Introduction to Computer Science

“The Analytical Engine has no pretensions whatever to originate anything. It can do whatever we know how to order it to perform. It can follow analysis; but it has no power of anticipating any analytical relations or truths. Its province is to assist us to making available what we are already acquainted with.”

Ada Lovelace Describing Charles Babbage's machine

MAP OF COMPUTER SCIENCE

THEORETICAL COMPUTER SCIENCE

COMPUTATIONAL COMPLEXITY
DOES P≠NP?
NXN CHESS PSPACE NXNXN GO
NP COMPLETE
TRAVELLING SALESMAN MAP COLOURING
NP GRAPH ISOMORPHISM
BQP
DISCRETE LOGARITHM FACTORING
P
TESTING IF PRIME GRAPH CONNECTIVITY
EFFICIENT FOR A QUANTUM COMPUTER
EFFICIENT FOR A COMPUTER

INFORMATION THEORY
0100110100011001
COMPRESSION ENTROPY
ERROR CORRECTION
0 0 1 1 0
1 1 0 0 1
1 1 0 0 1
1 0 1 1 1
CODING THEORY
PARITY CHECKING

CRYPTOGRAPHY
PUBLIC KEY
ALL THE SECRETS
7bh;"ngmp$avr
7bh;"ngmp$avr
ALL THE SECRETS
PRIVATE KEY

COMPUTABILITY THEORY
LOGIC
ZERO ONE
OR NOT AND
XOR NAND
GRAPH THEORY
COMPUTATIONAL GEOMETRY

TURING MACHINE
ALAN TURING
STATE REGISTER
1: MOVE LEFT
2: MOVE RIGHT
3: FLIP DIGIT
INFINITELY LONG TAPE
HEAD
123: STOP
LAMBDA CALCULUS

AUTOMATA THEORY
S1 S2

QUANTUM COMPUTATION
|0⟩ |0⟩+|1⟩/√2 |1⟩

AND MORE
MAIN JOB
JOB 1
JOB 2
JOB 3
JOB 4
SMALLER JOBS

PARALLEL PROGRAMMING

DATA STRUCTURES
LINKED LIST
TREE GRAPH STACK HASHING

FORMAL METHODS
START ALERT
POSSIBLE STATES

ALGORITHMS
BUBBLESORT(A)
1: GO FROM LEFT TO RIGHT.
2: COMPARE EACH PAIR.
3: IF LEFT ONE HIGHER, SWITCH.
4: DO UNTIL NO MORE SWITCHES.
BUBBLE SORT O(n²)
1 2 3 4 5 6 7 8
MERGE SORT O(n log n)
1 2 3 4 5 6 7 8
ANALYSIS OF ALGORITHMS
ALGORITHMIC COMPLEXITY

COMPUTER ENGINEERING

HARDWARE
MONITOR
SOUND
SSD
GPU
RAM
POWER
INPUT
CPU
MOTHERBOARD

SCHEDULING
PROCESSES
SCHEDULER
CPU 1 CPU 2 CPU 3 CPU 4
MULTIPROCESSING

COMPUTER ARCHITECTURE
CPU
CENTRAL PROCESSING UNIT
CONTROL UNIT
ARITHMETIC/LOGIC UNIT
MEMORY UNIT
INPUT OUTPUT
GPU
MULTIPROCESSORS
FPGA
LOGIC BLOCK
INTERCONNECTION
INPUT/OUTPUT
SWITCH BOX
CONNECT BLOCK

SOFTWARE AND PROGRAMMING LANGUAGES
PYTHON JAVASCRIPT WEB APPS
PHP SWIFT PERL BROWSER
SQL APPLICATIONS
JAVA C# C++ C OPERATING SYSTEM
ASSEMBLY BIOS
SILICON MACHINE CODE
JAVASCRIPT COMPILER
C++ COMPILER
C COMPILER
ASSEMBLY COMPILER

COMPILERS

DATA MANAGEMENT
DATABASES SQL DATACENTRES

NETWORKING
CONCURRENT/DISTRIBUTED/PARALLEL SYSTEMS

OPERATING SYSTEMS
iOS
macOS

SOFTWARE ENGINEERING
FORMAL METHODS
UNIT TESTING
VERSION CONTROL
OBJECT ORIENTED DESIGN

PERFORMANCE
COMPUTER ANALYSIS
BENCHMARKING

APPLICATIONS

MACHINE LEARNING
SUPERVISED UNSUPERVISED
NEURAL NETWORK
CAT
REINFORCEMENT

OPTIMISATION
FINANCE
LEAGUE OF LEGENDS
AMAZON WAREHOUSE

BOOLEAN SATISFIABILITY
x_1 OR x_2 OR $\bar{x}_3$
$\bar{x}_1$ OR $\bar{x}_2$ OR x_3
$\bar{x}_1$ OR $\bar{x}_2$ OR $\bar{x}_3$
$\bar{x}_1$ OR x_2 OR x_3
(SAT)

SUPER COMPUTING

COMPUTER GRAPHICS

COMPUTATIONAL SCIENCE
COMPUTATIONAL PHYSICS
NUMERICAL ANALYSIS
BIOINFORMATICS
COMPUTATIONAL CHEMISTRY

HACKING

ARTIFICIAL INTELLIGENCE
A.I.

ROBOTICS

COMPUTER VISION
FIND THE HUMANS

VIRTUAL REALITY

SIMULATION

BIG DATA

NATURAL LANGUAGE PROCESSING
CHATBOTS
-HEY
HELLO THERE-
-ARE U A ROBOT?
YES-
WAIT, I MEAN NO-
-PROVE IT!
CALCULATING...-
I MADE YOU CAKE-

KNOWLEDGE REPRESENTATION
SCONES TEA FLOUR BUTTER
BIRTHDAY CAKE FOOD
BACON
CELEBRATION PANCAKE BREAKFAST

IMAGE PROCESSING

TELEPRESCENCE

AUGMENTED REALITY
YOUTUBE
DOMAIN OF SCIENCE
MAP OF COMPUTER SCIENCE

HUMAN COMPUTER INTERACTION

INTERNET OF THINGS

BY DOMINIC WALLIMAN ©2017

Agenda

- Computational Thinking
- Abstraction in Computer Science
- Algorithm
- Fun :)

Computational Thinking

Computational Thinking

Computational +	Biology	-->	Computational Biology
	Chemistry		Computational Chemistry
	Physics		Computational Physics
	Anthropology		Computational Anthropology
	History		Computational History
	Agriculture		Computational Agriculture
	...		Computational ...

Computational + Thinking --> Computational Thinking

Abstraction

Binary Light Bulb

Abstraction

123 → 1111011

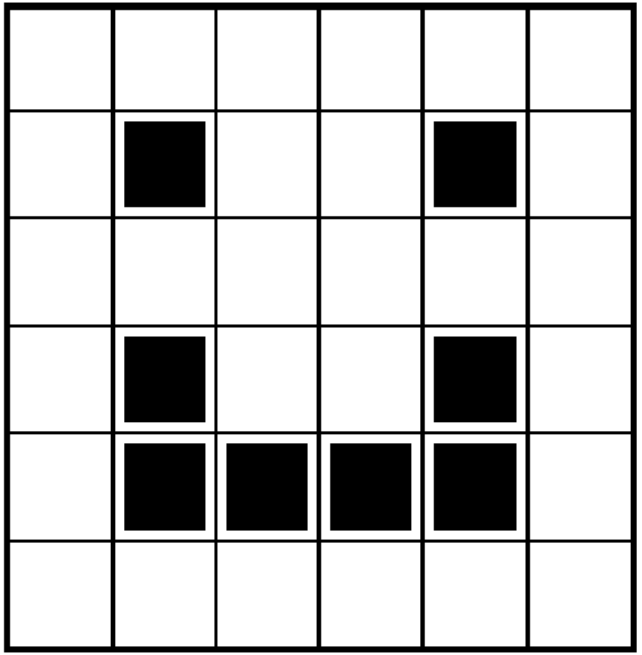
Abstraction

Text → 84 101 120 116 → 01010100 01100101 01111000 01110100

Abstraction

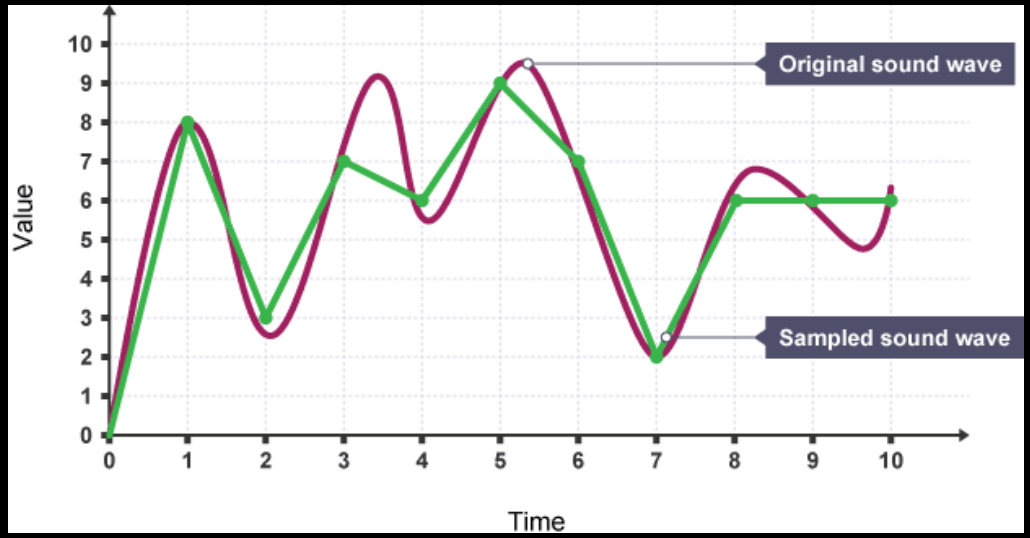
 → 11110000 10011111 10011000 10001111

Abstraction



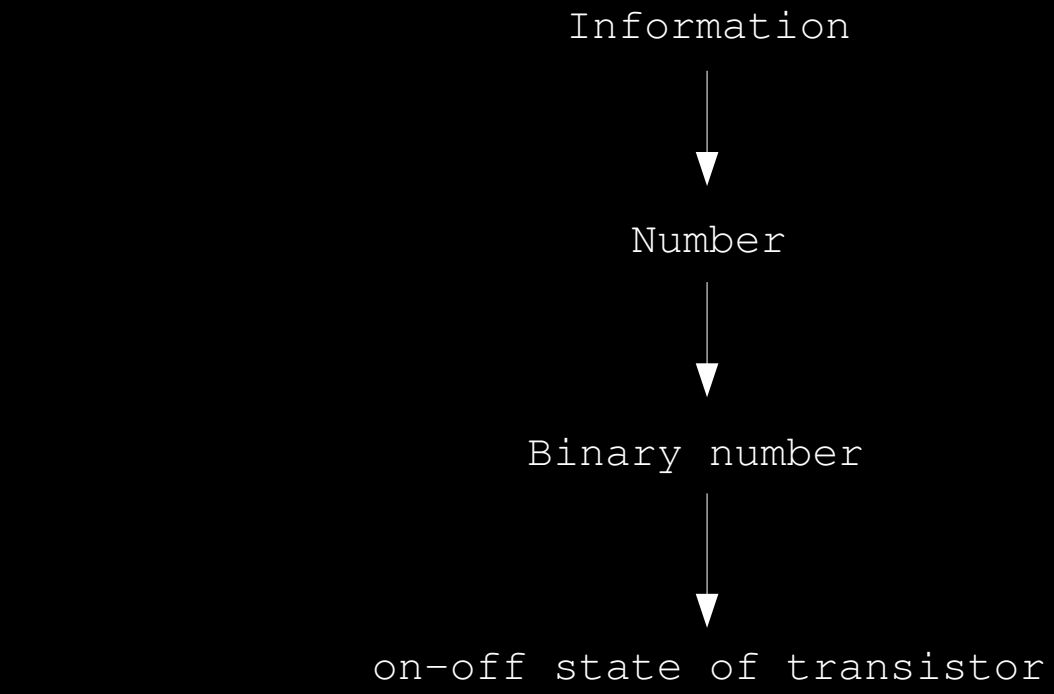
```
1 1 1 1 1 1
1 0 1 1 0 1
1 1 1 1 1 1
1 0 1 1 0 1
1 0 0 0 0 1
1 1 1 1 1 1
```

Abstraction

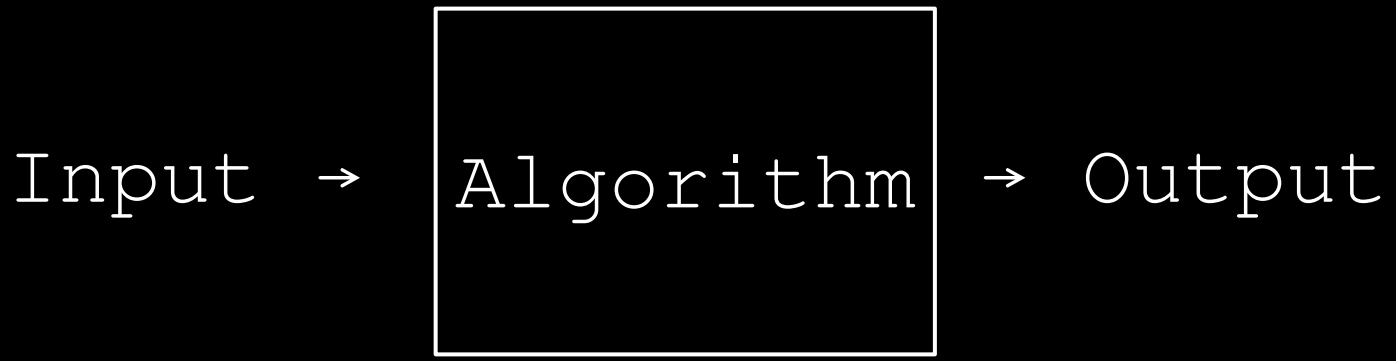


Time sample	1	2	3	4	5	6	7	8	9	10
Denary	8	3	7	6	9	7	2	6	6	6
Binary	1000	0011	0111	0110	1001	0111	0010	0100	0110	0110

Abstraction



Algorithm



Algorithm

- 1000dictionary.py
- random_array_of_number.py

Lightbot Hour