

CS-151: Project guidelines

Saeed Mehraban

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Each student taking CS 151 has the option to complete an extra credit course project. Projects can be completed in groups of one or two. This handout provides a pool of suggested topics around which you can complete your project. The project can be viewed as a further investigation of one of the topics we have covered during the class. It can also be an extra topic the student deems relevant to the course topic. You are welcome to use one of the topics below or suggest a new one. Please reach out to us if you have a suggestion in mind. You will first need to submit a title and a paragraph explaining your proposed effort and one paper that you wish to learn and present to the class. The deadline for this submission is **March 15, 2024 via gradescope**. **The students have until the end of April to study their proposed papers and submit a 3-pages report**. The submissions that are above expected standards may be published on the Tufts quantum weblog <https://tuftsqis.wordpress.com>. Each student will hold a 15 minutes presentation at the end of the semester (possibly 4/29). If you plan to complete a project please reach out to the instructors to confirm your selected topic/resources.

- **Project expectation:** The goal of this project is to expand your knowledge about a specific topic related to the course and explain it to your classmates.
- **Final class presentations:** We hold a special lecture dedicated to class presentations at the end of April (possibly 4/29). Each presentation will be 15 minutes.
- **Project report:** The deadline to Submit Project Reports is **Monday, April 29**, via gradescope. The report must consist of three main pages plus an unlimited number of appendices.
- **Publication:** If your report is above expected standards we can publish your project on our weblog <https://tuftsqis.wordpress.com>. If you decide to keep working on the project beyond this class, I am happy to help you complete the project and pursue publication venues.

1 Suggested project topics

We provide some suggested papers. Some of these topics are also found in Nielsen and Chuang's book. You are welcome to use one of these papers (or come up with something else).

- Gateset universality <https://arxiv.org/abs/quant-ph/0301040>
<https://journals.aps.org/prl/abstract/10.1103/PhysRevLett.75.346>
- Quantum games (e.g. Explain and analyze CHSH game)
- Implement the Gottesman-Knill algorithm <https://arxiv.org/abs/quant-ph/0406196>
- Quantum compiling <http://cba.mit.edu/docs/theses/01.05.aram.pdf>
- Fast Hamiltonian simulation <https://arxiv.org/abs/1412.4687>

- Programming a quantum computer (Give a tour of available quantum programming languages and example of a simple protocol implemented in one of the devices)
- Classical simulation of quantum models <https://arxiv.org/abs/0804.4050>
- Quantum algorithms for chemistry <https://arxiv.org/pdf/2001.03685.pdf>
- Quantum Machine learning <https://www.nature.com/articles/nature23474>
- Quantum Inspired Algorithms <https://arxiv.org/abs/1807.04271>
- Quantum cryptography <https://arxiv.org/abs/quant-ph/0003004>
- Quantum computation using linear optics <https://arxiv.org/abs/1011.3245>
- Algorithms for factoring/fourier transform <https://arxiv.org/abs/2308.06572>
<https://arxiv.org/abs/quant-ph/0006004>
- Hidden subgroup problem <https://arxiv.org/abs/quant-ph/0401083>
- Lattices <https://cs.uwaterloo.ca/~cbright/reports/cs667proj.pdf>
- Quantum algorithms and topology: <https://arxiv.org/abs/0707.2831>
- Quantum algorithms for graph properties <https://arxiv.org/abs/quant-ph/9901029>