

# Digital Logic Design

## Lecture # 1

### Objective: Digital Logic design Overview

#### Number systems

#### Boolean algebra

Switch and CMOS design ( A brief)

#### Combinational logic

Logic gates

Building blocks: de/mux, de/encoder, shifters, adder/subtractor, multiplier

Logic minimization

Mixed logic

#### Sequential logic

Latches, Flip-flops

State machine: Mealy/Moore machines

## Course Logistics & Administration

### TEXTBOOK:

A. M. Morris Mano and Charles R. Kime, *Logic and Computer Design Fundamentals*,  
Pearson Education Inc.

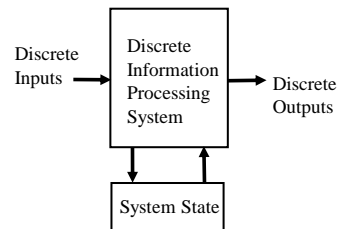
B. Introduction to Logic And Computer Design by Alan B Marcovitz ( For Examples )

### HOMEWORK:

Regular homework will be assigned on regular basis. Work handed in must be original and not a duplicate.

### DIGITAL & COMPUTER SYSTEMS - Digital System

- Takes a set of discrete information inputs and discrete internal information (system state) and generates a set of discrete information outputs.

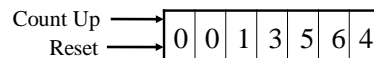


### Types of Digital Systems

- No state present
  - Combinational Logic System
  - Output = Function(Input)
- State present
  - State updated at discrete times  
=> Synchronous Sequential System
  - State updated at any time  
=> Asynchronous Sequential System
  - State = Function (State, Input)
  - Output = Function (State)  
or Function (State, Input)

### Digital System Example:

A Digital Counter (e. g., odometer):



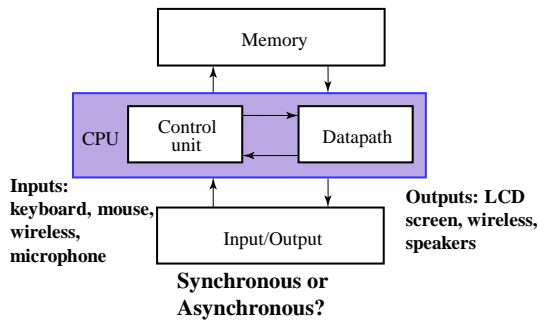
Inputs: Count Up, Reset

Outputs: Visual Display

State: "Value" of stored digits

Synchronous or Asynchronous?

## Digital Computer Example



## And Beyond – Embedded Systems

- Computers as integral parts of other products
- Examples of embedded computers
  - Microcomputers
  - Microcontrollers
  - Digital signal processors

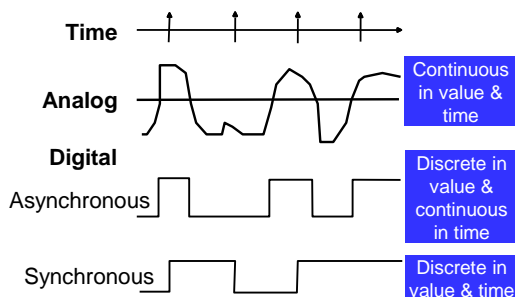
## Embedded Systems

- Examples of Embedded Systems Applications
  - Cell phones
  - Automobiles
  - Video games
  - Copiers
  - Dishwashers
  - Flat Panel TVs
  - Global Positioning Systems

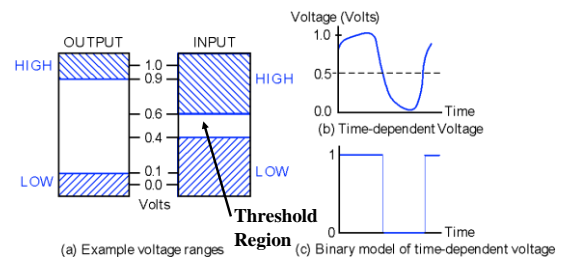
## INFORMATION REPRESENTATION - Signals

- Information variables represented by physical quantities.
- For digital systems, the variables take on discrete values.
- Two level, or binary values are the most prevalent values in digital systems.
- Binary values are represented abstractly by:
  - digits 0 and 1
  - words (symbols) False (F) and True (T)
  - words (symbols) Low (L) and High (H)
  - and words On and Off.
- Binary values are represented by values or ranges of values of physical quantities

## Signal Examples Over Time



## Signal Example – Physical Quantity: Voltage



## Binary Values: Other Physical Quantities

- What are other physical quantities represent 0 and 1?
  - CPU Voltage
  - Disk Magnetic Field Direction
  - CD Surface Pits/Light
  - Dynamic RAM Electrical Charge