CAO: Lecture 4
Combinational Logic Blocks

Topics Covered

- NAND-only Logic circuits
- Integrated circuits
- An SSI chip contains independent NAND gates

NAND-ONLY LOGIC CIRCUITS

- Any logic circuits can be transformed to an implementation where only NAND gates (and inverters) are used.
- The general approach to finding a NAND-gate realization: Use De Morgan's theorem to eliminate all the OR operations.

NAND-ONLY LOGIC CIRCUITS

(Example)

F = A + B • (C + D′)

= A + B • (C′D)′

Note that (C′D)′ = C + D′ and (A′X′)′ = A + X

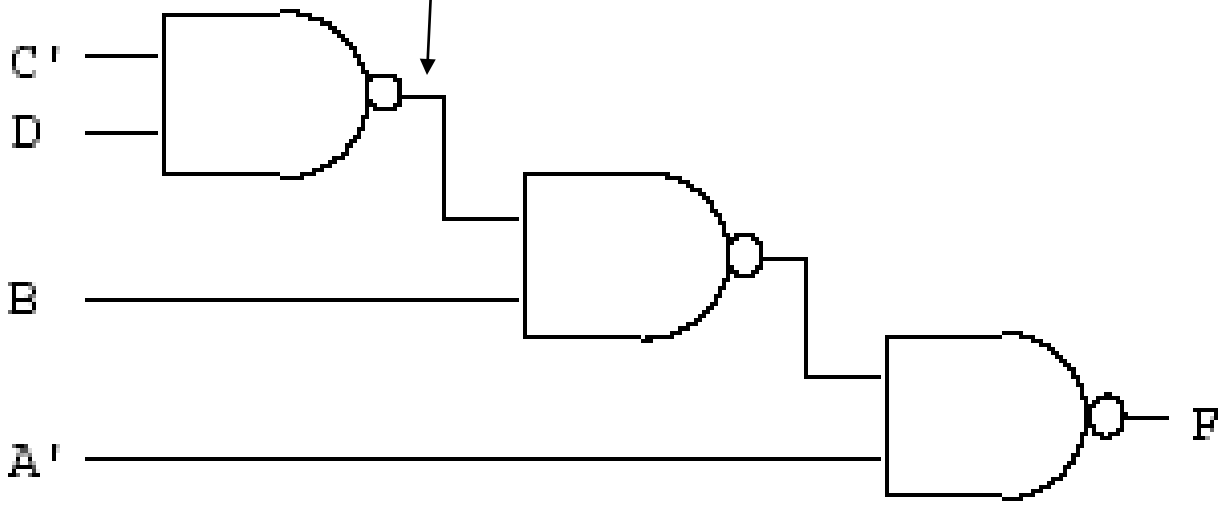
F = (A′ • (B • (C′D)′)′)′

Now there is no OR operation in the Boolean expression. Note that

A NAND B = (AB)′

F= (A’ • (B • (C’D)’)’)’

The logic circuit for this function is given by:



We can also use the same procedure to do NOR only gates.

Integrated Circuits

- An **integrated circuit** is a piece (also called a *chip*) of silicon on which multiple gates or transistors have been embedded

- These silicon pieces are mounted on a plastic or ceramic package with pins along the edges that can be soldered onto circuit boards or inserted into appropriate sockets

Integrated Circuits

Abbreviation	Name	Number of Gates
SSI	Small-Scale Integration	1 to 10
MSI	Medium-Scale Integration	10 to 100
LSI	Large-Scale Integration	100 to 100,000
VLSI	Very-Large-Scale Integration	more than 100,000

- SSI, MSI, LSI: They perform small tasks such as addition of few bits. small memories, small processors
- VLSI Tasks: - Large memory - Complex microprocessors, CPUs

An SSI chip contains independent NAND gates