DM534

Introduction to Computer Science

Joan Boyar

September 4, 2013

Format

- Lectures (most in English)
  - Joan Boyar + other CS faculty
  - My office hours: Mondays 13:00–13:45, Fridays 8:30–9:15
  - Questions in English or Danish
- Labs and discussion sections
  - Uffe Thorsen S17
  - Magnus Gausdal Find S7
- Study groups (with and without advisors)

Studiestartsopgave

- Study start project
  - available from course homepage
  - due September 22, 23:59
  - turn in paper and through Blackboard — 1 PDF file
  - start early
  - read questions carefully
  - write clear, complete answers
  - explain your answers
  - do not write too much

Assignments

- assignments to be approved
  (6 – at most 2 retries total)
  - no working together
    (talk with me or instruktor)
  - no late assignments
  - turn in paper to me and via Blackboard – 1 PDF file
  - if sick, use a retry
  - must be nearly correct
  - grading – pass/fail

Discussion sections and labs

- Read notes/textbook sections
- Think about problems
- Prepare at least one problem to present
- There will be support for installing LaTeX, Java, etc.
  See DM536 schedule (also available through this course).

Computer Science

Computer Science is Not:

- Learning applications
- Programming

The course gives a broad overview.

Course Topics:

- Algorithms
- Computer architecture
- Operating systems
- Networks
- Database systems
- Theoretical limits
- Artificial intelligence
- Cryptology
- Software tools — LaTeX, Subversion (version control)
- Computers and society – study group topics

Computer Science

Computer science = Science of algorithms?????

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Algorithm: a well-ordered collection of unambiguous and effectively computable operations, that, when executed, produces a result in a finite amount of time.

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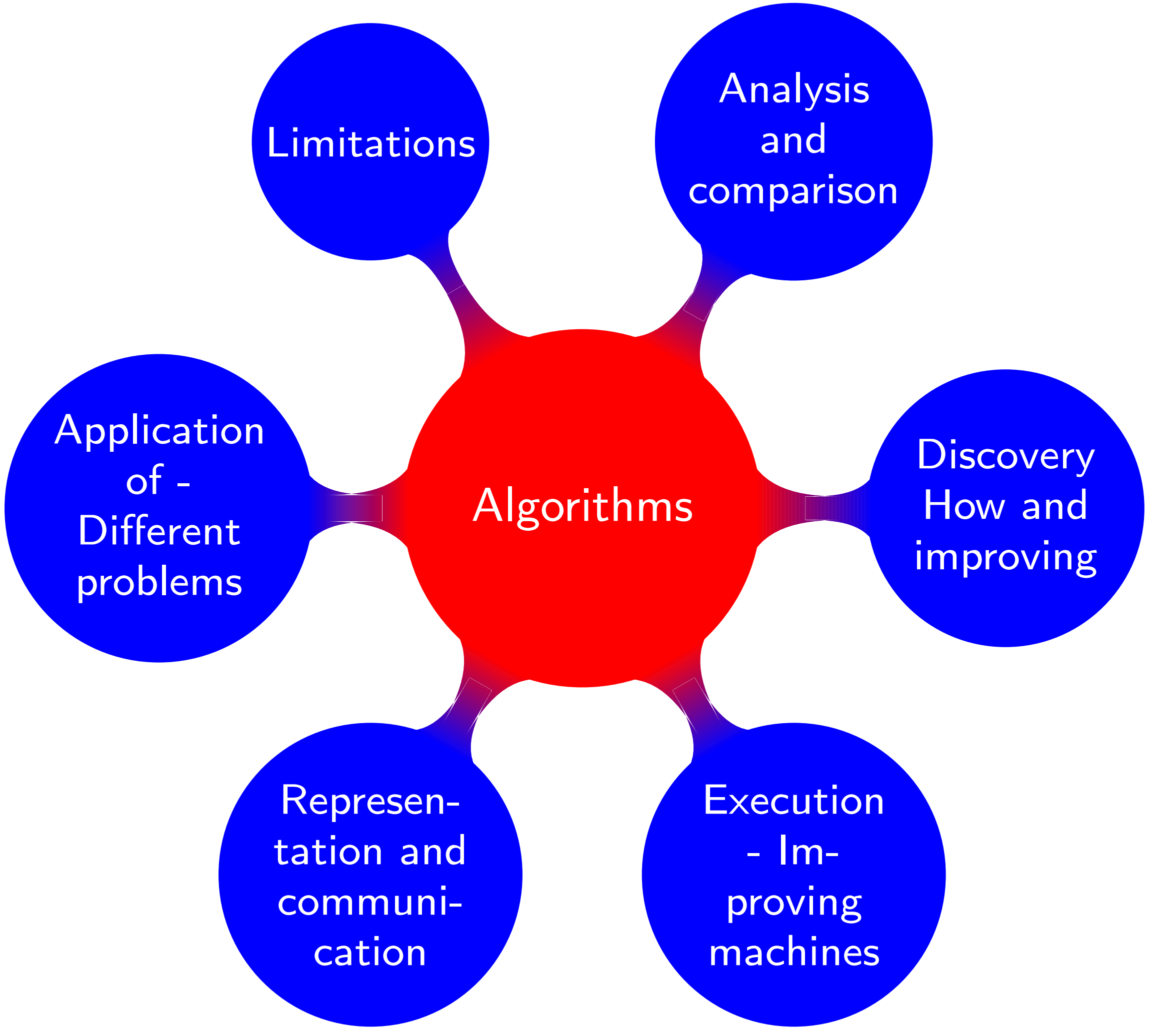
Algorithms


Limitations
Analysis and comparison
Application of - Different problems
Algorithms
Discovery How and improving
Represen- tation and communi- cation
Execution - Im- proving machines

Greatest Common Divisor

gcd$(a, b) = \max\{g \mid g$ divides a and $b\}$

Examples:

gcd(15,9) = gcd(9,15) = 3

gcd(15,8) = gcd(8,15) = 1

Greatest Common Divisor

GCD(M, N):
{ Input: two positive integers M, N }
{ Output: gcd(M, N) }

$A \leftarrow \max(M, N)$
$B \leftarrow \min(M, N)$

$Q \leftarrow A$ div B
$R \leftarrow A - (Q \cdot B)$
while $R \neq 0$ **do**
  $A \leftarrow B$
  $B \leftarrow R$
  $Q \leftarrow A$ div B
  $R \leftarrow A - (Q \cdot B)$
return(B)

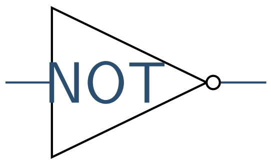
Types of data

The basic unit of data is a bit — 0 or 1.

Bit string — 01101000

- chars
- numbers
- images
- sounds
- truth values
  - 0 – false
  - 1 – true

Gates



$$\neg 0 = 1; \quad \neg 1 = 0;$$

x_1	NOT(x_1)
0	1
1	0

Gates

$$0 \wedge 0 = 0;\ 0 \wedge 1 = 0;\ 1 \wedge 0 = 0;\ 1 \wedge 1 = 1;$$

x_1	x_2	AND(x_1, x_2)
0	0	0
0	1	0
1	0	0
1	1	1

Gates

$$0 \lor 0 = 0;\ 0 \lor 1 = 1;\ 1 \lor 0 = 1;\ 1 \lor 1 = 1;$$

x_1	x_2	OR(x_1, x_2)
0	0	0
0	1	1
1	0	1
1	1	1

Gates

$$0 \oplus 0 = 0;\ \ 0 \oplus 1 = 1;\ \ 1 \oplus 0 = 1;\ \ 1 \oplus 1 = 0;$$

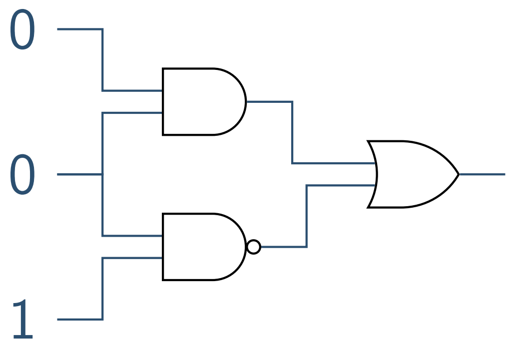
x_1	x_2	XOR(x_1, x_2)
0	0	0
0	1	1
1	0	1
1	1	0

Gates

0 nand $0 = 1$; 0 nand $1 = 1$; 1 nand $0 = 1$; 1 nand $1 = 0$;

x_1	x_2	NAND(x_1, x_2)
0	0	1
0	1	1
1	0	1
1	1	0

Example circuit



What are the top, bottom and rightmost gates?

A. AND, NAND, XOR

B. OR, NAND, XOR

C. AND, NAND, OR

D. OR, NAND, OR

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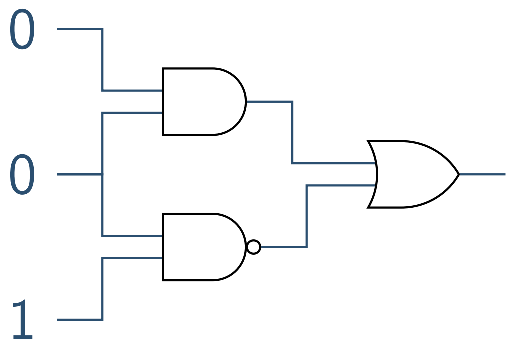
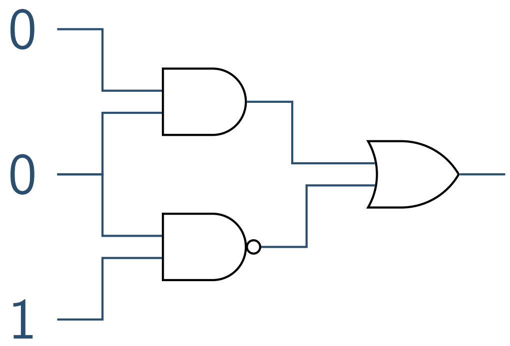
Example circuit



What are the top, bottom and rightmost gates?

C. AND, NAND, OR

Example circuit



What is the output of this circuit?

A. 0

B. 1

C. not defined

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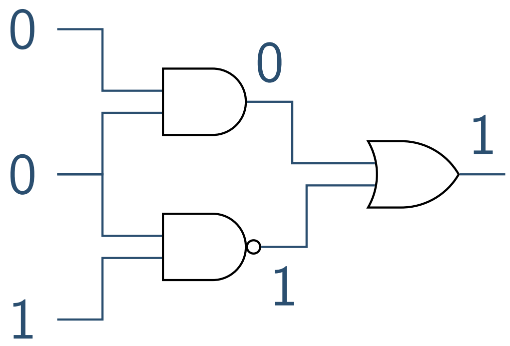
Example circuit

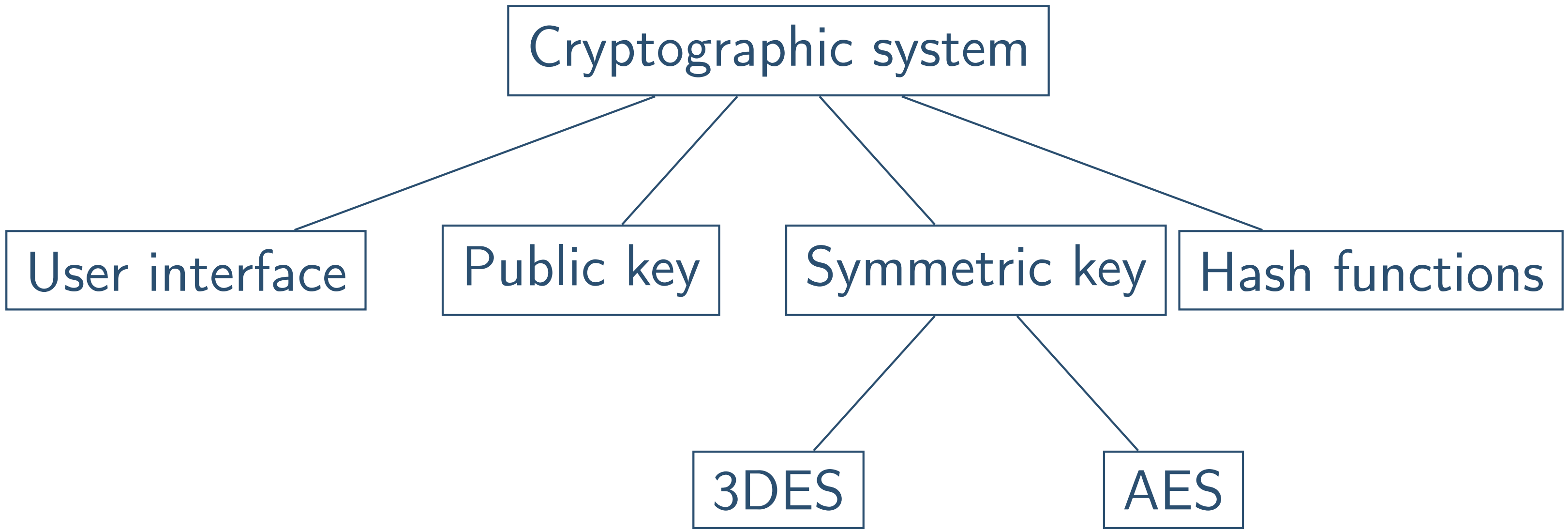


What is the output of this circuit?

B. 1

Abstraction

Example: Top-down design - cryptographic system



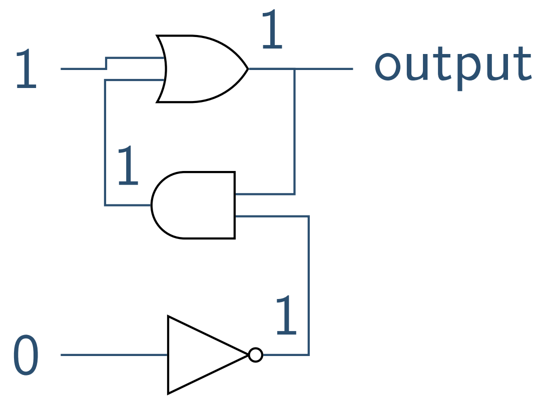
Abstraction

Things at higher levels need not know how things at lower levels function, only how to use them.

Interface, modularity, and modelling give:

- Structure — divide up work
- Independence between modules
  (can re-implement without changing the rest)
- Ability to analyze
- Increased innovation, productivity
  (don't need to re-invent the wheel)

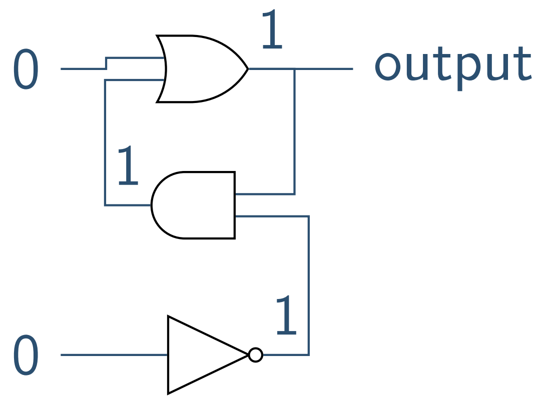
Flip flop



Note that this is stable.
Keeps same output until temporary outside pulse.
Can store a bit.

University of Southern Denmark

Flip flop



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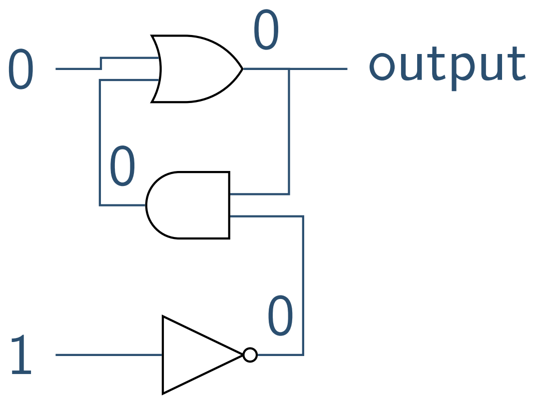
Flip flop



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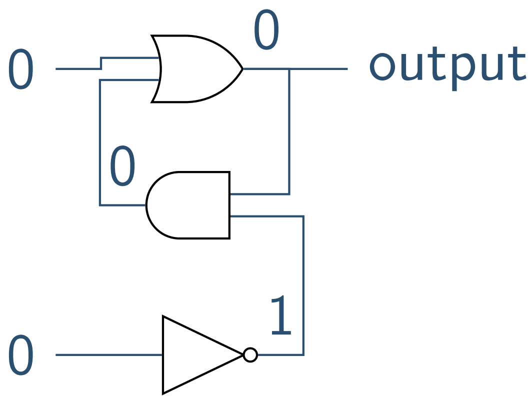

Note that this is stable.
But two different stable outputs are possible with input (0,0).

Flip flops can be implemented differently. Fig. 1.5, p. 38.
Abstraction: know input/output effect —
don't care about implementation.