CSE 410: Quantum Computation through Linear Algebra
Fall 2018 Overview

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1 Objective

CSE 410 is intended to give students a solid grounding in numerical linear algebra, which will allow them to grasp the fundamentals of algorithms for quantum computing. In addition, the linear algebraic material will be useful for a deeper understanding of much of machine learning and high-dimensional data analysis.

2 Course Description

This course provides a mathematical foundation for subsequent study in Quantum Computing, as well as developing the skills necessary to solve practical problems. Topics include:

- Linear operators and matrix representations
- Operator norms
- Orthogonalization, and the SVD and QR factorizations
- Conditioning and Stability
- Asymptotic Analysis
- Quantum States
- Deutsch's Algorithm
- Deutsch-Jozsa Algorithm
- Grover's Algorithm

2.1 Text

The texts for the course are Quantum Algorithms via Linear Algebra: A Primer by Richard J. Lipton and Kenneth W. Regan and Numerical Linear Algebra by Lloyd N. Trefethen and David Bau, III. Class notes have been prepared for each class, and the lecture will follow the notes. Students may read over these notes prior to attending class, but the lecture may deviate from the notes somewhat.

2.2 Course Webpage

We will use Piazza for class discussion. The system is designed to provide help from classmates, TAs, and myself quickly and efficiently. Rather than emailing questions to the teaching staff, I encourage you to post your questions on Piazza, although email to the instructors is welcome. If you have any problems or feedback for the developers, email team@piazza.com. Find our class page at: https://piazza.com/buffalo/fall2018/cse410/home.

Please note the following about the Piazza platform:

1. If you are not comfortable posting with your name visible to everyone, anonymous posting is available.
2. As anonymous posting is available on Piazza, please be respectful to your classmates.
3. Please do not post sensitive material/questions to everyone on Piazza. You may restrict posts to only be visible to TAs/myself. If you are uncertain, pose a question with restricted visibility and we can always open it to the entire class if it is a general concern.
4. A follow up to the previous point – don't post solutions to Piazza. If you are posting your specific work, please limit visibility.

You should have received an invitation in your UB provided email to join our course on Piazza. You will be unable to join without being added by the teaching staff.

3 Absence Policy

Attendence is not required, and failure to attend class will not impact a student's grade. However, much of the information for the class will be delivered in lecture, so it may prove difficult to complete some assignments without attendance.

4 Office Hours

Office hours will be held in 334 Davis Hall from 11am–12pm every Wednesday. The instructor will also be available by appointment if that time is unavailable or oversubscribed.

5 Disability Support Services

If you have a diagnosed disability (physical, learning, or psychological) that will make it difficult for you to carry out the course work as outlined, or that requires accommodations such as recruiting note-takers, readers, or extended time on exams or assignments, you must consult with the Office of Disability Services (25 Capen Hall, Tel: 645-2608, TTY: 645-2616, Fax: 645-3116, http://www.student-affairs.buffalo.edu/ods/). You must advise your instructor during the first two weeks of the course so that we may review possible arrangements for reasonable accommodations.

Your attention is also called to the Counseling Center (645-2720), 120 Richmond Quad. The Counseling Center staff are trained to help you deal with a wide range of issues, including how to study effectively and how to deal with exam-related stress. Services are free and confidential. Their web site is

http://www.student-affairs.buffalo.edu/shs/ccenter/

6 Academic Integrity

Source:
http://www.cse.buffalo.edu/undergrad/policy_academic.php

The academic degrees and the research findings produced by our Department are worth no more than the integrity of the process by which they are gained. If we do not maintain reliably high standards of ethics and integrity in our work and our relationships, we have nothing of value to offer one another or to offer the larger community outside this Department, whether potential employers or fellow scholars.

For this reason, the principles of Academic Integrity have priority over every other consideration in every aspect of our departmental life, and we will defend these principles vigorously. It is essential that every student be fully aware of these principles, what the procedures are by which possible violations are investigated and adjudicated, and what the punishments for these violations are. Wherever they are suspected, potential violations will be investigated and determinations of fact sought. In short, breaches of Academic Integrity will not be tolerated.

6.1 Departmental Statement on Academic Integrity in Homework Assignments

The following statement further describes the specific application of these general principles to a common context in the CSE Department environment, the production of homework assignments. It should be thoroughly understood before undertaking any cooperative activities or using any other sources in such contexts.

All academic work must be your own. Plagiarism, defined as copying or receiving materials from a source or sources and submitting this material as one's own without acknowledging the particular debts to the source (quotations, paraphrases, basic ideas), or otherwise representing the work of another as one's own, is never allowed. Collaboration, usually evidenced by unjustifiable similarity, is never permitted in individual assignments. Any submitted academic work may be subject to screening by software programs designed to detect evidence of plagiarism or collaboration.

It is your responsibility to maintain the security of your computer accounts and your written work. Do not share passwords with anyone, nor write your password down where it may be seen by others. Do not change permissions to allow others to read your course directories and files. Do not walk away from a workstation without logging out. These are your responsibilities. In groups that collaborate inappropriately, it may be impossible to determine who has offered work to others in the group, who has received work, and who may have inadvertently made their work available to the others by failure to maintain adequate personal security In such cases, all will be held equally liable.

These policies and interpretations may be augmented by individual instructors for their courses. Always check the handouts and web pages of your course and section for additional guidelines.

6.2 Departmental Policy on Violations of Academic Integrity

Any student accused of a violation of academic integrity will be so notified by the course director. An informal review will be conducted, including a meeting between these parties. After this review and upon determination that a violation has occurred, the following sanctions will be imposed. **It is the policy of this department that, in general, any violation of academic integrity will result in an F for the course, that all departmental financial support including teaching assistantship, research assistantship or scholarships be terminated, that notification of this action be placed in the student's confidential departmental record, and that the student be permanently ineligible for future departmental financial support.** A second violation of academic integrity will cause the department to seek permanent dismissal from the major and bar from enrollment in any departmental courses. Especially flagrant violations will be considered under formal review proceedings, which may in addition to the above sanctions result in expulsion from the University.

7 Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change without advance notice.