

BOOK REVIEW

***DISCRETE MATHEMATICS* by Rza Bashirov**

Abdelajalil Nachaoui¹, Latifa Agamalieva^{2,3}

¹University de Nantes, Nantes, France

²Azerbaijan University, Baku, Azerbaijan

³Institute for Physical Problems, Baku State University, Baku, Azerbaijan

The first edition of Discrete Mathematics published in EMU Press is a concise textbook for the eponymous course at introductory level for students majoring in mathematics, computer science, engineering and technology. This textbook introduces discrete concepts and structures of mathematics as opposed to continuous ones. To increase readability for a target audience, the textbook focuses on the interplay between science, engineering and technology. The textbook also introduces mathematical methods of proof such as proof by induction, proof by truth table, proof by Venn diagram, proof by pigeonhole principle, etc.

This is a wonderful and gentle textbook, which motivates concepts; contains interesting trivia; and gives short bibliographical notes about famous mathematicians and computer scientists. The textbook provides many examples, problems with solutions that facilitate understanding of a concept soon after learning it. The textbook contains a plenty of the chapter-ending exercises with solutions or answers, which help students to get prepared to examinations. The textbook has very simple language for readers and fleshes out the key subjects such as logic, counting, graphs, etc., while providing brief overview of their applications. The author names all definitions in accordance with the context, perhaps to speed up search by keyword, which increases readability of the text. These combine to make it an excellent first textbook for learning discrete mathematics. We highly recommend this textbook for those readers who are not familiar with the topics covered in the book. The textbook consists of ten chapters that the author presented according to the logical precedence of the topics. Here is a subject-based summary of the contents covered by this textbook.

Basic Structures: Sets, Relations, and Functions

In the first three chapters, the author introduces the basic objects one is likely to encounter throughout the present textbook. Most of the concepts seem to be pretty standard with the exceptions that functions are defined in terms of relations rather than limits of sequences or sets - a typical discrete approach.

Logic: Propositional Logic and Boolean Algebra

The logic starts with propositional and predicate logic and continues with Boolean algebra at an introductory level. Propositional logic presents the atomic and molecular propositions and their types; introduces well-formed propositions - a foundation of syntax check of computer programs; and defines the logical equivalence between propositions. Boolean algebra concerns a set of rules for manipulating Boolean functions. Boolean algebra is important because its application in circuit design. The textbook first introduces the terminology and rules of Boolean

algebra; and then moves on to circuits of logic gates and their relationship with Boolean functions; finally ending up with a way to minimize the complexity of Boolean circuits - Karnaugh Maps Method.

Induction and Recursion

Mathematical induction and recursion are two concepts that are of utmost importance in computer science. There is a misconception regarding two forms of mathematical induction. When we first encounter mathematical induction, it seems it is the weak form, but not strong one, which is often used. In the analysis of discrete structures, however, we extensively employ the strong form of the principle. The textbook deals with both weak and strong forms of mathematical induction. This textbook first introduces recursive sequences such as arithmetic and geometrical sequences, and then moves on to recurrence relations and details the method for solving the second order linear homogenous recurrence relation with constant coefficients.

Counting

To me the counting is the most exciting subject discussed in the textbook. Counting starts with inclusion-exclusion; and then moves to other basic counting principles such as the product rule, the sum rule, the pigeonhole principle (both weak and strong forms), k-permutations, k-combinations, repetitions, permuting indistinguishable objects, derangements. The subject ends up with introduction of binomial coefficients and Pascal's triangle.

Compared to other subjects, I feel that most readers would be familiar with the present one. However, one must know that counting exercises are usually a bit tricky and not easy to solve. Correct solution path consists of careful understanding of the problem with further setting of right solution strategy and use of appropriate formulae for calculating the result. In this textbook, the author achieves this learning environment by solving plenty of problems and exemplifying each formula as much as possible.

Graphs and Trees

Excursion to the world of graphs starts with introducing Problem of Königsberg Bridges and Problem of Three Houses - Three Utilities. After detailing terminology, the textbook presents undirected graphs such as complete graph, bipartite graph, complete bipartite graph, multi-graph or pseudograph. The textbook introduces the concepts of isomorphism, Eulerian circuits, Hamiltonian cycles and theorems related to these terms.

Then the book moves on to trees - connected acyclic graphs. We get to the topic of spanning trees and minimal spanning trees of graphs, which are respectively trees that contain every vertex in the graph and those with the minimal sum of the weights. Two algorithms are presented for finding minimal spanning trees - Prim's and Kruskal's algorithms.

Final Notes

We think that Rza Bashirov's Discrete Mathematics is by far the best for readers who are not familiar with discrete mathematics. This is a great book to get readers up to speed on key concepts. We also believe that it is a pretty "fun" skim tutorial, even if you're already familiar with some of the topics.

References

Bashirov, R. (2022). *Discrete Mathematics*. Eastern Mediterranean University Press.