

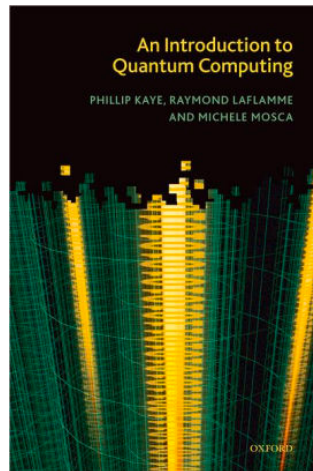
Spring'19 CSCE 440/640

Quantum Algorithms

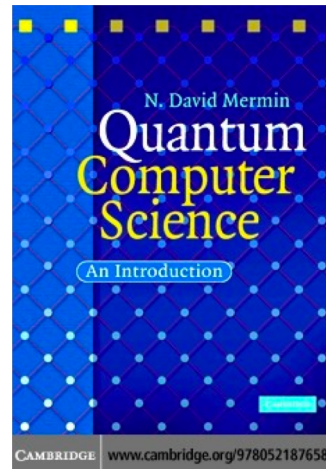


CSCE 440/640 Quantum Algorithms

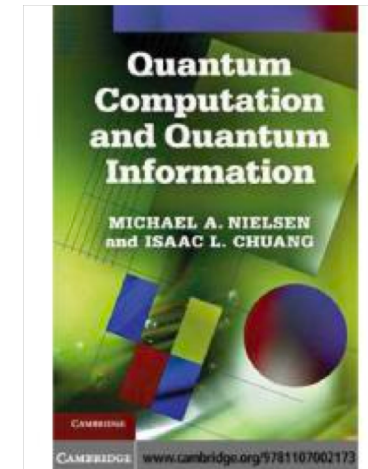
- **Instructor:** Prof. [Fang Song](#) @ HRBB 427B
- **Email:** fang.song "AT" tamu.edu. Start your subject line with "SI9-QC"
- **Lectures:** M/W 5:45 – 7pm @ HRBB 126
- **Office hours:** T 3 – 5 pm and by appointment
- **Texts:** no required one. Use online notes. Some books as supplements.



KaleLaflammeMosca



Mermin



NielsenChuang

Main Topics

- Basic formalism (3 weeks)
 - Qubits, measurement, entanglement
- Important quantum algorithms (5 weeks)
 - Deutsch, Simon's, Kitaev's phase estimation, Shor's factorization, Grover's search
- Quantum information theory (4 weeks)
 - Mixed state, error correction, entropy
- Selected advanced topics and project presentations (3 weeks)

Objectives

- Understanding (the beauty of) the quantum computing paradigm
- Ability to analyze basic quantum algorithms and applications
- Establishing a theoretical foundation to become a critical reader
 - Even better, a researcher in this field

Prerequisite

Comfortable with **READING & WRITING**
Mathematical proofs

- Useful skills:

- Algorithm analysis: big O, poly-time, ...
- Linear algebra: vector, matrix, eigenvalue, linear transformation, ...
- Probability: random variable, independence, expectation, ...

- No clue about these?

- Study review materials and HW I to get you up to speed (more later)
- Still no clue afterwards? Reconsider if this class suits you

Policy

■ Homework: 40%.

- 5 assignments.
- Only PDF format accepted. Typeset (LaTeX source file provided) or Scan clearly.
- Late homework subject to penalty: 20%(<1d), 40%(1-2d), 60(2-3d), 100%(>3d)
- Collaboration encouraged. Must write up individually and list collaborators!

■ Project: 30%.

- Small groups (2-3).
- Proposal (5%), in-class presentation (15%) and final report (10%).

■ Mid-term exam: 20%.

■ Participation: 10%.

Policy



Academic Integrity

“An Aggie does not lie, cheat, or steal, or tolerate those who do.”

<http://aggiehonor.tamu.edu>

- Academic accommodations

- Contact me and the Disability Services (<http://disability.tamu.edu>)

How to succeed in this class?

- Commitment and open mind
 - Dare to think differently, and work hard
- Study the reading materials in advance
 - Main source: lecture notes posted online
 - Supplement: KLM book and other resources
- *Ask a lot of questions!*
- Form study groups

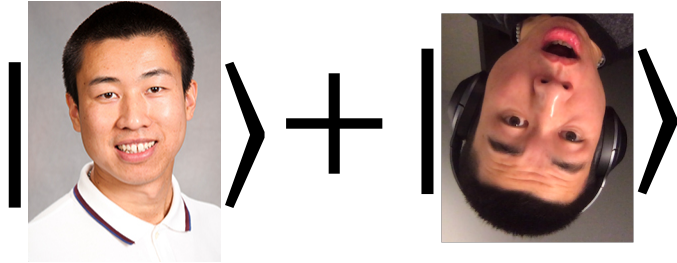
What to do till you see me in person?

- W 01/16/19: cancelled due to [QIP](#) conference (hope to see you there someday)
- M 01/21/19: MLK day, no class
- W 01/23/19: we will see each other in person

**No worries,
I have
To-Do's
to keep you entertained**

In case you are anxious to see me

- How I look (in a quantum world) and sound (classically)



A short intro video on [Youtube](#)

- What I do?

Quantum-safe Cryptography

Guarding cybersecurity against quantum attacks

Quantum Algorithms

Solving hard problems on quantum computers



Quantum complexity theory, etc.

Boundary of quantum computing?

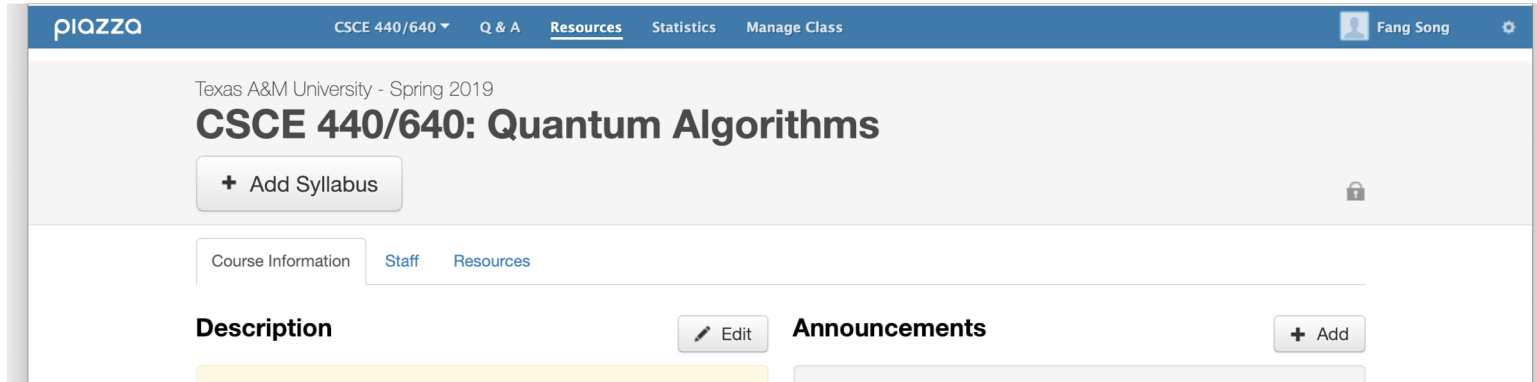
To-do #0: course webpage

*You've probably accomplished it already. **Congrats!***

- Familiarize yourself with it
 - https://fangsong.info/teaching/sl9_4640_qc/
- "Schedule" page
 - Post reading materials and assignments
- "Resource" page contains useful and extended materials

Check regularly!

To-do #1: Piazza



- Enroll on Piazza
 - <https://piazza.com/tamu/spring2019/csce440640/home>
 - Extra credit: upload a headshot
 - Will use extensively for discussion and communication
- Post a **public** note introducing yourself
 - Bio, interest and strength, reason for taking this class, etc.
- Due *January 20, 11:59pm*

To-do #2: math review

- Study the materials posted on Piazza

- Under “Resources” tag
 - Math Review (Week 1)
- Need not to read all

The screenshot shows the Piazza interface for the course CSCE 440/640: Quantum Algorithms at Texas A&M University, Spring 2019. The 'Resources' tab is selected, displaying a list of materials for 'Math Review (Week 1)'. Each material has an 'Edit', 'Post a note', and 'Delete' action.

Math Review (Week 1)	Actions
KLM_Chapter2_LinearAlgebra.pdf	Edit Post a note Delete
Trevisan's note on discrete probability	Edit Post a note Delete
LLM_Part4_probability.pdf	Edit Post a note Delete

- How to know if you are ready? Try Homework 1

To-do #3: get started on HW1

- Practice on linear algebra, probability, algorithms
 - Download PDF at course webpage
https://fangsong.info/teaching/s19_4640_qc/s19_4640_hw1.pdf
 - TeX file available if you want to typeset your solutions in LaTeX
- Feel challenging? Revisit the study materials (#2)
- Discuss in groups and on Piazza

To-do #4: get to know each other

- You will need to form a group for the course project
 - 2 – 3 people
 - Can mix undergrad. & grad students
 - Details to be announced
- It's very helpful to form a study group as well
- Suggestion: Use M/W lecture time to mingle!
 - In addition to Piazza posts