Introduction

COMS10017 - Algorithms 1

Dr Christian Konrad

Algorithms?

Algorithms?

A procedure that solves a *computational problem*

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Computational Problem?

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Computational Problem?

- How often does "Juliet" appear in Shakespeare's "Romeo And Juliet"?

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- How often does "Juliet" appear in Shakespeare's "Romeo And Juliet"? (181 times) (text/strings)

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Computational Problem?

- How often does "Juliet" appear in Shakespeare's "Romeo And Juliet"? (181 times) (text/strings)
- Sort an array of n numbers (all areas)

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Computational Problem?

- How often does "Juliet" appear in Shakespeare's "Romeo And Juliet"? (181 times) (text/strings)
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- How do we factorize a large number? (crypto)

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- Is it possible to partition the set $\{17, 8, 4, 22, 9, 28, 2\}$ into two sets s.t. their sums are equal? (scheduling, load balancing)

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  $\{8, 9, 28\}$, $\{2, 4, 17, 22\}$

Brain Behind Your Software

Algorithms:

- Fabric that Software is made of
- Inner logic of your Software

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Algorithms:

- Fabric that Software is made of
- Inner logic of your Software
- Insufficient computational power $\rightarrow$ Improve your algorithms!

Efficiency

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- The faster the better: **Time complexity**

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- Use as little memory as possible: **Space complexity**

What we want and how we work

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Mathematics

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Theoretical Computer Science

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Theoretical Computer Science

No implementations in this unit!

What you get out of this unit

Algorithm 1 Single-pass Semi-Streaming Algorithm for MDS

Require: Bipartite input graph $G = (A, B, E)$ with $|A| = |B| = n$

1: Let $D_1, D_2, \ldots, D_{\log n} \leftarrow \{\}$
2: For every $a \in A$: $d(a) \leftarrow 0$
3: $U \leftarrow \varnothing$ {Keep track of dominated nodes ($U \subseteq B$ always holds)}
4: For every $b \in B$: $C(b) \leftarrow \perp$ {Output cover certificate}

Goals:

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1. Learn techniques that help you design & analyze algorithms

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1. Learn techniques that help you design & analyze algorithms
2. Understand a set of well-known algorithms

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- Study a problem, discover structure within it, exploit structure and design algorithms

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- Useful in all areas of Computer Science

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Systematic Approach to Problem/Puzzle Solving

- Study a problem, discover structure within it, exploit structure and design algorithms
- Useful in all areas of Computer Science
- **Interview Questions:** Google, Facebook, Amazon, etc.

My Goals

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- Get you excited about Algorithms

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- Shape next generation of Algorithm Designers at Bristol

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Algorithms in Bristol

- 1st year: Algorithms (Algorithms 1)

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Algorithms in Bristol

- 1st year: Algorithms (Algorithms 1)
- 2nd year: Algorithms 2

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Algorithms in Bristol

- 1st year: Algorithms (Algorithms 1)
- 2nd year: Algorithms 2
- 3rd year: Advanced Algorithms (Algorithms 3)

My Goals

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Algorithms in Bristol

- 1st year: Algorithms (Algorithms 1)
- 2nd year: Algorithms 2
- 3rd year: Advanced Algorithms (Algorithms 3)
- 4th year: Advanced Topics in Theoretical Computer Science (Algorithms 4)

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Algorithms in Bristol

- 1st year: Algorithms (Algorithms 1)
- 2nd year: Algorithms 2
- 3rd year: Advanced Algorithms (Algorithms 3)
- 4th year: Advanced Topics in Theoretical Computer Science (Algorithms 4)

BSc/MEng Projects, Reading Group, Summer Internships, PhD students

Unit Structure

Teaching Sessions

- **Lectures:** Mondays 3pm, Thursdays 11pm
- **Problem sheet sessions:** (Tuesdays) TA-led problem sheet sessions, come prepared!
- **OPTIONAL Drop-in/discussion session:** (Mondays 10am-11am) ask questions about the material or other algorithms-related topics
- **OPTIONAL Office hours:** (Mondays 4pm-5pm) Ask me anything about the unit

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Assessment

- Exam: Counts 50% towards your final mark in the joint unit "Object-Oriented Programming and Algorithms"
- You pass the joint unit if your final grade is at least 40%

Teaching Staff

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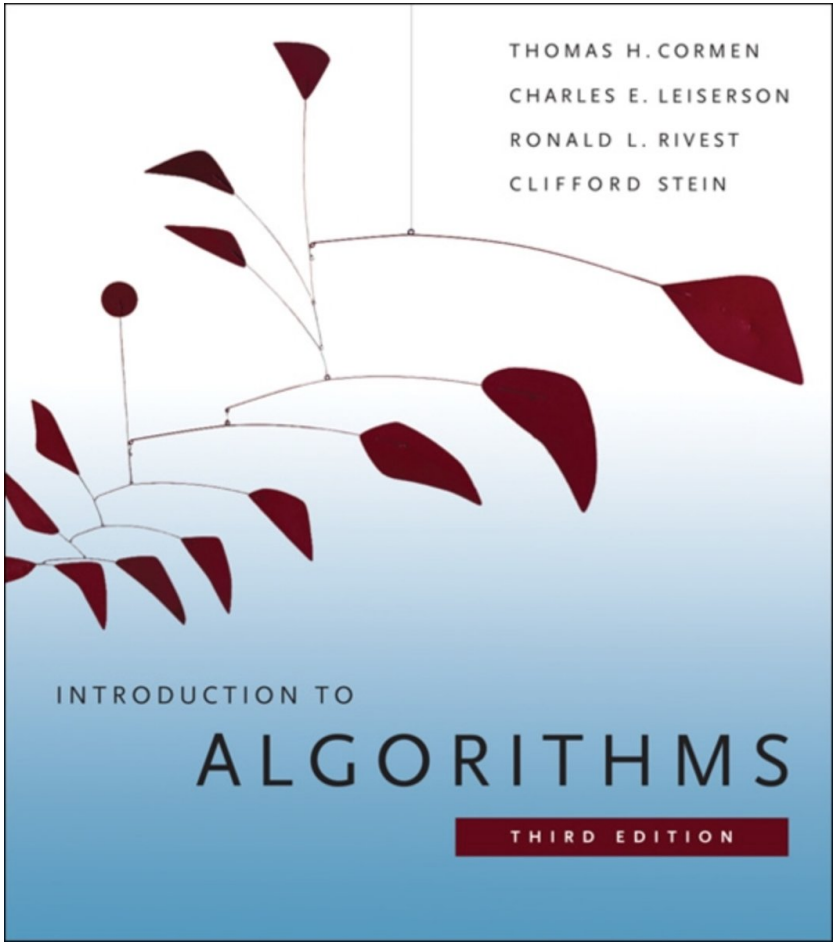
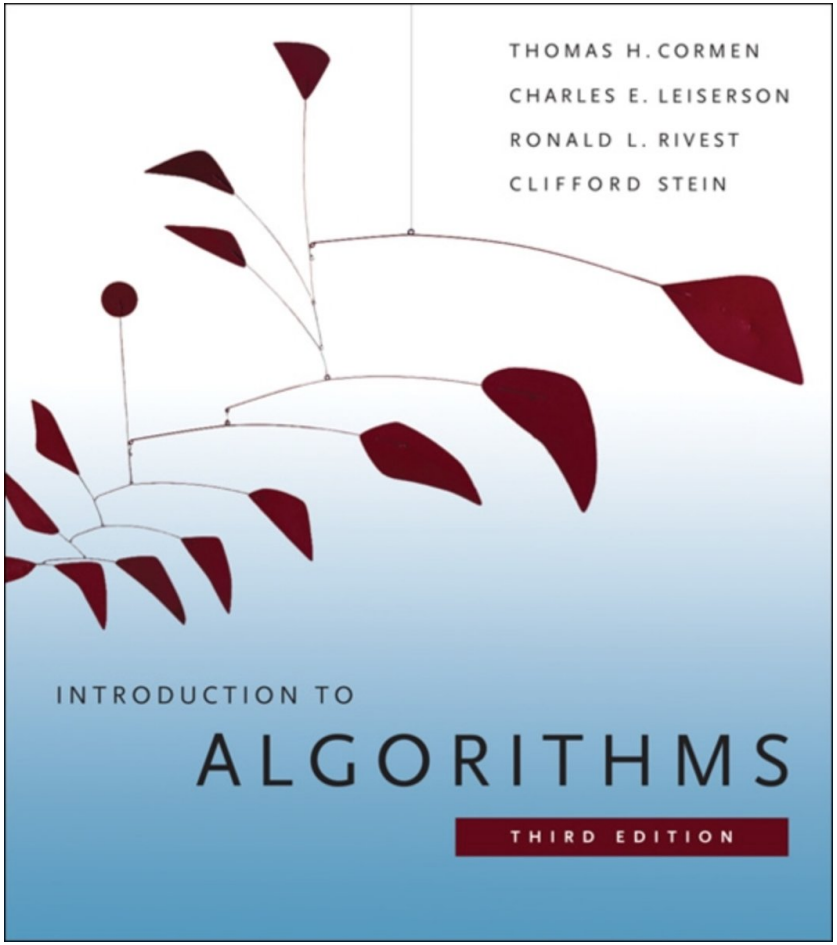
- **Unit Director:** Dr Christian Konrad (christian.konrad@bristol.ac.uk)
- **Lead TA:** Adithya Diddapur (adi.diddapur@bristol.ac.uk)
- **TAs:** Alexander Bell, Michael Degamo, Amos Holland, Piotr Kozicki, Philip Mortimer, Conor O'Sullivan, Thomas Parr, Robert Popescu, Jaehyun Roh, Thammadol Tansrivorarat, Archie Walton, Eric Wang

Book


THOMAS H. CORMEN
CHARLES E. LEISERSON
RONALD L. RIVEST
CLIFFORD STEIN
INTRODUCTION TO
ALGORITHMS
THIRD EDITION

Book

- More details on many of the topics discussed in this unit



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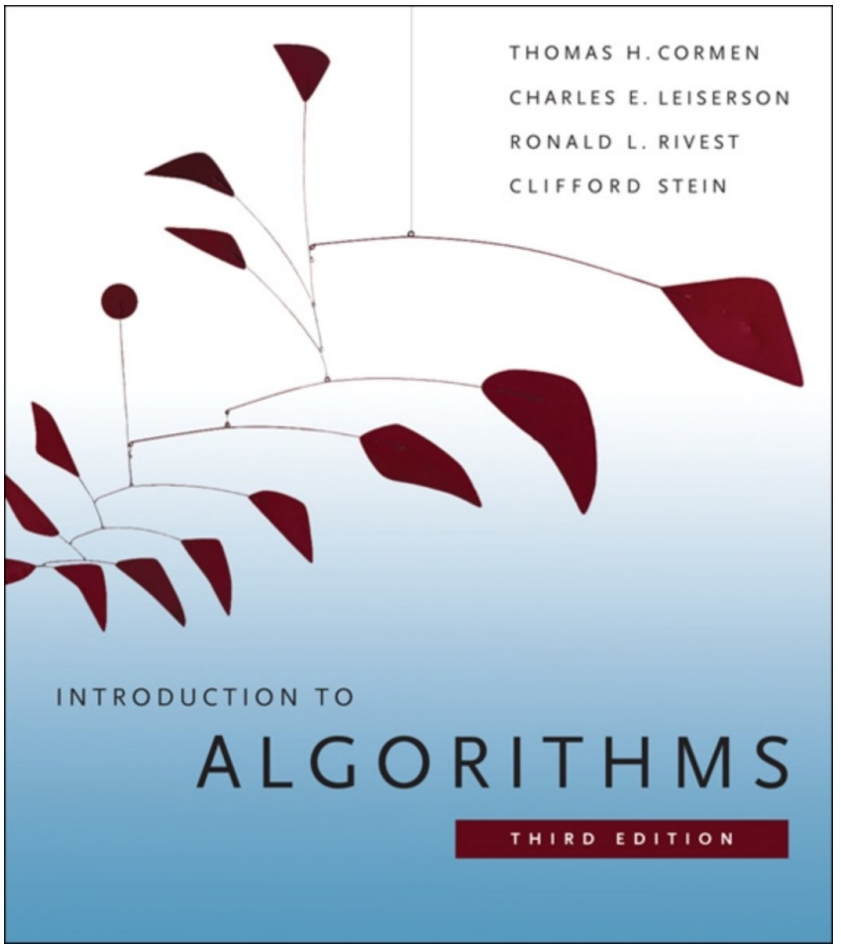
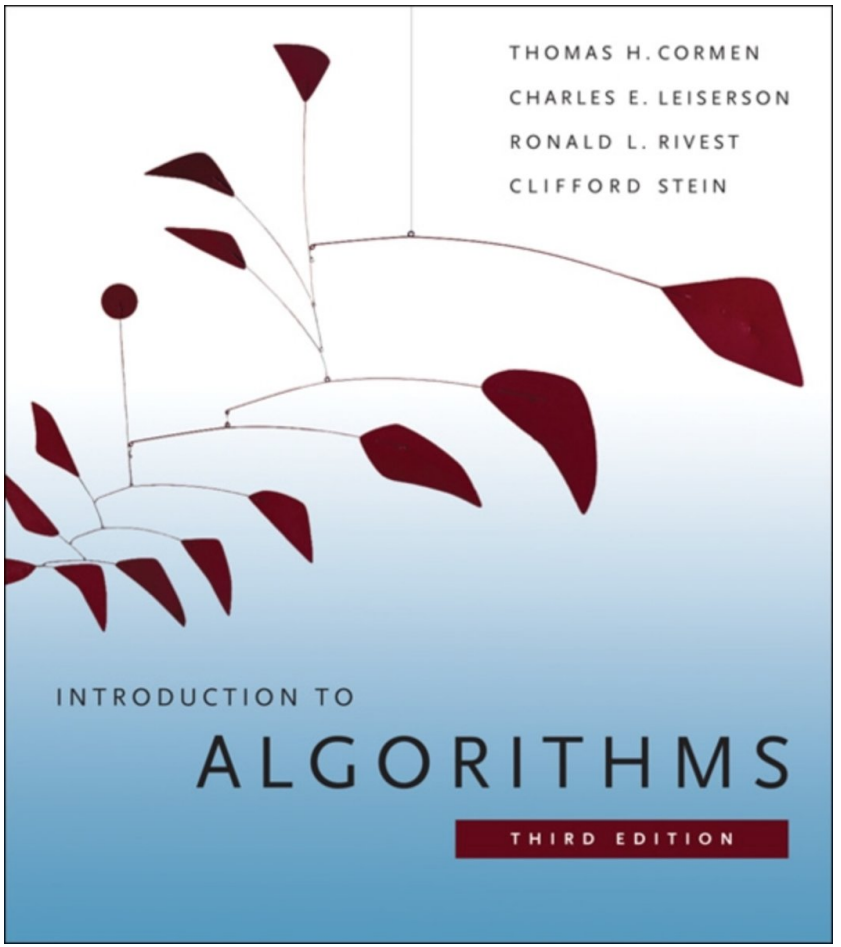


Book

- More details on many of the topics discussed in this unit
- However, not all topics can be found in this book
- Unit materials cover everything you need to know



How to Succeed in this Unit

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- **Work on provided exercises!**

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Unit webpage: Use link on blackboard

`https://bristolalgo.github.io/courses/2023_2024_COMS10017/coms10017.html`

What's next

This Week

- Monday 3pm-4pm: Lecture (today)
- OPTIONAL Monday 4:15pm-5pm: Office hours (MVB03.06)
- Thursday 11am-12pm: Lecture

Next Week

- Monday 3pm-4pm: Lecture
- OPTIONAL Monday 4pm-5pm: Drop-in Session in 1.06QB (exception!)
- Tuesday: Small-group problem sheet sessions
- Thursday 11am-12pm: Lecture

What's next (2)

Every Subsequent Week

- OPTIONAL Monday 10am-11am: Drop-in Session in 1.60QB
- Monday 3pm-4pm: Lecture
- OPTIONAL Monday 4:15pm-5pm: Office Hours
- Tuesday: Small-group problem sheet sessions
- Thursday 11am-12pm: Lecture

Good luck and enjoy! Questions?