ADMINISTRIVIA

CSE 490Q: QUANTUM COMPUTATION

COURSE STAFF

- **Instructor:** Kevin Zatloukal (kevinz at cs)
  - (former / occasional) quantum computing researcher
- **TAs:** Christopher Kang (ck32 at cs)
  Andres Paz (anpaz at cs)
- Office hours will be posted on the web site soon

GOALS

- Learn the quantum model of computation and see some areas in which it provides an advantage over classical computation, e.g.
  - factoring large numbers
  - simulating the interactions of large molecules
  - generating certifiable randomness
- Will approach this as "tourists"
  - see the sights, gain an appreciation for their beauty & value, and have fun
  - (although this material is much of what future researchers would want to learn)

TOPICS

- Quantum is **too big** to be covered in one course
- Any CS topic becomes new when "quantum" added before it
  - quantum machine learning, quantum cryptography, quantum algorithms, quantum architecture, quantum compilers, …
- We will focus on
  - the "classic" results (about 2/3rd of course)
  - additional topics I find fun or interesting (about 1/3rd of course)

APPROXIMATE TOPICS

"Classics" of QC

1. Quantum Model of Computation
2. Entanglement
3. Quantum circuits and gates
4. Standard quantum algorithms
5. Hamiltonian simulation
6. Quantum complexity classes

Additional Topics (as time allows)

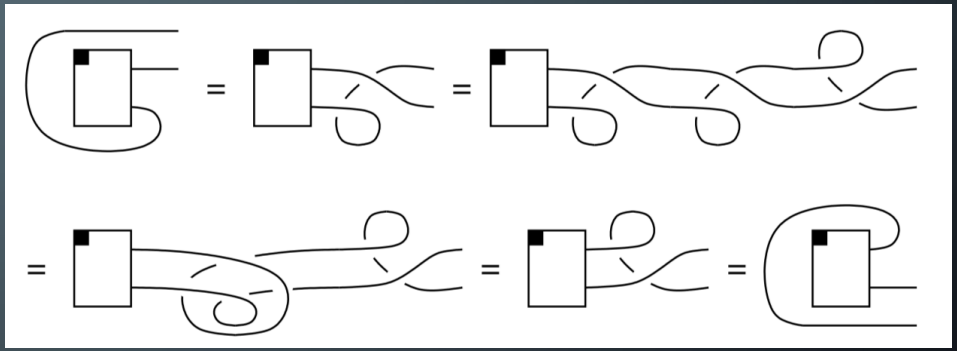
1. Diagrammatic reasoning
2. Non-local games
3. Classical simulation of quantum circuits
4. Quantum query complexity
5. Advanced quantum algorithms

FORMAL PREREQUISITES

- Assuming you are familiar with
  - **linear algebra**
  - **probability**
- See this document for some linear algebra facts that will be used in lectures.
- Not a big deal if one or two facts used are unfamiliar, but the basic concepts of both should be familiar friends.

INFORMAL PREREQUISITES

- "Mathematical maturity"
- Open-mindedness to "weird math"
  - not hard math, weird math
  - don't freak out if I present this as proof (assuming I can justify the equalities)



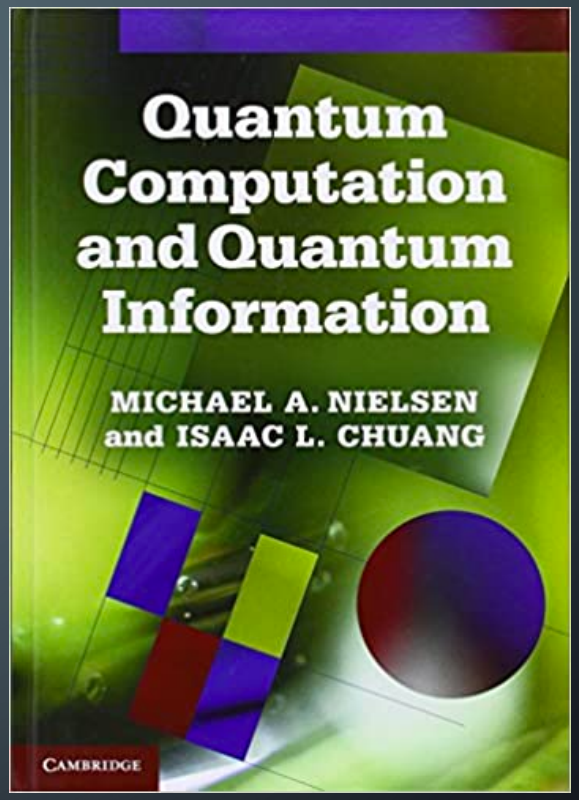
- Weird math like this is part of the fun of QC
  - this type ("diagrammatic reasoning") is far from the only example

STAYING IN TOUCH

- **Ed message board** for most questions
  - allow others to see the answers as well
  - (should get an invite shortly if you haven't already)
- **cse490q-staff at cs** for private questions (e.g., grading or lateness)
- **cse490qa_au20 at uw** for *emails from me* about each lecture
  - already subscribed via your UW email address
  - will get an email at least 24 hours before each lecture

OPTIONAL TEXTBOOK

- Known as “Mike & Ike” in the field
- In-depth presentation of most topics from the first two thirds of the course
  - good alternative presentation of the material



LECTURES

- Split into two parts:
  1. Pre-recorded lecture video (links via email)
  2. Live Q&A session (via Zoom) at the calendar time
- Lecture video times will fluctuate
  - may average more than 50 min per lecture
- Q&A session will also be recorded

HOMEWORK

- Planning for 8 total assignments, with no more than one per week
- 5 written assignments (math)
- 3 “coding” assignments
  - programming a quantum simulator (not regular coding)
- Submit all via Gradescope (invitations coming soon)

LATE-POLICY

- Work is generally expected to be completed on time
- Will grant extensions requested at least 30 hours beforehand (and also in cases of emergency)
  - don't start the night before!

COLLABORATION

- Written assignments: collaboration is encouraged, but you…
  - **must** list your collaborators
  - **must** write up your own solution
  - we recommend the following rules for collaboration
    1. do take away any records of the group work
    2. wait at least 30 minutes before writing up your solution
- Coding assignments are done individually

EXAMS

- No midterm, no final
- Last coding assignment will be considered a “final project”
  - this may be include extra elements (e.g., longer write-up)

PARTICIPATION

- Students asked to submit notes for (part of) one lecture
  - we will make these available to other students
- Sign-up sheet will be posted this week.
  - at most two students per lecture
- Graded on a credit / no credit basis

GRADING

- Should be something roughly along these lines:

70%	Homework
15%	Final Project (last coding assignment)
15%	Participation (lecture notes)

- I expect high grades from everyone who **completes** all the assignments
  - successfully learning this topic is an accomplishment