To the Student

What is discrete mathematics? Discrete mathematics is the part of mathematics devoted to

the study of discrete objects. (Here discrete means consisting of distinct or unconnected

elements.) The kinds of problems solved using discrete mathematics include:

a How many ways are there to choose a valid password on a computer system?

a W hat is the probability of winning a lottery?

a Is there a link between two computers in a network?

a How can I identify spam e- mail messages?

a How can I encrypt a message so that no unintended recipient can read it?

a What is the shortest path between two cities using a transportation system?

a How can a list of integers be sorted so that the integers are in increasing order?

a How many steps are required to do such a sorting?

a How can it be proved that a sorting algorithm correctly sorts a list?

a How can a circuit that adds two integers be designed?

a How many valid Internet addresses are there?

You wi11 learn the discrete structures and techniques needed to solve problems such as these.

More generally, discrete mathematics is used whenever objects are counted, when relationships

between finite (or countable) sets are studied, and when processes involving a finite number

of steps are analyzed. A key reason for the growth in the importance of discrete mathematics is

that information is stored and manipulated by computing machines in a discrete fashion.

WHY STUDY DISCRETE MATHEMATICS? There are several important reasons for

studying discrete mathematics. First, through this course you can develop your mathematical

maturity : that is, your ability to understand and create mathematical arguments. You will not

get very far in your studies in the mathematical sciences without these skills.

Second, discrete mathematics is the gateway to more advanced courses in all parts of

the mathematical sciences. Discrete mathematics provides the mathematical foundations for

many computer science courses including data structures, algorithms, database theory, automata

theory, formal languages, compiler theory, computer security, and operating systems. Students

find these courses much more difficult when they have not had the appropriate mathematical

foundations from discrete math. One student has sent me an e- mail message saying that she

used the contents of this book in every computer science course she took !

Math courses based on the material studied in discrete mathematics include logic, set theory,

number theory, linear algebra, abstract algebra, combinatorics, graph theory, and probability

theory (the discrete part of the subject).

Also, discrete mathematics contains the necessary mathematical background for solving

problems in operations research (including many discrete optimization techniques), chemistry,

engineering, biology, and so on. In the text, we will study applications to some of these areas.

Many students find their introductory discrete mathematics course to be significantly more

challenging than courses they have previously taken. One reason for this is that one of the

primary goals of this course is to teach mathematical reasoning and problem solving, rather

than a discrete set of skills. The exercises in this book are designed to reflect this goal. Although

there are plenty of exercises in this text similar to those addressed in the examples, a large

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percentage of the exercises require original thought. This is intentional. The material discussed

in the text provides the tools needed to solve these exercises, but your job is to successfully

apply these tools using your own creativity. One of the primary goals of this course is to learn

how to attack problems that may be somewhat different from any you may have previously

seen. Unfortunately, learning how to solve only particular types of exercises is not sufficient for

success in developing the problem-solving skills needed in subsequent courses and professional

work. This text addresses many different topics, but discrete mathematics is an extremely diverse

and large area of study. One of my goals as an author is to help you develop the skills needed to

master the additional material you will need in your own future pursuits.

THE EXERCISES I would like to offer some advice about how you can best learn discrete

mathematics (and other subjects in the mathematical and computing sciences). You will learn the

most by actively working exercises. I suggest that you solve as many as you possibly can. After

working the exercises your instructor has assigned, I encourage you to solve additional exercises

such as those in the exercise sets following each section of the text and in the supplementary

exercises at the end of each chapter. (Note the key explaining the markings preceding exercises.)

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The best approach is to try exercises yourself before you consult the answer section at the

end of this book. Note that the odd- numbered exercise answers provided in the text are answers

only and not full solutions; in particular, the reasoning required to obtain answers is omitted in

these answers. The Student 50 Solutions Guide, available separately, provides complete, worked

solutions to all odd- numbered exercises in this text. When you hit an impasse trying to solve an

odd- numbered exercise, I suggest you consult the Student 50 Solutions Guide and look for some

guidance as to how to solve the problem. The more work you do yourself rather than passively

reading or copying solutions, the more you will learn. The answers and solutions to the evennumbered

exercises are intentionally not available from the publisher; ask your instructor if you

have trouble with these.

WEB RESOURCES You are strongly encouraged to take advantage of additional resources

available on the Web, especially those on the MathZone companion website for this

book found at www.mhhe.com/rosen. You will find many Extra Examples designed to clarify

key concepts; Self Assessments for gauging how well you understand core topics; Interactive

Demonstration Applets exploring key algorithms and other concepts; a Web Resources Guide

containing an extensive selection of links to external sites relevant to the world of discrete

mathematics; extra explanations and practice to help you master core concepts; added instruction

on writing proofs and on avoiding common mistakes in discrete mathematics; in- depth

discussions of important applications; and guidance on utilizing Maple software to explore the

computational aspects of discrete mathematics. Places in the text where these additional online

resources are available are identified in the margins by special icons. You will also find NetTutor,

an online tutorial service that you can use to receive help from tutors either via real- time chat or

via messages. For more details on these online resources, see the description of the MathZone

companion website immediately preceding this "To the Student" message.

THE VALUE OF THIS BOOK My intention is to make your investment in this text an

excellent value. The book, the associated ancillaries, and MathZone companion website have

taken many years of effort to develop and refine. I am confident that most of you will find that

the text and associated materials will help you master discrete mathematics. Even though it is

likely that you will not cover some chapters in your current course, you should find it helpfulas

many other students have-to read the relevant sections of the book as you take additional

courses. Most of you will return to this book as a useful tool throughout your future studies,

especially for those of you who continue in computer science, mathematics, and engineering. I

have designed this book to be a gateway for future studies and explorations, and I wish you luck

as you begin your journey.

Kenneth H. Rosen