

Computer Science CSCI 355

Digital Logic and Computer Organization

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Logic Families

A logic family refers to a set of techniques used to implement logic within an integrated circuit.

- Transistor Transistor Logic (TTL)
 - circuits use bipolar junction transistors (BJT)

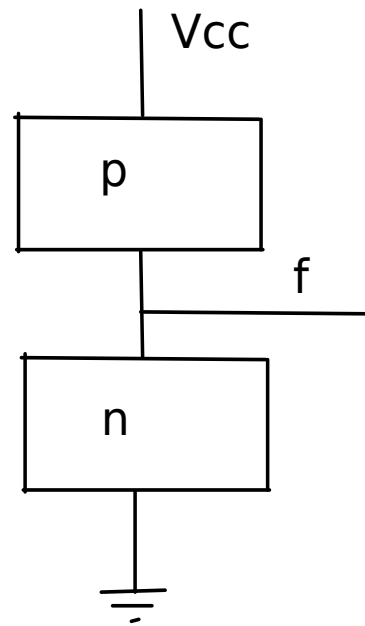
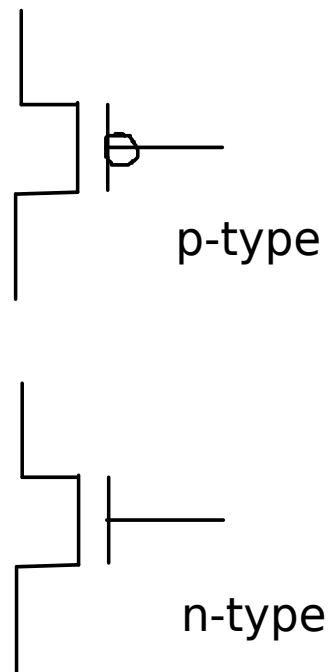
- Complementary-Symmetry
Metal-Oxide-Semiconductor (CMOS)
 - circuits use field effect transistors (FET)

CMOS Logic

Complementary-Symmetry Metal-Oxide-Semiconductor is a type of metal-oxide semiconductor field-effect transistor fabrication process that uses complementary and symmetrical pairs of p-type and n-type transistors for logic functions (see CMOS Wikipedia entry).

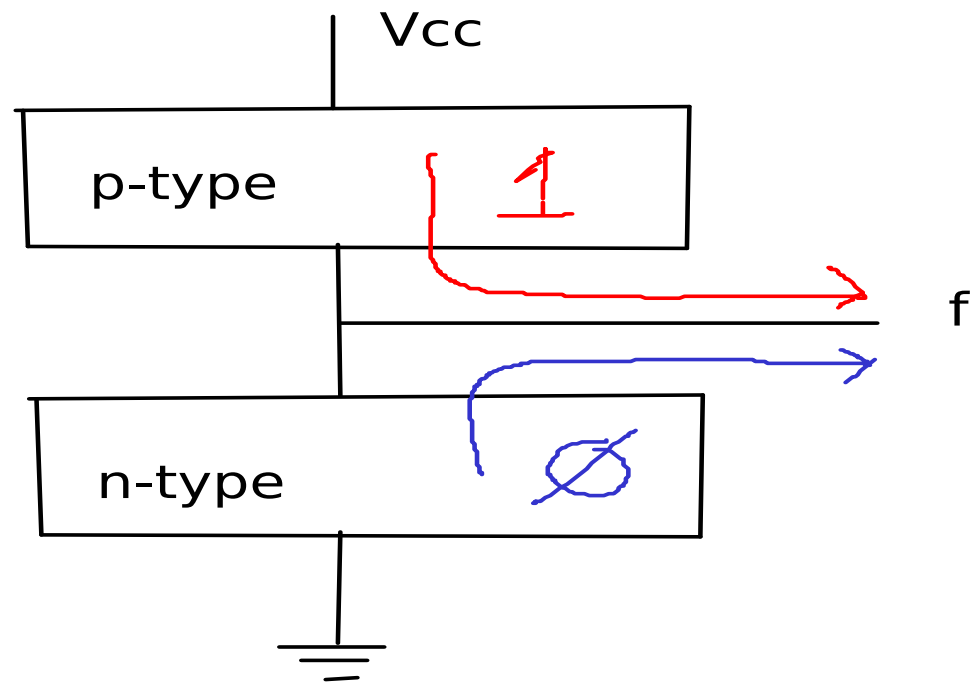
- Advantages (over TTL)
 - lower power consumption
 - reduced complexity
 - higher packing density
 - better noise tolerance
 - better fan-in and fan-out capabilities
- Disadvantages (over TTL)
 - susceptible to electrostatic discharge
 - higher propagation delay

CMOS Circuits



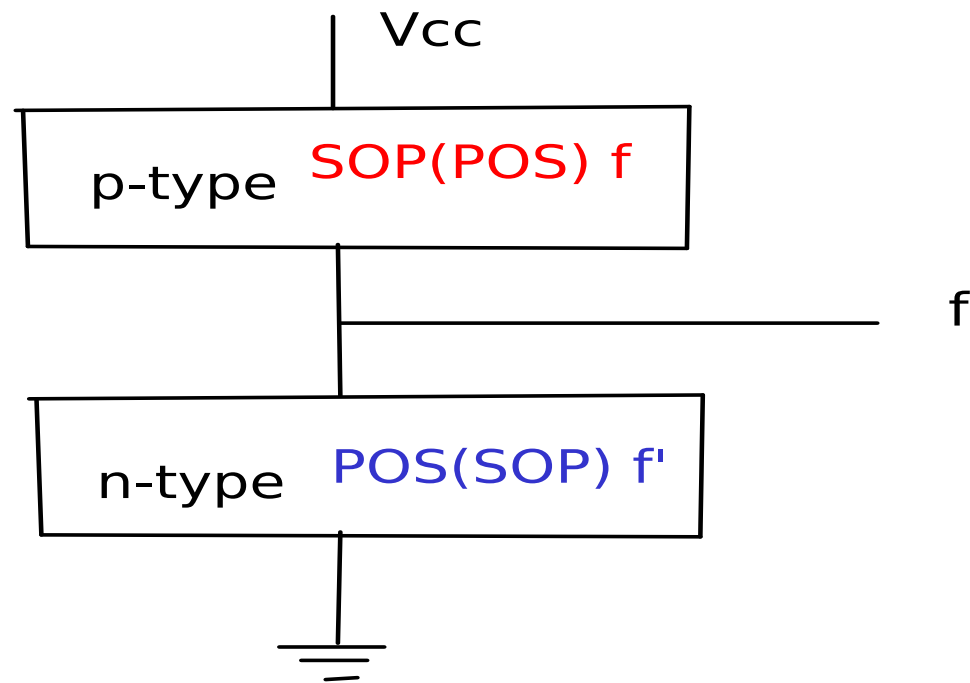
CMOS Circuits cont.

- Complementary

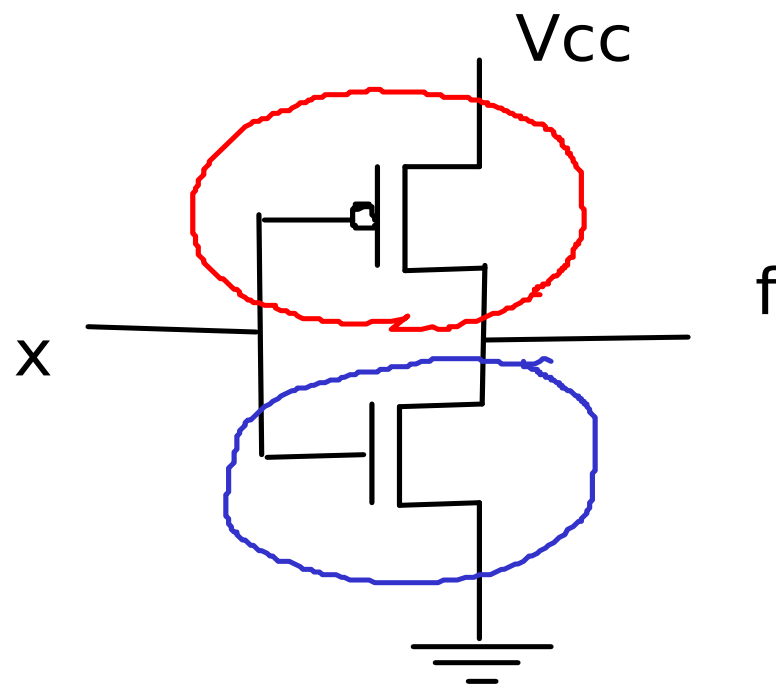


CMOS Circuits cont.

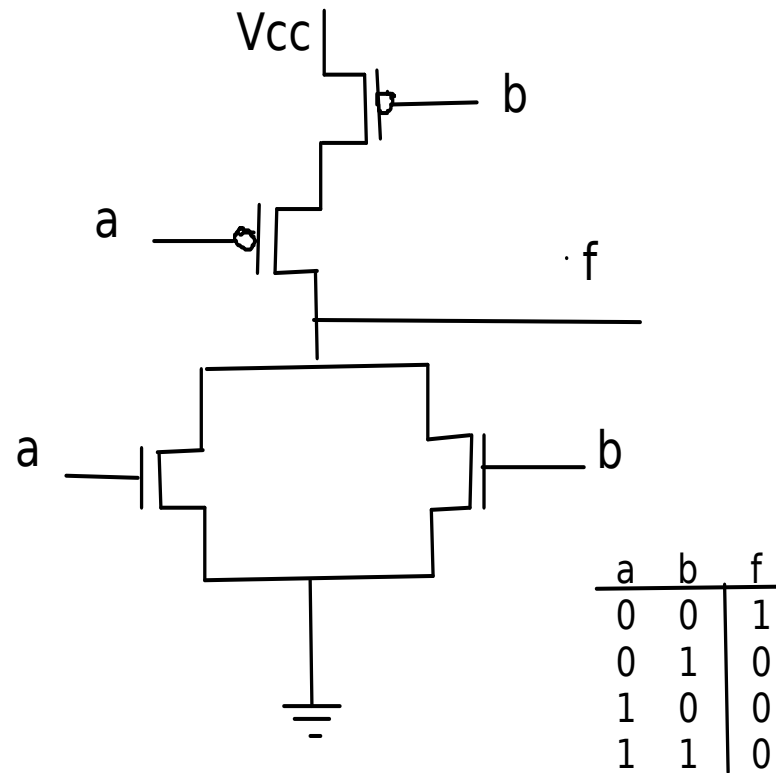
- Symmetry



CMOS Inverter Gate

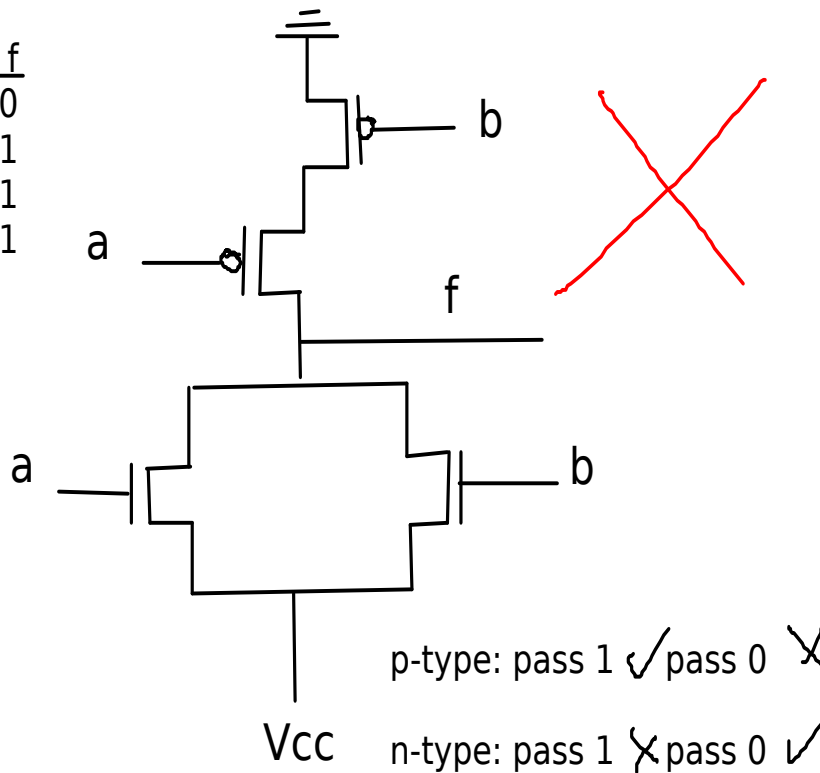


CMOS Nor Gate

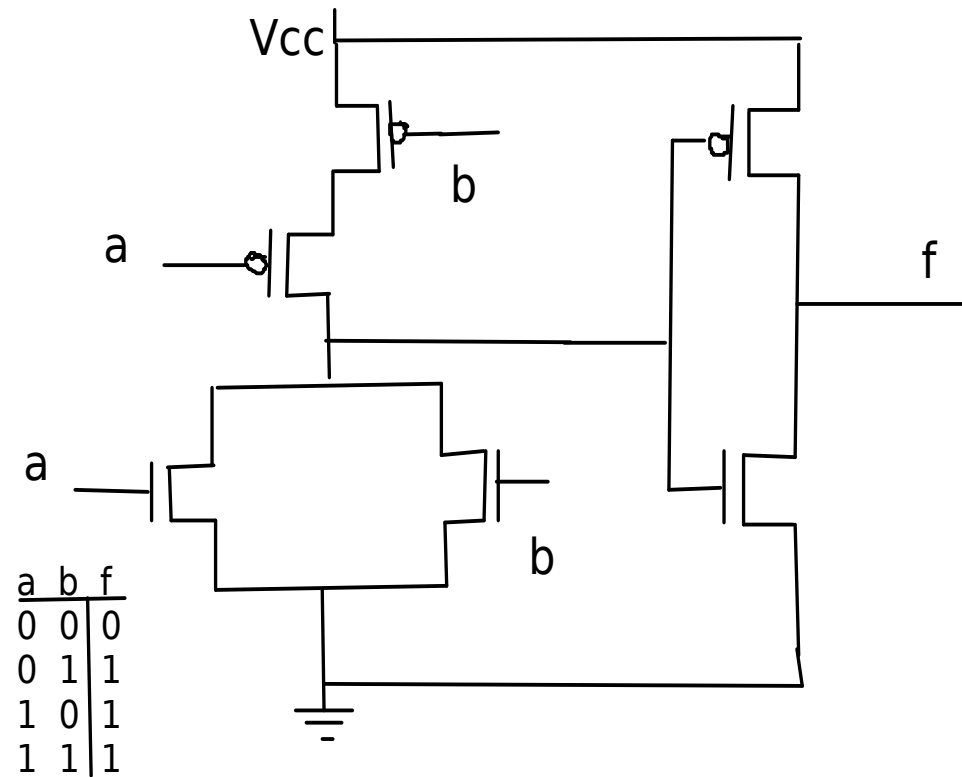


CMOS Or Gate

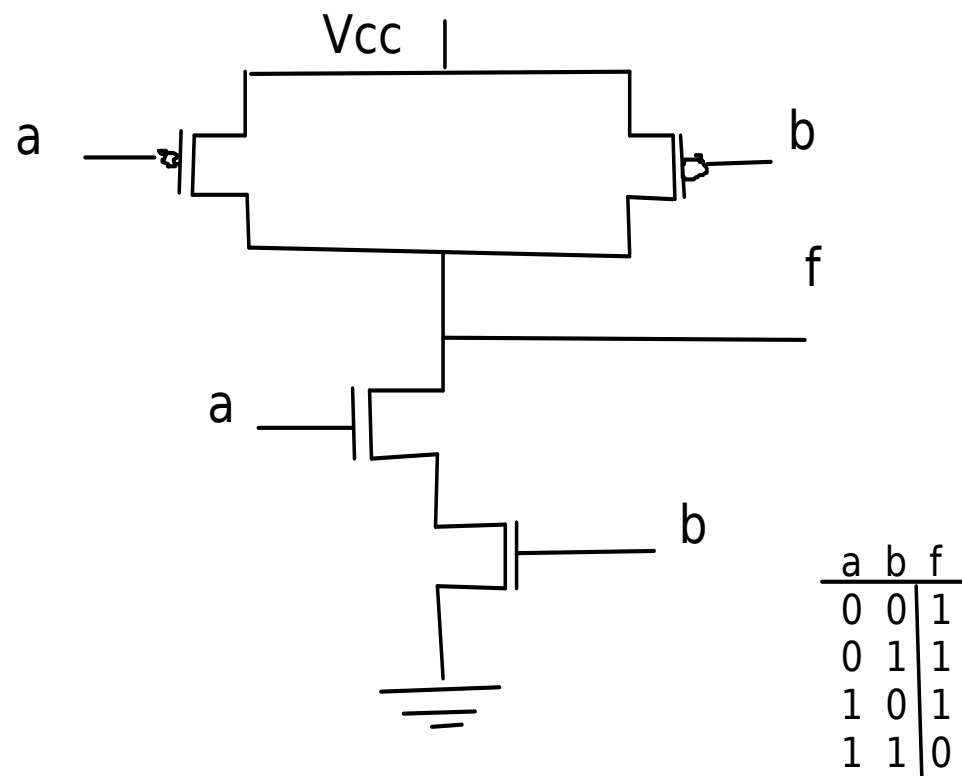
a	b	f
0	0	0
0	1	1
1	0	1
1	1	1



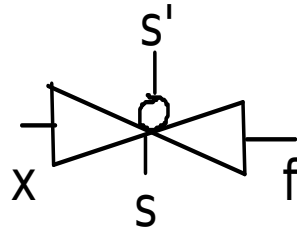
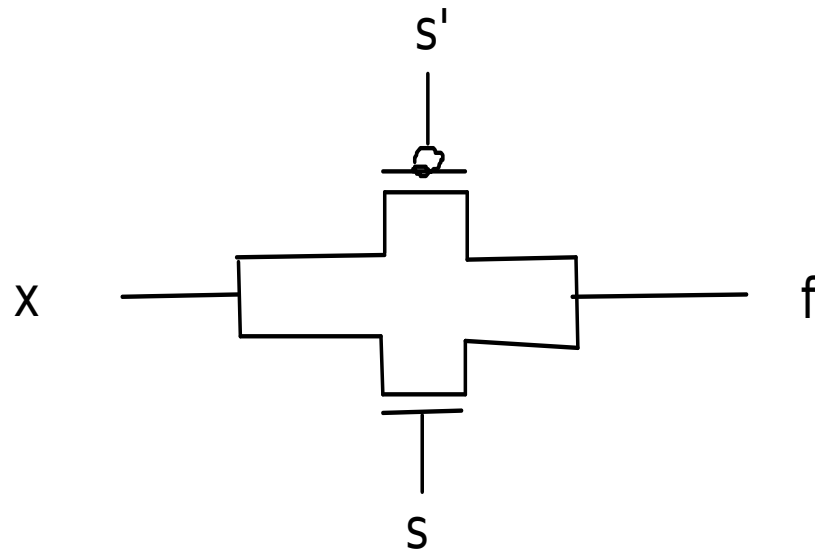
CMOS Or Gate cont.



CMOS Nand Gate

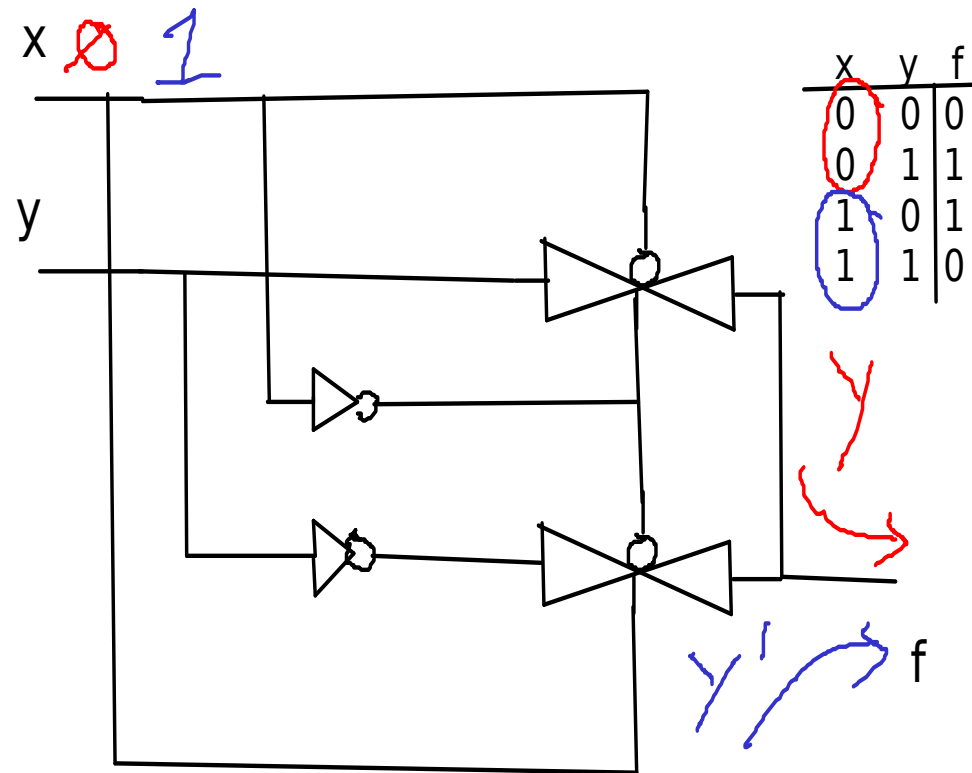


CMOS Transmission Gate



s	f
0	Z
1	good x

CMOS Xor Gate



CMOS Gate Transistor Cost

- inverter
 - 2 transistors
- nand, nor
 - 4 transistors each
- and, or
 - 6 transistors each
- transmission
 - 2 transistors
- xor
 - 8 transistors (2 inverters, 2 transmission gates)
 - 22 transistors (2 inverters, 2 and gates, 1 or gate)