

Computational Complexity

IIC3242

Before we start!

First things first: this will be in English!

- ▶ Why? So that you can practice it
- ▶ (Also they asked me to do it in English)

Who is your lecturer?

- ▶ Me (Domagoj Vrgoč)
- ▶ Why do I have such a difficult name?
- ▶ I like sarcasm and dark humour
 - ▶ Don't get offended (it's all well intended)

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What is the course about?

Objective: Measure computational complexity of a problem.

That is: We want to measure computational resources **needed** to solve a problem.

- ▶ Time
- ▶ Space
- ▶ Randomness
- ▶ ...

Why is this useful?

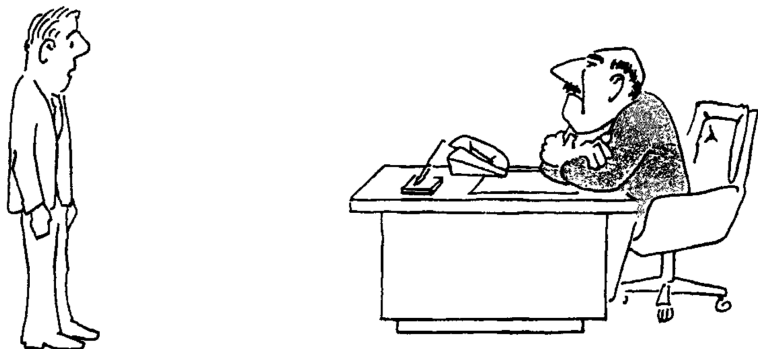
What does it mean that a problem is difficult?

Assume your boss gave you a problem.

And you are struggling to solve it efficiently.

What do you do?

Option 1



“I can’t find an **efficient** algorithm, I guess I’m just too dumb.”

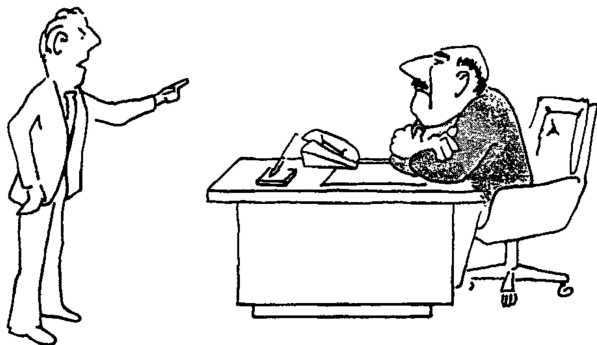
What we do in this course

Maybe not the best approach (you might get sacked).

So in this course we will learn the methods which allow us to answer this question a bit better!

Generally we will have two alternatives.

The best option



“I can’t find an efficient algorithm, because no such algorithm is possible!”

What often happens in practice



“I can’t find an efficient algorithm, but neither can all these famous people.”

Course structure

Classes twice a week!

- ▶ Monday and Wednesday Module 4

Office hours: contact me by e-mail/in person to arrange

We might have some weeks off!

All materials will be on SidInq!

Topics we will cover

1. Turing machine basics (setting the notation)
2. Time complexity
3. Space complexity (where things start getting really cool)
4. Relationships between classes (cool and bizarre)
5. Polynomial hierarchy
6. Circuit complexity (this is the best part :))
7. Random computation
8. (If there is time) Complexity of counting

Slides on SidInG

Sanjeev Arora and Boaz Barak. *Computational Complexity. A modern approach*. Cambridge University Press, 2009.

Michael Sipser. *Introduction to the Theory of Computation*. Second Edition. Thompson Course Technology, 2006.

Christos Papadimitriou. *Computational Complexity*. Addison Wesley, 1994.

Dexter C. Kozen. *Theory of Computation*. Second Edition. Springer-Verlag, 2006.

If you don't have the books maybe check <https://www.dropbox.com/sh/uvu34t7xi8fseit/AAD2q3iRCSvK03X5uIS7CQ9Ja?dl=0>

Homeworks!

- ▶ Between 3 and 7 (most likely 5 or 6)!
- ▶ One week to finish them (no exceptions)!
- ▶ Must be written on a computer (Latex preferred)
- ▶ All handed materials must be in English

One final seminar

- ▶ You select a topic
- ▶ And write an essay/do a presentation about it
- ▶ Let's vote which one
- ▶ Tests your writing and presentations skills
- ▶ Also your English