Mathematics for Algorithm and System Analysis

for students of computer and computational science

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Preface

Discrete mathematics is an essential tool in almost all subareas of computer science. Interesting and challenging problems in discrete mathematics arise in programming languages, computer architecture, networking, distributed systems, database systems, AI, theoretical computer science, and other areas.

The course. The University of California, San Diego, has a lower-division two-quarter course sequence in discrete mathematics that includes Boolean arithmetic, combinatorics, elementary logic, induction, graph theory and finite probability. These courses are core undergraduate requirements for majors in Computer Science, Computer Engineering, and Mathematics-Computer Science. This text, *Mathematics for Algorithm and System Analysis*, was developed for the second quarter and *A Short Course in Discrete Mathematics* was developed for the first quarter. Because some students transfer into the second quarter of the course without having taken the first quarter, there is some overlap between the two texts and, with appropriate students, this text could be used without the first.

This book consists of four units of study (Counting and Listing—CL; Functions—Fn; Decision Trees and Recursion—DT; and Basic Concepts of Graph Theory—GT), each divided into four sections. Each section contains a representative selection of problems. These vary from basic to more difficult, including proofs for study by mathematics students or honors students. The first three sections in units CL and Fn are primarily a review of material in *A Short Course in Discrete Mathematics* needed for this course.

The review questions. "Multiple Choice Questions for Review" appear at the end of each unit. The explanatory material in this book is directed towards giving students the mathematical language and sophistication to recognize and articulate the ideas behind these questions and to answer questions that are similar in concept and difficulty. Many variations of these questions have been successfully worked on exams by most beginning students using this book at UCSD.

Students who master the ideas and mathematical language needed to understand these review questions gain the ability to formulate, in the neutral language of mathematics, problems that arise in various applications of computer science. This skill greatly facilitates their ability to discuss problems in discrete mathematics with other computer scientists and with mathematicians.

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Asterisks (stars) are used in the text to mark more difficult material that is not needed in later sections.

Unit DT: Decision Trees and Recursion

Unit GT: Basic Concepts in Graph Theory