Digital Logic Circuits

ELEC2200

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Introduction

- Design of digital circuits
- Number representation
- Two common types of digital circuits
- Design Methods
- Validation Techniques

Digital vs. Analog

- Analog
  - Continuous
  - Represented with real numbers
  - Manipulated with classical algebra
- Digital
  - Discrete
  - Represented as whole numbers(digits)
  - Boolean algebra applies in this case

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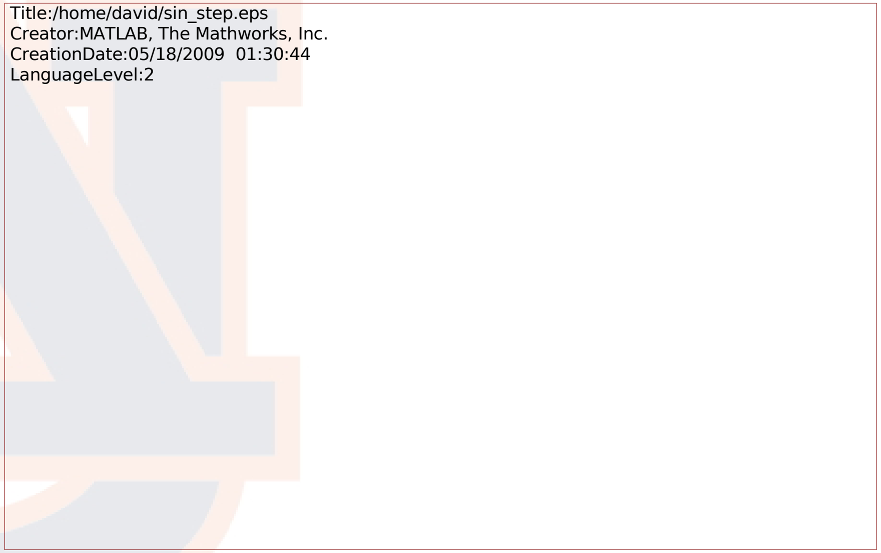
Why Digital?

- We're not changing the signal, we're just representing it differently
- This representation is :
  - more flexible
  - cost effective
  - more precise
  - allows for error detection
  - more easily minimized
- Care must be taken to avoid loss of accuracy
- Can also represent letters and symbols



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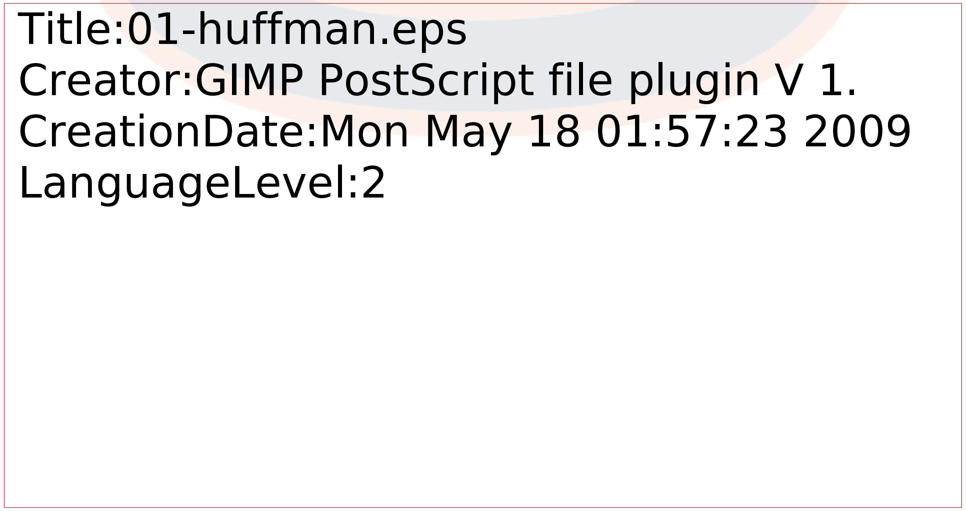
Logic Types

- Combinational
  - A combination of logic operations
  - The output is dependent solely on the inputs
  - Analogous to a continuous function, y=f(x)
  - All inputs, x, will generate an output,y
  - Creating the mapping from input to output is one design problem we will be concerned with

Logic Types

- Sequential
  - Output is dependent on inputs AND previous values
  - We must be able to 'remember' previous values to accomplish this
  - Think of this as a difference equation, $y_{K+1}=f(x,y_K)$
  - Generally described by the *Huffman Model*



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CreationDate:Mon May 18 01:57:23 2009
LanguageLevel:2

Abstraction

- How do we solve these design problems?
- Break a system down into simpler units
- Looking from the 'Top-Down' perspective:
  - System Level
  - Register Level – Focus of Comp. Sys.
  - Gate Level – Focus of this class
  - Transistor Level – Focus of Dig. Elec.

Design Methods

- Top-Down
  - Begin on the system level
  - Subdivide into lower levels (Register,Gate, Transistor)
  - Focus on the end function of the system
- Bottom-Up
  - Uses many pre-defined subsystems to build a greater whole
  - Solution may be sub-optimal
  - Results in an unclear system structure

Design Validation

- Checking your answers
- We can easily validate our work by simulating each input
- AUSIM is a simple digital logic simulator that will allow us to automate validation

Where Does This Leave Us?

- What are the particulars of representing things digitally?
- How do we manipulate these representations with boolean algebra?
- Can we methodically find a relationship between inputs and the desired outputs?
- Can we find a minimized version of this relationship?
- How is this employed on the system level?