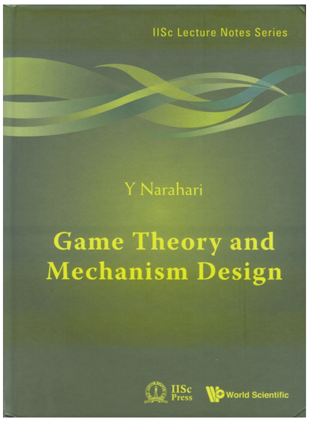

Game Theory and Mechanism Design. Y. Narahari. World Scientific Publishing Co. Pte. Ltd., 5 Toh Tuck Link, Singapore 596224. 2014. xl + 492 pages. Price: US$ 148.

Game Theory and Mechanism Design is an easily accessible introduction to the theories of games and mechanism design, and their applications to problems at the intersection of mathematics, economics, and computer science. The specific applications discussed in the book include resource allocation, standard auctions, sponsored search auctions in Internet advertising, and the problem of stable matching. While the theory of games focuses on the modelling of conflict situations and the analysis of outcomes, mechanism design focuses on the 'reverse engineering' of games to achieve desired outcomes. The Preface correctly states that there are many excellent text books and monographs on game theory. But most of these are inspired by applications in the social sciences and economics. What sets this book apart is (i) the emphasis on applications from computer science and engineering, and (ii) the treatment of mechanism design and game theory on an equal footing. Game theorists from the beginning have been interested in questions related to the computation of equilibrium strategies. Lemke and Howson Jr (1964) described an algorithm for finding an equilibrium in a bimatrix game and thus provided a 'constructive proof' of the existence of an equilibrium. Earlier, Brown (1951) suggested 'fictitious play' as an iterative method that agents could employ to 'learn' their equilibrium strategies. The term 'bounded rationality' was coined in the 1950s to describe the idea that an individual's decision is limited by issues of computational tractability. The limitation may arise due to either structural constraints (resulting in cognitive constraints) or due to limited time to perform the computations. However, it was only in the late 1990s that computer scientists began a serious study of the question of complexity of computation of equilibrium strategies. This reviewer is less familiar with the history of mechanism design. The description in the book suggests that mechanism design has passed through a similar history. It is only with the emergence of Internet search engines and e-commerce, when these enabled fertile application domains for mechanism design, that computer scientists became seriously interested in the design of mechanisms. The book is an outcome of the confluence of these two fields – game theory and mechanism design on the one hand and computer science on the other. A lot remains to be understood at this intersection, for example computational aspects of combinatorial auctions, dynamic mechanism design, etc., that there is a greater need for the coming together of game theorists, mechanism designers, computer scientists and engineers. This book will provide an accessible 'two-way door' through which computer scientists and engineers on one side and economists, sociologists, and game theorists on the other can easily pass and learn about the other's domain.

The book is divided into three parts. The initial chapter of Part I, which deals with non-cooperative game theory, describes several motivating examples that have counterintuitive outcomes. These are well-chosen to capture a reader's attention and to draw him into probing the book further. Then, in a series of short chapters, the book introduces the key ideas of game theory. The shortness of the chapters is an attractive feature of the book. The many examples in the initial chapters will enable the reader to test the theory's predictions when the analysis begins in chapter five. The general scheme that is followed is that of a soft introduction of the examples followed by a more formal analysis at a later point, after the required definitions and tools have been introduced. The existence of equilibria is shown using techniques from linear algebra and mathematical analysis. Simon (1945) had already pointed out in his insightful review of the classic *Theory of Games and Economic Behaviour* by von Neumann and Morgenstern (1944) that while the techniques of the subject are not difficult, a certain mathematical maturity is required. The author of *Game Theory and Mechanism Design*, through his lucid explanations, has made every effort to make the techniques accessible. The last chapter of the book summarizes the necessary mathematical preliminaries.

It is the clear exposition of mechanism design, that will make this book an outstanding and useful reference. The topic of design is always a more difficult subject to write about. 'Analysis' is often simpler to handle, because it usually deals with a 'given' system. 'Design' is more difficult to handle because of the multitude of possibilities that can achieve the same end goal. The two introductory mechanisms in the first chapter of Part II highlight this point. One is a mechanism designed by a wise mother to ensure fair division of a cake so that both of her two children are satisfied with the outcome. The other is a mechanism designed by a wise king that elicits truth in a conflict situation where two mothers claim a child as their own. These examples have clearly been chosen with the aim of drawing the reader deeper into the book. But they also suggest that any good exposition of a theory of design must explore the design space and justify a good choice. An additional complication is the often unknown boundary between the possible and the impossible. The book expertly guides the reader through the maze of impossibility theorems, suggests alternative means to get around them, to arrive eventually at some positive results. These are some spectacular mechanisms that include Vickrey's second price auction and Myerson's revenue maximizing mechanism. The book's masterful treatment of this subject makes it a 'must read' for every computer scientist or engineer aspiring to apply the theory of mechanism design to his problem. Part III is on the theory of cooperative games. A notable chapter here is the application to matching markets and college admissions.

Given the advertisement that the book is at the intersection of game theory and computer science, this reviewer hoped to see a more detailed proof of the complexity of computing an equilibrium. The corresponding chapter stops at the level of a discussion. Similar is the case for the famous impossibility theorem in social choice due to Arrow and the result that the deferred acceptance algorithm for college admissions leads to a stable outcome. However, the book provides a wealth of references where an interested reader can probe further. The historical details on some influential researchers of game theory and mechanism design will be a source of inspiration to the readers. This reviewer hopes that the book will play the role of a catalyst in bringing game theorists, mechanism designers, computer scientists, and engineers closer to each other. The author is overly modest in stating that the primary objective of the book is to present the essentials of game theory and mechanism design to an engineering audience. Economists, sociologists, and others interested in the theory of games will benefit equally from an understanding of the computational questions and related applications described in *Game Theory and Mechanism Design*.

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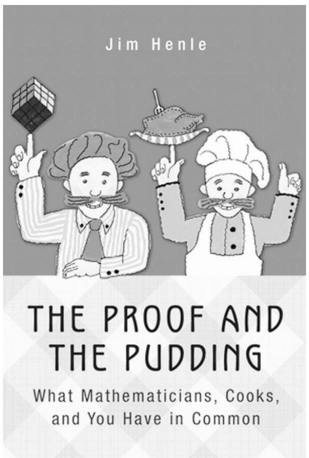

The Proof and the Pudding: What Mathematicians, Cooks, and You Have in Common. Jim Henle. Princeton University Press, UK. 2015. 176 pages. Price: US$ 26.95/£19.95.

Could there be any similarity between mathematics and cookery? Neither do cooks deal in numbers nor do mathematicians indulge in recipes. Why search for similarity when there is none, one might wonder. After all, no one eats numbers and neither can anyone order the square root of a muffin. Is it as linear as that or are we missing out on something more vital? Jim Henle, a Professor of Mathematics at Smith College, thinks we often miss tantalizing similarities between the two – both intimidate novices, both pose difficulties, and both celebrate champions. Further, mathematicians and cooks have similar dreams, similar fears, and similar guilty secrets.

It may be hard for someone who is average in mathematics and rarely ventures into the kitchen to concur with such similarities. Yet, it can hardly be denied that both mathematicians and chefs solve ‘problems’. While Chefs create new and wonderful dishes, mathematicians create new and fascinating formulae. Called fusion, both of them bring together two or more old things to create something that’s new. Cuisines are anything but fusion of the old and new – flavours, ingredients, techniques. So, is mathematics! Come to think of it, algebra was borne out of calculus. The original problems of calculus – calculating areas, constructing tangents – were considered geometric till algebra was applied to get out of them. That could easily be a mathematical cuisine.

Every cuisine is a work of mathematics, though. Sample this: a puff pastry is but a single layer of butter surrounded by dough to begin with. The combination is then rolled out, and folded in three, creating three layers of butter within four layers of dough. This is quite obvious! The unobvious is once it gets folded further, say three more times. Each time the number of layers of butter is tripled: 9 layers, 27 layers, 81 layers. As a consequence, it creates 10, 28 and 82 layers of dough. For the chef, the numbers of layers are significant as these reflect in ultimate appearance and taste of the puff pastry, for a mathematician it is the fun of creating 82 layers of dough in just four operations with implications beyond sheer numbers.

The self-taught cook-cum-gourmet mathematician makes it clear that cooking can be as much fun as mathematics, and vice versa. The bottom line is that if you are an avid cook, you can do math. And, if you are a successful mathematician, you can cook. What if you are neither of these two? It is so because neither does our education inculcate mathematical preparedness in us nor do our mothers coax us to try our hands at the frying pan. To be able to engage in either of the two subjects, argues Henle, one ought to be playful and fun-loving in life. Simply put, if you have fun doing something you will keep doing it. And, if you keep doing something you will get better at it. That, ladies and gentlemen, is the crux of both mathematics and cooking.

The Proof and the Pudding is a non serious book on a serious subject; half of the book is filled with recipes while the other half is devoted to mathematics. The author finds perfect escape in pursuing his culinary skills to recreate the magic of mathematics in loafs of breads and layers of cheese. The lessons he draws are cross-cutting, and may not relate directly to either math or cooking. Enjoyment in failure holds the key to get good at any creative endeavour. Both math and cooking can help in being bad at something and yet be able to cross the dead ends.

Exploring the two subjects from diverse perspectives, viz. vanity, sloth, parsimony, lust, and gluttony, Henle finds amazing similarities in both math and cooking. But it does not stop him from drawing mathematical parallels on aesthetic features like elegance, simplicity, complexity and usefulness common to both. If a recipe could be elegant, so could be a mathematical formula. From sticky buns to fennel pizza, and from cheese sandwich to vegetarian cassoulet, there is one for every taste that the self-taught cook could dish out with its associated mathematical proof using games, doodles, puzzles or card tricks. After all, the proof of the pudding lies in its taste.

Cooking and math may have begun as simple and useful crafts but these have evolved into complex and pleasurable arts today. Ironically, while chefs have attained higher social recognition, mathematicians are still languishing in obscurity. No wonder, Henle makes a case for mathematicians to be chefs. Else, the glaring dissimilarity will continue to linger with Chicken *tikka* persisting over Euclidian *geometry*. Is it because mathematics exists in our minds and does not deliver anything on the plate?

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