CS 111, "Discrete Structures"
Fall 2021

Schedule

- **Lecture:**
  TR 3:30PM-4:50PM, Life Sciences 1500 (sec 1).
  TR 11:00AM-12:20PM, University Lecture Hall 1000 (sec 2);
  Instructor: Elena Strzheletska, email: elenas@cs.ucr.edu.
  Office hours: TBA

- **Discussion:**
  Friday 12:00PM-12:50PM, online (sec 21),
  Friday 11:00AM-11:50AM, online (sec 22),
  Tuesday 06:30PM-07:20PM, online (sec 23),
  Monday 1:00PM-1:50PM, online (sec 24),
  Wednesday 4:00PM-4:50PM, online (sec 25)
  Teaching Assistants:
  Alexander Choi, email: achoi035@ucr.edu (sec. 21, 23, 25);
  Huong Luu, email: hluu008@ucr.edu (sec. 22, 24);
  Office hours: TBA

Syllabus

Recommended textbooks:

- K. Rosen, Discrete Mathematics and its Applications
- O. Levin, Discrete Mathematics.
- E. Lehman, T. Leighton and A. Meyer *Mathematics for Computer Science.*

Prerequisites: CS10, CS/MATH11, MATH 9C (or equivalents). The prerequisites are strictly enforced.

Prerequisites by topic: basic programming, logic (propositional, predicate), sets, operations on sets, sequences, relations (equivalence, partial orderings), functions, combinations, basic counting methods, elementary linear algebra (matrices, determinants), proof methods (induction, contradiction), elementary number theory.

Topics Covered:

- Asymptotic notation: O(f(n)), Ω(f(n)), Θ(f(n)), asymptotic relations between basic functions: polynomial, exponential, and logarithmic functions
- Number theory: modular arithmetic, Fermat's Theorem, public-key cryptography, the RSA
- Advanced counting: inclusion-exclusion, linear recurrence equations, divide-and-conquer recurrences
- Elements of graph theory: undirected and directed graphs, connectivity, planarity, Euler cycles, Hamiltonian cycles, matchings, trees
- Other possible topics (if time suffices): elements of game theory, error-correcting codes

Homework Assignments: Five homework assignments.

Homework assignments can be done individually or in groups of two (strongly recommended). To submit an assignment, you will need to upload the pdf file to Gradescope. Each group submits one assignment. Both students will receive the same credit (unless requested otherwise). If a student (or a group) fails to submit the assignment, he/she receives a "0".

Homework papers must be prepared with **LaTeX**. Handwritten assignments or assignments in Word or other word processors will not be accepted. LaTeX templates for homework assignments and other help with LaTeX will be available.

Homework papers must be well written, in grammatical English, self-contained, and aesthetically formatted. During the first week of the quarter you are required to read the homework assignment guidelines, and follow these guidelines throughout the quarter. Sloppy papers will not be graded.

Quizzes: Five 30-minute quizzes (the first quiz is not graded). . The first "entrance" quiz will cover the prerequisite topics and will not be graded.

Final: Saturday, December 4, 8AM.

Attendance: Regular attendance at lectures and discussions is strongly advised. Some of the presented material may not be covered in the book or in posted lecture notes. In addition, extra credit assignments may be given during the lectures. Students are also strongly encouraged to take advantage of the office hours.

Remember that mask wearing is required indoors regardless of vaccination status.

Grading: Quizzes 40%, Final 35%, Homeworks 25%. Course grades are expected to be determined as follows: A (A-, A, A+) = 90-100%, B = 80-89%, C = 70-79%, D = 60-69%. Minor adjustments of this scale can be made at the end of the quarter.

Copyright: See UC Copyright Policies.

Academic Integrity: Zero-tolerance policy on plagiarism is enforced. Cheating on homework assignments or tests will result in an F grade for the course and a disciplinary action, independently of the extent of plagiarism. You are required to print, read, and sign the academic integrity statement, and upload it to Gradescope no later than Tuesday, September 28. You can find more information here.

Lectures

Week 0	Tuesday, September 21 -- No Class Thursday, September 23	THINGS TO DO during the first week Review: logic, sets, functions, relations, basic summation formulas, important numbers, sequences
Week 1	Tuesday, September 28 Thursday, September 30	Review: logic, sets, functions, relations, basic summation formulas, important numbers, sequences, approximations, number theory basics, proofs, proofs by induction Asymptotic notation
Week 2	Tuesday, October 5, Thursday, October 7	Number theory and cryptography Review: Gcd, Euclid's algorithm

		Computing inverses mod p Fermat's theorems Computing powers modulo an integer
Week 3	Tuesday, October 12 Thursday, October 19	Turing's code The RSA cryptosystem RSA: correctness, security, efficiency Famous open (and solved) problems in number theory
Week 4	Tuesday, October 19 Thursday, October 21	Linear recurrence equations (homogeneous) Linear recurrence equations (non-homogeneous)
Week 5	Tuesday, October 26 Thursday, October 28	Linear recurrence equations (non-homogeneous) Divide-and-conquer recurrences Inclusion-Exclusion Integer partitions
Week 6	Tuesday, November 2, Thursday, November 4	Graphs Euler tours, Hamiltonian cycles
Week 7	Tuesday, November 9 Thursday, November 11	Hamiltonian cycles, Dirac's theorem, Ore's theorem Graph coloring, coloring graphs with maximum degree D
Week 8	Tuesday, November 16, Thursday, November 18	Bipartite graphs: matchings, Hall's Theorem.
Week 9	Tuesday, November 23 Thursday, November 25 -- **Thanksgiving Day (No class)**	Trees Planar graphs: Kuratowski's theorem. Euler's formula/inequality for planar graphs. The 4-Color Theorem. Coloring planar graphs with 6 and 5 colors.
Week 10	Tuesday, November 30 Thursday, December 2	Adjacency matrices and matrix multiplication Trees. Binary trees. Applications (lower bound for comparison sorting). Review

Homework Assignments

LaTeX and Homework help.

- Guidelines for homework papers.
- Overleaf
- Sample homework assignment in pdf: HwSample.pdf

Quizzes

- Quiz 0.
  - Quiz syllabus
- Quiz 1.
- Quiz 2.
- Quiz 3.
- Quiz 4.

Final

Other Books

- V. Shoup, A Computational Introduction to Number Theory and Algebra (free)
- S. Lipschutz, M. Lipson, Schaum's Outline of Discrete Mathematics
- K. Bogart, C. Stein, R. Drysdale, Discrete Mathematics for Computer Science
- B. Kolman, R. Busby, S. Ross, Discrete Mathematical Structures
- R.C. Penner, Proof techniques and Mathematical Structures
- F. Preparata, R. Tzu-Yau Yeh, Introduction to Discrete Structures for Computer Science and Engineering
- S. Ross, Topics in Finite and Discrete Mathematics
- K. Joshi, Foundations of Discrete Mathematics
- R. Mc Eliece, R. Ash, C. Ash, Introduction to Discrete Mathematics
- N.L. Biggs, Discrete Mathematics
- I. Anderson, A First Course in Combinatorial Mathematics
- S. Barrett, Discrete Mathematics, Numbers and Beyond
- R.J. Wilson, Introduction to Graph Theory
- S. Foldes, Fundamental Structures of Algebra and Discrete Mathematics

Useful Links

- Discrete Mathematics course at Brown University
- Lots of resources on discrete mathematics
- Devlin's Angle, essays by K.Devlin.
- The A. Turing home page