ITI1100C

Professor :

Dr. Fadi Malek
Email: malek@uottawa.ca

Digital Systems 1

ITI1100 Digital Systems I (3,0,3b) 3 cr.

Digital computers and information. Number systems and alphanumeric codes. Binary arithmetic. Boolean algebra. Logic functions representation, minimization and realization. Analysis, design and implementation of combinational circuits. Basic sequential circuits. Latches and flip-flops. Analysis and design of simple sequential circuits. Registers and counters. Implementation of digital circuits.

Course and Lab Schedule:

ITI1100 C
(Jan 12 - Apr 14)

Lec 1	Tue 13:00 - 14:30	HGN 302
Lec 2	Thu 11:30 - 13:00	HGN 302
DGD 1	Thu 17:30 - 19:00	DMS 1130
DGD 2	Wed 11:30 - 13:00	MRT 211
Lab 1	Tue 14:30 - 17:30	CBY B302
Lab 2	Fri 08:30 - 11:30	CBY B302

Mid-term exam date:
Saturday 28 Feb 2014
Location: TBD

- **Course website:**

On Virtual Campus (Blackboard Learn).
Enter your InfoWeb user name (with prefix E)
and password (all in caps) in the appropriate cells
and click on “Sign In”.
Click on ITI1100 to access the course web site.

Course Outline

Digital Design

1.Binary Systems.

Digital Systems. Binary Numbers. Number Base Conversions. Octal and Hexadecimal Numbers. Complements. Signed Binary Numbers. Binary Codes. Binary Storage and Registers. Binary arithmetic

2.Boolean Algebra and Logic Gates.

Basic Definitions. Basic Theorems and Properties of
Boolean Algebra. Boolean Functions. Canonical and Standard Forms. Other

Course Outline

Digital Design [2]

3.Gate Level Minimization

The Map Method. Four Variable Map. Product of Sums Simplification. Don’t Care Conditions. NAND and NOR, Implementation. Other Two Level Implementations. Exclusive OR Function.

4.Combinational Logic

Combinational Circuits. Analysis Procedure. Design Procedure. Binary Adder Subtractor. Magnitude

Course Outline

Digital Design [3]

5.Synchronous Sequential Logic.

Sequential Circuits. Latches. Flip Flops. Analysis of Clocked Sequential Circuits. Design Procedure.

6.Registers ad Counters.

Registers. Shift Registers. Ripple Counters. Synchronous Counters. Other Counters.

Textbook

Available at the University of Ottawa bookstore.

MUST BUY!

Book Title: Digital Design

Authors: M Morris Mano & Michael D. Ciletti

Edition: Fourth Edition

ISBN: 0-13-198924-3

Publisher: Pearson-Prentice Hall

Course Format

- 7.5 Hours of scheduled instruction per week
  - 3 hours of Lecture
  - 1.5 hour of Group Discussions. (starting date: to be announced in the class)
  - 3 hours of Laboratory (starting date: to be announced in the class)

Laboratory

- →Each student will have a laboratory session every week. There are six experiments to be performed, each requiring a group preparation and completion report.

- → Laboratory groups will consist of **two** students only.

- → Students are required to stay in the same group
- and with the same TA for the whole semester.

Laboratory

→Every group performing the experiment is required to record their data on paper and this should be seen and signed by the TA.

→The data should be attached to the submitted report. One lab report is expected from each group after each lab.

→The lab report should be prepared according to the guidelines specified in the lab manual.

Assignments

There will be five or six assignments for this course. Stick to deadlines; late submissions are not accepted!

Grading Scheme

Assignments	10%
Laboratories	15%
Mid term exam	25%
Final Exam	50%

Cheating and plagiarism

•Cheating is any act that gives you unfair advantage at the expense of another classmate.

•Examples:

–copying on exams, homework

•**Plagiarism** see the following URL: **http://www.uottawa.ca/plagiarism.pdf**

•If we detect you are involved in cheating or plagiarism you will be turned over to the Faculty, for investigation and sanctions

Digital Systems (DS)

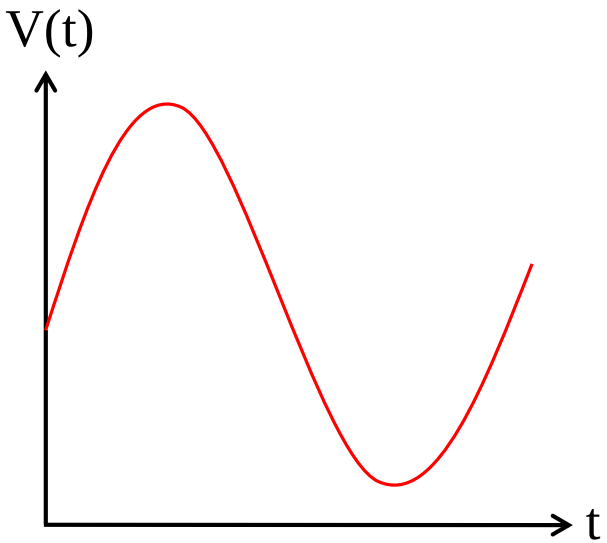
- Used in Communications, Business Transactions, Medical Systems, Internet, Computers, etc.
- Found in Digital Telephones, Digital Cameras, Digital Television, etc..
- DS Represent and manipulate discrete elements of information.
- Set of **finite number** of elements is a discrete set.
- Otherwise it is a continuous set

Digital Systems (DS)

- Discrete elements of information is represented in a digital computer by physical quantities called *signals* such as voltages, currents, etc.
- Electronic devices implement signals.
- Most Today's digital systems use 2 discrete values 0 and 1 and are called binary digits.
- Binary digit (*bit*)= 0 or 1
- Discrete elements of information is represented by a group of bits called a binary code.
- Interpretation of Binary codes depends on the coding system

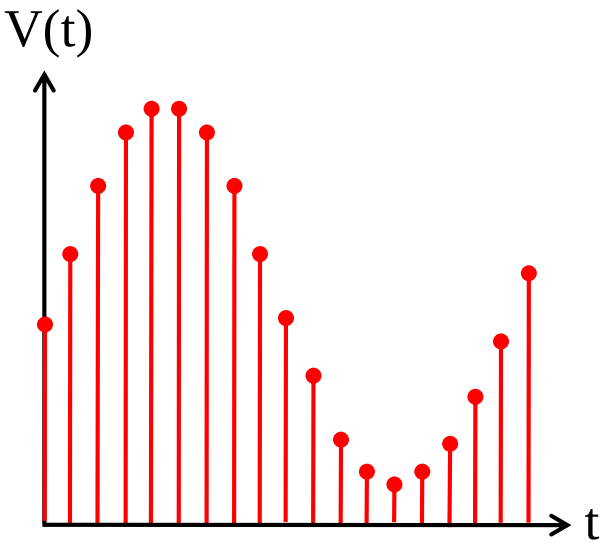
Digital Systems and Binary Numbers

DIGITAL SYSTEM
(Discrete Information Processing System)



Analog

Continuous quantities



Digital

Discrete quantities

DIGITAL SYSTEM
(Discrete Information Processing System)

System
is an organized collection of **components** that interact via **links** among themselves to form a whole

System Structure **(= (components, links))**
defines the composition of the system

System Behavior **(= (inputs, outputs))**
defines the functionality of the system

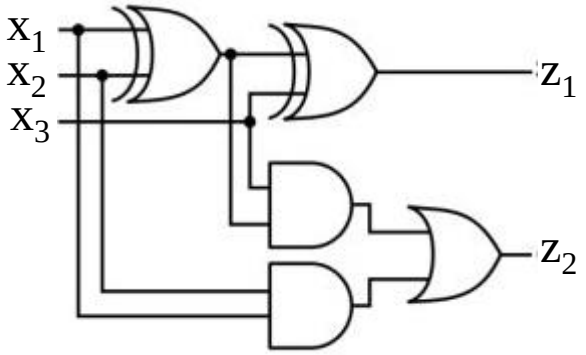
System Design (Synthesis)

is to construct an efficient and cost-effective structure which provides a desired behavior

i.e., Given the behavior (functionality) of a system, construct its structure

$z_1 = \mathbf{f}(x_1, x_2, x_3) = (x_1 \oplus x_2) \oplus x_3$

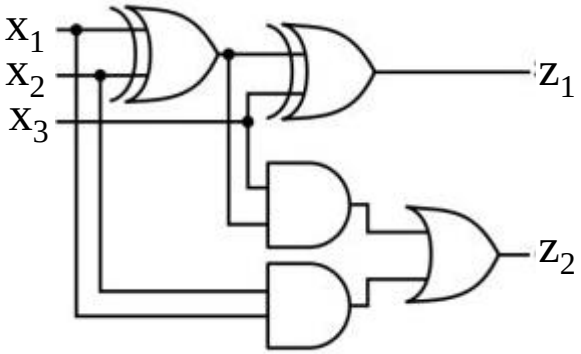
$z_2 = \mathbf{f}(x_1, x_2, x_3) = (x_1 \oplus x_2) \bullet x_3 + x_1 \bullet x_2$



System Analysis

is to determine the behavior exhibited by a structure

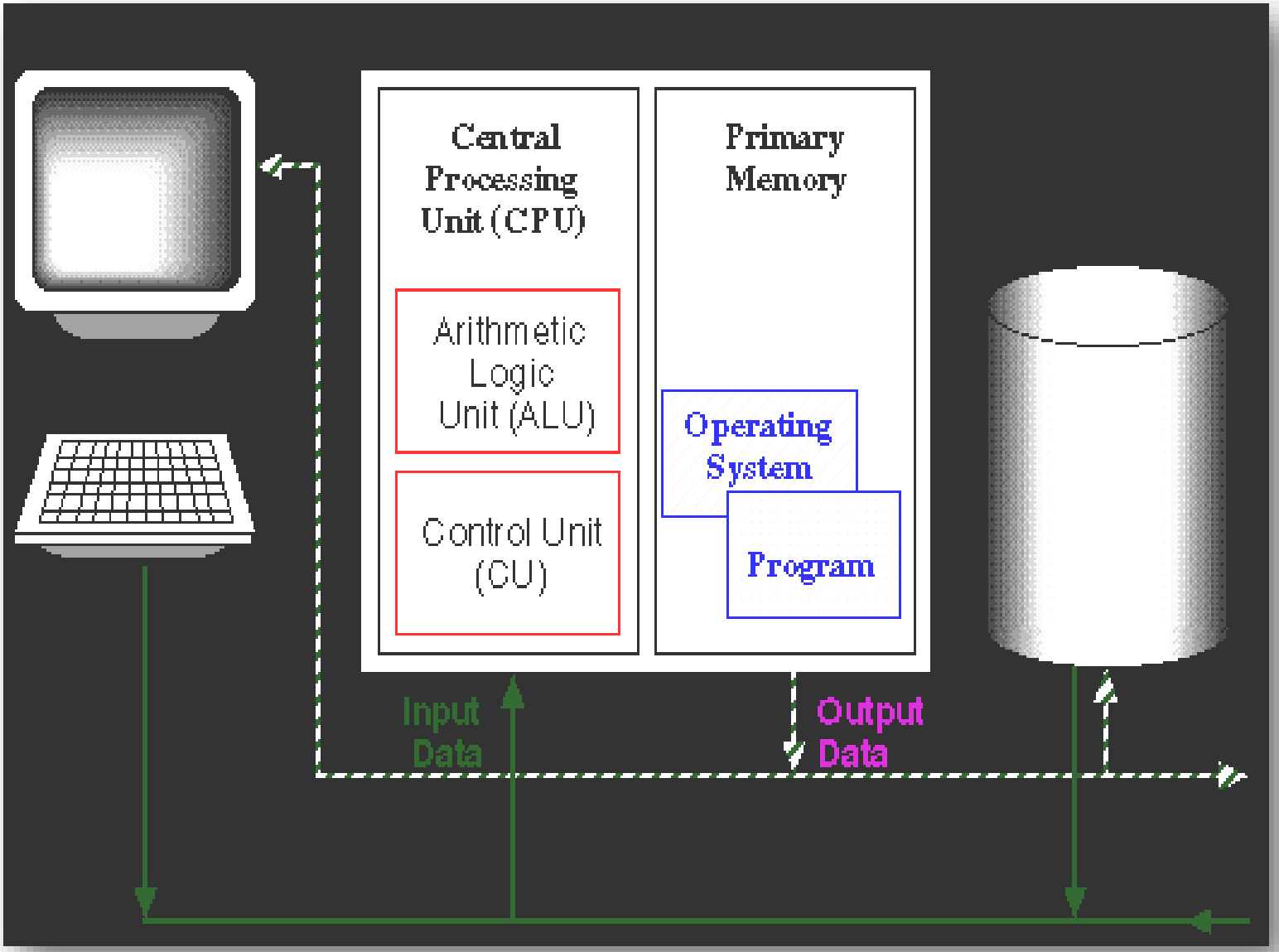
i.e., Given the structure of a system, determine its behavior (functionality)



$z_1 = \mathbf{f}(x_1, x_2, x_3) = (x_1 \oplus x_2) \oplus x_3$

$z_2 = \mathbf{f}(x_1, x_2, x_3) = (x_1 \oplus x_2) \bullet x_3 + x_1 \bullet x_2$

e.g. : Digital Computer is a Digital System



A Digital Computer Processes Discrete Information

Discrete Information

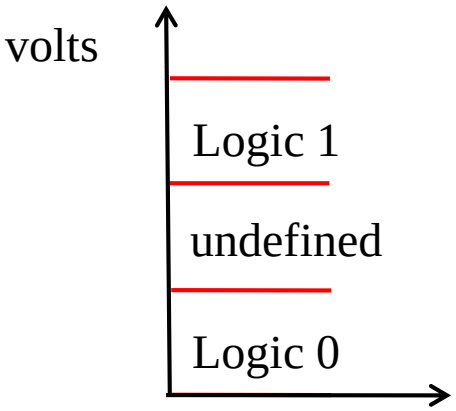
- Numeric Information is represented in Binary Number System

- Alphanumeric Information is represented in Binary Coding Systems

Binary values are represented abstractly by:

- Digits 0 and 1
- Words (letters) False (F) and True (T)
- Words (letters) Low (L) and High (H)
- Words Off and On

Binary values are represented physically by :



Discrete Information

Numeric Information is in Binary Number System

∴ **Number Systems**
(Binary, Octal, Decimal, Hexadecimal)
- **Representation**
- **Conversion**
- **Arithmetic Operations**

Alphanumeric Information is in Binary Coding Systems

∴ **Coding Systems**
- **Encoding**
- **Decoding**
- **Error Detecting Codes**
- **Error Correcting Codes**

Discrete Information Processing

* is expressed in a two valued Boolean Algebra as Boolean functions

∴ **Switching Algebra**
- **Boolean Expressions (e)**
- **Truth Tables (TT)**
- **Conversion between e and TT**

* is realized by means of Logic Circuits

∴ **Logic Circuits**
- **Logic Gates**
- **Minimization**
- **Combinational Circuits**
- **Sequential Circuits**

Combinational Circuits (circuits without memory **)**

- **Half Adder**
- **Full Adder**
- **Magnitude Comparator**
- **Code Converter**
- **Decoder**
- **Encoder**
- **Multiplexer**
- **Demultiplexer**

  ROM, PLA, ALU, etc.

i.e.,

x_i = INPUT, $1 \leq i \leq n$

z_j = OUTPUT , $1 \leq j \leq m$

$z_j = f(x_1, ..., x_n)$

z_j = f (current input alone)

Sequential Circuits (circuits with memory)

- **Asynchronous Sequential Circuits**
  - **Latches**

- **Synchronous Sequential Circuits**
  - **Flip-Flops**
  - **Analysis**
  - **Design**

- **Counters**
- **Registers**


Thank You!
Ευχαριστώ
ขอบคุณ
Vielen Dank
Merci
Teşekkürler
DMnvwd
شكراً
متشكرم
Gracias
Grazie
Bedankt
THANK YOU
Dankie
Köszönettel
Obrigado!
Díky
謝謝
شکریا
GADDA GUEY
WAD MAHAD
SAN TAHAY
감사합니다
Urakoze