What is a Computer?

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What is a Computer?

A computer is ...

A programmable machine that receives input, stores and manipulates data, and provides output in a useful format

-- From Wikipedia.org

Functions

A function is …

A set of input-output pairs such that no two of them have the same first element

f = {⟨0,1⟩, ⟨1,2⟩, ⟨2,3⟩, ...}
or f(0) = 1, f(1) = 2, f(2) = 3, ...
or f(i) = i + 1 (by formula)

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Computers

A computer can be viewed as a "machine" that mysteriously converts input into output

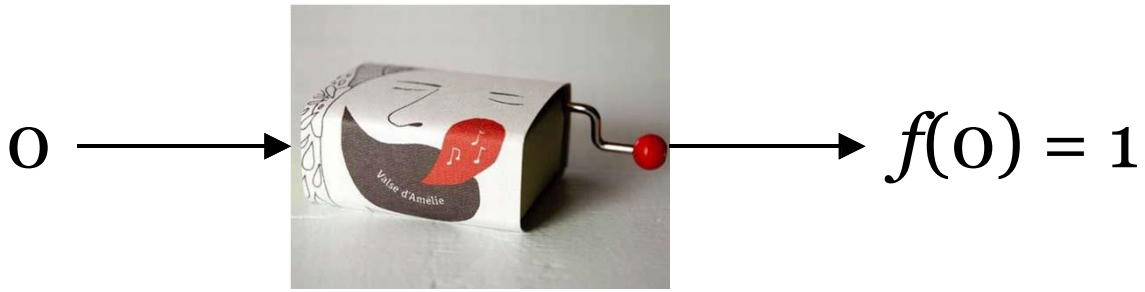
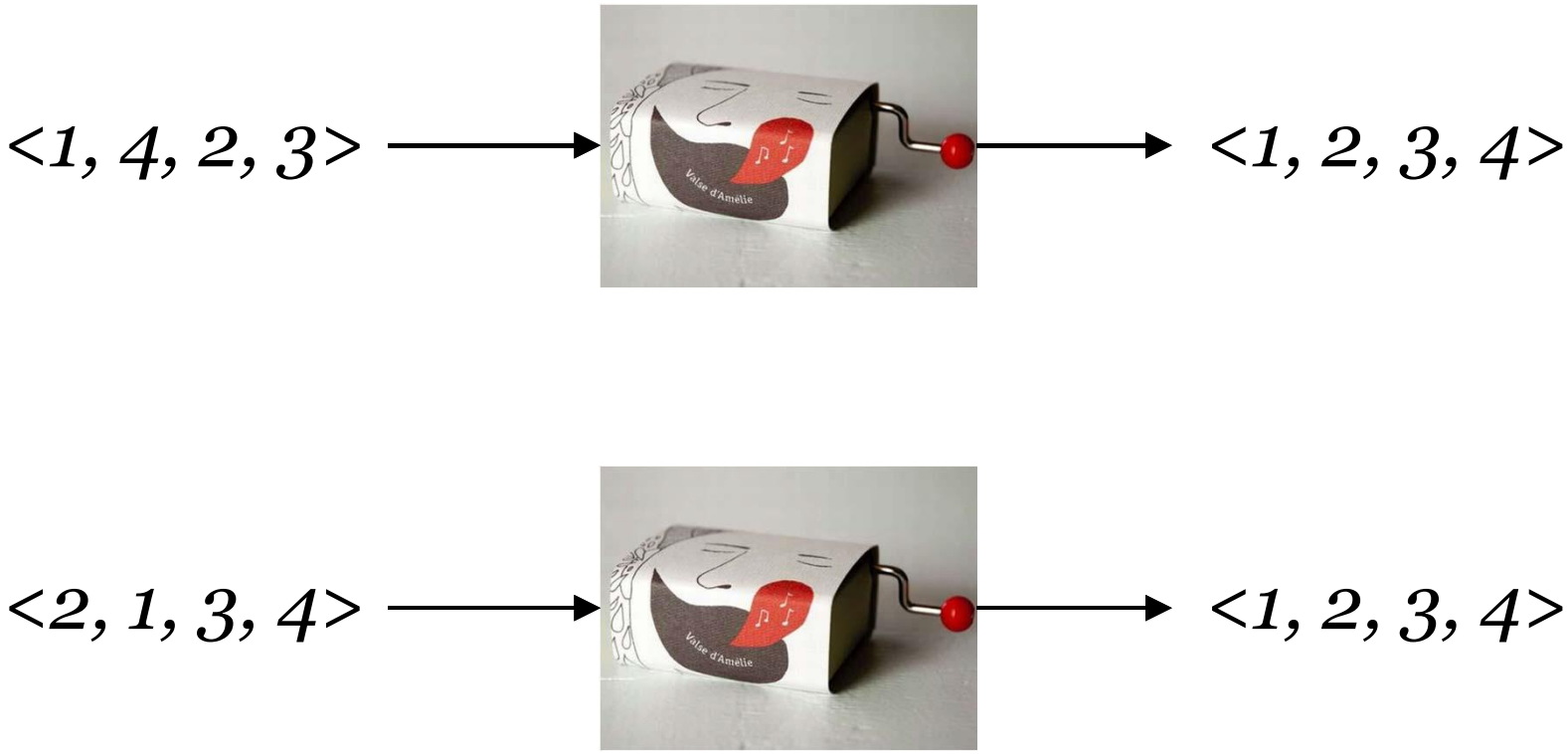


Image from http://shop.gessato.com

Example

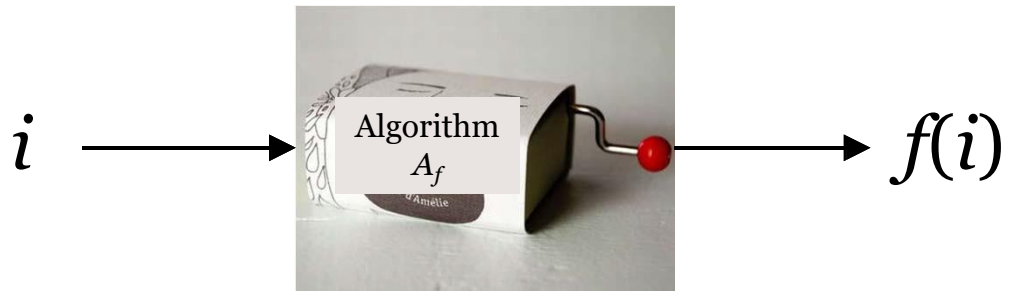
What does this function?



Computable Functions

A function f is computable if there is an "algorithm" that computes f

- i.e., there is an algorithm A_f such that, for all input i, $A_f(i) = f(i)$



$A_f(i)$:
input i;
add i to 1;
output result;

Algorithm

An ordered set of unambiguous steps that produces a result and terminates in a finite time

Derived from the last name of "Muhammad ibn Musa Al-Khowarizmi", a Persian mathematician

What is Computer Science?

Misconception I

Computer science is the study of computers

"Computer science is no more about computers than astronomy is about telescopes, biology is about microscopes, or chemistry is about beakers and test tubes. Science is not about tools. It is about how we use them and what we find out when we do."

-- Michael R. Fellows and Ian Parberry

Misconception II

Computer science is the study of how to write computer programs

Programming is extremely important to study new ideas and build and test new solutions

Like the computer itself, it is a tool

Computer science is not about programming, but about problem solving

Misconception III

Computer science is the study of the uses and applications of computers and software

Learning to use a software package is no more a part of computer science than driver's education is a branch of automotive engineering

The computer scientist is responsible for specifying, designing, building, and testing software packages as well as the computer systems on which they run

What is Computer Science?

The study of algorithms, including

Their formal and mathematical properties

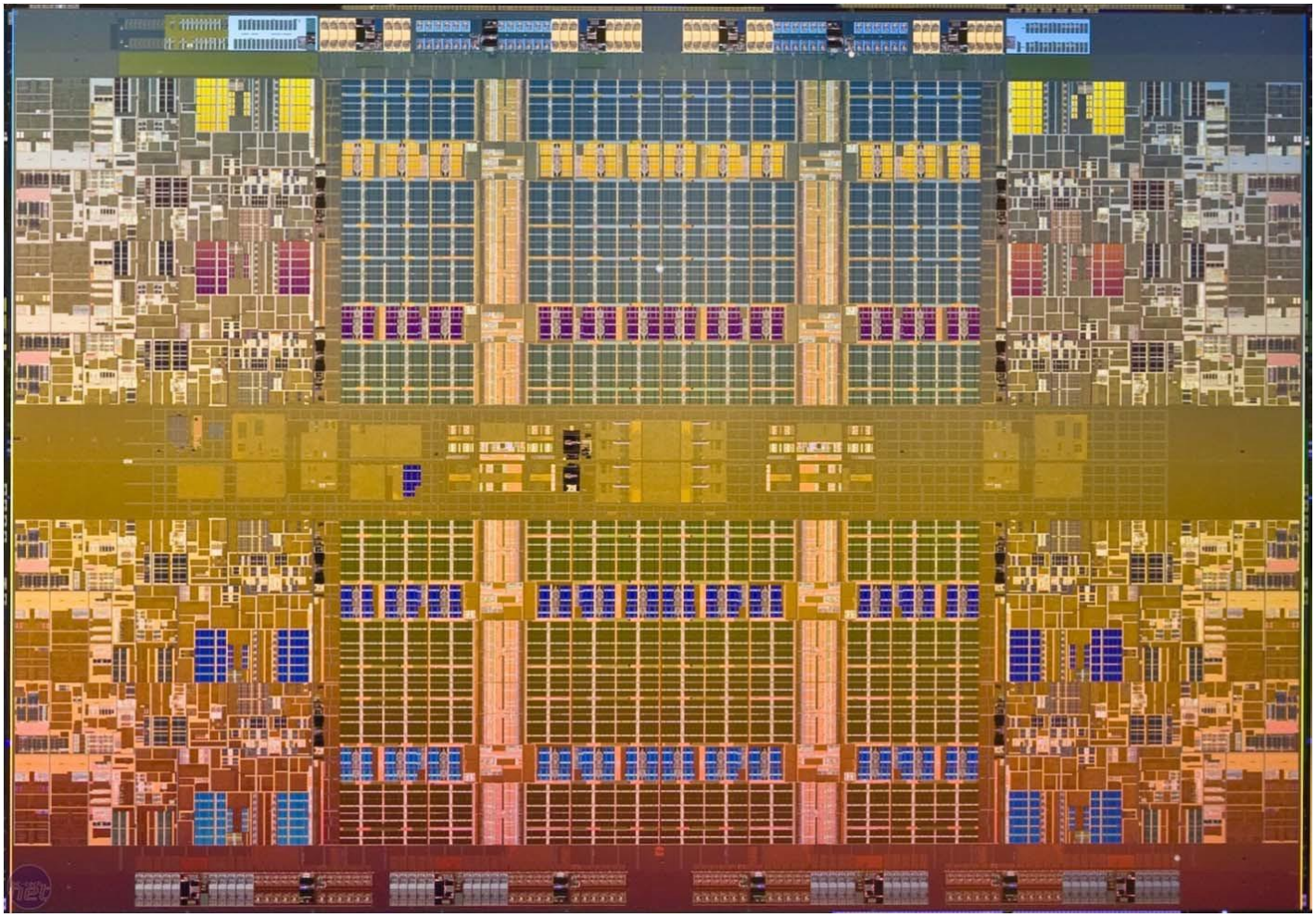
Their hardware realizations

Their linguistic realizations

Their applications

Complexity

Intel Xeon 7560 (8-core): 2.3B transistors

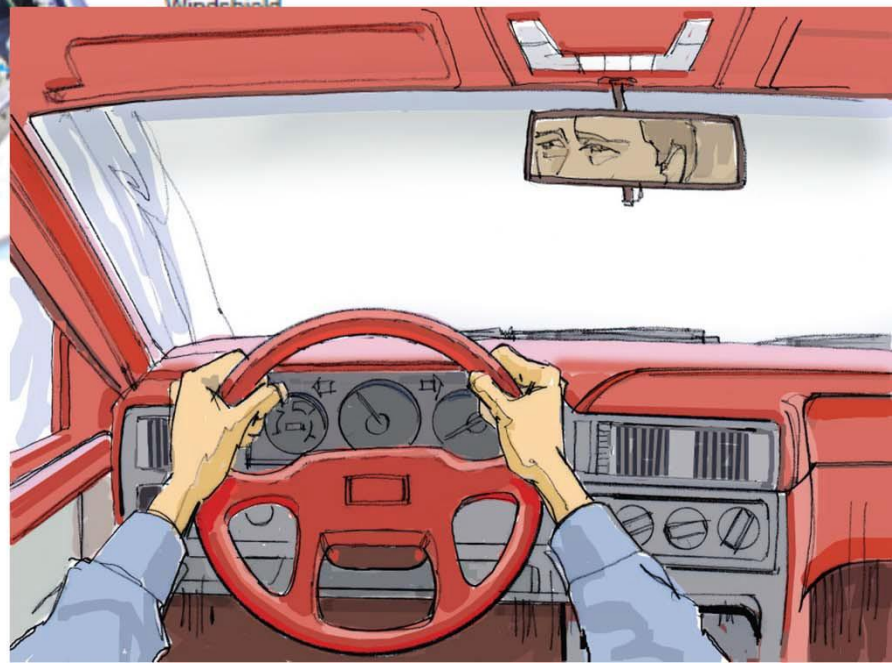


Abstraction

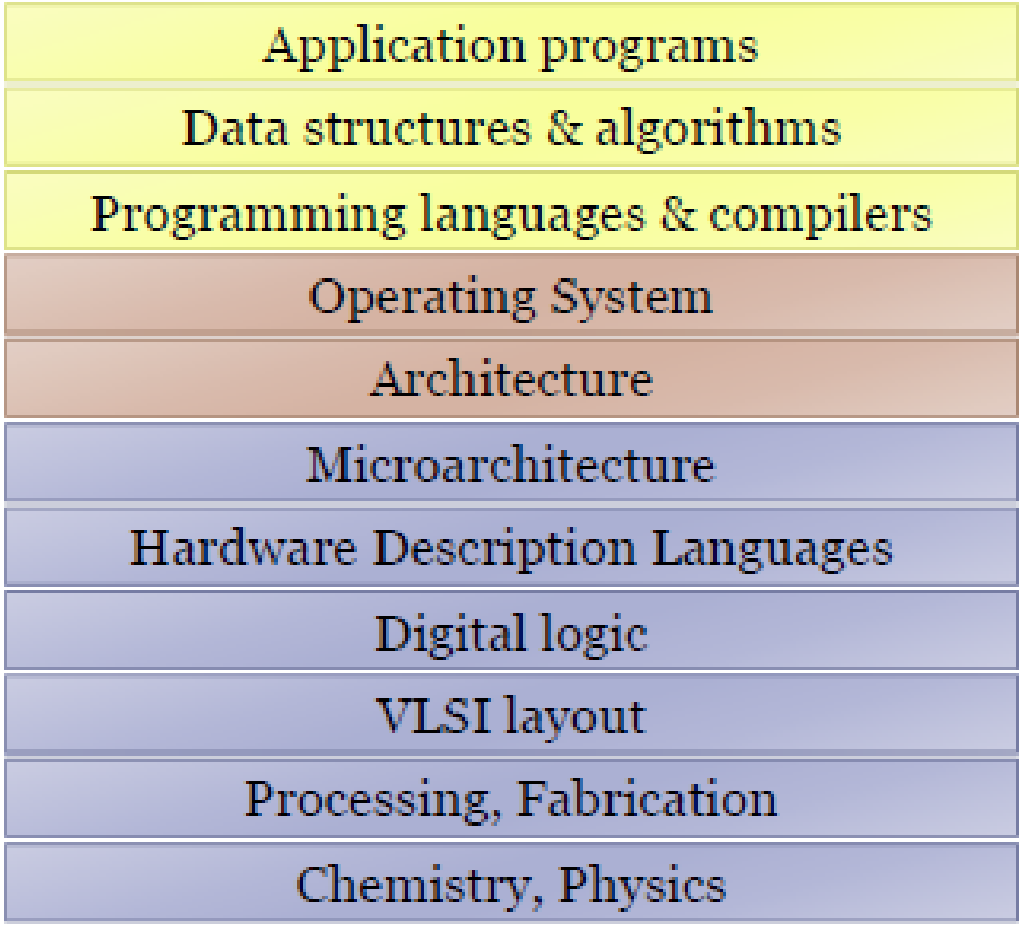
Removes or hides complex details, leaving only the information necessary to accomplish our goal

A key concept to tame the complexity!

Abstraction Everywhere



Levels of Abstraction



Computer Science Is

Science

- Discover truth by scientific methods

Engineering

- Achieve a solution that works for a particular problem
- Develop "good enough" heuristics
- Performance/cost

Art

- Elegance, beauty, and simplicity
- Make complex ideas more comprehensible

How To Be A Successful Computer Scientist

A passion for finding elegant solutions

An ability to use mathematical analysis and logical rigor to evaluate such solutions

Creativity in modeling complex problems through the use of abstractions

How To Be A Successful Computer Scientist

Attention to details and hidden assumptions

An ability to recognize variants of the same problem in different settings

Being able to retarget known efficient solutions to problems in new settings