

L.079.05743

Quantum Complexity Theory (in English)

Syllabus

Course code: L.079.05743
Course Level: Masters
Instructor: Jun. Prof. Dr. Sevag Gharibian
Office: F2.313
Office hours: 14:00 – 15:00 Wednesdays
Email: sevag.gharibian@upb.de
Classroom: Online asynchronous lectures. All details shared in PANDA.
Class website:
http://groups.uni-paderborn.de/fg-qi/courses/UPB_QCOMPLEXITY/2020/UPB_QCOMPLEXITY.html

Note:

All correspondence for the course will be through PANDA. Please ensure you can see course postings there.

1.0 – Major Topics Covered (tentative):

- Review of classical complexity theory
- Review of quantum circuit model and density operator formalism
- Bounded error quantum polynomial time (BQP)
- Linear systems of equations and a BQP-competete problem
- Quantum Merlin Arthur (QMA) and strong error reduction
- Quantum Cook-Levin Theorem
- Quantum-Classical Merlin Arthur (QCMA) and Ground State Connectivity
- Quantum Interactive Proofs
 - Semidefinite programming
 - Matrix Multiplicative Update Weights Method
 - QIP = PSPACE
- Potential additional topics: QMA with multiple unentangled proofs (QMA(2)), QIP with multiple provers sharing entanglement (MIP*), Boson sampling, BQP versus the Polynomial-Time Hierarchy,

2.0 – Class Schedule:

- Lectures: 9:00-12:00 Mondays. Asynchronous online format. Beginning 26.10.2020.
- Tutorial: 11:00-13:00 Tuesdays. Synchronous online format via BigBlueButton. Beginning 10.11.2020.
- Final Exam (first sitting): Either in-person oral exam or take-home written exam, depending on COVID status. Date TBA.
- Final Exam (second sitting): Either in-person oral exam or take-home written exam, depending on COVID status. Date TBA.

3.0 – Grading Scheme:

- The full grade for the course is based on the final exam, which will be oral. The grading scheme for the final exam is as follows:

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|------------|-------|
| 95% - 100% | : 1,0 |
| 90% - 94% | : 1,3 |
| 85% - 89% | : 1,7 |
| 80% - 84% | : 2,0 |
| 75% - 79% | : 2,3 |
| 70% - 74% | : 2,7 |
| 65% - 69% | : 3,0 |
| 60% - 64% | : 3,3 |
| 55% - 59% | : 3,7 |
| 50% - 54% | : 4,0 |
| 0 - 49% | : 5,0 |

- Research project option: You may opt to do a research project instead of a final exam. Research project guidelines will be posted to PANDA.
- *Homework:* Are graded only for completeness. The bonus points for completing homeworks are as follows. Note the bonus applies only if you pass the final exam.

>= 60% of homeworks completed: 1 step bonus (eg 1,3 to 1,0)
 >= 90% of homeworks completed: 2 steps bonus (eg 1,7 to 1,0)