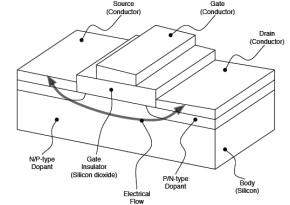


# Lecture 24

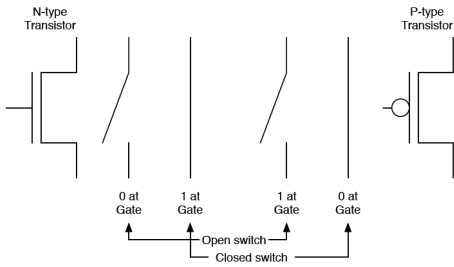
- Transistors
- A look ahead
- Course summary

# What's in a logic gate?

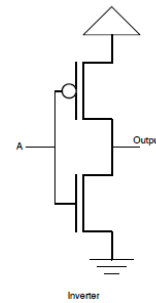
- Metal-oxide-semiconductor field-effect transistor (MOSFET)
  - Complementary MOS
    - N-type (NMOS transistor)
    - P-type (PMOS transistor)



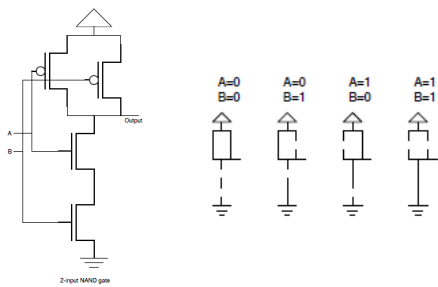
# CMOS transistors



# Inverter

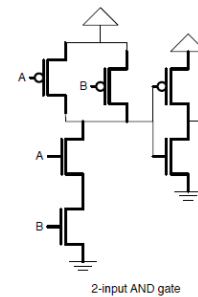


# NAND

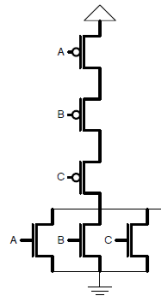


# AND gate

- An AND gate is a NAND gate with an inverter.



## [ 3-input NOR gate ]



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## [ Computer organization ]

- Assembly language and registers
- Fetch-decode-execute
- Arithmetic logic unit (ALU)
- Pipelining

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## [ What you (hopefully) learned ]

- Number systems
  - Binary
  - Octal
  - Hexadecimal
  - Conversion to and from decimal
- Boolean algebra
  - Simplifying Boolean expressions
- Logic gates and truth tables
- Canonical forms
  - SOP
  - POS

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## [ What you (hopefully) learned ]

- NAND/NOR conversions
- Karnaugh maps
- Logic minimization with K-maps
- Multiplexers, demultiplexers
- PLAs/PALs
- ROMs
- Multi-level logic
- Timing diagrams
- Hazards
- Adders, propagation delays

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## [ What you (hopefully) learned ]

- Sequential logic
- Flip-flops and latches
- Registers
  - Shift registers
- Counters
- Timing
  - Setup time
  - Hold time
  - Propagation delay
- Finite state machines
  - Moore machine
  - Mealy machine

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## [ What you (hopefully) learned ]

- FSM design process
  - State diagram
  - State transition table
  - State minimization
    - Row matching
    - Implication tables
  - State encoding
    - Sequential (binary)
    - One-hot encoding
  - Next-state logic minimization via K-maps
  - Implement the circuit

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