form (2)

- Example

- Function

- $\phi(a,b) = a \oplus b$ 

- Minterms

- $m_0 = \neg a \wedge b$

- $m_1 = a \wedge \neg b$

- DNF

- $\phi(a,b) = (\neg a \wedge b) \vee (a \wedge \neg b)$ 

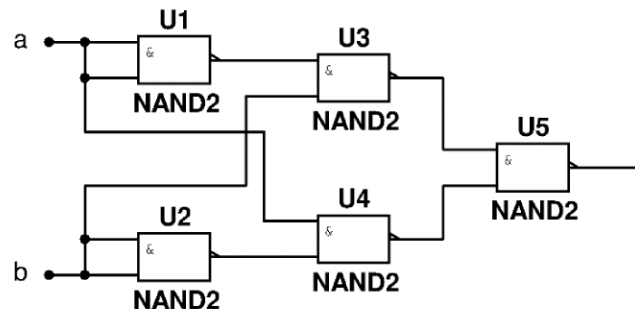
a	b	$\phi(a,b)$	
0	0	0	
0	1	1	m_0
1	0	1	m_1
1	1	0	

NAND Form (2)

- Example (continued)
 - DNF
 - $\phi(a,b) = (\neg a \wedge b) \vee (a \wedge \neg b)$
 - Double negation
 - $\phi(a,b) = \neg \neg ((\neg a \wedge b) \vee (a \wedge \neg b))$
 - De Morgan
 - $\phi(a,b) = \neg (\neg (\neg a \wedge b) \wedge \neg (a \wedge \neg b))$

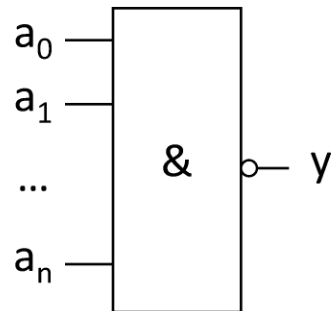
NAND Form (3)

- Example (finished)
 - NAND contraction
 - $\phi(a,b) = \neg ((\neg a | b) \wedge (a | \neg b))$ (inner terms)
 - $\phi(a,b) = (\neg a | b) | (a | \neg b)$ (outer terms)
 - NOT elimination
 - $\phi(a,b) = ((a | a) | b) | (a | (b | b))$



Circuit Symbol

- Compound NAND



$$|: \{0,1\}^n \rightarrow \{0,1\}$$

$$(a_0, a_1, \dots) \mapsto \begin{cases} 0 & \text{if } a_0 = a_1 = \dots = 1 \\ 1 & \text{else} \end{cases}$$

