

# **FM2:**

# **Foundations of Computer Science**

## ***Welcome***

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# Reading Course

- You follow two **video courses**.
- You get a list of **book chapters** for supporting your studies.
- You get a series of **assignments**.
  - Try and apply the knowledge you gained.
  - Prepare for the exam.
- **Meetings** (*here*) for discussion of solutions to the assignments and about your questions.
  - in certain intervals, to check the progress you make
  - and when needed

# Contents of FM2

## 1. Fundamentals of Computing

- Algorithms and their Complexity; Growth of Functions
- Algorithmic Paradigms  
(Recursion, Divide and Conquer, Dynamic Programming)
- Fast Algorithms (Sorting, Searching, ...)

## 2. Theory of Computation

- Finite State Automata
- Determinism *versus* Nondeterminism
- Regular Expressions
- Context-Free Grammars
- Pushdown Automata
- Turing Machines and Undecidability
- NP-Completeness

# Video Lectures

## 1. Fundamentals of Computing

<https://class.coursera.org/algorithmicthink-001/lecture>

## 2. Theory of Computation

<https://online.stanford.edu/courses/soe-ycsautomata-automata-theory>

*You need an account at coursera.org in order to get free access.*

# Additional Reading

1. For **Fundamentals of Computing**, e.g.,  
R. Sedgewick, K. Wayne: *Algorithms*. Addison-Wesley, 2011,  
ISBN 032157351X.
2. For **Theory of Computation**:  
J.E. Hopcroft, R. Motwani, J.D. Ullman: *Introduction to  
Automata Theory, Languages, and Computation*. Pearson,  
2013, ISBN 1292039051.  
(or earlier editions)

# Theory of Computation (1)

1. 1.5 The Central Concepts of Automata Theory (*approx. 5 pages*)
2. Chapter 2: Finite Automata (*approx. 40 pages*)
3. 3.1 Regular Expressions,  
3.2 Finite Automata and Regular Expressions (*approx. 23 pages*)
4. 4.1 Proving Languages not to be Regular (*approx. 4 pages*)
5. 5.1 Context-Free Grammars (*approx. 12 pages*)
6. Chapter 6: Pushdown Automata (*approx. 30 pages*)

# Theory of Computation (2)

- 7. 8.1 Problems that Computers Cannot Solve
  - 8.2 The Turing Machine (*approx. 22 pages*)
  - 8.4 Extensions to the Basic Turing Machine (*approx. 7 pages*)
- 8. 9.1 A Language That is Not Recursively Enumerable,
  - 9.2 An Undecidable Problem That is RE (*approx. 14 pages*)
- 9. Preface of Chapter 10 and 10.1 The Classes **P** and **NP** (*approx. 11*)
  - 10.4 Additional **NP**-complete problems (*approx. 15 pages*)

*Hint: Whenever the text refers to problems you don't know (such as SAT or 3-SAT), please find the descriptions of those problems in 10.2 or 10.3.*

# Assignments and Meetings

<http://www.cs.uni-potsdam.de/bordihn>

→ Teaching → Foundations of Computer Science

11.11. Meeting on Assignment 1a (Fast Algorithms and Recursion I)

25.11. Meeting on Assignment 1b (Fast Algorithms and Recursion II)

09.12. Meeting on Assignment 2 (Finite Automata)

17.12. Meeting on Assignment 3 (Regular Expressions)

06.01. Meeting on Assignment 4 (Non-Regular and Context-Free Languages)

20.01. Meeting on Assignment 5 (Properties of CFLs and Pushdown Automata)

03.02. Meeting on Assignment 6 (Turing Machines, Decidability)

17.02. Meeting on Assignment 7 (Complexity, NP-Completeness, Reductions)

(Have the solutions ready and be prepared to present them.

But your questions are „first citizens.“)