Welcome to CS 240: Introduction to Computer Systems
Course Website: https://courses.engr.illinois.edu/cs240/

Description: Basics of computer systems. Number representations, assembly/machine language, abstract models of processors (fetch/execute, memory hierarchy), processes/process control, simple memory management, file I/O and directories, network programming, usage of cloud services. 3 credit hours.

Instructor:
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Teaching Associate Professor of Computer Science, Grainger College of Engineering

Coursework and Grading
A total of 1,000 points are available in CS 240, along with many opportunities to earn extra credit. The points are broken down in the following way:

- **150 points**: Homeworks (10 × 15 points)
  - Points over 200 are extra credit!
  - Usually on PrairieLearn, but occasionally another platform
- **200 points**: Midterm Exams in CBTF (2 × 100 points)
  - Midterm 1 Exam (CBTF): Oct. 5 - Oct. 9
  - Midterm 2 Exam (CBTF: Nov. 30 - Dec. 4
- **500 points**: Machine Projects (10 weeks × 50 points)
  - Weekly machine problems, released every Friday and due the following Friday
  - Automatic 3-day grace period, extending to Monday
- **150 points**: Final Project
  - Multi-week Final Project, presented during finals weeks instead of a final exam (no final exam!)

We never curve individual exam or assignment scores; instead, if necessary, we may lower the points required for each grade cutoff to be lower than the stated cutoff. In no case will we raise the cutoff.

<table>
<thead>
<tr>
<th>Points</th>
<th>Grade</th>
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<th>Points</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>[870, 900)</td>
<td>B+</td>
<td>[830, 870)</td>
<td>B</td>
<td>[800, 830)</td>
<td>B-</td>
</tr>
<tr>
<td>[770, 800)</td>
<td>C+</td>
<td>[730, 770)</td>
<td>C</td>
<td>[700, 730)</td>
<td>C-</td>
</tr>
<tr>
<td>[670, 700)</td>
<td>D+</td>
<td>[630, 670)</td>
<td>D</td>
<td>[600, 630)</td>
<td>D-</td>
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<tr>
<td>(600, 0]</td>
<td>F</td>
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Final Course Grades
Your final course grade is determined by the number of points you earned during the semester:

Foundations of Computer Systems
There are six major components to a computer, which we will refer to as the “foundations” of a computer system:

[1]:

[2]:

[3]:

[4]:

[5]:

[6]:
System-level Abstractions
After covering the “foundations”, we will begin to abstract the entire system as single node and explore more complex topics:

[1]:

[2]:

[3]:

Representing Data: Binary
All data within a computer is _______________; either 0 or 1.

Converting between base-2 and base-10:

\[
\begin{align*}
1_2 &= 1_{10} \\
10_2 &= 2_{10} \\
11_2 &= 3_{10} \\
100_2 &= 4_{10}
\end{align*}
\]

Just like every digit has a “place value” in decimal (base-10), every digit has a “place value” in binary:

<table>
<thead>
<tr>
<th>Binary Number:</th>
<th>0</th>
<th>1</th>
<th>0</th>
<th>1</th>
<th>1</th>
<th>0</th>
<th>0</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>(x) Place Value:</td>
<td>$2^7$</td>
<td>$2^6$</td>
<td>$2^5$</td>
<td>$2^4$</td>
<td>$2^3$</td>
<td>$2^2$</td>
<td>$2^1$</td>
<td>$2^0$</td>
</tr>
<tr>
<td>Decimal Place Value:</td>
<td>128</td>
<td>64</td>
<td>32</td>
<td>16</td>
<td>8</td>
<td>4</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>SUM:</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Any value can be represented in binary by writing it in base-2:

\[
\begin{align*}
4_{10} &= 2 \\
7_{10} &= 2 \\
18_{10} &= 2
\end{align*}
\]

In C/C++, you can write a number in binary by prefixing the number with 0b:

\[
\begin{align*}
18_{10} &= 0b \\
11_{10} &= 0b \\
33_{10} &= 0b
\end{align*}
\]

Bit Manipulation:
We can manipulate bits by binary operations:

- **AND, & operator:**
- **OR, | operator:**
- **XOR, ^ operator:**
- **NOT, ! or ~ operator:**

<table>
<thead>
<tr>
<th>Bit Manipulation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
</tr>
<tr>
<td>----</td>
</tr>
<tr>
<td>1100</td>
</tr>
<tr>
<td>110011</td>
</tr>
<tr>
<td>101</td>
</tr>
</tbody>
</table>