Universität Rostock
Traditio et Innovatio

INSTITUT FÜR INFORMATIK

Field Seminar: Complexity

Winter Semester 2025/26

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What is Complexity Theory?

- Branch of Theoretical Computer Science – Formal field of study that explores options and limits of computational problem solving.
- Natural Extension of Computability Theory – Investigates how resource consumption increases with the input size growth for computational problems. Resources of interest are usually time and memory.
- Extensive Classification of Problems – Drawing a map for computational problems to categorize them by machine model, result type, difficulty, resource constraints and so on.

Why is it exciting to learn about Complexity Theory?

- Understand Computational Costs – Find out for all kinds of problems how easy or difficult it is for a computer to solve them.
- Explore Computational Limits – Become aware of fundamental barriers in problem solving that prohibit certain efficient approaches.
- Discover the Frontier of Efficient Algorithms – Master the most efficient algorithmic methods known to us, today.
- Take Notice of Practical Implications – Hear about real word applications like in logistics, communication and security and in other sciences such as physics and biology.
- Learn about famous Mathematical Riddles – See what is behind the many unsolved questions at the heart of computer science like P vs. NP.

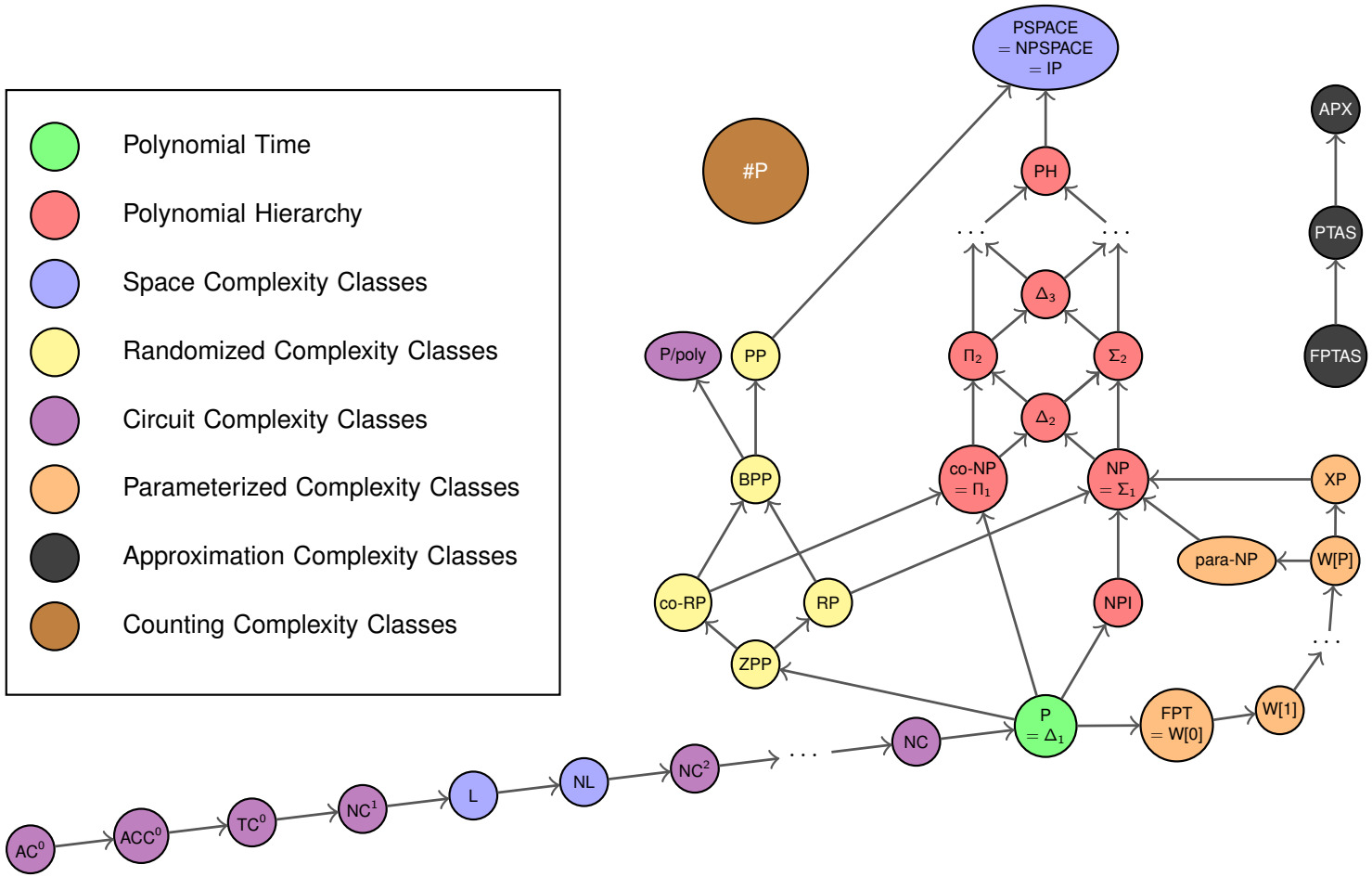
Schedule

- We will start with 2 – 3 introductory lectures to reiterate results given in basic courses from complexity theory and outline the available topics.
- After that you will pick a topic and receive references to useful literature.
- While you do your research, there will be weekly meetings where you can ask questions and get advice.
- At the end of the seminar, you will give a 30 minutes talk about the state of the art in your chosen field of complexity theory.
- Having the feedback on your talk, you will write a $\sim$ 8 pages survey paper on your topic and hand it in four weeks after your talk.

Possible Topics of this Seminar

1. Time Classes beyond P and NP i. e., co-NP, NP-Intermediate, Polynomial Hierarchy
2. Space Classes i. e., L, NL, PSPACE, Savitch's Theorem, Space-Hierarchy-Theorem
3. Randomized Complexity i. e., ZPP, RP, co-RP, BPP, PP
4. Circuit Complexity i. e., AC^0, ACC^0, TC^0, NC, P/poly
5. Approximation Complexity i. e., APX, (F)PTAS, weakly NP-Hardness
6. Parameterized Complexity i. e., FPT, XP, W-Hierarchy, para-NP
7. Other Topics i. e., Interactive Proof Systems, Fine-Grained Complexity, Exponential-Time-Hypothesis, PCP-Theorem, Counting Complexity, Game Theory

Complexity Landscape explored during the Seminar



Registration

- We have topics for at most 16 students.
- Please register by Oct. 12, 2025 at the latest.
- Join StudIP course 23942 for the English-language seminar and 23935 for the German-language seminar.
- Send your questions to
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