Welcome to 02195 – Quantum Algorithms and Machine Learning

We will start at 13.00 :-)

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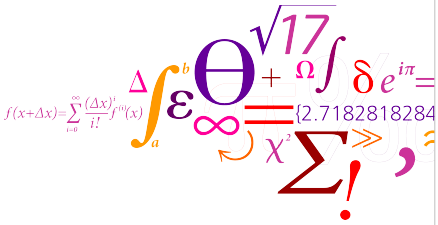

Who is that Sven anyway?

- Began programming in '81
  - Assembly and machine code '84
  - Worked on many different systems
- Background in the “Demo scene”, still active
- Implemented operating systems since '89
  - Lead architect for two deployed operating systems
  - Project lead and lead architect for a new operating system
- ASIC designer
- Computer architect
  - Developed several processor architectures
  - Implemented several processors
- Researcher since '97, more about that later in the course!
- Educator since ‘93
- Corporate experience as research leader and manager
- Active quantum computer researcher since 2021

Meet and greet

- Name signs!

This is about Quantum and classical

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- What is quantum good for?
- What is classical good for?

Outline

- Intro to the course
- Break I
- Practicals
- Recap / Refresh
- Break II
- Lab
- Break III
- Lab
- Wrapup

Discussion

- Think about something you really *know*. How did you learn it?
- Have you ever had a really bad learning experience? What happened?
- Start on your own for three minutes

What is a Reader?

What is learning?

- Learning is something you do
  - We, the course staff, cannot make you learn anything
  - That is something you will have to do
- But, we can help you!
  - Activities known to help you learn
  - Make use of us!
  - Research studies have investigated different teaching/learning methods and concluded what works
  - We use that research
  - Can provide pointers if you are interested

Quantum is an active research subject and the area is moving!

- Discussion class – We expect you to engage

- Reading instructions at the latest Thursdays week before class
  - Lab instructions in the same time frame
- Course documentation will evolve over the semester
  - Initial set this week!

Course outline

- Algorithmic theory
- Quantum complexity theory
- Quantum algorithms
- QRAM; Cryptography in the context of Quantum computing
- Quantum Machine Learning
- Algorithms in the NISQ era
- Algorithms for HPC – QC integration

Engineering competences

This course aims at helping you improve the following engineering competences:

- Solving open-ended ill-formed problems
- Critical thinking
- Life-long learning and personal development
- Information search and retrieval

Learning objectives

- Course defined by a elaborate set of learning objectives
  - You will find them all on DTU Learn
  - Objectives on different levels
- Whole set of objectives => Grade 12

Schedule

- Mon. 13-17, start 13.00

- Facilities: 308 / A11
- We are going to make use of the flexible space outside!

Course team

- Several people involved – Everyone could not be here this week

Assessment

- Four hour written exam, all written aids permitted
- Expected to be on May 16 2025

Databar excercises

- Small, usually practical, exercises to be done during class
- Instructions handed out on Thursdays the week before the databar
- We are going to use the DTU HPC system. You do not need any particular laptop!

Web resources

- Look at DTU Learn for information on the course
- Save the forests: Try to reduce your paper consumption

- We are going to use the black and white boards
- Any slides are uploaded after activities, not before

Feedback

- Feedback is very important
- I will regularly ask you to provide feedback
  - Focus groups
  - Polls
  - Pop quizes
  - Interviews

How to reach the course staff

- DTU Learn
- In class
- Mailing list: dtu-02195@lists.fenixforge.com (not active yet)

It is a daunting task to find me in my office outside class!

Also, I teach other courses, engage actively in research, develop new research areas and programs → I try my best but do not expect me to answer your mails immediately. Do not expect me to be in my office unless you have scheduled an appointment with me.

First lab

- See https://www.hpc.dtu.dk/?page_id=2501
- Log on to the cluster
  - Use your DTU username and password
- Follow linux variant of https://docs.quantum.ibm.com/start/install
  - Use the module system to enable a recent Python version
  - Install into your home directory on the HPC system
    - In a suitable sub-folder
      - python3 -m venv 02195-venv

Next week on 02195

- Thursday: Lab and reading instructions for next week
- Some advancement of QIT
- Classical complexity theory