

WELCOME

TO

ECE 2030: Introduction to Computer Engineering*

Richard M. Dansereau
rdanse@pobox.com

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*** ELEMENTS OF NOTES AFTER W. KINSNER, UNIVERSITY OF MANITOBA**

LEARN BASICS BEHIND COMPUTER SYSTEMS

- Hardware architecture and organization
- Digital logic design
 - Switching and logic gate design
- Computer architecture building blocks
 - Adders/subtractors/counters
 - Shift/rotate registers
 - Multiplexers/demultiplexers and encoders/decoders
 - Controllers and sequencers
- Software mapping to hardware
 - Instruction types and assembly languages
 - OS issues, branching, jumping, interrupts, subroutines

APPRECIATION OF:

- Computer system architectures and organization

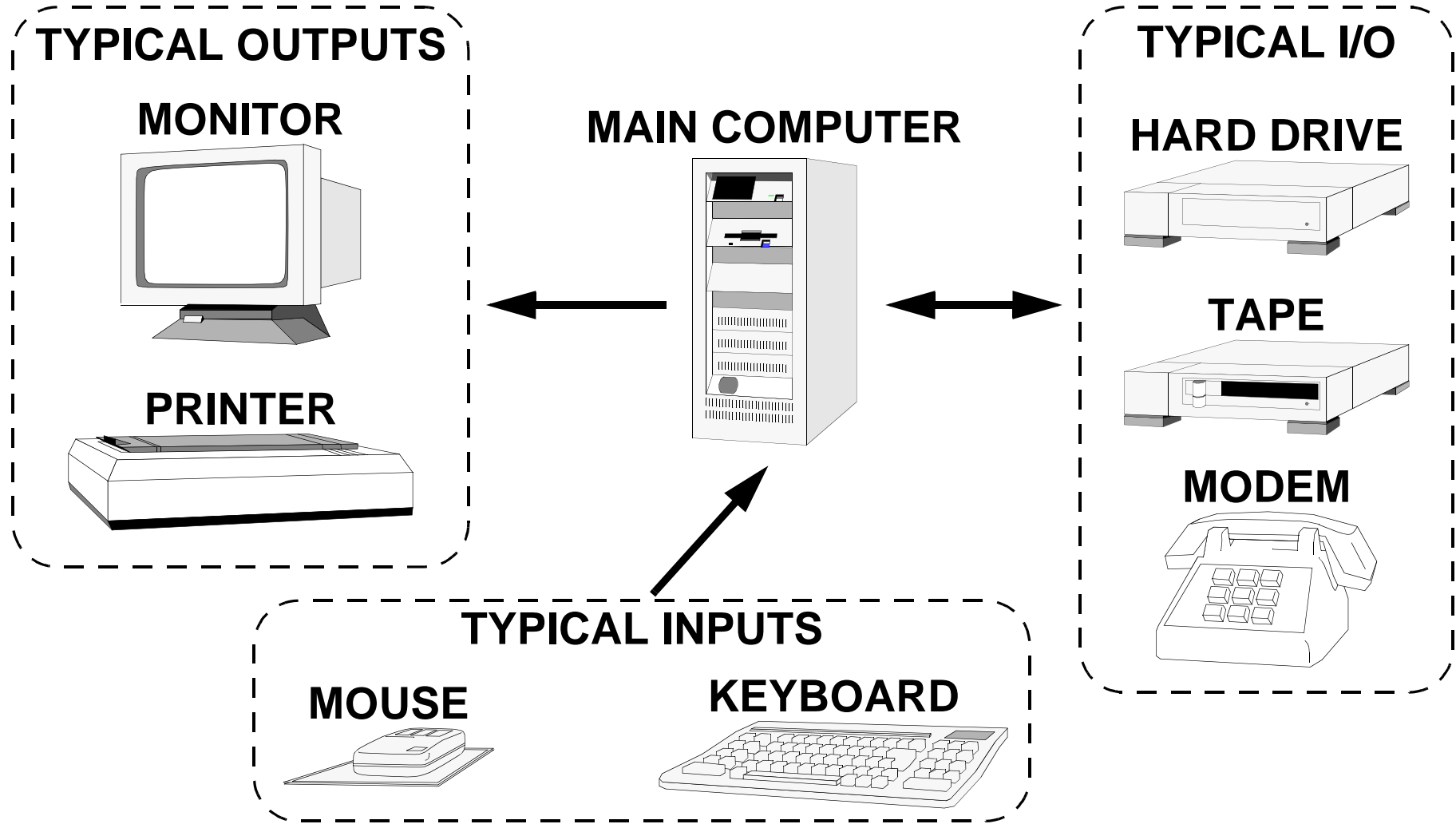
KNOWLEDGE OF:

- Taxonomy of computing structures
- Switching and Boolean algebra
- Combinational logic and sequential logic
- Building blocks to computer architectures
- State machines, finite states machines
- Instruction types and addressing modes
- Single and multi-cycle data path units, microcode
- Software execution in hardware for higher level operating systems

SYSTEM

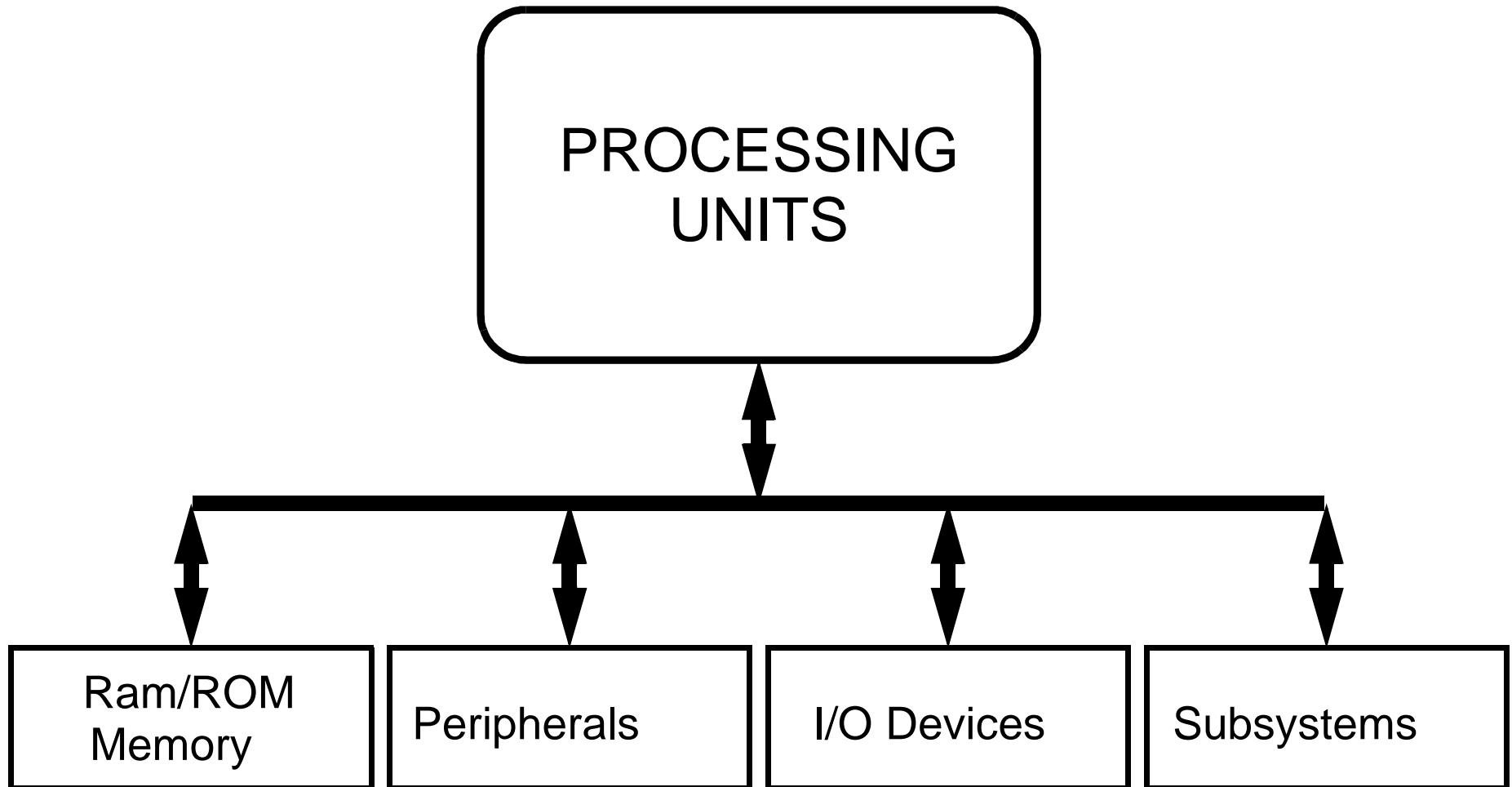
TYPICAL DESKTOP SYSTEM

- WELCOME
- PRELIMINARIES
 - GOAL
 - OBJECTIVES



SYSTEM

GENERIC SYSTEM



SYSTEM

HIERARCHY IN A SYSTEM

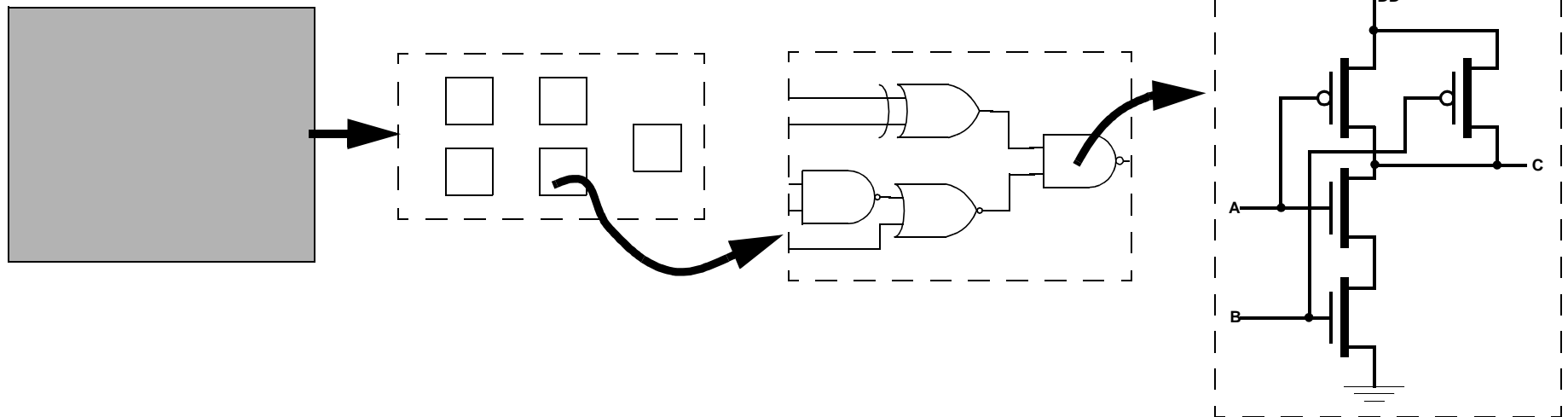
- PRELIMINARIES
- SYSTEM
 - TYPICAL DESKTOP SYST.
 - GENERIC SYSTEM

SYSTEM

MODULES

**GATES AND
FLIP-FLOPS**

TRANSISTORS



SYSTEM

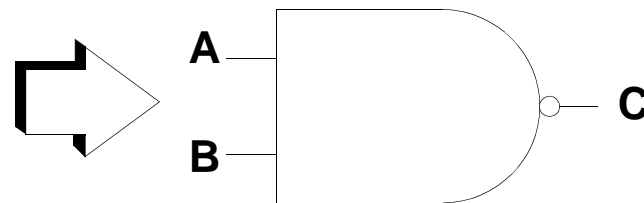
NAND GATE EXAMPLE

- SYSTEM
- TYPICAL DESKTOP SYST.
- GENERIC SYSTEM
- HIERARCHY IN A SYSTEM

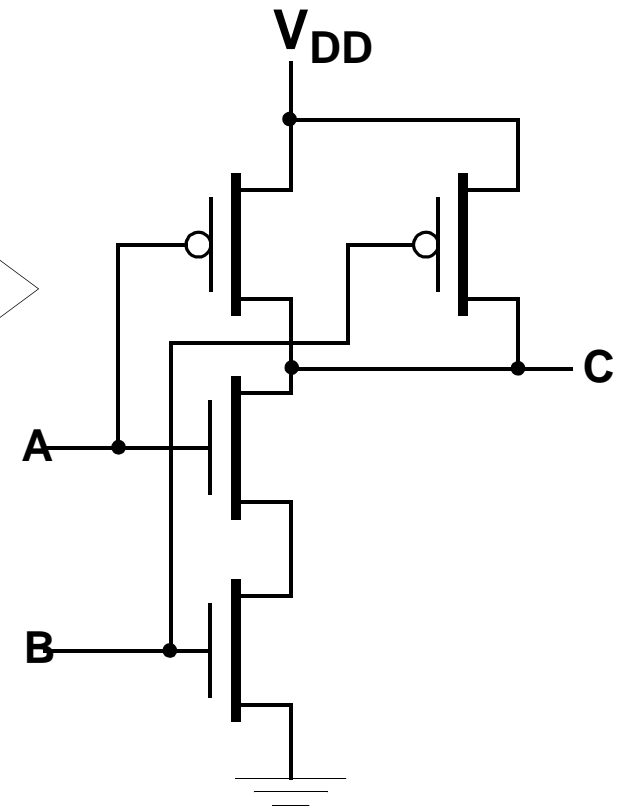
TRUTH TABLE

A	B	C
0	0	1
0	1	1
1	0	1
1	1	0

LOGIC GATE REPRESENTATION



TRANSISTOR (SWITCH) IMPLEMENTATION



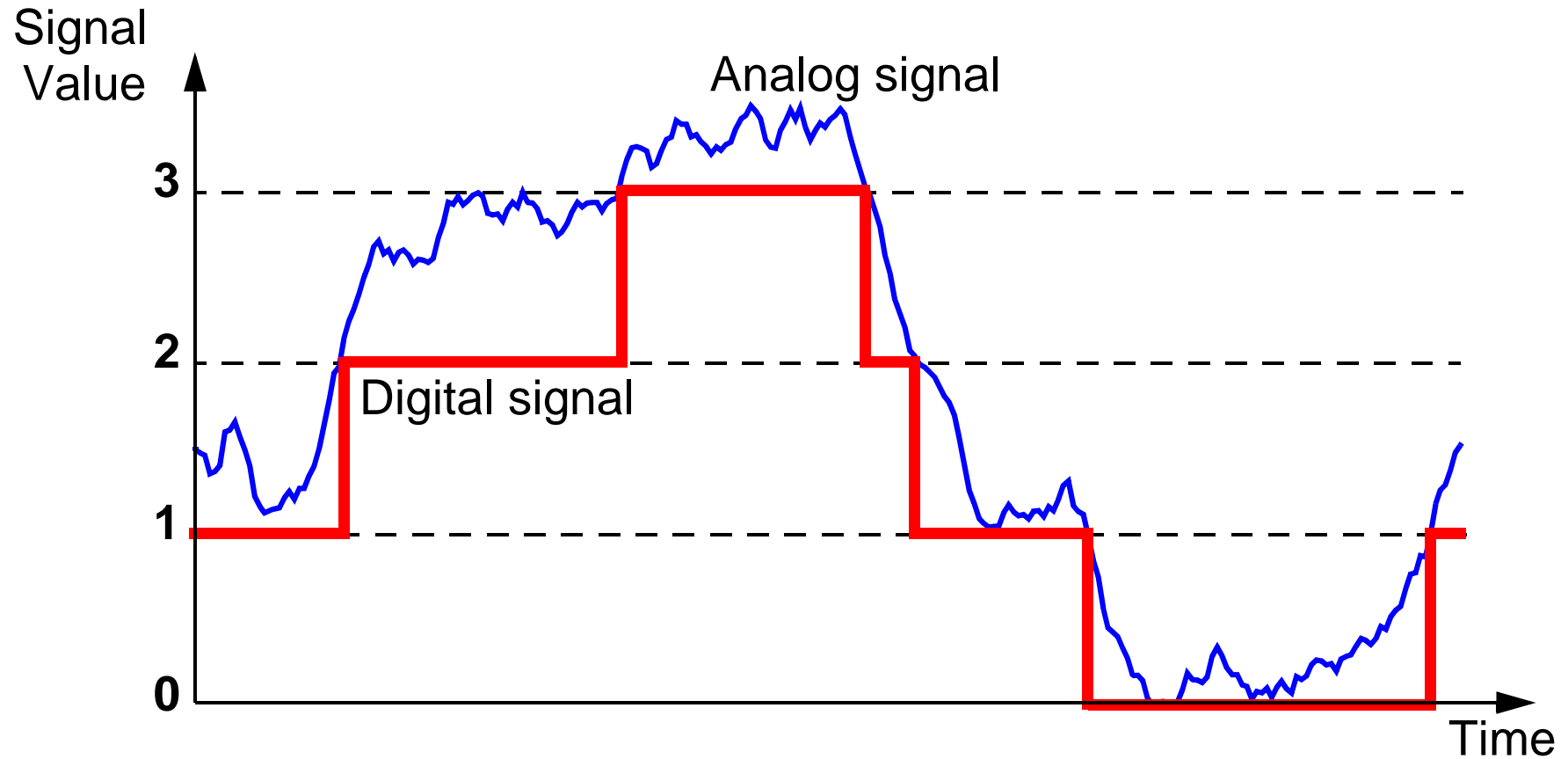
- SYSTEM LEVEL:** -Processors, memories, peripherals
 -Words, files, records, programs
 -HDL, natural language
- REGISTER-TRANSFER LEVEL:** -Registers, ALUs, buses, CCUs
 -Bytes, words, double words
 -Block diagrams, state diagrams
- LOGIC LEVEL:** -Gates, flip-flops
 -1, 0, X (unknown); Strong, weak, Z
 -Logic diagrams, boolean equations
- CIRCUIT LEVEL:** -R, C, L, Diodes, Transistors
 -Voltage, current, temperature
 -Schematic diagrams, circuit equations
- SILICON LEVEL:** Elements: -nPN & PNP transistors, CMOS
 Values: -Voltage, current, temp., fields
 Description: -Device models, interconnects

- **Small scale integration (SSI)**
 - ~10 transistors
 - Individual gates, flip-flops
- **Medium scale integration (MSI)**
 - 10-100 transistors
 - Adders, encoders/decoders, multiplexers, shift registers, counters
- **Large scale integration (LSI)**
 - 100-10,000 transistors
 - small memories, ROMs, PLAs, small memories
- **Very-large scale integration (VLSI)**
 - > 10,000 transistors
 - microprocessors, DSP chips, large memories

ANALOG VS. DIGITAL

A-TO-D CONVERSION

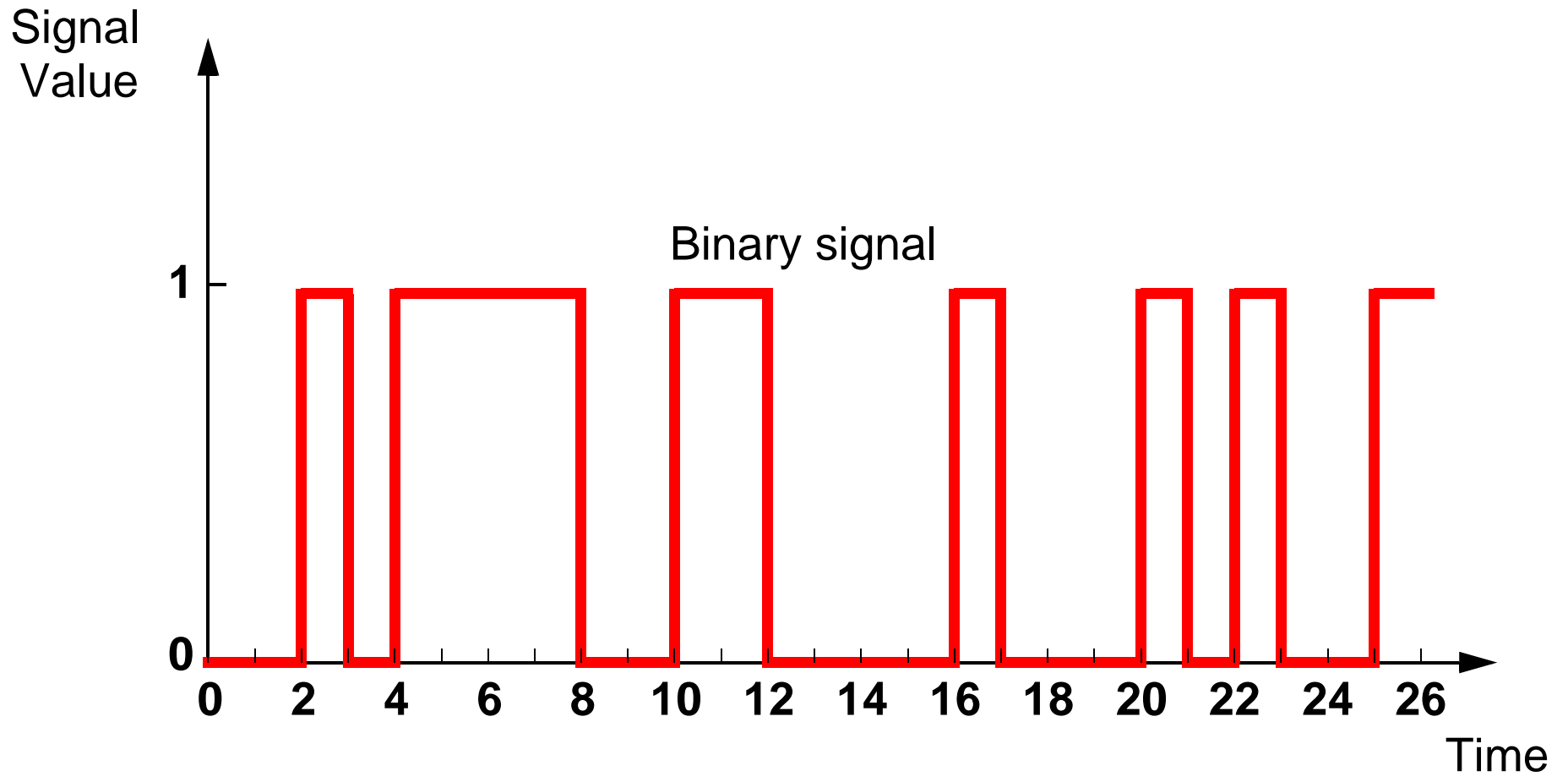
- SYSTEM
- NAND GATE EXAMPLE
- SYSTEM DESCRIPTION
- LEVELS OF INTEGRATION



ANALOG VS. DIGITAL

BINARY SIGNAL

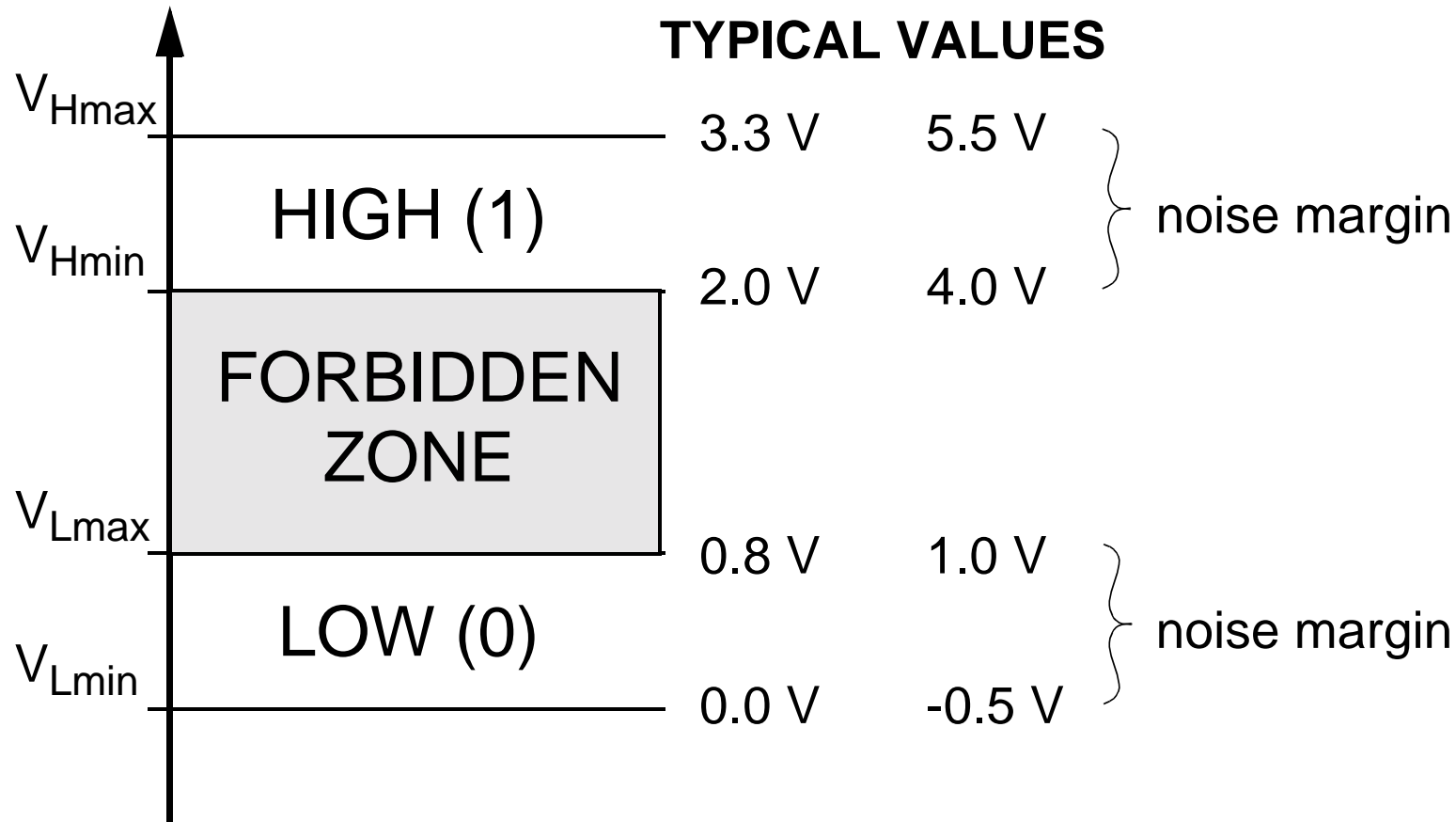
- SYSTEM
- ANALOG VS. DIGITAL
- A-TO-D CONVERSION



BINARY

BINARY LOGIC LEVELS

- SYSTEM
- ANALOG VS. DIGITAL
 - A-TO-D CONVERSION
 - BINARY SIGNAL



BINARY

BINARY NUMBERS

- Binary numbers are base 2 as opposed to base 10 typically used.
- Instead of decimal places such as 1s, 10s, 100s, 1000s, etc., binary uses powers of two to have 1s, 2s, 4s, 8s, 16s, 32s, 64s, etc. places.

Examples:

$$101_2 = (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) = 4_{10} + 1_{10} = 5_{10}$$

$$10111_2 = (1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) = 23_{10}$$

$$00101111_2 = (1 \times 2^5) + (1 \times 2^3) + (1 \times 2^2) + (1 \times 2^1) + (1 \times 2^0) = 47_{10}$$

- We will discuss binary numbers and binary arithmetic in a little more depth later.