EE210: Switching Systems

Lecture 1: Course Introduction and Outline Number Systems

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Department of Electrical Engineering
The City College of New York
The City University of New York (CUNY)
Introduce yourself

- Name
- Which year of your undergraduate study?
- Why take this course (your expectations)?
- Home country
- Others you want to share
General Information

- **Class Time:** Monday, Wednesday: 2:00pm – 3:15pm
- **Location:** Shepard Hall S-378
- **Office Hours:** Monday 10:00-12:00am
  Wednesday 3:30pm – 4:30pm
  Room ST512 or by appointment
- **Email:** yeyuancheng1988@gmail.com
- **TA:** Mr. Yuancheng Ye, yeyuancheng1988@gmail.com
- **Course Web-page:**
  http://www-ee.ccny.cuny.edu/www/web/yltian/EE2100.html
Pre-requisites

- Math2020

OR

- If you haven’t taken Math2020, please drop this course because:
  - You will not get the credits (Dept requirement).
COURSE PROTOCOLS & POLICIES
Course textbook

- **Introduction to Logic Design**, 3rd Edition, by Alan B. Marcovitz,


- **E-Book**: can be searched from website
Course Objective

- Be aware where logic circuits are in our daily life.
- To know that how logic circuits are implemented in real world.
- To get familiar with the concept of design process
  - Learn fundamental technologies of analysis and synthesis of combinatorial circuits
  - Karnaugh maps
  - Analysis and design of sequential circuits
- Digital computer and industrial applications
- Have fun!
Course outline

- Assignments
  - Reading, Practices, and Review – help to understand better what you have leant.
  - Homework – Finish before due day.

- 2 Exams
  - Mid Exam – 25% of final grade
  - Final Exam – 35% of final grade
HW

- Hand in on time in the class or email to TA (keep the email receipt in case the email does NOT go through.)
- HW counted 40% of your final grade.
- Late homework submissions will receive 0% credit.
- Any HW copied from other students (both students), textbook solutions, or other resources will get 0 credits for that HW.
Grading Policy

- Homework: 40%
- Mid Exam: 25%
- Final Exam: 35%
- Grades: A+: 97~100; A: 93~96; A-: 90~92; B+: 87~89; B: 83~86; B-: 80~82; C+: 77~79; C: 73~76; C-: 70~72; D: 60~69; F: under 60

The final exam covers material of the entire semester

Note: The final grades are non-negotiable unless the TA makes mistakes.
Course Policy

- Attend classes
- Silence your cell phone
- No talking when I am talking
- Be active in the class

Zero-Tolerance on Cheating

- Exams & Homework
- Anyone caught cheating will be dealt with according to applicable University policy.
Make-up Exams

- Make-up examinations will only be given to students who miss examinations as a result of excused absences according to applicable current University policy. The student should provide the necessary documents. Make-up examinations may be in a different format from the missed examination.
INTRODUCTION TO SWITCHING SYSTEMS — LOGIC DESIGN
Logic Circuits in Our Life

- Computers
- Digital watches
- CD players
- Electronic games
- Telephone and television networks
- Missile guidance systems
- Airplanes and space shuttles
Logic Design

- One or more digital signal inputs
- One or more digital signal outputs
- Outputs are only functions of current input values (ideal) plus logic propagation delays
Example 1

A system with three inputs, A, B, and C, and one output, Z, such that Z=1, if two of the inputs are 1.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 1.1 A truth table for Example 1.1.
Combinational Logic

- Combinational logic has no memory (see Example 1)!
  - Outputs are only function of current input combination
  - Nothing is known about past events
  - Repeating a sequence of inputs always gives the same output sequence
- Sequential logic (covered later) does have memory
  - Repeating a sequence of inputs can result in an entirely different output sequence
Sequential Logic Examples

Example 2: A system with one input, A, plus a clock, and one output, Z, which is 1 if and only if the input was 1 at the last three consecutive clock times.
Number Systems

\[ N = a_{n-1}r^{n-1} + a_{n-2}r^{n-2} + \cdots + a_2 r^2 + a_1 r^1 + a_0 \]

- \( n \) – the number of digits
- \( r \) – radix or base
- \( a_i \) -- coefficients
- If \( r = 10 \) – decimal \( \quad 7642 = 7 \times 10^3 + 6 \times 10^2 + 4 \times 10 + 2 \)
- If \( r = 2 \), binary – also called “bits”. A n-bit number can represent the positive integers from \( 0 \) to \( 2^n - 1 \)
- \( 11011 = 1 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2 + 1 = 27 \)
### Number Systems -- Binary

#### Table 1.2  Powers of 2.

<table>
<thead>
<tr>
<th>$n$</th>
<th>$2^n$</th>
<th>$n$</th>
<th>$2^n$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>11</td>
<td>2,048</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>12</td>
<td>4,096</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>13</td>
<td>8,192</td>
</tr>
<tr>
<td>4</td>
<td>16</td>
<td>14</td>
<td>16,384</td>
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<tr>
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</tr>
<tr>
<td>6</td>
<td>64</td>
<td>16</td>
<td>65,536</td>
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<tr>
<td>7</td>
<td>128</td>
<td>17</td>
<td>131,072</td>
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<td>8</td>
<td>256</td>
<td>18</td>
<td>262,144</td>
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<td>9</td>
<td>512</td>
<td>19</td>
<td>524,288</td>
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<tr>
<td>10</td>
<td>1,024</td>
<td>20</td>
<td>1,048,576</td>
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</tbody>
</table>
# Binary Integers

**Table 1.3** First 32 binary integers.

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Binary</th>
<th>4-bit</th>
<th>Decimal</th>
<th>Binary</th>
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</thead>
<tbody>
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<td>0000</td>
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<td>10000</td>
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<td>4</td>
<td>100</td>
<td>0100</td>
<td>20</td>
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<td>0110</td>
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<td>10110</td>
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<td>10111</td>
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<td>15</td>
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<td>31</td>
<td>11111</td>
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</tbody>
</table>
Announcement:

- Read Chapter 1.1, 1.2
- Next class:
  - Binary Addition
  - Signed and unsigned numbers
  - Combinational Systems
  - Truth Tables (Chapter 2.1)