TEXAS A&M UNIVERSITY

Course Syllabus

Course Information

Course Number:	CSCE 222
Course Title:	Discrete Structures for Computing
Section:	200
Time:	T+TR 3:55 pm–5:10 pm
Location:	HRBB 126
Credit Hours:	3

Instructor Details

Instructor:	Jianer Chen
Office:	PETR 428
Phone:	(979) 845-4259
E-Mail:	chen@cse.tamu.edu
Office Hours:	T+TR 2:00 pm–3:30 pm, PETR 428

Course Description

The course provides mathematical foundations from discrete mathematics for the study of computer science and engineering, in particular for analysis of computer algorithms (for both correctness and performance), and studies models of computation, including finite state machines and Turing machines. As an honors class, the course will also cover some more advanced topics, such as probability theory and its applications in computer science, and computationally hard problems in Boolean algebra.

Course Prerequisites

MATH 151, and solid background in high school mathematics.

Course Learning Outcomes

At the end of the course, students will be able to

1. Write valid and correct proofs for mathematical theorems related to computing.
2. Use propositional/predicate logic to formulate and express mathematical statements.
3. Understand set theory and mathematical functions related to computer science.
4. Analyze complexities of computer algorithms.
5. Apply counting techniques and recurrence relations in analysis of computer algorithms.
6. Understand models of computation, such as finite state automata and Turing machines.
7. (honors class only) Apply probability theory in design and analysis of computer algorithms.
8. (honors class only) Understand Boolean algebra and related computationally hard problems

Textbook

1. Rosen K.H. Discrete Mathematics and its Applications. McGraw-Hill.
2. Supplementary reading materials to be handed out in class

Grading Policy

1. Grading Scale: A = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%, F = less than 60
2. The course has written assignments handed out every 1 or 2 weeks, 2 midterms, and a final exam.
3. Homework assignment (35%), midterm exam (15% each), and final exam (35%).

Late Work Policy

The homework is due on the designated due date at the beginning of class. No late submissions will be accepted. Discuss unusual circumstances in advance with the instructor.

Course Schedule

Week 1. Course introduction and proof techniques
Week 2. Proof techniques (continued) and mathematical logic
Week 3. Mathematical logic (continued)
Week 4. Sets, functions, and sequences
Week 5. Algorithms and complexities
Week 6. Induction and recursion, midterm I (Sept. 26)
Week 7. Counting, permutations, and combinations
Week 8. Elementary probability theory
Week 9. Elementary probability theory (continued), graphs
Week 10. Recurrence relations and generating functions
Week 11. Inclusion-exclusion and its applications, midterm II (Oct. 31)
Week 12. Boolean algebra and satisfiability
Week 13. Finite-state automata
Week 14. Models of computation: Turing machines
Week 15. Advanced topics in discrete mathematics
Dec. 9: Final exam (1:00 pm-3:00 pm)

Optional Course Information Items

1. The course webpage can be accessed by the following link: https://people.engr.tamu.edu/j-chen3/courses/222/2024/courseweb.html, or you can go to the instructor's home page then click the course link. The webpage published course syllabus, lecture notes, homework assignments, exams, and other course handouts
2. The course is using Canvas learning management system. Students submit their homework via Canvas.

University Policies

Attendance Policy

The university views class attendance and participation as an individual student responsibility. Students are expected to attend class and to complete all assignments.

Please refer to Student Rule 7 in its entirety for information about excused absences, including definitions, and related documentation and timelines.

Makeup Work Policy

Students will be excused from attending class on the day of a graded activity or when attendance contributes to a student's grade, for the reasons stated in Student Rule 7, or other reason deemed appropriate by the instructor.

Please refer to Student Rule 7 in its entirety for information about makeup work, including definitions, and related documentation and timelines.

Absences related to Title IX of the Education Amendments of 1972 may necessitate a period of more than 30 days for make-up work, and the timeframe for make-up work should be agreed upon by the student and instructor" (Student Rule 7, Section 7.4.1).

"The instructor is under no obligation to provide an opportunity for the student to make up work missed because of an unexcused absence" (Student Rule 7, Section 7.4.2).

Students who request an excused absence are expected to uphold the Aggie Honor Code and Student Conduct Code. (See Student Rule 24.)

Academic Integrity Statement and Policy

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

"Texas A&M University students are responsible for authenticating all work submitted to an instructor. If asked, students must be able to produce proof that the item submitted is indeed the work of that student. Students must keep appropriate records at all times. The inability to authenticate one's work, should the instructor request it, may be sufficient grounds to initiate an academic misconduct case" (Section 20.1.2.3, Student Rule 20).

You can learn more about the Aggie Honor System Office Rules and Procedures, academic integrity, and your rights and responsibilities at aggiehonor.tamu.edu.

Americans with Disabilities Act (ADA) Policy

Texas A&M University is committed to providing equitable access to learning opportunities for all students. If you experience barriers to your education due to a disability or think you may have a disability, please contact the Disability Resources office on your campus (resources listed below). Disabilities may include, but are not limited to attentional, learning, mental health, sensory, physical, or chronic health conditions. All students are encouraged to discuss their disability related needs with Disability Resources and their instructors as soon as possible.

Disability Resources is located in the Student Services Building or at (979) 845-1637 or visit disability.tamu.edu.

Title IX and Statement on Limits to Confidentiality

Texas A&M University is committed to fostering a learning environment that is safe and productive for all. University policies and federal and state laws prohibit gender-based discrimination and sexual harassment, including sexual assault, sexual exploitation, domestic violence, dating violence, and stalking.

With the exception of some medical and mental health providers, all university employees (including full and part-time faculty, staff, paid graduate assistants, student workers, etc.) are Mandatory Reporters and must report to the Title IX Office if the employee experiences, observes, or becomes aware of an incident that meets the following conditions (see University Rule 08.01.01.M1):

- The incident is reasonably believed to be discrimination or harassment.
- The incident is alleged to have been committed by or against a person who, at the time of the incident, was (1) a student enrolled at the University or (2) an employee of the University.

Mandatory Reporters must file a report regardless of how the information comes to their attention – including but not limited to face-to-face conversations, a written class assignment or paper, class discussion, email, text, or social media post. Although Mandatory Reporters must file a report, in most instances, a person who is subjected to the alleged conduct will be able to control how the report is handled, including whether or not to pursue a formal investigation. The University's goal is to make sure you are aware of the range of options available to you and to ensure access to the resources you need.

Students wishing to discuss concerns in a confidential setting are encouraged to make an appointment with Counseling and Psychological Services (CAPS).

Students can learn more about filing a report, accessing supportive resources, and navigating the Title IX investigation and resolution process on the University's Title IX webpage.

Statement on Mental Health and Wellness

Texas A&M University recognizes that mental health and wellness are critical factors that influence a student's academic success and overall wellbeing. Students are encouraged to engage in healthy self-care by utilizing the resources and services available on your campus.
Students who need someone to talk to can contact Counseling & Psychological Services (CAPS) or call the TAMU Helpline (979-845-2700) from 4:00 p.m. to 8:00 a.m. weekdays and 24 hours on weekends. 24-hour emergency help is also available through the National Suicide Prevention Hotline (800-273-8255) or at suicidepreventionlifeline.org.

The 2023 ACM A.M. Turing Award

The 2023 ACM A.M. Turing Award Honors

Avi Wigderson

for Foundational Contributions to the Theory of Computation

ACM has named Avi Wigderson as recipient of the 2023 ACM A.M. Turing Award for foundational contributions to the theory of computation, including reshaping our understanding of the role of randomness in computation, and for his decades of intellectual leadership in theoretical computer science.

Wigderson is the Herbert H. Maass Professor in the School of Mathematics at the Institute for Advanced Study in Princeton, New Jersey. He has been a leading figure in areas including computational complexity theory, algorithms and optimization, randomness and cryptography, parallel and distributed computation, combinatorics, and graph theory, as well as connections between theoretical computer science and mathematics and science.

The ACM A.M. Turing Award, often referred to as the "Nobel Prize of Computing," carries a $1 million prize with financial support provided by Google, Inc. The award is named for Alan M. Turing, the British mathematician who articulated the mathematical foundations of computing.

What is Theoretical Computer Science?

Theoretical computer science is concerned with the mathematical underpinnings of the field. It poses questions such as "Is this problem solvable through computation?" or "If this problem is solvable through computation, how much time and other resources will be required?"

Theoretical computer science also explores the design of efficient algorithms. Every computing technology that touches our lives is made possible by algorithms. Understanding the principles that make for powerful and efficient algorithms deepens our understanding not only of computer science, but also the laws of nature. While theoretical computer science is known as a field that presents exciting intellectual challenges and is often not directly concerned with improving the practical applications of computing, research breakthroughs in this discipline have led to advances in almost every area of the field—from cryptography and computational biology to network design, machine learning, and quantum computing.

The 2024 Wolf Prize in Mathematics

Noga Alon

Princeton University
Princeton, USA

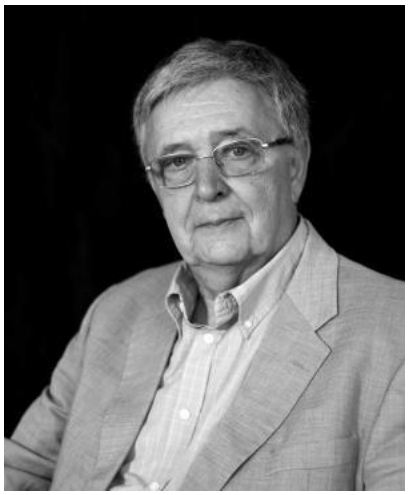
for “his fundamental contributions to combinatorics and theoretical computer science,”

Adi Shamir

Weizmann Institute of Science
Rehovot, Israel

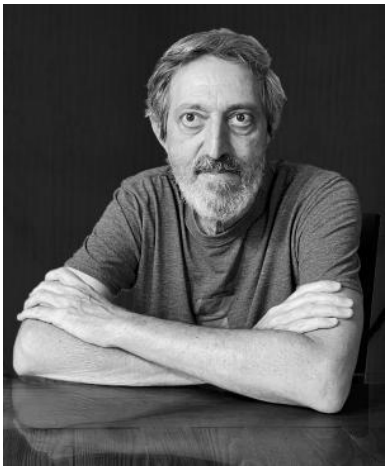
for "being a truly exceptional scientist and has been the leading force in transforming cryptography into a scientific discipline that is heavily based on mathematics,"

The 2021 Abel Prize



László Lovász

Alfréd Rényi Institute of Mathematics (ELKH, MTA Institute of Excellence) and Eötvös Loránd University,
Hungary



Avi Wigderson

Institute for Advanced Study,
Princeton, USA

"for their foundational contributions to theoretical computer science and discrete mathematics, and their leading role in shaping them into central fields of modern mathematics."

Jianer Chen's Publications in Discrete Math.

1. Chen, J. "A new complete language for DSPACE($\log n$)," *Discrete Applied Mathematics 25*, pp. 19-26, 1989.

2. Chen, J., Gross, J. L., and Rieper, R. G. "Overlap matrices and imbedding distributions," *Discrete Mathematics 128*, pp. 73-94, 1994.

3. Chen, J. "A linear-time algorithm for isomorphism of graphs of bounded average genus," *SIAM Journal on Discrete Mathematics 7*, pp. 614-631, 1994.

4. Chen, J., Archdeacon, D., and Gross, J. L. "Maximum genus and connectivity," *Discrete Mathematics 149*, pp. 19-29, 1996.

5. Chen, J., Kanchi, S., and Gross, J. L. "Tight lower bound on maximum genus of a simplicial graph," *Discrete Mathematics 156*, pp. 83-102, 1996.

6. Chen, J. and Kanchi, S. P. "Graph ear decompositions and graph embeddings," *SIAM Journal on Discrete Mathematics 12*, pp. 229-242, 1999.

7. Oh, E. and Chen, J., "On strong Menger-connectivity of star graphs," *Discrete Applied Mathematics 129*, pp. 499-511, 2003.

8. Deng, H., Chen, J., Li, Q., Li, R., and Gao, Q., "On the construction of most reliable networks," *Discrete Applied Mathematics 140*, pp. 19-33, 2004.

9. Chen, J. and Kanj, I., "Improved exact algorithms for Max-SAT," *Discrete Applied Mathematics 142*, pp. 17-27, 2004.

10. Chen, J., Huang, X., Kanj, I., and Xia, G., "Polynomial time approximation schemes and parameterized complexity," *Discrete Applied Mathematics 155-2*, pp. 180-193, 2007.

11. Xie, M., Wang, J., and Chen, J., "A practical parameterized algorithm for the individual haplotyping problem MLF," *Mathematical Structures in Computer Science 20*, pp. 851-863, 2010.

12. Akleman, E., Chen, J., and Gross, J. L., "Extended graph rotation systems as a model for cyclic weaving on orientable surfaces," *Discrete Applied Mathematics 193*, pp. 61-79, 2015.

13. Akleman E., Chen, J., Gross, J. L., and Hu, S., "A topologically complete theory of weaving," *SIAM Journal on Discrete Mathematics 34-4*, pp. 2457-2480, 2020.