

EE 200- Digital Logic Circuit Design

3.6 NAND and NOR Implementation

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Introduction

- Can you give an example of don't-care condition



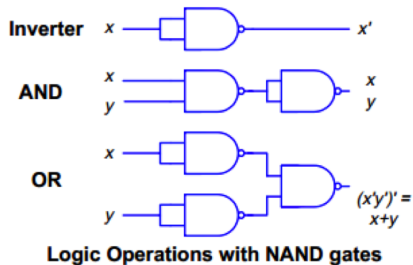
Lecture Outline

- 1 The Map Method
 - NAND Implementation
 - NOR Implementation



NAND Implementation

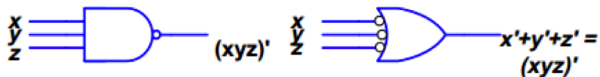
- Using NAND instead of AND and OR.





NAND Implementation

- Alternative graphic symbol for NAND gate.

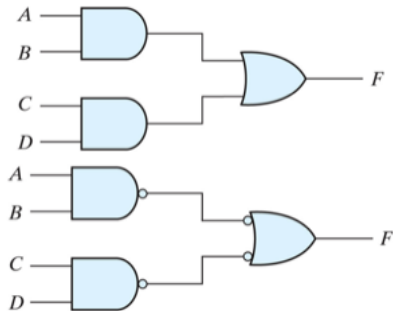


Two Graphic Symbols for NAND gate



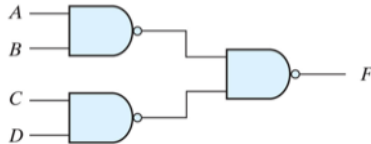
Two-Level Implementation with NAND

- Must have the function as sum-of-products.
- $F = AB + CD$





Two-Level Implementation with NAND

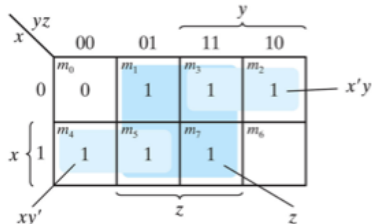


- $F = ((AB)'(CD)')' = AB + CD$



Two-Level Implementation (Example)

- Implement F using NAND gates $F(x, y, z) = (1, 2, 3, 4, 5, 7)$

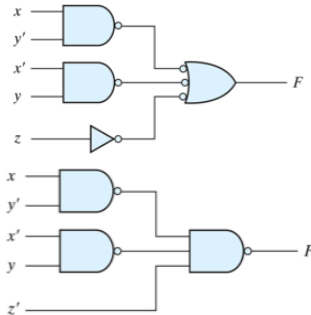


- $F = xy' + x'y + z$



Two-Level Implementation (Example)

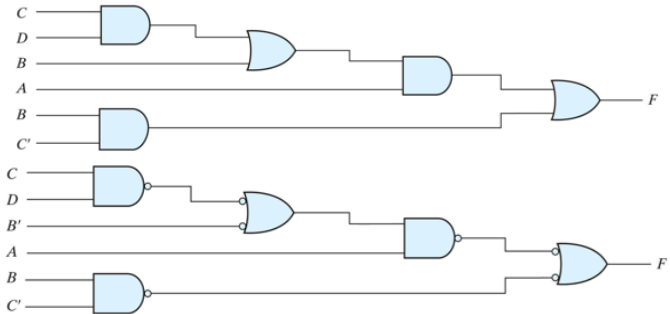
$$F = xy' + x'y + z$$





Multi-Level Implementation with NAND

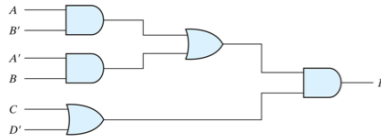
- $F = A(CD + B) + BC'$



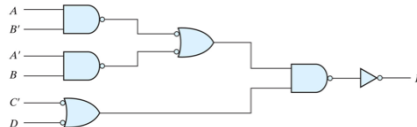


Multi-Level Implementation with NAND

- $F = (AB' + A'B)(C + D')$



AND-OR gates



NAND gates



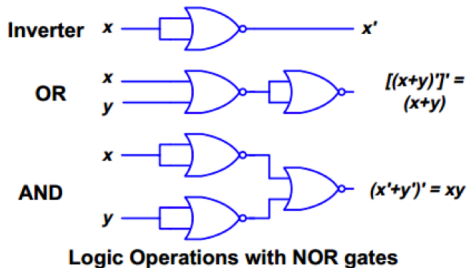
Multi-Level Implementation with NAND (HOW TO)

- Convert all AND gates to NAND gates with AND-invert symbol.
- Convert all OR gates to NAND gates with invert-OR symbol.
- Make sure that every bubble is compensated with another on the same line, if not, insert an inverter.



NOR Implementation

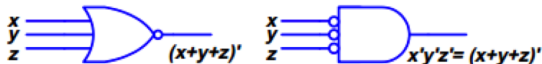
- Using NOR instead of AND and OR.





NAND Implementation

- Alternative graphic symbol for NOR gate.

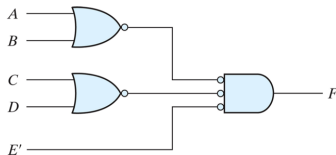


Two graphic symbols for NOR gate



NOR Implementation

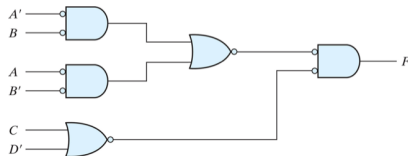
- $F = (A + B)(C + D)E$





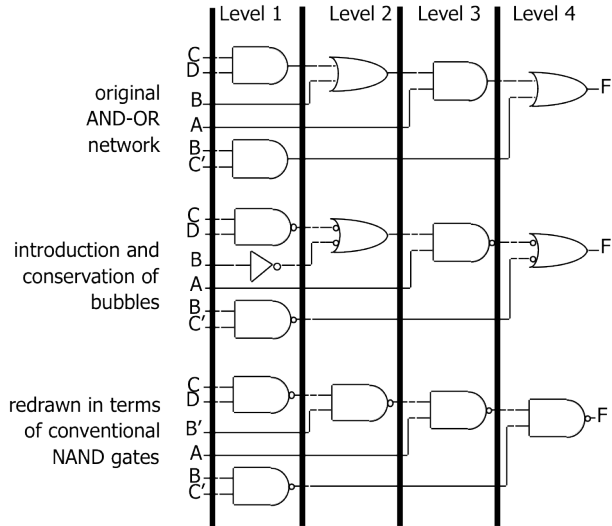
NOR Implementation

- $F = (AB' + A'B)(C + D')$



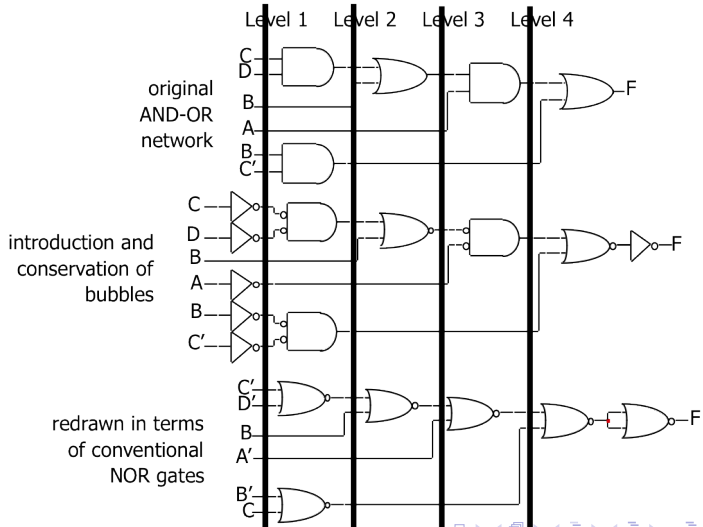


AND-OR to NAND Conversion





AND-OR to NOR Conversion





Summary

- 1 The Map Method
 - NAND Implementation
 - NOR Implementation



Next Lecture

- XOR
- HDL