Algorithms and Data Structures

Introduction to the Course

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More emphasis on “Algorithms” rather than “Data Structures”.

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Mostly same techniques, more advanced applications.

Divide-and-Conquer, Greedy, Dynamic Programming

More emphasis on “Algorithms” rather than “Data Structures”.

More theorem proving.

Pre-requisites

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Officially: Informatics 2 - Introduction to Algorithms and Data Structures OR Discrete Mathematics and Probability.

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If you are a visiting student or an MSc student, please contact me.

Maths background

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You should know:

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How to multiply matrices or polynomials.

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Some basic probability theory.

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What it means to prove a theorem, and some techniques for theorem proving (e.g., proof by induction, proof by contradiction, etc).

The Team

Aris Filos-Ratsikas
course coordinator, lecturer

Kat Molinet
TA, tutor

Mohamad Latifian
lecturer

Lectures and Tutorials

Lectures:

Mondays 16.10 - 17.00, Weeks 1-10
2.13 Geography (Old Infirmary)

Thursdays 16.10 - 17.00, Weeks 1-10
LG.09 - 40 George Square Lower Teaching Hub

Tutorials:

Tuesdays 15.10 - 17.00, Weeks 3-10
Room TBD

More about tutorials

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Tutorials are scheduled for 2 hours.

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The first hour it will be for you to work on the tutorial questions with other students.

More about tutorials

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"Are the tutorials important? Should I attend them really?"

More about tutorials

“Are the tutorials important? Should I attend them really?”

Yes! They are the best preparation for the assignments and the exam.

Past students have reported that actively engaging with the tutorials was a huge plus for their final performance/mark.

More about tutorials

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(c) Use the FFT algorithm to mutiply the polynomials $p(x) = x + 1$ and $q(x) = x^2 - 1$. To do this, use the following steps:

i. First figure out what the degree of $p(x) \cdot q(x)$ is. Let $n = \deg(p(x) \cdot q(x)) + 1$. If this is not a power of two, pick an n that is a power of 2 by padding.

ii. Write down each of the nth roots of unity.

iii. Evaluate both $p(x)$ and $q(x)$ at each of the nth roots of unity x_j, and then compute $p(x_j) \cdot q(x_j)$ for every j. You may do this directly, without using the FFT recurrence.

iv. Explain how we can use the FFT recurrence to reduce the running time of the evaluation at the nth roots of unity. Then redo the evaluations in part (iii) for $q(x)$ only, at each of the nth roots of unity, but this time using the FFT recurrence.

v. Recall the two methods of interpolating a polynomial; the first method is to define an appropriate polynomial $D(x)$ and evaluate it at the nth roots of unity; the second method is to use a matrix product, and invert a matrix with the appropriate powers of ω_n as coefficients. Using whichever method you prefer, recover the coefficients of the polynomial $p(x) \cdot q(x)$. You do not need to use the FFT recurrence.

[*10 marks*]

Exam Question 2025

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Exam Question 2025

B. Use the FFT algorithm to mutiply the polynomials $p(x) = x - 4$ and $q(x) = x^2 - 1$. To do this, use the following steps:

(a) First figure out what the degree of $p(x) \cdot q(x)$ is. Let $n = \deg(p(x) \cdot q(x)) + 1$. If this is not a power of two, work as in Problem 2 to pick an n that is a power of 2 by padding.

(b) Write down each of the nth roots of unity.

(c) Evaluate both $p(x)$ and $q(x)$ at each of the nth roots of unity x_j, and then compute $p(x_j) \cdot q(x_j)$ for every j. To save time, you may do this directly as in Part A of this question, without using the FFT recurrence. We will the FFT recurrence in the next step, for the polynomial interpolation.

(d) Recover the coefficients of the polynomial $p(x) \cdot q(x)$. To do that, define an appropriate polynomial $d(x)$ as presented in the lectures and apply FFT to $d(x)$ to evaluate it at the nth roots of unity.

Tutorial Question

More about

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It’s always better to attend anyway!

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Still, it might be helpful to code some of the algorithms to enhance your understanding.

Assessment

Written Exam (75%)

Coursework (25%)

Coursework 1 (0% - not accessed): for practice
Released: 29/09/2025
Due: 17/10/2025
No individual feedback, but general feedback and solutions will be provided.

Coursework 2 (25% - accessed)
Released: 27/10/2025
Due: 17/11/2025

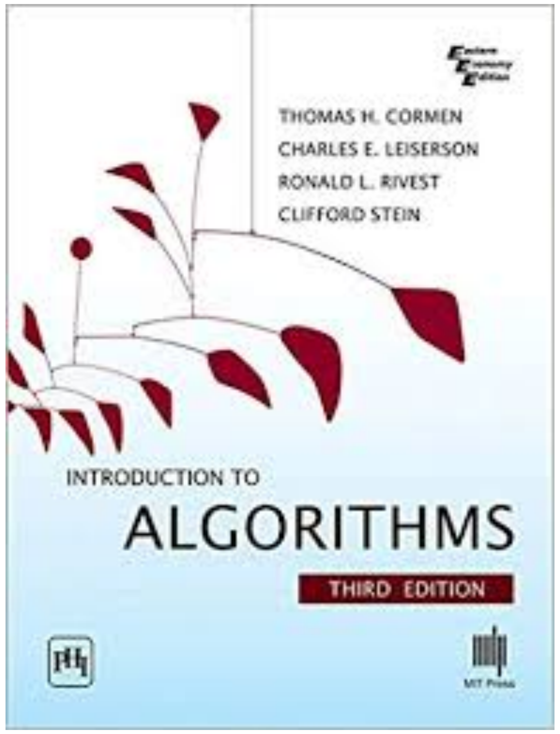
Submission via Gradescope (via Learn).

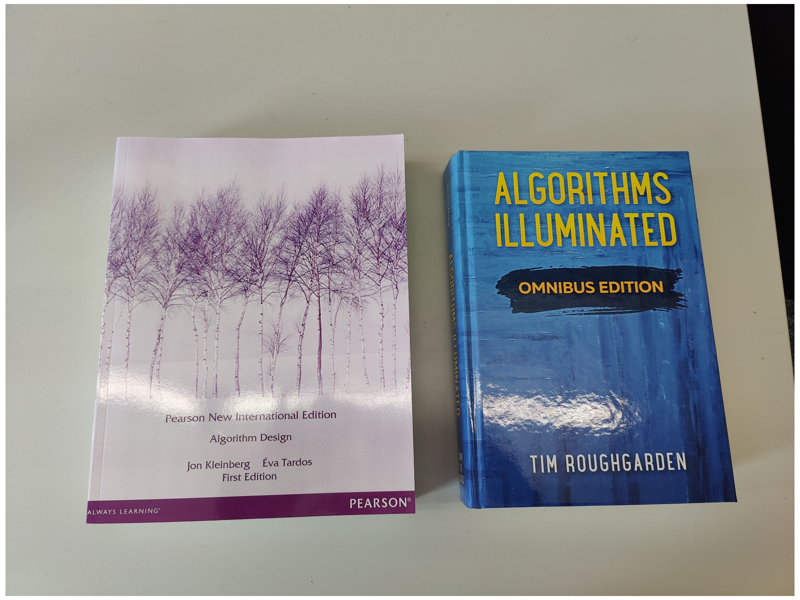
Course textbooks

Introduction to Algorithms by Cormen, Leiserson, Riverst, and Stein (CLRS).

Algorithm Design by Kleinberg and Tardos (KT).

Algorithms Illuminated by Tim Roughgarden.





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Questions after the lectures are very much welcome!