EE 2720 (Digital Logic I) (1)

Course Summary and Overview

Introduction

- Analog versus digital
- Why is digital chosen over analog.
- Digital devices (AND gate, OR gate, NOT gate or inverter, NAND gate, NOR gate, EXCLUSIVE-OR gate, EXCLUSIVE-NOR gate).
- Classification of Digital Circuits (combinational → EE 2720; sequential → EE 2730).
- Integrated Circuits (Chips)
- Size classification of Integrated Circuits (SSI, MSI, LSI, VLSI)

Number Systems and Computer Arithmetic

- **Fixed Point (FXP Systems)**
  - Positional Number Systems (decimal, binary, octal, hexadecimal)
  - Binary to octal conversion
  - Octal to binary "
  - Binary to hexadecimal "
  - Hexadecimal to binary "
  - Radix-r to Decimal "
  - Decimal to Radix-r " (integer part, fractional part)
  - Addition of binary numbers

- **Unsigned binary FXP systems**
  - Dynamic Range (DR)
  - Overflow
  - " Detection

• Signed Fixed Point (FXP) Systems
Representation of Negative Numbers

- Signed-Magnitude System for binary numbers; CDR, addition/subtraction in signed-magnitude system)
- Radix-Complement System
- Two's-Complement ,, ; CDR, addition/subtraction in the two's complement system, overflow/underflow, overflow/underflow detection
- Diminished Radix-Complement System
- One's-complement system; CDR) Addition/Subtraction in one's complement system, overflow/underflow, overflow/underflow detection)
- Addition/Subtraction in the Signed-Magnitude System)

• Binary Multiplication

- Unsigned multiplication
- Binary multiplication for two's complement numbers

• Codes

- BCD (BCD Addition)
- Gray Code
- 2421 Code
- Excess-3 code
- 2-out-of-5 code
- Character Codes (ASCII)

• Boolean Algebra and Switching Algebra

- Switching Algebra
- Axioms
- Switching Algebra Theorems
- Simplification of logic expressions using switching algebra theorems

- Algebraic simplification of Switching Expressions

- **Multiplying out and Factoring**
  - Multiplying out
  - Factoring
  - Proving the validity of an equation

- **Duality**
  - Principle of duality
  - Dual of a logic expression

- **Standard representations of logic functions.**
  - minterms
  - maxterms
  - Canonical sum
  - " product

- **n-input AND gate**
- **n-input OR gate**
- **n-input NAND gate**

- n-input NOR gate

— Any digital function can be realized using only NAND gates; (the NAND operator is a complete operator)
— Any digital function can be realized using only NOR gates; (the NOR operator is a complete operator)
— Realization of a logic function using only NAND gates
— Ralization of a logic function using only NOR gates

- Transforming an AND–OR logic circuit into an OR–AND logic circuit and vice versa.

- The 2-input Exclusive–OR (XOR) gate and " " " " – NOR (XNOR) "

- Combinational-Circuit Analysis

(given a logic circuit find out what it does).

- Combinational-Circuit Synthesis

(given a problem statement design the circuit; obtain its logic diagrams)

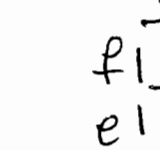
- Combinational-Circuit minimization

(make the circuit cheaper and faster).

- Getting away from algebra; graphical techniques and approaches for circuit simplification and minimization → Karnaugh maps; (very important topic; you will enjoy this)

• Decoders

- General definition
- 1-out-of 2^n decoder; (very important in computer design)
- Implementing logic functions (digital circuits) using 1-to-2^n decoders.
- Seven-Segment decoders

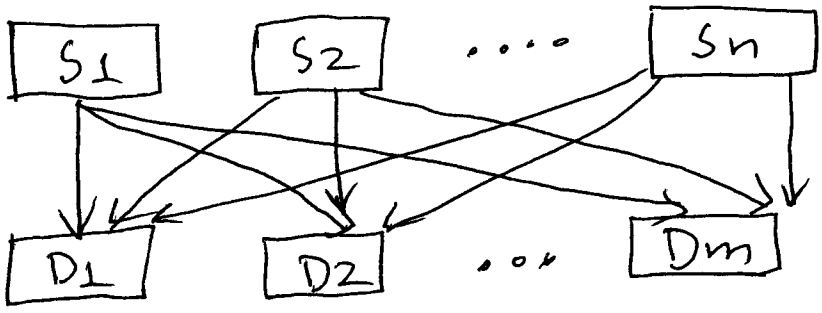


; (used in digital watches and other digital equipment). I'll show you how to design such decoders.
- Decoders with an Enable input
- Constructing large decoders using smaller ones
- Decoders with more than one enable inputs

- Encoders
- Priority encoders
- An interesting application of priority encoders in computers.
- Cascading priority encoders; (constructing large priority encoders using smaller ones).
- Multiplexers; (very useful in designing the Central Processing Unit (CPU) of computers; you will see this in EE 3755 (Computer Organization) if you take it). I'll show you how to design multiplexers. (2^n-to-1 multiplexers)
  - Designing large multiplexers from smaller ones.

- Demultiplexers ; (the opposite of multiplexers.). A binary decoder with an enable input can be used as a demultiplexer

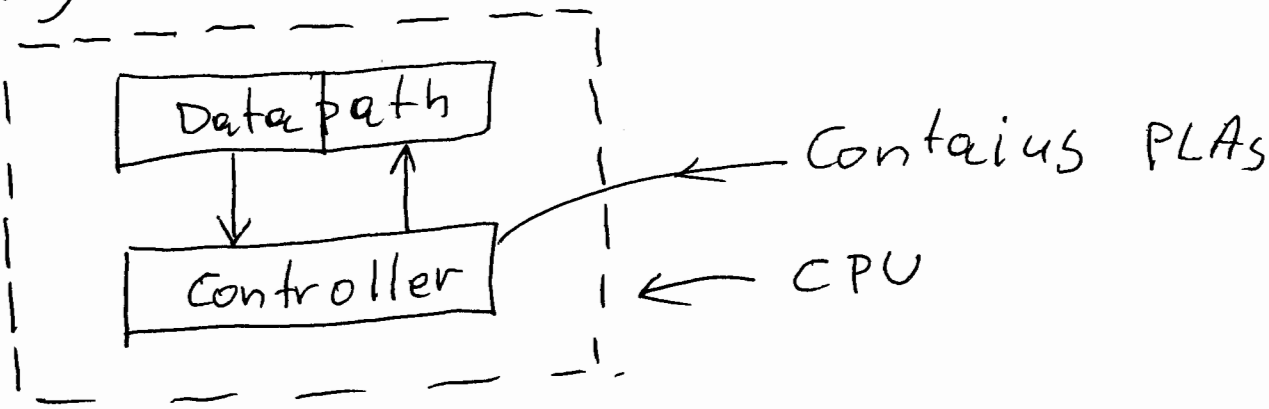
- Combining multiplexers together with demultiplexers ; (application is to connect information from many source locations to many destination locations ⟹ communications)



- Using multiplexers to realize logic functions

- Propagation Delay
- Timing diagrams; (you will need them in EE 2730 → Digital Logic II).
- Programmable Logic Devices (PLDs)

— Programmable Logic Arrays (PLAs); (the are used in the design of the CPU of computers; you will see them in EE 3755 if you take it)



— Programmable Array Logic Devices; (PALs); less flexible than PLAs but cheaper

— Implementation of logic functions using PLAs and PALs.

- Tristate elements and tristate BUSES.

- Ripple Carry Adders

— How to construct them and how to cascade (connect) them

Note: If time allows I'll cover more topics.

Sequence of computer courses