

CS 211 - Digital Logic Design 211 عال - تصميم المنطق الرقمي

First Term - 1439/1440
Lecture #1

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Teaching Staff

➤ Instructor:

- Hazem Ibrahim Shehata
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- Lectures: Wednesday 8:00am – 9:50am
- Tutorial/lab: Sunday 1:00pm – 2:50pm
- Office Hours: TBA

Course Info

➤ Course website:

- <http://hshehata.github.io/courses/su/cs211/>

➤ Textbook:

- “Digital Fundamentals”, Thomas L. Floyd, 10th Edition, 2009,
<http://catalogue.pearsoned.co.uk/educator/product/Digital-Fundamentals-Pearson-New-International-Edition-10E/9781292025629.page>

Course Info (Cont.)

➤ Grading

Course Work	Grade Distribution	
Attendance	10pt	60pt
Quizzes	10pt	
Assignments	10pt	
Midterm Exam (1)	15pt	
Midterm Exam (2)	15pt	
Final Exam	40pt	
Total Points	100pt	

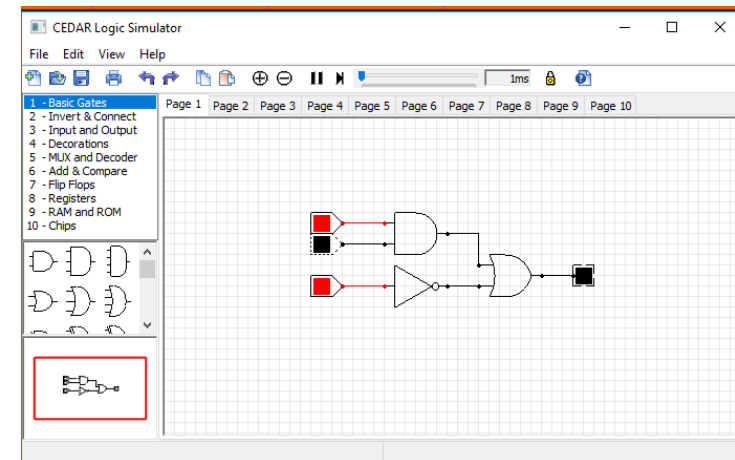
Course Overview

- Number Systems, Operations, Codes → Ch. 2
- Logic Gates and Boolean Algebra → Ch. 3, 4
- Combinational Logic → Ch. 5, 6
- Sequential Logic → Ch. 7, 8, 9
- Memory → Ch. 10 [Optional!]

Cedar Logic Simulator

➤ Concepts learned in this course are applied using: **Cedar Logic Simulator** (or shortly: **Cedar LS**).

- Open-source digital logic simulator
- Developed for academic purposes.
- Very simple and intuitive user interface.
- Download link:
 - <https://sourceforge.net/projects/cedarlogic/files/latest/download>





Ch.2: Number Systems, Operations, and Codes

Decimal Numbers

- Position of each digit in a **weighted number system** is assigned a weight based on the **base** or **radix** of that system.
- Radix/base of decimal system is **10**.
 - **Ten possible values** for each digit: 0, 1, 2, ..., 9.
 - **Example**: The number 409.631_{10}
- Column weights of decimal numbers are **powers of 10**:
... 10^3 10^2 10^1 10^0 . 10^{-1} 10^{-2} 10^{-3} 10^{-4} ...

Radix Point
(Decimal Point)

Decimal Numbers (Cont.)

- Decimal numbers can be expressed as **sum of products** of each digit times column value for that digit.
- **Example:**
 - Express the number 480.52_{10} as the sum of values of each digit.
- **Solution:**
 - $480.52_{10} = (4 \times 10^2) + (8 \times 10^1) + (0 \times 10^0) + (5 \times 10^{-1}) + (2 \times 10^{-2})$

Binary Numbers

- Digital systems use binary number system.
- Radix/base of system is **2**.
 - **Two** possible values for each binary digit (know as **bit**): 0 or 1.
 - **Example**: The number 10010.001_2
 - **Note**: Values 0 and 1 can be easily represented in hardware using 2 distinct voltage values: low (e.g., 0 volt) and high (e.g., 5 volt)!
- Column weights of decimal numbers are **powers of 2**:

... 2^3 2^2 2^1 2^0 . 2^{-1} 2^{-2} 2^{-3} 2^{-4} ...

Binary Point

Conversion: Binary \rightarrow Decimal

- Method: **Sum of weights** (Add column values of all of bits that are 1 and discard all of bits that are 0).
- **Example**: Convert 100101.01_2 to decimal.
- **Solution**: Write column weights \rightarrow Add weights that correspond to 1's.

2^5	2^4	2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}
32	16	8	4	2	1	.	$\frac{1}{2}$	$\frac{1}{4}$
1	0	0	1	0	1	.	0	1
32			+4		+1			+ $\frac{1}{4}$
								= 37.25_{10}

Conversion: Decimal \rightarrow Binary (Integer)

- Method #1: **Reverse sum-of-weights** (Write down column weights and place 1's in columns that sum to decimal num.)
- **Example:** Convert 49_{10} to binary.
- **Solution:** Write down column weights until the last number is larger than the one you want to convert.
 - $2^6 \quad 2^5 \quad 2^4 \quad 2^3 \quad 2^2 \quad 2^1 \quad 2^0$
 - 64 32 16 8 4 2 1
 - 0 1 1 0 0 0 1 = 110001_2

Conversion: Decimal → Binary (Integer)

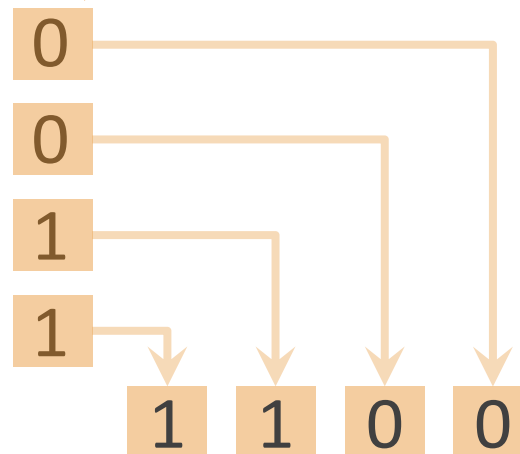
➤ Method #2: **Repeated division-by-2** (divide decimal num. by 2 until **quotient** is 0. **Remainders** form binary num.)

➤ **Example:** Convert 12_{10} to binary.

➤ **Solution:**

	Quotient	Remainder
◦ $12 \div 2$	6	0
◦ $6 \div 2$	3	0
◦ $3 \div 2$	1	1
◦ $1 \div 2$	0	1

STOP

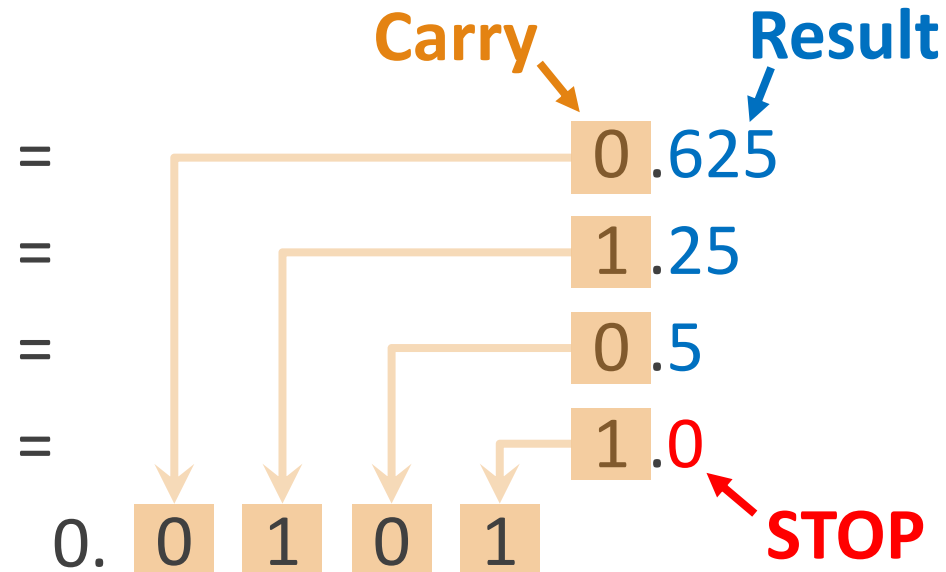


Conversion: Decimal → Binary (Fraction)

- Method: **Repeated multiplication-by-2** (multiply fractional **results** repeatedly by 2. **Carries** form binary fraction)
- **Example:** Convert 0.3125_{10} to binary.

- **Solution:**

- $0.3125 * 2$
- $0.625 * 2$
- $0.25 * 2$
- $0.5 * 2$



Counting in Binary

- Using 4 bits, we can represent numbers: $0 : 2^4-1$
- Using n bits, we can represent numbers: $0 : 2^n-1$

Decimal Number	Binary Number			
00	0	0	0	0
01	0	0	0	1
02	0	0	1	0
03	0	0	1	1
04	0	1	0	0
05	0	1	0	1
06	0	1	1	0
07	0	1	1	1
08	1	0	0	0
09	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Reading Material

- Floyd, Chapter 2:
 - Pages 45 – 54