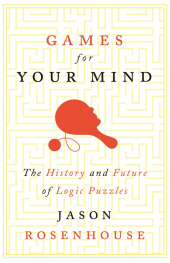
Games for your mind by *Jason Rosenhouse*, Princeton University Press, 2020 (352 p.), isbn: 9780691174075.




J. Rosenhouse

If you ask a connoiseur where to look for logic puzzles, then she will almost certainly mention Raymond Smullyan (1919-2017), perhaps also Lewis Carroll (1832-1898), and some columns of Martin Gardner (1914-2010). Obviously this kind of puzzles existed since antiquity, but these three names are certainly among the ones that popularized the topic as we know it today. Jason Rosenhouse is a mathematics professor at James Madison University. He has written a book on the *The Monty Hall Problem* (Oxford U. Press, 2009), he is also co-author of one entitled *Taking Sudoku Seriously* (Oxford U. Press, 2011), and he is co-editor of three volumes on *Mathematics of Various Entertaining Subjects* (Princeton U. Press, 2015-2019). So he has gained some reputation in the gamers-and-puzzlers community. This book will considerably add to this authority.

In his preface Rosenhouse mentions that his original idea was to write a book with some entertaining logic puzzles à la Carroll and Smullyan. However, the eventual result is a book that goes well beyond just a collection of entertaining brain teasers. It explains the mechanisms and principles needed to solve the puzzles, but it also instructs the reader about the history of logic and its interpretation by different philosophical disciplines. There are some example puzzles solved and discussed, and, like in a mathematics text book some solved exercises are inserted illustrating the theory. After some principle is explained, a list of puzzles is given for the reader to solve. They feel like exercises after the lesson. Solutions are given at the end of each chapter.

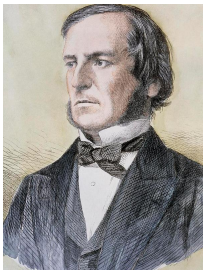
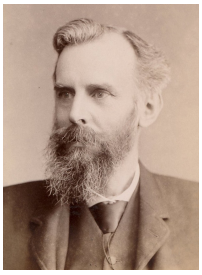
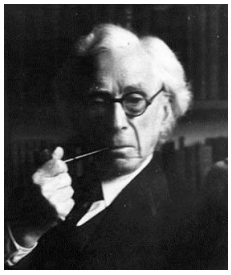
It is clear that logic influences and interacts with mathematics. Deciding what is true and what is not, means deciding what to accept as being proved or not. We do that by checking the rules that were followed to come to the result. Therefore one has to agree on what rules should be followed and what axioms one should start from. This quickly results in a discussion about the foundations of mathematics and philosophical considerations. Thus when the puzzles as such are challenging but entertaining, there is some background to assimilate that is not just leisurely scanning the text but it requires staying focused while reading.

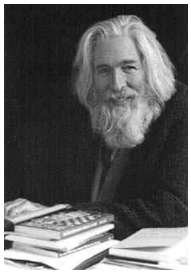
Rosenhouse divides the book into five parts: (1) A general introduction about logic and puzzles, (2) Lewis Carroll and Aristotelian logic, (3) Raymond Smullyan and mathematical logic, (4) Puzzles based on nonclassical logics, (5) Miscellaneous topics. The titles of the first four are self-explanatory. First, in part one, some general considerations about logic are given as well as some sample puzzles to wet the appetite. Logic is boringly simple in everyday life, but when philosophy is involved, it needs more precise definitions of its atoms, called propositions, and it is required to understand the mechanism of categorical syllogisms, if one wants to explore puzzles based on Aristotlean logic.

Parts 2 and 3 are the main parts of the book. In the part about Lewis Carroll, a short introduction of Aristotle's syllogism that serves as an introduction to a discussion of Carroll's book *The game of logic* (1886) in which he used certain diagrams to visualize the syllogism that solves the puzzles. In his book *Symbolic logic* (1896) Carroll solves sorites puzzles, that means that one has to deduce a conclusion from more than two categorical propoitions. Rosenhouse explains how Carroll did this with more analytical techniques and tree graphs. Finally there are two journal papers that Carroll published in Mind. The first one involves if-then propositions and *modus ponens* and *modus tollens* arguments. The other paper is a regression problem. If p and $p \to q$ are true, then one would normally conclude that q is true, using $(p\&(p \to q)) \to q$. But what if we do not accept the latter form of the modus ponens. A naive solution is to add it to the system, but that sets into action a recursive addition of propositions ad infinitum like in Zeno's paradox of Achilles and the tortoise. Rosenhouse gives an extensive discussion about how this problem has been tackled by different authors.

In part 3, we leave syllogisms and move on to newer forms of formal logic, with Smullyan as the main puzzler. Smullyan's puzzles often involve knights (who always speak the truth) and knaves (who always lie). Some examples of that type of puzzles are given with a bit of formal logic in an appetizing chapter. That is however followed by several chapters containing the history of logic, ranging from Aristotle, over John Locke, George Boole and John Venn, to the formal system of Bertrand Russell and Kurt Gödel's incompleteness theorems. There is less room for puzzles in these chapters, but still some elements can be illustrated in the form of a puzzle. Then we arrive at the typical Smullyan puzzles in which we meet people of which we do not know if they are knights or knaves. The problem is then usually to ask a question such that it becomes clear who is what or what is true. In several puzzles where the problem is to find out whether p is true, the appropriate question to ask has the form: Is p true if and only if you are a knight. Smullyan attributes this principle to Nelson Goodman.





L. Carroll (1832-1898) J. Locke (1632-1704) G. Boole (1815-1864) J. Venn (1834-1923) B. Russell (1872-1970) K. Gödel (1906-1978) R. Smullyan (1919-2017)

Part 4 gives an introduction to several more recent forms of logics. For example, three valued logic is involved if people can be knight or knave or neutral. Or probability can be involved in fuzzy logic if people are not either knight or knave, but can be picked from a continuum between the two extremes and thus they answer a question truthfully or not according to a certain probability distribution.

Finally in the last part several topics are discussed. One is the *Hardest Logic Puzzle Ever* published by George Boolos in 1996 and that has attracted a lot of academic interest and it became a bit of a legend with a life of its own. It involves three gods: one answers with a lie, one with the truth, and one answers randomly. You do not know who is who and their answers are 'da' and 'ja', but you do not know what means 'yes' and what is 'no'. Which questions and how many do you have to ask to find out who is who. Other topics are paradoxes and so called metapuzzles (in which some extra hidden information can be deduced). The concluding chapter gives some examples from fiction in the form of film and literature where some logic is involved. That is a broad spectrum from Mr. Spock in Star Trek to the famous super intelligent detectives Auguste Dupin, Sherlock Holes, Hercule Poirot, and many others who solve crimes using logic. An appendix contains a very useful glossary of definitions of logic-related terms and an extensive index.

So, although the book is entertaining and addressing a lay public, it goes beyond just a popularizing puzzle book, it can be situated somewhere in between entertainment and an introductory course to logic. The part on Gödel's theorems is for example not just an entertaining puzzle, but it explains the problem quite well for an interested lay reader, including a Turing-like machine. Puzzles range from simple to extremely difficult. In most cases the origin of the puzzle is mentioned. They are mostly formulated in the form of a story like the initiator of the genre, Lewis Carroll, introduced his puzzles for children. Lovers of the Smullyan puzzles or Lewis Carroll will be happy to read more background material compiled in this book. Conversely, this book may introduce readers to Smullyan's many puzzle books. Moreover, extending the type of underlying logic, Rosenhouse opens a road to more general entertaining puzzles. To raise interest in logic is a good point not only for everyday life or for mathematics, but logic is also very important in computer science with topics such as logic programming and its use in machine learning. Adhemar Bultheel