Algorithms and Data Structures

Introduction to the Course

Algorithms and Data Structures

A continuation of Introduction to Algorithms and Data Structures (INF2 - IADS).

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

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

Unofficially:

You should like algorithms and/or maths/theory courses, and ideally to have passed them with a good mark.

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

Maths background

You should know:

How to multiply matrices or polynomials.

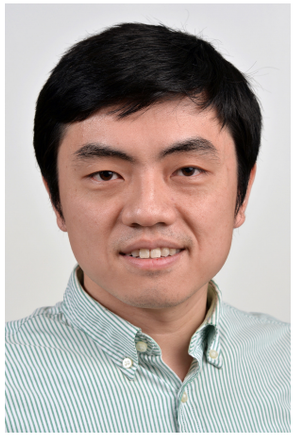
Some basic probability theory.

Some basic graph theory.

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

The Team

Heng Guo
course coordinator, lecturer



Georgios Kalantzis
Tutor

Dhairya Mangla
Tutor

Lectures and Tutorials

Lectures:

Monday 16.10 - 17.00, Weeks 1-10
Lecture Theatre 1 - Appleton Tower

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

Tutorials:

Tuesday 11.10 - 13.00, Weeks 3-10
LG.09 - 40 George Square Lower Teaching Hub

Friday 11.10 - 13.00, Weeks 3-10
(Location TBA)

More about tutorials

Tutorials are scheduled for 2 hours.

The second hour will be with the tutor.

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

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

(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

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 tutorials

“Should I prepare for the tutorials before attending, or is simply showing up enough?”

There will most likely be a large benefit from attempting the tutorial questions before attending.

It’s always better to attend anyway!

More about tutorials

“Should I code the algorithms that appear in the tutorials?”

Coding is not part of the course (unlike INF2-IADS).

In fact, we want you to start think more abstractly rather than in terms of a programming language.

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

Assessment

Written Exam (75%)

Coursework (25%)

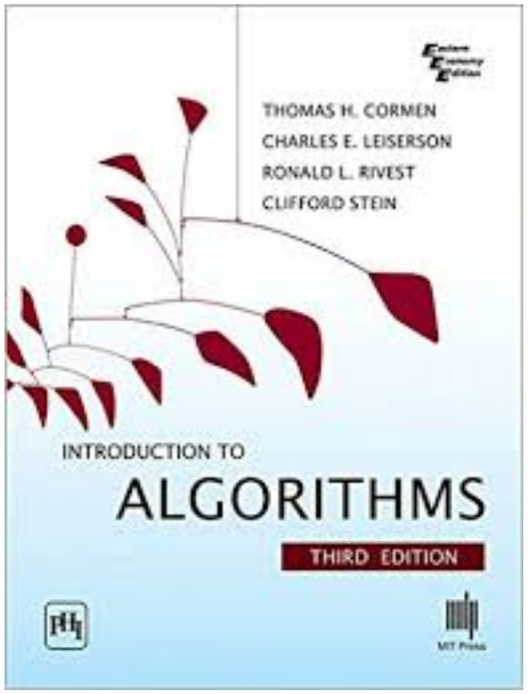
Coursework 1 (0% - not accessed): for practice
Released: 28/09/2026
Due: 16/10/2026
No individual feedback, but general feedback and solutions will be provided.

Coursework 2 (25% - accessed)
Released: 26/10/2026
Due: 16/11/2026

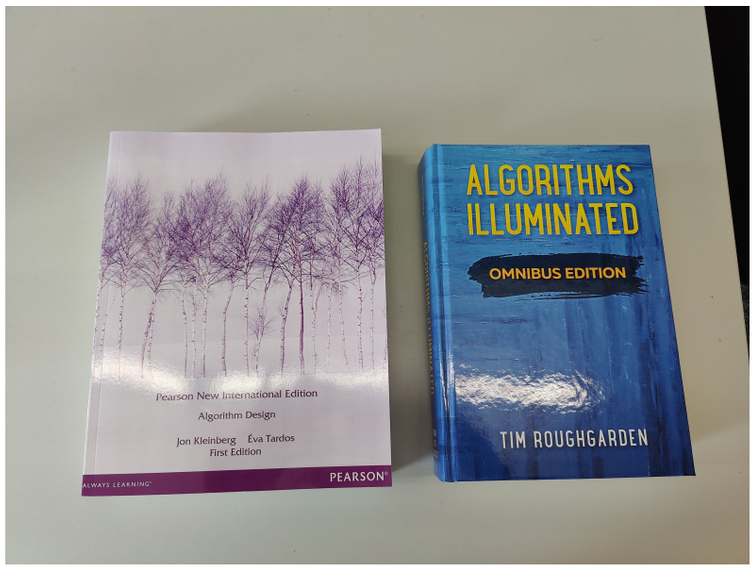
Submission via Gradescope (via Learn).

Course textbooks

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



Algorithm Design by Kleinberg and Tardos (KT).



Algorithms Illuminated by Tim Roughgarden.

Keeping in Contact

How to access the material:

Course webpage for material, slides, and general instructions. (Rolling update)

Learn page for assessment instructions and details, lecture recordings, and access to teaching tools.

EdStem: a forum like piazza, links in Learn and course website.

EdStem allows you to discuss and ask questions either in your own name, or under and anonymised “handle”.

It has functionality to ask “private questions”, only visible to the lecturing team.

We will keep a close eye on the forum, so please use it!

Questions after the lectures are very much welcome!