Welcome to CS 240 + Binary Digits

CS 240 - The University of Illinois
Wade Fagen-Ulmschneider
August 24, 2021
No good party starts without introductions…
Wade Fagen-Ulmschneider (waf)
Teaching Associate Prof. of Computer Science
Grainger College of Engineering
Nerding out in life...

Industry

Google

CISCO

Morgan Stanley

Impact

ACADEMIA
Course Staff:
You:
Overview: You Already Know
Overview: You Already Know C++ Programming (CS 225)
Overview: You Already Know

C++ Programming (CS 225)

Data Structures (CS 225)
Overview: You Already Know

C++ Programming (CS 225)
Data Structures (CS 225)
Algorithm Analysis (CS 173)
Overview: You Already Know

C++ Programming (CS 225)

Data Structures (CS 225)

Algorithm Analysis (CS 173)

Programming Skills (CS 125/126/225)
Overview: After CS 240
Overview: After CS 240

Foundational Computer Architecture
Overview: After CS 240

Foundational Computer Architecture

Operating System Design
Overview: After CS 240

- Foundational Computer Architecture
- Operating System Design
- Multiprogramming and Resource Sharing
Overview: After CS 240

Foundational Computer Architecture
Operating System Design
Multiprogramming and Resource Sharing
Cloud-based Infrastructure
Overview: After CS 240

- Foundational Computer Architecture
- Operating System Design
- Multiprogramming and Resource Sharing
- Cloud-based Infrastructure
- Building Cloud-scale Applications
Course Structure
Course Structure
★ Lecture: Tuesday/Thursdays
Course Structure

★ Lecture: Tuesday/Thursdays

★ Weekly MPs and PL Homework
Course Structure
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★ Weekly MPs and PL Homework
★ Two Exams in the CBTF
Course Structure
★ Lecture: Tuesday/Thursdays
★ Weekly MPs and PL Homework
★ Two Exams in the CBTF
★ Final Course Project
Everything Else:

https://courses.grainger.illinois.edu/cs240/
Foundations of Computer Systems
Computer Systems Foundations
#2: Central Processing Unit
Computer Systems Foundations

#3: Memory and Storage
#4: Peripherals
Computer Systems Foundations

#5: Operating System
#6: Processes
System-Level Abstractions
System Level Abstractions
System Level Abstractions

#1: Virtual Machine
System Level Abstractions

#2: Containers
System Level Abstractions

#3: Nodes / Servers in the “Cloud”
Representing Data
Representing Data

All data within a computer is:
$1_2 = 10$

$10_2 = 10$

$11_2 = 10$

$100_2 = 10$
101 \times 1000_2 = 10
Place Value of Digits

\[ \begin{align*}
1 & \quad 0 & \quad 1 & \quad 1 & \quad 0 & \quad 0 & \quad 0 & \quad 2 \\
2^6 & \quad 2^5 & \quad 2^4 & \quad 2^3 & \quad 2^2 & \quad 2^1 & \quad 2^0 
\end{align*} \]
<table>
<thead>
<tr>
<th>Place Value of Digits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 0 1 1 0 0 0 2</td>
</tr>
<tr>
<td>64 32 16 8 4 2 1 10</td>
</tr>
</tbody>
</table>
## Place Value of Digits

<p>| | | | | | | | | | | | |</p>
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<td>0</td>
<td>0</td>
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× | 64 | 32 | 16 | 8 | 4 | 2 | 1 |   |

× 10
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<tr>
<th>Place Value of Digits</th>
<th>×64</th>
<th>32</th>
<th>16</th>
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<th>4</th>
<th>2</th>
<th>1</th>
<th>10</th>
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<tr>
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<table>
<thead>
<tr>
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<td>10</td>
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</table>

\[
64 + 0 + 16 + 8 + 0 + 0 + 0 + 10
\]
Place Value of Digits

\[
\begin{array}{cccccccc}
1 & 0 & 1 & 1 & 0 & 0 & 0 & 2 \\
\hline
64 & 32 & 16 & 8 & 4 & 2 & 1 & 10 \\
\hline
64 & + & 0 & + & 16 & + & 8 & + & 0 & + & 0 & + & 0 & 10 \\
\hline
= & 88 & 10
\end{array}
\]
$4_{10} = 2$

$7_{10} = 2$

$18_{10} = 2$
18_{10} = 0b

11_{10} = 0b

33_{10} = 0b
Bit Manipulation
Bit Manipulation

AND, &

A = 1100
B = & 1010
Bit Manipulation

OR,  |  

A = 1100
B = 1010
Bit Manipulation

XOR, ^

A = 1100
B = ^ 1010
Bit Manipulation

NOT, !, ~

A = 1100

!A =
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>110011</td>
<td>&amp; 11</td>
</tr>
<tr>
<td>110011</td>
<td></td>
</tr>
<tr>
<td>110011</td>
<td>^ 11</td>
</tr>
<tr>
<td>110011</td>
<td>! 11</td>
</tr>
</tbody>
</table>

**Table:**

- **A:** 110011
- **B:** & 11
- **A:** 110011
- **B:** | 11
- **A:** 110011
- **B:** ^ 11
- **A:** ! 110011
- **B:** | 11
<table>
<thead>
<tr>
<th>A</th>
<th>101</th>
<th>A</th>
<th>101</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>&amp; 010</td>
<td>B</td>
<td></td>
</tr>
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Homework #1
Dream Computer