Quantum Error Correction

Being at the mercy of quantum mechanics, quantum computation can fall short on its promise. Qubits are intrinsically tricky to handle, and experiments are subject to errors, no matter how perfect they are.

Quantum Error Correction (QEC) has long motivated this field by proving that errors can be reversed with clever circuit design, and the opportunity to learn the same from one of the founders of this field was remarkable. Throughout the course, Prof. Terhal never had an "error", and always brought interesting and up-to-date topics, so that the curriculum managed to raise my interest about some fundamental issues pertaining to this field of research.

The course was theoretically oriented, where we covered the basics of QEC types of circuits and their mathematical background. Python simulations also helped us to play around with some parameters and see their implications.

Having had no background in QEC prior to this course, at times I fell short of engaging in the "live discussions". I had to read more about every topic – especially deal with the math - in order to ask questions, something that other students did not seem to struggle with as much.

Nevertheless, due to its unique structure I enjoyed the course even if it was intense.

The weekly exercise sheets counted for 60% of the total grade for this course, and a final presentation completed the rest 40%. The consequent workload pushed my group partner and me to our limits. Reading long papers, struggling with Python packages, and being on Zoom calls all the time, you can imagine some of our struggles.

At the end of the day, the comprehensive readings of the papers and the preparation of the final presentation taught me a lot about the subject and how to extract important information and present them.

We had concerns, that the lecture with Prof. Terhal was being recorded with TU-Delft students and then played back to us, the RWTH students, which seemed suboptimal... Nevertheless, the tutors tried their best to explain some confusion points and answer all our questions to make it feel as natural as possible. A Slack channel also helped with some further discussions (sometimes private) to understand specific details.

All in all, it was not an easy course, but I am glad that I took it, managed the workload, and learned so much about QEC theory and many other aspects.

In the end, I hope to be able to put this knowledge into my *experimental research* and contribute to bringing the dream of quantum computers a step closer… or should I say: fault-tolerantly closer?

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