Graph Theory *By J.A. Bondy and U.S.R. Murty.* Springer, 2008. $69.95. x+651 pp., hardcover. ISBN 978-1-84628-969-9.

This book is a follow-on to the authors' 1976 text, *Graph Theory with Applications*. What began as a revision has evolved into a modern, first-class, graduate-level textbook reflecting changes in the discipline over the past thirty years. What has changed in that time? Graph theory has escaped the "slums of topology" and become an important discipline in its own right, first because of its applications to computer science, communications networks and combinatorial optimization through the design of efficient algorithms or the study of desirable properties of networks. Second, it has seen increasing interactions with other areas of mathematics: probability sees increased use in the probabilistic method, while geometry and topology play a greater role, and tools from analysis, algebra, and number theory have been brought to bear. Conversely, results such as Szemerédi's Regularity Lemma have seen application in areas such as number theory. With major problems, such as the Four Color Problem and the Strong Perfect Graph Conjecture, now settled, the emphasis of research efforts has shifted. Clearly, a major overhaul was needed.

The book is supported by a Wordpress blog (`http://blogs.springer.com/bondyandmurty/`) where the table of contents may be downloaded. Each chapter begins with a mini-table of contents listing the subsections, and the titles of further subdivisions. These initial pages of each chapter are also available for download. So the interested reader can obtain a very accurate impression of the topics and organization and we will not repeat that information here. However, broadly speaking, the topics covered by the twenty-one chapters are consistent with the authors' introductory remarks about the current state of the discipline and feature colorings, connectedness, planarity, matchings, algorithms, networks, and coverings. The only major advance escaping coverage (appropriately) is the theory of graph minors initiated by Robertson and Seymour.

This text hits the mark by appearing in Springer's *Graduate Texts in Mathematics* series, as it is a very rigorous treatment, compactly presented, with an assumption of a very complete undergraduate preparation in all of the standard topics. While the book could ably serve as a reference for many of the most important topics in graph theory, it fulfills the promise of being an effective textbook. The plentiful exercises in each subsection are divided into two groups, with the second group deemed "more challenging." Any exercises necessary for a complete understanding of the text have also been marked as such. There is plenty here to keep a graduate student busy and any student would learn much in tackling a selection of the exercises. Each chapter contains several "proof techniques": short insets describing techniques employed in proofs, either more general in nature (e.g. proof by contradiction), or more specific to combinatorics (e.g. Möbius inversion). Definitions, theorems, examples, and especially algorithms are amply illustrated with excellent illustrations of nontrivial graphs. Reasonably detailed pseudo-code presents algorithms unambiguously.

Each chapter is organized to begin with more routine aspects and then move into more advanced aspects of the relevant topic. So an instructor can vary the breadth and depth of a course, along with the difficulty, by adjusting just how far to penetrate each chapter. The blog contains suggested course outlines, including introductory courses for students in mathematics, computer science or operations research, along with eight "ideas" for more specific courses. These latter courses suggest in-depth analysis of topics such as colorings, or more general courses focusing on open problems or proof techniques.

A goal stated in the preface is for the book to serve as an introduction to research in graph theory. This is to great measure accomplished by the more advanced material at the end of the chapters, and the more challenging homework exercises. However there are open problems frequently inserted into the narrative, and highlighted by a double-edged box. An appendix at the end collects exactly one hundred of these problems. Even for the student who may not tackle any one of these problems, it is instructive to see that the material of the text could carry one forward to the forefront of current research. Perhaps the book's blog, and associated RSS feed, will be used to track and announce progress on these conjectures.

Not only is the content of this book exceptional, so too is its production. The high quality of its manufacture, the crisp and detailed illustrations and the uncluttered design complement the attention to the typography and layout. Even in simple black and white with line art, it is a beautiful book. The authors' 1976 predecessor is out-of-print, but can be freely downloaded for non-

commercial use as scanned images from Bondy's website, and for this new edition the authors have retained the copyright. Hopefully their intent to make the previous version available, along with their control of the copyright on this version, will translate to an effort to keep the text available for many years to come. Additionally, considering the quality of the content and presentation, plus the necessary effort and cost to write and produce a comprehensive 650 page hardback, the authors and publisher should be commended for the very fair pricing.

This book could serve several purposes for a graduate student's education. Introductory courses, a variety of advanced topics courses, and individual preparation for thesis research could all be supported. Talented undergraduates with the right preparation might also find the text useful. While any one course could only cover a fraction of the book, it is a book worth keeping for a student's personal library. Libraries supporting research and professionals in discrete mathematics will want to add a copy to their collections.

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