

CS 22: Discrete Structures and Probability

Catalogue description. This course seeks to place on solid foundations the most common structures in computer science, to illustrate proof techniques, to provide the background for an introductory course in computational theory, and to introduce basic concepts of probability theory. Introduces Boolean algebras, logic, set theory, elements of algebraic structures, graph theory, combinatorics, and probability.

Syllabus outline.

1. Propositions and propositional logic, structure of logic arguments.
2. Predicate logic (quantified statements), direct and contrapositive proofs, proof by contradiction.
3. Well-ordering principle, induction, proofs by induction, loop invariants.
4. Sets and set theory: relations among logic, set theory, and switching algebra.
5. Cartesian products of sets, relation between sets and on a set.
6. Graphs and path problems. Trees, spanning trees.
7. Functions. Cardinality of sets. Introduction to FSAs.
8. Combinatorial objects: permutations, arrangements, selections. Inclusion-exclusion.
9. Counting by recursion, recurrence relations and their solution.
10. Probability theory: sample spaces, random variables, discrete distributions, moments. Conditional probability, Bayes' theorem, independence.
11. Probability theory: Bernoulli and Poisson distributions. Applications, Chebyshev's inequality.
12. Probability theory: weak law of large numbers, simple bounds on tails of distributions. Central limit theorem and the normal distribution.

Prerequisites. None

Textbooks Susanna S. Epp, *Discrete Mathematics with Applications*, Thomson.