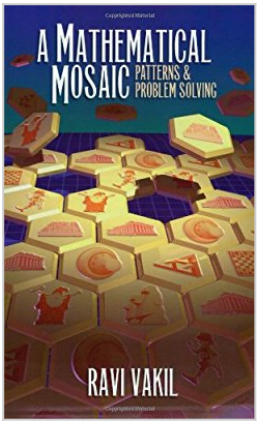

A Mathematical Mosaic: Patterns & Problem Solving

By Ravi Vakil

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A Mathematical Mosaic: Patterns & Problem Solving by Ravi Vakil is a must for teachers seeking to challenge their best students, and for students preparing for mathematics competitions. In this exciting book, Vakil, a preeminent winner of International Mathematics Olympiads, develops some of the powerful problem-solving ideas underpinning the major branches of mathematics and weaves them into a mosaic that reveals their interconnections.The mathematics is presented at the level of the capable high school mathematics student, but there is much substance for the advanced undergraduate and the intelligent lay reader. You will find this book an invaluable source of enrichment problems and ideas. The style is informal, friendly, and often humorous. In this book, Vakil profiles seven other mathematics olympiad winners including Noam Elkies, the youngest professor to receive tenure at Harvard.

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Editorial Review

Review
Ravi Vakil has put together a collection of wonderful topics from number theory through combinatorics to game theory in a fashion that seventh- and eighth-grade students can handle yet high school students will find challenging.His book is divided into two parts. Part 1 introduces to the young reader a number of mathematics topics that will be very useful in part 2. For example, in the first section, "Number Theory," such topics as calculating tricks, divisibility rules with proofs of why they work, and magic squares are investigated fully and clearly. In part 2, many of the earlier topics are revisited, but the level of difficulty is increased. In 'Number Theory Revisited,' an in-depth study of rational and irrational numbers, a fascinating painted-school-lockers problem, and other topics challenge students in an entertaining manner.Perhaps the best features of the book, however, are the historical digressions on great mathematicians and short personal profiles of c! ! ontemporaries of the author. These glimpses into the lives of young male and female mathematicians make this book very much worth its price. Without a doubt, this book is a must for any library, teacher's reference, or student's amusement.-John Cocharo, Saint Mark's School of Texas, 10600 Preston Rd., Dallas, YX 75230-4000. -- *The Mathematics Teacher, Vol 89, #7. October 1996*

Reviewed by Andre ToomThere are different books on my shelf. Some are large like dinosaurs: these are textbooks. Others are much smaller, but their educational value may be greater. For example, Kordemsky's book [3] contributed a lot to Russian childrens' interest in mathematics although its English edition fits in a hand. The book I am going to discuss fits in a coat pocket, but it speaks in an interesting and understandable way about number theory, combinatorics, game theory, geometry, and calculus, to say nothing about magic tricks, puzzles and other digressions. What is most important is that whenever Vakil starts to discuss something, he never leaves the reader without a piece of exact, rigorous knowledge. This is a book about mathematics, not about its fuzzy placebo.Ravi Vakil received several olympiad prizes and now is an instructor at Princeton University. This is his first book, and in it he tries to share his expertise with his readers. He tries to encourage! ! curiosity, a sense of beauty, and the love of knowledge. This is a book I would like to have read as a boy. Why? Because it addresses the normal curiosity of children. It contains many good problems, facts, and stories. It is a mixture of just those ingredients which are most useful for children. Vakil enjoys ideas that seem simple if you already know them, but may seem paradoxical if you don't. One of them is presented as a card trick (p. 44): I ask you to shuffle a deck of cards thoroughly. Then I ask for them back (face down). Carefully examining the backs of the cards, I separate them into two piles. I then claim that, through the power of magic, I've made sure that the number of black cards in the first pile is the number of red cards in the second pile!The explanation starts as follows: "While pretending to exmine the backs of the cards, I was simply " Can you complete this explanation? I remember that as a boy I was quite fond of various tricks and had a notebook wh! ! ere I wrote as many of them as I could find. Although Vakil's book is intended to be recreative and facultative, it contains many facts that are indispenable for mathematical literacy, including: Criteria for divisibility. Those for 2, 3 and 7 are proved; other proofs are left for the reader (pp. 23, 29). Let g(x) denote any polynomial in x. Then the remainder when g(x) is divided by x a is g(a). 2 is irrational (p. 121). There are infinitely many primes (p. 124). Heron's formula for the area of a triangle (p. 160) The harmonic series diverges (p. 180).Each of these facts is not only proved, but accompanied with several variations that are presented as problems or comments. Sometimes they lead into quite substantial mathematics. There are many "local" proofs, which also help to develop the readers' "proof sense." I like the following most:The "hypervolume" of a "four-dimensional sphere" of radius r is H = (r^ 2)^2/2. Can you use a method similar to that of Par! ! t 1 and Part 4 to find the "surface volume/" (p. 81). This book contains several "personal profiles" of gifted youngsters with whom Vakil became acquainted at olympiads. Vakil writes several lines about how they found their way into mathematics, for example: "J. P.'s

curiosity is typical of the young mathematicians profiled in this book" (p. 41), "It was at this time that Katy discovered the tremendous enjoyment she gains from solving problems" (p. 54). Vakil cites one talented student's advice: "Do math for math's sake, not because your parents will be proud of you, or because people will think you are smart" (p. 143).More than once Vakil stresses that mathematics is beautiful. In his preface he writes: "Math is a uniquely aesthetic discipline; mathematicians use words like beauty, depth, elegance, and power to describe excellent ideas" (p. 10). When starting to speak about combinatorics, he writes: "More important (to me, at least) is its aesthetic appeal" (p. 45). Before p! ! resenting the proof of irrationality of 2, he writes: "It is also extremely beautiful. its elegance lies in its simplicity" (p. 121). Is Vakil alone in stressing the beauty of mathematics? By far not. He refers to G. H. Hardy who said similar things in his A Mathematician's Apology. (p. 120).Here is the last problem in the book:On a remote Norwegian mountain top, there is a huge checkerboard, 1000 squares wide and 1000 squares long, surrounded by steep cliffs to the north, south, east, and west. Each square is marked with an arrow pointing in one of the eight compass directions, so (with the possible exception of some squares on the edges) each square has an arrow pointing to one of its eight nearest neighbors. The arrows on squares sharing an edge differ by at most 45. A lemming is placed randomly on one of the squares, and it jumps from square to square following the arrows. Prove that the poor creature will eventually plunge from a cliff to its death.Is this a "real! ! -world" problem? Certainly not. There is no such checkerboard in the mountains of Norway. According to some educational theories, students should not be interested in this problem, but they are. In fact this problems was invented by a secondary-school student Kevin Purbhoo. Is Kevin abnormal? If he is, I am also. Bobrov's book [1], which mixes mathematics with fantasy, accompanied all my childhood, and I lilked its fantastic element most! Vakil writes about this problem: "Although Kevin did not know at the time, this problem anticipates several subtle and important results in topology" This is typical of Vakil's book: recreational mathematics leads to deep and important ideas. It deserves many readers.There is a good-old editorial "Yes, Virginia, there is a Santa Claus" an answer to a girl named Virginia who asked the editor of the New York Sun in 1897, "Is there a Santa Claus?" It seems to me that some modern educators have lost the pathos of spirituality expressed there! ! , which makes humans human. It is in human nature to be interested in abstractions. The human ability to think without and immediate material gratification is at the base of civilization. In this context, Vakil's book might be called "Yes, Virginia, Math is Beautiful."References1. Sergey Bobrov, The Magic Two horn (in Russian). Detgiz, Moscow-Leningrad, 1949.2. Donald E. Knuth, The Art of Computer Programming, 2nd ed. Addison-Wesley, 1981.3. Boris A Kordemsky, The Moscow Puzzles. English edition, translated by Albert Parry and edited by Martin Gardner, Charles Scribner's Sons. 1972. Reprinted, Dover Publications, 1992. -- *American Mathematical Monthly, January 1998*

About the Author

Dr. Vakil is currently Professor of Mathematics at M.I.T. Ravi Vakil's preeminence in the world of mathematical competitions is evident in the long list of his many triumphs. To highlight just a few:

1988 USA Mathematical Olympiad

placed first in North America

International Mathematical Olympiad

won two gold medals and one silver medal

Putnam Mathematical Competition

placed among the top five competitors

in North America in each of his four undergraduate years.

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Damon Smith:

The book A Mathematical Mosaic: Patterns & Problem Solving will bring that you the new experience of reading the book. The author style to spell out the idea is very unique. Should you try to find new book to study, this book very acceptable to you. The book A Mathematical Mosaic: Patterns & Problem Solving is much recommended to you to see. You can also get the e-book from the official web site, so you can more readily to read the book.

Emma Berkey:

Precisely why? Because this A Mathematical Mosaic: Patterns & Problem Solving is an unordinary book that the inside of the book waiting for you to snap the item but latter it will zap you with the secret it inside. Reading this book alongside it was fantastic author who have write the book in such wonderful way makes the content inside of easier to understand, entertaining way but still convey the meaning fully. So , it is good for you because of not hesitating having this any longer or you going to regret it. This phenomenal book will give you a lot of benefits than the other book get such as help improving your ability and your critical thinking approach. So , still want to hold off having that book? If I had been you I will go to the book store hurriedly.

Kent Ibarra:

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