Computing Systems and Number Systems

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CSC 120.02: Introduction to Computer Science
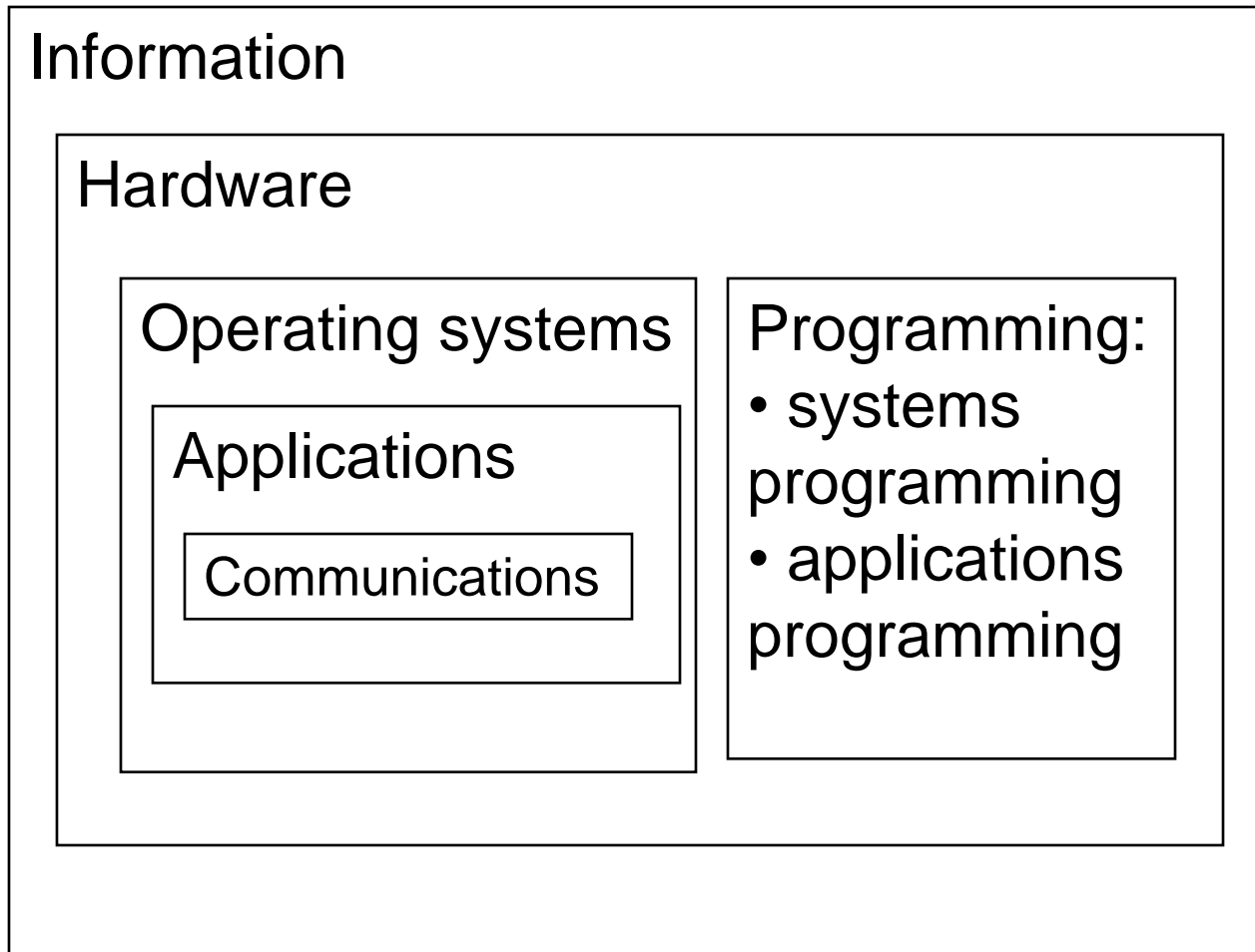
Lecture 1, January 23, 2007

Components of Computing Systems

- Hardware: Circuit boards, chips, disk drives, peripherals, wires, etc.

- Software: Programs (sequences of instructions for the computer to carry out)
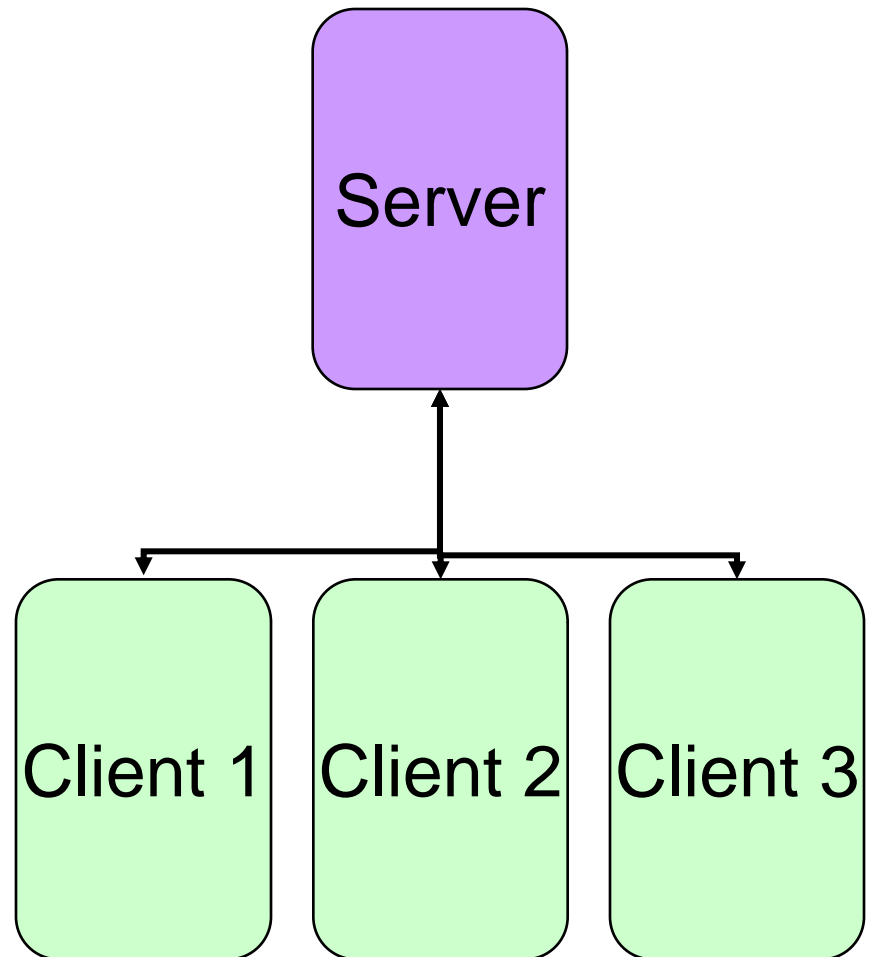
- Data (information in its digital form)

Layers of a Computing System

Information

Hardware

Operating systems

Applications

Communications

Programming:
• systems programming
• applications programming

Abstraction…

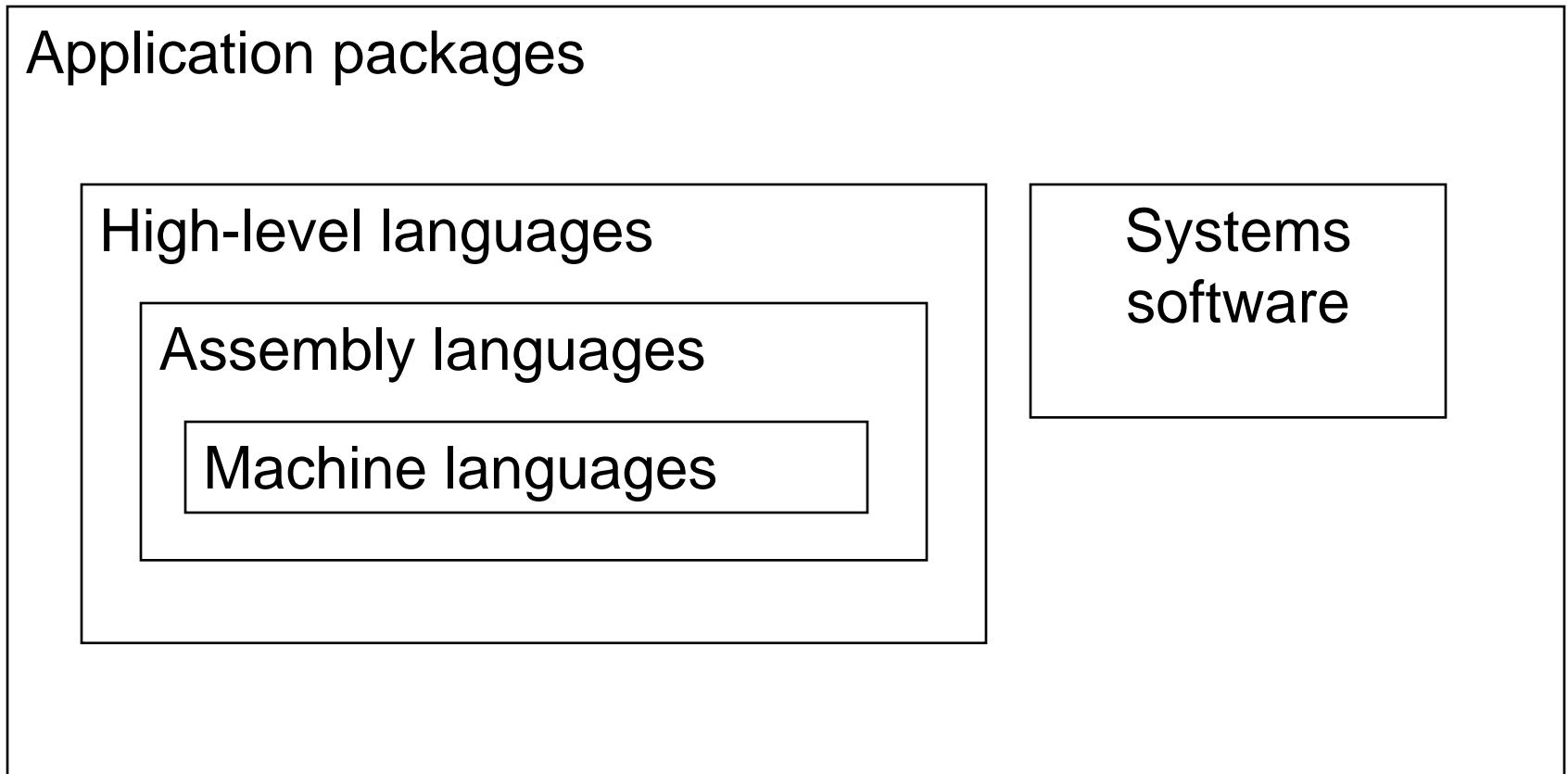…removes or hides complex details.

Server

Client 1   Client 2   Client 3

The History of Computing

- Textbook, Section 1.2
- http://www.computerhistory.org/exhibits/internet_history/

Layers of Software

Application packages

High-level languages

Assembly languages

Machine languages

Systems software

Computer Science

Systems

- Algorithms and data structures
- Programming languages
- Computer architecture
- Operating systems
- Software methodology and engineering
- Human-computer communication

Applications

- Numerical and symbolic computation
- Databases and informational retrieval
- Artificial intelligence and robotics
- Graphics
- Organizational informatics
- Bioinformatics

Number Categories

- *Natural numbers*: The number *0* and numbers obtained by repeatedly adding *1* to this number. Example: *3=0+1+1+1*

- *Negative numbers*: Less than *0*. Example: $-\sqrt{2}$

- *Integers*: Natural numbers and their negatives

- *Rational numbers*: Fractions, quotients of two integers. Examples: *16/13; 4/1=4*

- *Irrational numbers*: Cannot be represented as quotients of two integers. Example: $\sqrt{2}$

How to represent a natural number?

Base of a number system: The number of digits used in the system. Example 1: Base 10 (*decimal*)

$$1760_{10} = 0*10^0 + 6*10^1 + 7*10^2 + 1*10^3$$

Numbers are written using *positional notation*.

Example 2: Base 2 (*binary*)

$$11101_2 = 1*2^0 + 0*2^1 + 1*2^2 + 1*2^3 + 1*2^4 = 29_{10}$$

More Number Systems!

Example 3: *Octal* (Base 8)

$$73_8 = 3 * 8^0 + 7 * 8^1 = 59_{10} = 111011_2$$

Example 4: *Hexadecimal* (Base 16)

$$AF_{16} = 15 * 16^0 + 10 * 16^1 = 175_{10} = 257_8 = 10101111_2$$

Extra digits: A=10, B=11, C=12, D=13, E=14, F=15

How to represent a ratio?
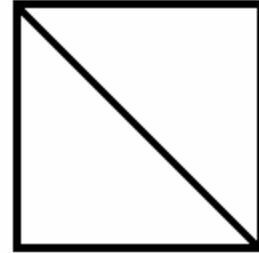
259:160=1.61875   241:149≈1.61745

A ratio is represented by an angle here.

How to represent an irrational number?

1. Geometrically

$$\sqrt{2}$$

2. By an algorithm: The Fibonacci numbers algorithm is a way to represent the golden ratio

$$\phi = \frac{1+\sqrt{5}}{2} \approx 1.618034$$