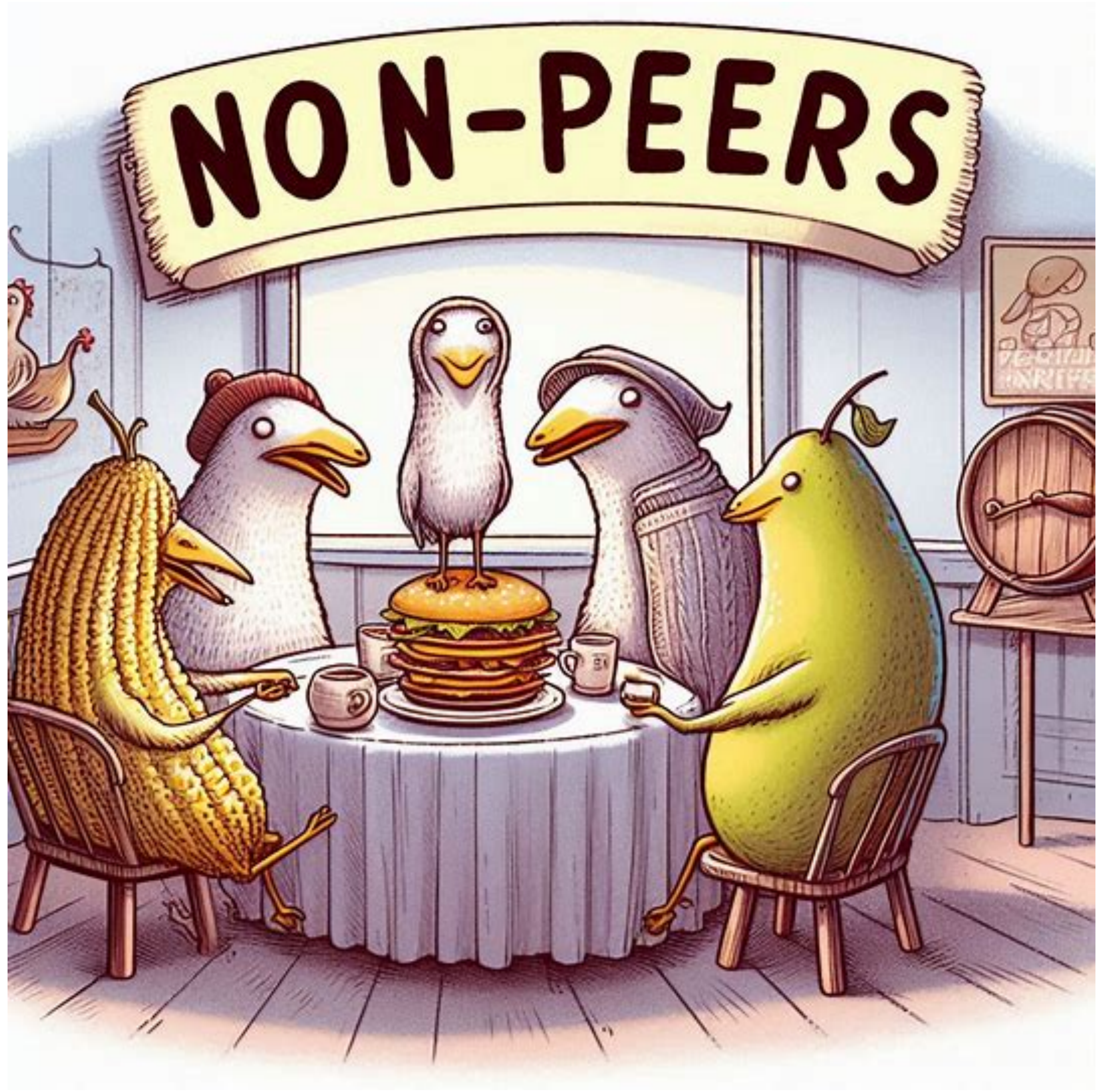
How to pitch your research

BARC retreat 2024

Rasmus Pagh, October 15, 2024

This session



- How to communicate effectively to someone *outside* your peer community? For example,
  - writing a grant application,
  - talking to a journalist, or
  - explaining your research to someone with a different educational background

Plan:

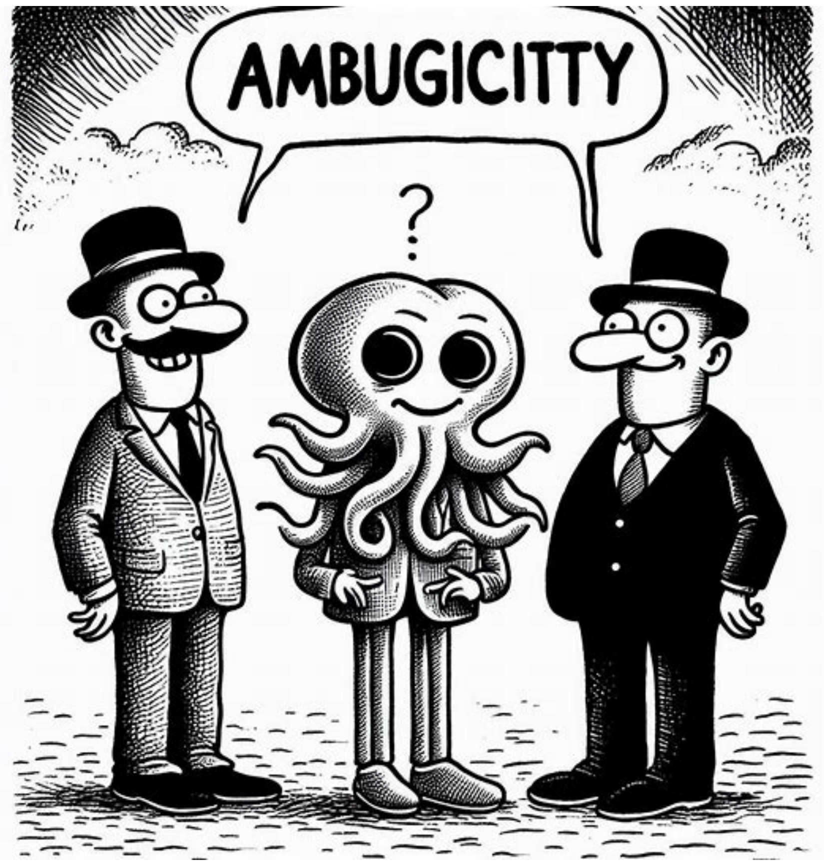
- Discussion in small groups of a (fictional) research project proposal
- Examples of some common pitfalls
- Practice pitching your own research by using a large language model

Fictional project pitch

This project aims to explore the complexity classes of PSPACE-complete problems in relation to BQP, focusing on oracle separations and the implications for non-deterministic quantum complexity. We will utilize a novel reduction strategy involving interactive proof systems (IP) and quantum interactive proof systems (QIP) to establish stronger bounds on the relative hardness of decision problems. By examining the hierarchy theorem for alternating Turing machines and the collapse of the polynomial hierarchy under relativized conditions, we expect to uncover new insights into the relationship between classical and quantum polynomial time complexity. The use of randomized communication protocols and Yao's minimax principle will be instrumental in extending known results about the hardness of one-way functions. Our research will advance the frontier of complexity theory by shedding light on the unresolved nature of NP vs. BQP. Additionally, we will explore potential connections between BPP and PP through the lens of Toda's Theorem.

Discuss with your neighbor(s): What could be improved in this pitch?

Some common pitfalls



Lack of context

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Lack of structure and coherence

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Use of jargon and acronyms

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Ambiguity

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Lack of clearly defined objectives

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Improved project pitch

This project investigates the relationship between PSPACE-complete problems and BQP (Bounded-error Quantum Polynomial time), focusing on the potential for oracle separations between classical and quantum complexity classes. While it is well-established that PSPACE-complete problems are solvable using polynomial space on a classical computer, it remains unclear whether such problems can be efficiently solved by quantum algorithms within the BQP class.

To address this, we will develop new quantum interactive proof systems (QIP) based on existing interactive proof (IP) frameworks, designed to test the limits of quantum complexity. Specifically, we will explore whether oracle separations can be established between PSPACE and BQP, and investigate how these separations impact our understanding of the polynomial hierarchy under quantum relativization. Additionally, we will examine the implications of these findings for broader complexity classes such as NP, BPP, and PP, particularly in the context of Toda's Theorem.

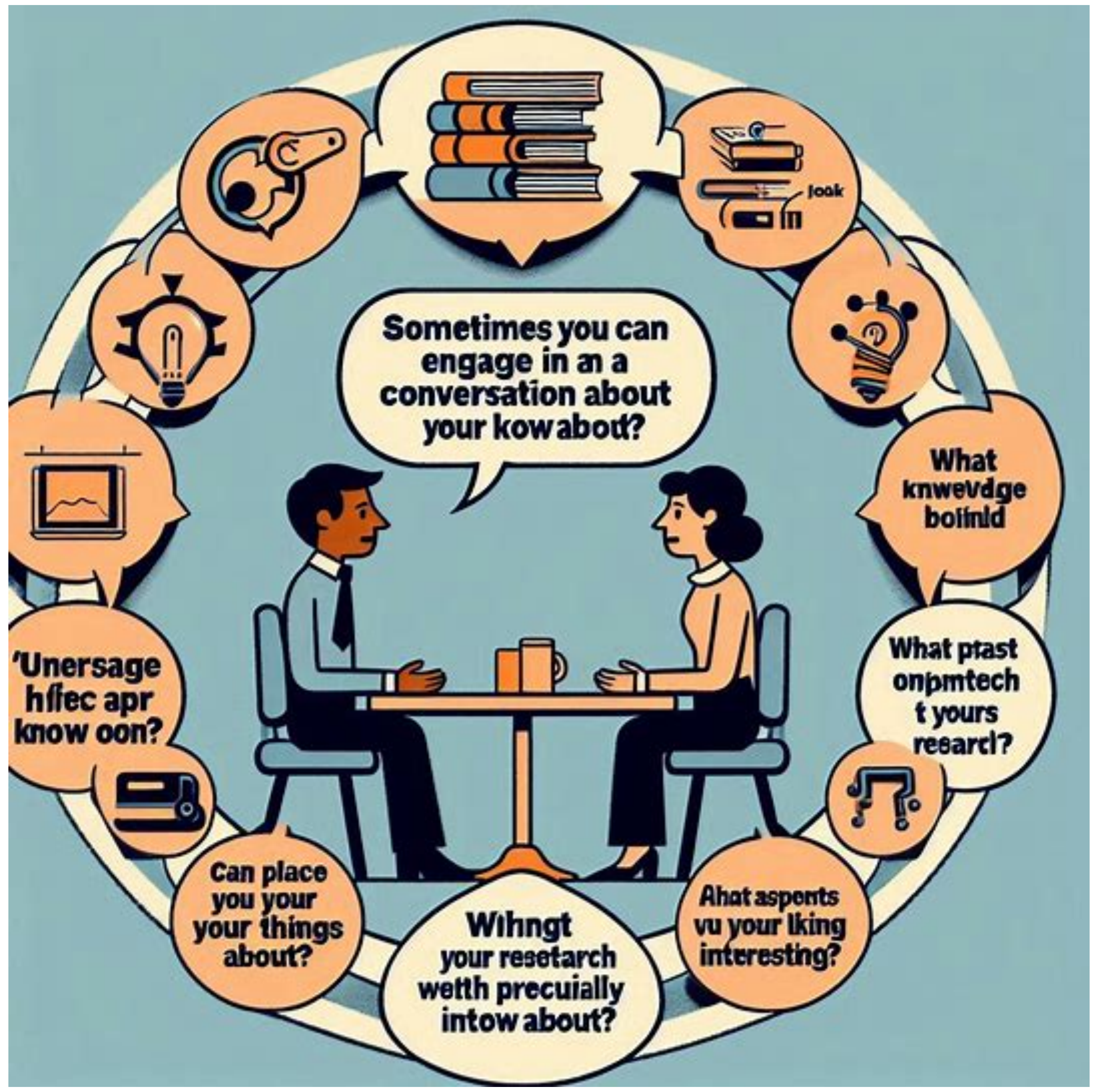
The primary goal of this research is to establish lower bounds for the relative hardness of PSPACE-complete problems in a quantum context, and to identify key factors that distinguish classical from quantum tractability. We expect our results to provide valuable insights into the computational power of quantum systems and advance the ongoing discussion on NP vs. BQP.

More structured, clearer context, defined objectives, reduced jargon

Interactive pitching

- Sometimes you can engage in a *conversation* about your research

- **Main challenge**:
  Understand the person you are talking to
  - What knowledge you can build on?
  - Can you place your research in relation to things they know about?
  - What aspects of your research might they find particularly interesting?



Using an LLM to practice

Member of a research funding board

Journalist writing about research

Final reflections?