

CS 10 Review (Basics)

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Today's Topics

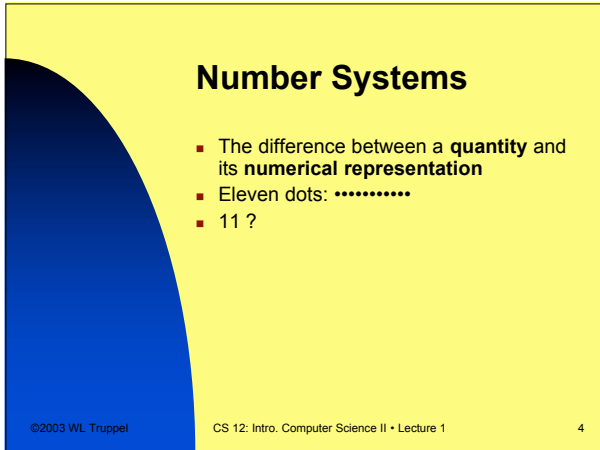
- Number Systems
- Computer Organization
- Computer Programming

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
.....

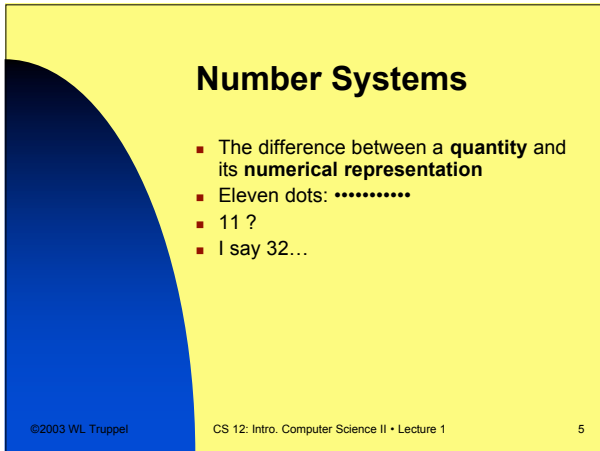
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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
▪ 11 ?

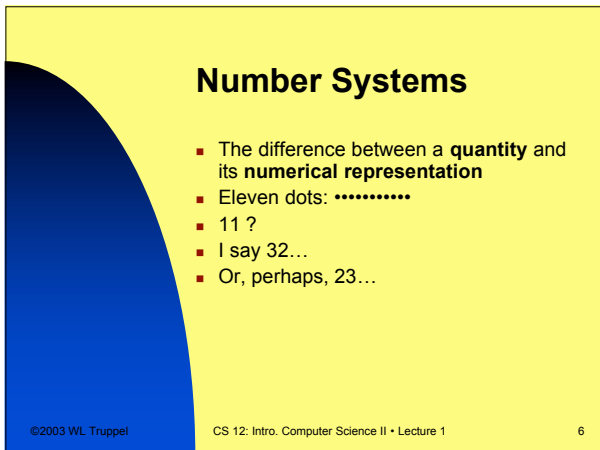
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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
▪ 11 ?
▪ I say 32...

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
▪ 11 ?
▪ I say 32...
▪ Or, perhaps, 23...

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
 - 11 ?
 - I say 32...
 - Or, perhaps, 23...
 - Or, if you prefer, 21...
 - But also 11.
 - How come ?

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
 - 3 ... and .. $\Rightarrow 32_3$

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
 - 3 ... and .. $\Rightarrow 32_3$
 - 2 and ... $\Rightarrow 23_4$

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
 - 3 ... and .. ⇨ 32_3
 - 2 and ... ⇨ 23_4
 - 2 and • ⇨ 21_5

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
 - 3 ... and .. ⇨ 32_3
 - 2 and ... ⇨ 23_4
 - 2 and • ⇨ 21_5
 - 1 and • ⇨ 11_{10}

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Number Systems

- The difference between a **quantity** and its **numerical representation**
- Eleven dots:
 - 3 ... and .. ⇨ 32_3
 - 2 and ... ⇨ 23_4
 - 2 and • ⇨ 21_5
 - 1 and • ⇨ 11_{10}
- 32_3 , 23_4 , 21_5 , and 11_{10} are different numerical representations of the **same** quantity

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Number Systems

- Eleven dots:
 - 2 and • $\Rightarrow 21_5$
 - 1 and • $\Rightarrow 11_{10}$
- The subscripted numbers are called the **base** of the number system in question
- = 21 in base 5 = 11 in base 10
- Base b only uses the digits 0, 1, ..., (b-1)
- Examples:
 - Base 10 uses 0, 1, 2, 3, 4, 5, 6, 7, 8, 9
 - Base 3 uses 0, 1, 2

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Number Systems

- Example: Base 3
 - $\Rightarrow 0_3$
 - $\Rightarrow 1_3$
 - $\Rightarrow 2_3$
 - $\Rightarrow 10_3$
 - $\Rightarrow 11_3$
 - $\Rightarrow 12_3$
 - $\Rightarrow 20_3$
 - $\Rightarrow 21_3$
 - $\Rightarrow 22_3$

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Number Systems

- Example: Base 3
 - \Rightarrow ?

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Number Systems

- Example: Base 3
... .. $\Rightarrow 30_3$?

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Number Systems

- Example: Base 3
... .. $\Rightarrow 30_3$? No !

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Number Systems

- Example: Base 3
... .. $\Rightarrow 30_3$? No !
..... = 1 group of nine
 = 1 group of 3 squared
 = ?

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Number Systems

- Example: Base 3
... .. ⇨ 30_3 ? No!
..... = 1 group of nine
 = 1 group of 3 squared
 = 100_3

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Number Systems

- Example: Base 3
... .. ⇨ 30_3 ? No!
..... = 1 group of nine
 = 1 group of 3 squared
 = 100_3
- Just like 100_{10} = 1 group of 10 squared
- Just like 1000_{10} = 1 group of 10 cubed

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Number Systems

- $21843_{10} = 3 \times 10^0 + 4 \times 10^1 + 8 \times 10^2 + 1 \times 10^3 + 2 \times 10^4$
- $21201_3 = 1 \times 3^0 + 0 \times 3^1 + 2 \times 3^2 + 1 \times 3^3 + 2 \times 3^4 = 1_{10} + 0_{10} + 18_{10} + 27_{10} + 162_{10} = 208_{10}$

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Number Systems

- 2 1 8 4 3_b
b⁰ units
b¹ units
b² units
b³ units
b⁴ units
- Remember to read from **right to left** !
- Remember that the exponents start at 0 !

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Number Systems

- Important: Base 2 (Binary System)

•	⇒ 0000 ₂	⇒ 0 ₁₀
••	⇒ 0001 ₂	⇒ 1 ₁₀
•••	⇒ 0010 ₂	⇒ 2 ₁₀
••••	⇒ 0011 ₂	⇒ 3 ₁₀
•••••	⇒ 0100 ₂	⇒ 4 ₁₀
••••••	⇒ 0101 ₂	⇒ 5 ₁₀
•••••••	⇒ 0110 ₂	⇒ 6 ₁₀
••••••••	⇒ 0111 ₂	⇒ 7 ₁₀
•••••••••	⇒ 1000 ₂	⇒ 8 ₁₀

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Number Systems

- The digits 0₂ and 1₂ are called **Binary digits or bits**
- 8 bits form one **byte**

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Number Systems

- Why should we care about base 2 ?

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Number Systems

- Why should we care about base 2 ?
- Because:
 - ◆ Electricity **not** flowing ⇨ 0
 - ◆ Electricity flowing ⇨ 1

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Number Systems

- Why should we care about base 2 ?
- Because:
 - ◆ Electricity **not** flowing ⇨ 0
 - ◆ Electricity flowing ⇨ 1
- Thus, we can represent numbers with electrical devices

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Number Systems

- Why should we care about base 2 ?
- Because:
 - ◆ Electricity **not** flowing ⇨ 0
 - ◆ Electricity flowing ⇨ 1
- Thus, we can represent numbers with electrical devices
- And that's what a computer is !

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Computer Organization

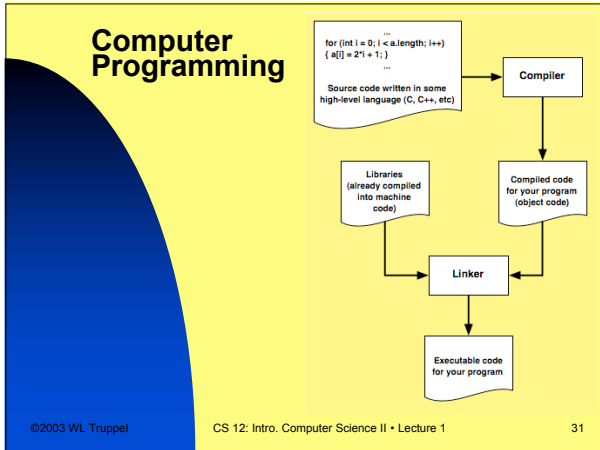
- Ok, there's more to a computer than just that...
 - ◆ Memory
 - ◆ ALU (Arithmetic and Logical Unit)
 - ◆ CPU (Central Processing Unit)
 - ◆ Clock
 - ◆ I/O devices
 - ◆ And more...

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Computer Programming

- What really happens when you write and compile a computer program ?

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Computer Programming

- Where does your program reside ?

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Computer Programming

- Where does your program reside ?
 - ◆ When it's not running, it's stored in the hard disk
 - ◆ When it's running, it's stored in memory
 - ◆ Why ?

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Computer Programming

- Where does your program reside ?
 - ◆ When it's not running, it's stored in the hard disk
 - ◆ When it's running, it's stored in memory
 - ◆ Why ?
- What really happens when you run a computer program ?

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Memory Organization

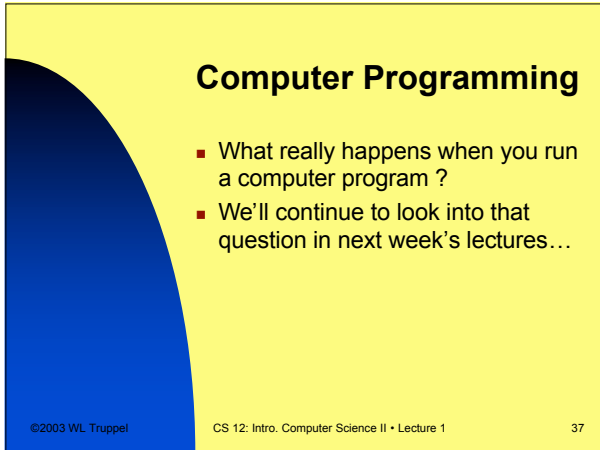
- Memory contents
- Addresses
- Program counter

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Computer Programming

- What really happens when you run a computer program ?

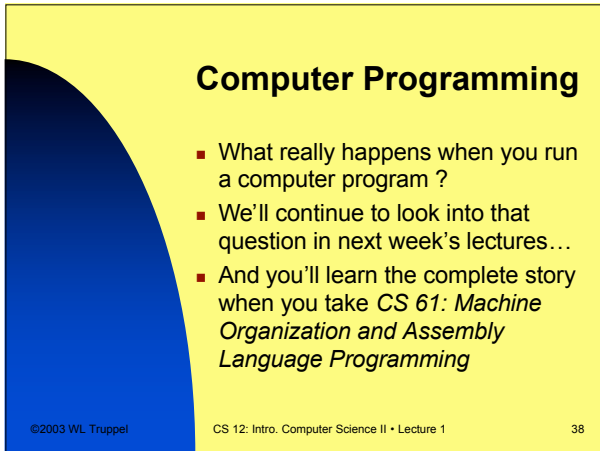
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Computer Programming

- What really happens when you run a computer program ?
- We'll continue to look into that question in next week's lectures...

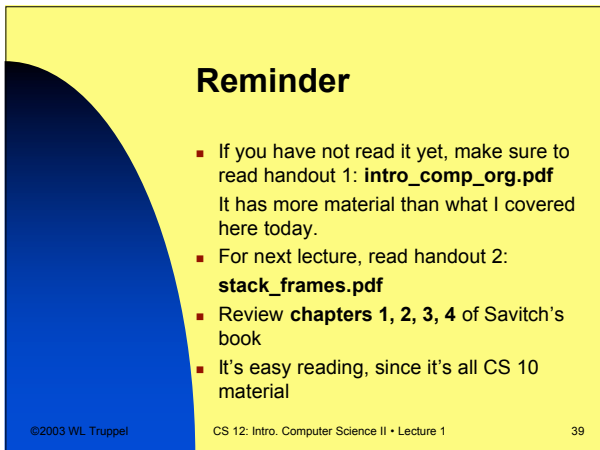
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Computer Programming

- What really happens when you run a computer program ?
- We'll continue to look into that question in next week's lectures...
- And you'll learn the complete story when you take *CS 61: Machine Organization and Assembly Language Programming*

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Reminder

- If you have not read it yet, make sure to read handout 1: **intro_comp_org.pdf**
It has more material than what I covered here today.
- For next lecture, read handout 2: **stack_frames.pdf**
- Review **chapters 1, 2, 3, 4** of Savitch's book
- It's easy reading, since it's all CS 10 material

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