Below is the **tentative** list of the topics that are available. Please, consider the specified literature as starting point for your literature research.

Topic Area 1: Quantum Algorithms

1. Quantum Singular Value Transformation: A unifying framework for Quantum algorithms? (Supervisor: Xiao-Ting To)
   - Martyn, John M., et al. Grand unification of quantum algorithms, 2021
   - PennyLane Tutorial

2. Windowed QFT (advanced): A novel primitive for quantum algorithms? (Supervisor: Xiao-Ting To)
   - Yin, Haiting, Dayong Lu, and Rui Zhang. Quantum windowed Fourier transform and its application to quantum signal processing., 2021
   - Chen, Yilei. Quantum algorithms for lattice problems., 2024

3. HHL: A quantum algorithm for solving linear systems of equations (Supervisor: Karl Fürlinger)
   - Harrow, Aram W., Avinatan Hassidim, and Seth Lloyd. Quantum algorithm for linear systems of equations., 2009
   - Zaman, Anika, Hector Jose Morrell, and Hiu Yung Wong. A step-by-step HHL algorithm walkthrough to enhance understanding of critical quantum computing concepts., 2023
   - Aaronson, Scott Quantum Machine Learning Algorithms: Read the Fine Print
   - Reference implementation Classiq
   - Refernce implementation Cirq

4. Solving Linear Differential Equations on a Quantum Computer (Supervisor: Karl Fürlinger)
   - Broeckmann, Jonas. Solving linear differential equations quantumly, 2024
   - Time marching algorithm implementation Classiq

5. Quantum Annealing: Can it outperform classical computers? (Supervisor: Fabio Genz)
   - Kadowaki, Tadashi, and Hidetoshi Nishimori. Quantum annealing in the transverse Ising model, 1998
   - Hauke, Philipp, et al. Perspectives of quantum annealing: Methods and implementations., 2019
   - DWAVE Tutorial

Topic Area 2: Quantum Machine Learning

6. Data Encoding from Classical to Quantum (Supervisor: Fabio Genz)
   - Schuld, Maria, and Francesco Petruccione Machine learning with quantum computers (Chapter 3.4), 2021

7. Machine learning for quantum many-body problems (Supervisor: Florian Kiwit)
   - Huang, Hsin-Yuan, et al. Provably efficient machine learning for quantum many-body problems., 2022

8. Comparing classical and quantum approaches to calculate the HOMO-LUMO gap (Supervisor: Josef Pichlmeier)

Topic Area 3: Quantum networks

9. How to design a quantum internet? (Supervisor: Daniel Diefenthaler)
   - Azuma, Koji, et al. Quantum repeaters: From quantum networks to the quantum internet., 2023

10. Quantum Cryptography beyond QKD (Supervisor: Fabian Dreer)
    Overview:
    - Bozzio, Mathieu, et al. Quantum cryptography beyond key distribution: theory and experiment., 2024

Examples:
- Aaronson, Scott. Introduction to Quantum information science (Quantum Money: Chapter 7.3 & 8.1), 2018
- Hahn, Frederik, Jarn de Jong, and Anna Pappa. Anonymous quantum conference key agreement., 2020

Topic Area 4: Quantum computing fundamentals

11. Measurement-based quantum computing (Supervisor: Korbinian Staudacher)
    - Aaronson, Scott. Introduction to Quantum information science II (Chapter 17), 2022
    - Jozsa, Richard. An introduction to measurement based quantum computation., 2005

12. Topological Error Correction (Supervisor: Korbinian Staudacher)
    - Aaronson, Scott. Introduction to Quantum information science (Chapter 28), 2018
    - Aaronson, Scott. Introduction to Quantum information science II (Chapter 3-6), 2022
    - Roffe, Joschka. Quantum error correction: an introductory guide., 2019
    - Fowler, Austin G., et al. Surface codes: Towards practical large-scale quantum computation., 2012

13. Theoretical Quantum Advantage - Why to build a Quantum Computer? (Supervisor: Florian Krötz)
    - Aaronson, Scott. Introduction to Quantum information science (Quantum complexity theory: Chapter 24), 2018
    - Aaronson, Scott. BQP and the Polynomial Hierarchy, 2009
    - Mosca, Michele. Quantum Algorithms, 2008
    - Quantum algorithm zoo

14. Density Matrix (Supervisor: Sergej Breiter)
    - Aaronson, Scott. Introduction to Quantum information science (Mixed States: Chapter 6, Monogamy of Entanglement: Chapter 10.1.2, Entanglement Entropy: Chapter 11.2.1), 2018
    - de Wolf, Ronald. Quantum Computing Lecture Notes (Mixed States and General Measurements: Chapter 15.1, Reduced Density Matrices: Chapter 18.3), 2023

15. SU2 (advanced)

Topic Area 5: Quantum software

16. QFT Arithmetics (Supervisor: Daniel Diefenthaler)
    - Sahin, Engin. Quantum arithmetic operations based on quantum Fourier transform on signed integers, 2020

17. Quantum Programming Languages (Supervisor: Fabian Dreer)
    - Heim, Bettina, et al. Quantum programming languages., 2020

18. Quantum circuit optimization with AlphaTensor (Supervisor: Florian Kiwit)
    - Ruiz, Francisco JR, et al. Quantum circuit optimization with alphatensor, 2025

Topic Area 6: Entanglement

19. Implications of the CHSH Game
    - Cleve, Richard, et al. Consequences and limits of nonlocal strategies., 2004
    - Aspect, Alain, Philippe Grangier, and Gérard Roger. Experimental realization of Einstein-Podolsky-Rosen-Bohm Gedankenexperiment: a new violation of Bell's inequalities., 1982

20. Black Holes and the Firewall Paradox: How does quantum complexity theory relate to entanglement in black holes? (advanced) (Supervisor: Sergej Breiter)
    - Aaronson, Scott. Introduction to Quantum information science II (Chapter 23-24), 2022

21. Approaches to visualize entanglement (Supervisor: Florian Krötz)
    - Filatov, Stanislav, and Marcis Auzinsh. Towards Two Bloch Sphere Representation of Pure Two-Qubit States and Unitaries., 2024
    - Jevtic, Sania, et al. Quantum steering ellipsoids., 2014
    - Gidney, Craig Visualizing 2-Qubit Entanglement, 2017
    - Qiskit Qsphere
    - Qiskit State City