

Introduction

COMS10018 - Algorithms

Dr Christian Konrad

Algorithms?

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Algorithms?

A procedure that solves a *computational problem*

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A procedure that solves a *computational problem*

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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- 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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- 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](#))

Algorithms?

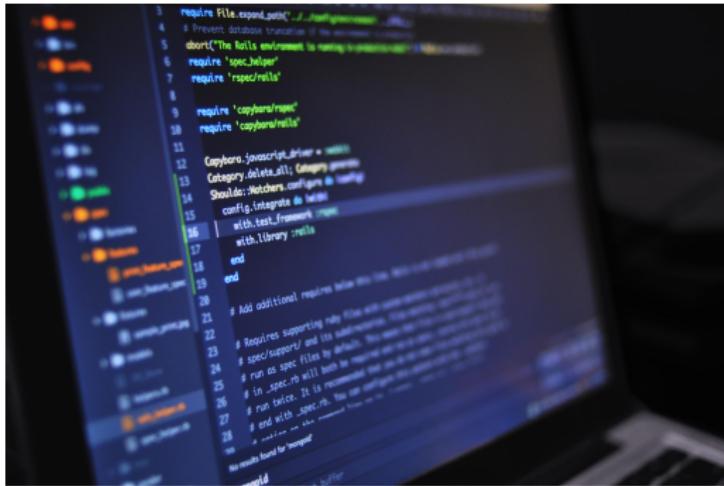
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 $\{8, 9, 28\}, \{2, 4, 17, 22\}$

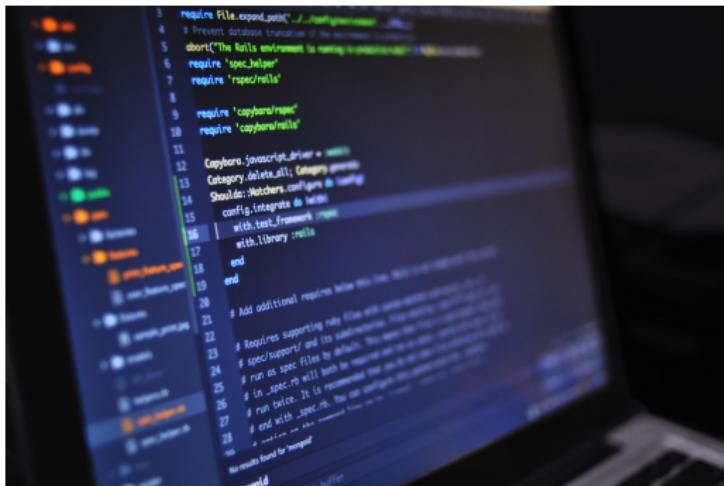
Brain Behind Your Software



Algorithms:

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

Brain Behind Your Software



Algorithms:

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

Efficiency



Efficiency

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



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- The faster the better: **Time complexity**
- Use as little memory as possible: **Space complexity**



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Mathematics

- We will prove that algorithms run fast and use little memory

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- **Tools:** Induction, algebra, sums, . . . , rigorous arguments

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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 $D_1, D_2, \dots, D_{\log n} \leftarrow \{\}$
- 2: For every $a \in A$: $d(a) \leftarrow 0$
- 3: $U \leftarrow \emptyset$ {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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- ② Understand a set of well-known algorithms

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

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Systematic Approach to Problem/Puzzle Solving

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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, exploit structure and design algorithms
- Useful in all areas of Computer Science
- **Interview Questions:** Google, Facebook, Amazon, etc.

My Goals

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- Make you contribute to Algorithms research in Bristol

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Algorithms in Bristol

- 1st year: OOP + **Algo** (Algorithms 1)

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Algorithms in Bristol

- 1st year: OOP + **Algo** (Algorithms 1)
- 2nd year: **Algorithms** and Data (Algorithms 2)

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- 3rd year: Advanced Algorithms (Algorithms 3)

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

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- 2nd year: **Algorithms** and Data (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**

Teaching Sessions

- **Lectures:** Mondays 10am, Fridays 2pm
- **Problem sheet sessions:** Throughout the week

Week $X + 1$ covers sheet released in Week X

- **OPTIONAL Drop-in/discussion session:** (Fridays 1pm-2pm) ask questions about the material or other algorithms-related topics
- **OPTIONAL Office hours:** (Monday 11-noon) Ask me anything about the unit

Unit Structure

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Assessment

- Exam: Counts 50% towards your final mark in the joint unit “Object-Oriented Programming and Algorithms”
- **Attention:** Algorithms exam is a must-pass component

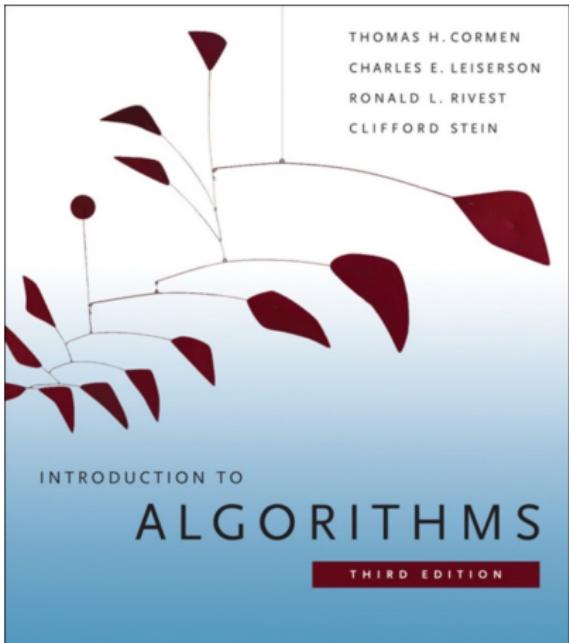
Teaching Staff

Teaching Staff

- **Unit Director:** Dr Christian Konrad
(christian.konrad@bristol.ac.uk)
- **Lead TA:** Conor O'Sullivan
(c.osullivan@bristol.ac.uk)
- **TAs:** Artem Borisov, Michael Degamo, Amos Holland, Harley Huang, Sophia Izwan, Thomas Parr, Vlad Petre, Kasim Rafiq, Ava Raisian, Archie Walton, Stephen Yang

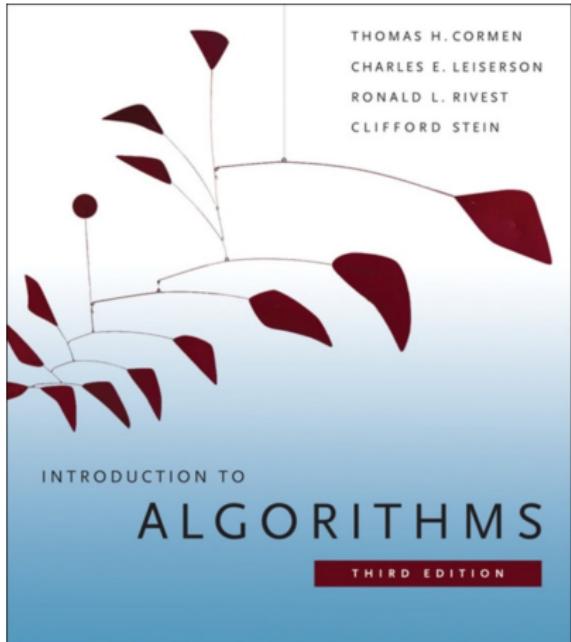


Further Reading



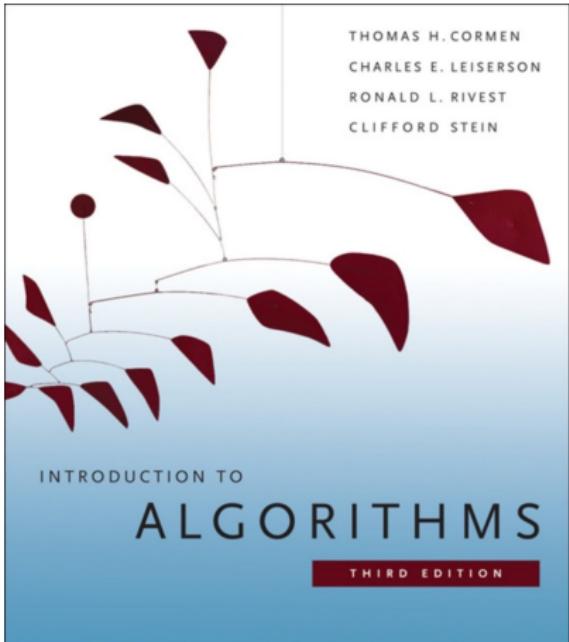
Further Reading

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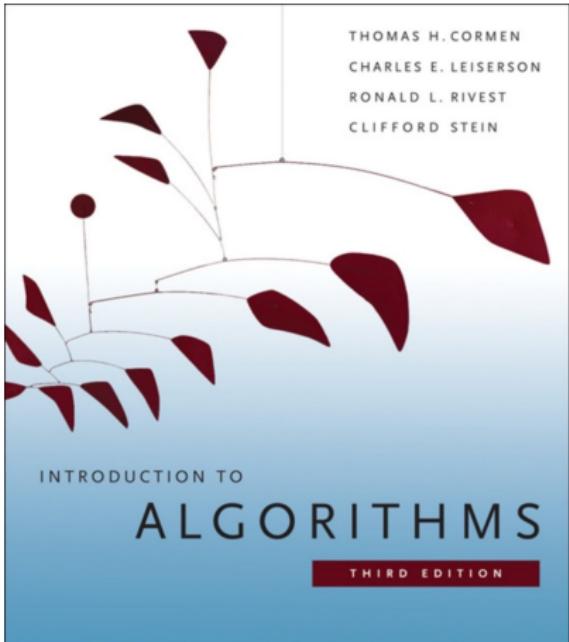
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- However, not all topics can be found in this book



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- 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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- Make sure you understand the material

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- **Work on provided exercises!**

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Unit webpage: Use link on blackboard

https://bristolalgo.github.io/courses/2025_2026_COMS10018/coms10018.html

What's next

This Week

- Monday 10am-11am: [Lecture](#) (today)
- Friday 2pm-3pm: [Lecture](#)

Next Week and every subsequent week

- Monday 10am-11am: [Lecture](#)
- OPTIONAL Monday 11-noon: [Office Hours](#)
- Monday, Tuesday, Thursday: [Small-group problem sheet sessions](#)
- Friday 2pm-3pm: [Lecture](#)
- OPTIONAL Friday 1pm-2pm: [Drop-in Session](#)



Good luck and enjoy! Questions?