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:

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Component</th>
</tr>
</thead>
<tbody>
<tr>
<td>70%</td>
<td>Homework</td>
</tr>
<tr>
<td>15%</td>
<td>Final Project (last coding assignment)</td>
</tr>
<tr>
<td>15%</td>
<td>Participation (lecture notes)</td>
</tr>
</tbody>
</table>

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