met at the University of Memphis. There are 157 problems in the first section (the first 28 can be seen at Amazon.com in the "Excerpt"), mostly stated in an informal fashion. A short section of hints follows, and then the final 315 pages contain full solutions written as proofs, often of reformulations of the problems in more formal terms. The serious nature of the mathematics is counterbalanced by lighthearted artwork by the author's wife.

It would be pointless to try to entirely classify the nature of the problems. Perhaps a majority have roots in discrete mathematics, but many are related to geometry, topology, or analysis. The author hopes that the problems could be used to "inspire undergraduates," and there are problems that are appropriate for strong, but not exceptional, undergraduates. However, many of the problems require a lot of machinery that even a strong undergraduate will not have seen before. There is no indicated gradation to the problems in difficulty or organization by the mathematics brought to bear. The author makes no apology for this, saying the collection is "haphazard" and is meant to be sampled rather than read from front cover to back cover. The first and penultimate problems illustrate the range.

Problem 1 is due to Rado and popularized by Littlewood:

> A lion and a Christian in a closed circular arena have equal maximum speeds. What tactics should the lion employ to be sure of his meal? In other words, can the lion catch the Christian in finite time?

The solution contains a journal reference and discusses generalizations such as n lions in an n-dimensional ball, and two lions in a bounded area with rectifiable lakes.

While the first problem is easy to state and understand, Problem 156 has a more technical statement:

> Let $x_1, x_2, x_3, \ldots, x_n$ be vectors of norm at most 1 in a d-dimensional normed space such that $x_1 + x_2 + x_3 + \cdots + x_n = 0$. Show that there is a permutation $\pi \in S_n$ such that
>
> $$\left\| x_{\pi(1)} + x_{\pi(2)} + x_{\pi(3)} + \cdots + x_{\pi(k)} \right\| \leq d$$
>
> for every k.

The hint includes a reformulation as a more general problem, and the proof in the solutions is followed by 17 references, including several from the 1980s and 1990s and one from 2000.

While both of these problems have proofs that might escape an undergraduate student, there are some problems appropriate for students, such as Problem 40, which requires an edifying application of induction:

> Cut out a square of a 2^n by 2^n chess board. Show that the remaining $2^{2n}-1$ squares can be tiled with L-tiles, where an L-tile is a union of three squares sharing a vertex.

Besides the memory of Erdös and Littlewood, the author's main criteria for selecting problems is that they should be "mathematics with fun." In this, the author has succeeded, and every mathematician should find something fun, novel, and unexpected, alongside some old friends. This book is a must-have for the problem solver, and would be a valuable addition to any personal library. Those who lead problem-solving seminars (such as preparation for the Putnam Mathematical Competition) will find additional material here. Finally, for an academic library this book provides a bridge between purely recreational mathematics and pure mathematics.

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Fuzzy Modeling and Fuzzy Control. *By Huaguang Zhang and Derong Liu.* Birkhäuser, Boston, 2006. $89.95. xvi+416, hardcover. ISBN 978-0-8176-4491-8.

The present book is devoted to the foundations of fuzzy control. Fuzzy control is the best-known and most successful branch of fuzzy logic. Fuzzy controllers are based on so-called fuzzy rules (or if-then rules), which are linguistic rules such as "if temperature is high and change of temperature is about zero, then set the fan to high (rpm)" or variants of such rules. A collection of such rules, which is supposed to be obtained from a domain expert, describes a control strategy. To run such a control strategy, one needs, in addition to a set of rules, a

suitable inference method, i.e., a method which allows us, given actual values of input variables (temperature and a change of temperature) to infer from a set of rules the value of the output variable (rpm of the fan). The role of fuzzy logic in such a scenario is that the concept of a fuzzy set allows us to represent linguistic expressions such as "high temperature."

Fuzzy controllers and rule-based fuzzy systems have been employed in a number of real-world products and applications including consumer electronics (fuzzy cameras, fuzzy washing machines, and fuzzy microwaves, for instance), which succeeded particularly in Japan, as well as various other control systems (car braking systems, automatic transmission systems, subway control, and kiln control, for example). Fuzzy control provides an alternative to classical control. Nowadays, courses in fuzzy control are parts of curricula in universities in the United States, Europe, and Japan, as well as other countries. The need for a comprehensive textbook in fuzzy control is thus obvious.

The present book aims to serve as a comprehensive textbook covering introductory as well as advanced topics in fuzzy control. In my opinion, the book has succeeded in achieving this goal.

The book consists of 13 chapters, each with a list of references and an index of key terms. Chapter 1 introduces basic concepts used in the book (preliminaries from fuzzy sets and rough sets). Chapters 2, 3, and 4 introduce three models of nonlinear systems based on fuzzy logic, namely, the Takagi–Sugeno model, a model based on rough sets, and a so-called fuzzy hyperbolic model. Basic descriptions of these models as well as identification of model structures and parameters are presented. Chapters 5, 6, 7, 8, and 9 are concerned with fuzzy inference and control methods. Problems such as design of a fuzzy control system, uncertainty management, performance evaluation, predictive control, and adaptive control are addressed. Chapters 10, 11, 12, and 13 contain various advanced topics in fuzzy control including stability, convergence, and filter design. Every chapter starts with an introduction to the topics dealt with in the chapter, then follows with a technical description of the topic, a couple of examples, a summary, and a list of references. The topics are clearly presented and the examples well chosen. Foundational results are presented in the form of theorems, when possible, which are presented with proofs. References are carefully selected. The only thing I missed in the book is a treatment of Mamdani-type fuzzy controllers.

Of the books on fuzzy control I have had a chance to study, this one ranks among the best. It can be recommended as a textbook for an advanced course in fuzzy control. Moreover, researchers as well as practitioners in the field of control will definitely profit from the book.

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Matrix Methods in Data Mining and Pattern Recognition. *By Lars Elden.* SIAM, Philadelphia, PA, 2007. $69.00. x+224 pp., softcover. ISBN 978-0-898716-26-9.

The author indicates that the book is intended as an undergraduate text for an introduction to data mining for students with some background in scientific computing or numerical analysis. Graduate students from other disciplines (engineering and the physical sciences, for example) will find the background material on linear algebra especially useful. The author seeks to demonstrate that linear algebra is a key player in the development of problem solving techniques in data mining and pattern recognition. One could easily use this book as a text for a second (semester) course in applied linear algebra.

The first nine chapters of the book are devoted to fundamental concepts of linear algebra and matrix decompositions. Topics of this first part of the book include matrix multiplication, matrix norms, rank, linear systems and least squares problems, orthogonality, QR decomposition, singular value decomposition, tensor decomposition, k-means, and nonnegative matrix factorization. Several MATLAB code examples are used to demonstrate the definition, solution, or factorization described. Examples drawn from text or web mining and image analysis are used throughout this section of the book.