

# *The Four Color Theorem*



*For any subdivision of the plane into non-overlapping regions, it is always possible to mark each of the regions with four different colors in such a way that no two adjacent regions receive the same color .*

# Four Color Theorem

**Robert Wilson**



## Four Color Theorem:

**The Four-Color Theorem** Rudolf Fritsch, Gerda Fritsch, 2012-12-06 During the university reform of the 1970s the classical Faculty of Science of the venerable Ludwig Maximilians Universität in Munich was divided into five smaller faculties One was for mathematics the others for physics chemistry and pharmaceuticals biology and the earth sciences Nevertheless in order to maintain an exchange of ideas between the various disciplines and so as not to permit the complete undermining of the original notion of universitas I the Carl Friedrich von Siemens Foundation periodically invites the professors from the former Faculty of Science to a luncheon gathering These are working luncheons during which recent developments in the various disciplines are presented by means of short talks The motivation for such talks does not come in the majority of cases from the respective subject itself but from another discipline that is loosely affiliated with it In this way the controversy over the modern methods used in the proof of the Four Color Theorem had also spread to disciplines outside of mathematics I as a trained algebraic topologist was asked to comment on this Naturally I was acquainted with the Four Color 1 A Latin word meaning the whole of something a collective entirety VII viii Preface Problem but up to that point had never intensively studied it As an outsider 2 I dove into the material not so much to achieve any scientific progress with it but to make this already achieved objective more understandable *A history of Chinese mathematics* Jean-Claude Martzloff, 1997 The Four-Color Problem, 2011-08-29 The Four Color Problem **Every Planar Map is Four Colorable** Kenneth I. Appel, Wolfgang Haken, 1989 In this volume the authors present their 1972 proof of the celebrated Four Color Theorem in a detailed but self contained exposition accessible to a general mathematical audience An emended version of the authors proof of the theorem the book contains the full text of the supplements and checklists which originally appeared on microfiche The thirty page introduction intended for nonspecialists provides some historical background of the theorem and details of the authors proof In addition the authors have added an appendix which treats in much greater detail the argument for situations in which reducible configurations are immersed rather than embedded in triangulations This result leads to a proof that four coloring can be accomplished in polynomial time **The Four-Color Theorem** Rudolf Fritsch, Gerda Fritsch, J Lie Peschke, 1998-08-13 The Four-color Problem Thomas L. Saaty, Paul C. Kainen, 1977 **The Four-Color Theorem and Basic Graph Theory** Chris McMullen, 2020-05-26 Explore a variety of fascinating concepts relating to the four color theorem with an accessible introduction to related concepts from basic graph theory From a clear explanation of Heawood's disproof of Kempe's argument to novel features like quadrilateral switching this book by Chris McMullen Ph D is packed with content It even includes a novel handwaving argument explaining why the four color theorem is true What is the four color theorem Why is it common to work with graphs instead of maps What are Kempe chains What is the problem with Alfred Kempe's attempted proof How does Euler's formula relate the numbers of faces edges and vertices What are Kuratowski's theorem and Wagner's theorem What is the motivation behind triangulation What is quadrilateral switching

What is vertex splitting What is the three edges theorem Is there an algorithm for four coloring a map or graph What is a Hamiltonian cycle What is a separating triangle How is the four color theorem like an ill conditioned logic puzzle Why is the four color theorem true What makes the four color theorem so difficult to prove by hand     Map Coloring, Polyhedra and the FourColor Problem David W. Barnette,1984-03-01     *Graphs, Colourings and the Four-colour Theorem* Robert Wilson,2002 This textbook for mathematics undergraduates graduates and researchers discusses the proof of the four colour theorem one of the most famous of the long standing mathematical problems solved in the 20th century     Four Colors Suffice Robin J. Wilson,2002 On October 23 1852 Professor Augustus De Morgan wrote a letter to a colleague unaware that he was launching one of the most famous mathematical conundrums in history one that would confound thousands of puzzlers for more than a century This is the amazing story of how the map problem was solved The problem posed in the letter came from a former student What is the least possible number of colors needed to fill in any map real or invented so that neighboring counties are always colored differently This deceptively simple question was of minimal interest to cartographers who saw little need to limit how many colors they used But the problem set off a frenzy among professional mathematicians and amateur problem solvers among them Lewis Carroll an astronomer a botanist an obsessive golfer the Bishop of London a man who set his watch only once a year a California traffic cop and a bridegroom who spent his honeymoon coloring maps In their pursuit of the solution mathematicians painted maps on doughnuts and horseshoes and played with patterned soccer balls and the great rhombicuboctahedron It would be more than one hundred years and countless colored maps later before the result was finally established Even then difficult questions remained and the intricate solution which involved no fewer than 1 200 hours of computer time was greeted with as much dismay as enthusiasm Providing a clear and elegant explanation of the problem and the proof Robin Wilson tells how a seemingly innocuous question baffled great minds and stimulated exciting mathematics with far flung applications This is the entertaining story of those who failed to prove and those who ultimately did prove that four colors do indeed suffice to color any map     The Philosophical Implications of the Four-color Theorem E. R. Swart,1979     *Higgs Boson Mass predicted by the Four Color Theorem* Ashay Dharwadkar,Vladimir Khachatryan,2009-12-28 We show that the mathematical proof of the four color theorem yields a perfect interpretation of the Standard Model of particle physics The steps of the proof enable us to construct the t Riemann surface and particle frame which forms the gauge We specify well defined rules to match the Standard Model in a one to one correspondence with the topological and algebraic structure of the particle frame This correspondence is exact it only allows the particles and force fields to have the observable properties of the Standard Model giving us a Grand Unified Theory In this paper we concentrate on explicitly specifying the quarks gauge vector bosons the Standard Model scalar Higgs boson and the weak force field Using all the specifications of our mathematical model we show how to calculate the values of the Weinberg and Cabibbo angles on the particle frame Finally we present our prediction of the Higgs boson mass  $M = 126 \text{ GeV}$  as a direct consequence

of the proof of the four color theorem      *The Four Colour Theorem* Ashay Dharwadkar, 2000-08-05 We present a new proof of the famous four colour theorem using algebraic and topological methods This proof was first announced by the Canadian Mathematical Society in 2000 and subsequently published by Orient Longman and Universities Press of India in 2008 Recent research in physics shows that this proof directly implies the Grand Unification of the Standard Model with Quantum Gravity in its physical interpretation and conversely the existence of the standard model of particle physics shows that nature applies this proof of the four colour theorem at the most fundamental level      **Map Color Theorem** G. Ringel, 2012-12-06 In 1890 P J Heawood 35 published a formula which he called the Map Colour Theorem But he forgot to prove it Therefore the world of mathematicians called it the Heawood Conjecture In 1968 the formula was proven and therefore again called the Map Color Theorem This book is written in California thus in American English Beautiful combinatorial methods were developed in order to prove the formula The proof is divided into twelve cases In 1966 there were three of them still unsolved In the academic year 1967 68 J W T Youngs on those three cases at Santa Cruz Sur invited me to work with him prisingly our joint effort led to the solution of all three cases It was a year of hard work but great pleasure Working together was extremely profitable and enjoyable In spite of the fact that we saw each other every day Ted wrote a letter to me which I present here in shortened form Santa Cruz March 1 1968 Dear Gerhard Last night while I was checking our results on Cases 2 8 and 11 and thinking of the great pleasure we had in the afternoon with the extra ordinarily elegant new solution for Case 11 it seemed to me appropriate to pause for a few minutes and dictate a historical memorandum We began working on Case 8 on 10 October 1967 and it was settled on Tuesday night 14 November 1967      **The Four Color Theorem** Joseph Miller Thomas, 1972 This paper proves that all maps on the sphere can be colored with four colors The term map is used as by Veblen with the trivial exceptions that each map here has exactly three faces at each vertex has in all at least three faces and covers the whole sphere      *The Four Color Theorem* Adrian Moncloa, 1990      **Chromatic Graph Theory** Gary Chartrand, Ping Zhang, 2019-11-28 With Chromatic Graph Theory Second Edition the authors present various fundamentals of graph theory that lie outside of graph colorings including basic terminology and results trees and connectivity Eulerian and Hamiltonian graphs matchings and factorizations and graph embeddings Readers will see that the authors accomplished the primary goal of this textbook which is to introduce graph theory with a coloring theme and to look at graph colorings in various ways The textbook also covers vertex colorings and bounds for the chromatic number vertex colorings of graphs embedded on surfaces and a variety of restricted vertex colorings The authors also describe edge colorings monochromatic and rainbow edge colorings complete vertex colorings several distinguishing vertex and edge colorings Features of the Second Edition The book can be used for a first course in graph theory as well as a graduate course The primary topic in the book is graph coloring The book begins with an introduction to graph theory so assumes no previous course The authors are the most widely published team on graph theory Many new examples and exercises enhance the new edition      *Four Colors Suffice*

Robin Wilson, 2021-10-12 On October 23 1852 Professor Augustus De Morgan wrote a letter to a colleague unaware that he was launching one of the most famous mathematical conundrums in history one that would confound thousands of puzzlers for more than a century This is the amazing story of how the map problem was solved The problem posed in the letter came from a former student What is the least possible number of colors needed to fill in any map real or invented so that neighboring counties are always colored differently This deceptively simple question was of minimal interest to cartographers who saw little need to limit how many colors they used But the problem set off a frenzy among professional mathematicians and amateur problem solvers among them Lewis Carroll an astronomer a botanist an obsessive golfer the Bishop of London a man who set his watch only once a year a California traffic cop and a bridegroom who spent his honeymoon coloring maps In their pursuit of the solution mathematicians painted maps on doughnuts and horseshoes and played with patterned soccer balls and the great rhombicuboctahedron It would be more than one hundred years and countless colored maps later before the result was finally established Even then difficult questions remained and the intricate solution which involved no fewer than 1 200 hours of computer time was greeted with as much dismay as enthusiasm Providing a clear and elegant explanation of the problem and the proof Robin Wilson tells how a seemingly innocuous question baffled great minds and stimulated exciting mathematics with far flung applications This is the entertaining story of those who failed to prove and those who ultimately did prove that four colors do indeed suffice to color any map This new edition features many color illustrations It also includes a new foreword by Ian Stewart on the importance of the map problem and how it was solved

**Neutrosophic Sets and Systems, vol. 8/2015** L. Kong, Y. Wu, J. Ye, F. Smarandache, A. Mukherjee, S. Sarkar, P. Biswas, S. Pramanik, Neutrosophic Sets and Systems has been created for publications on advanced studies in neutrosophy neutrosophic set neutrosophic logic neutrosophic probability neutrosophic statistics that started in 1995 and their applications in any field such as the neutrosophic structures developed in algebra geometry topology etc

Graph Theory with Applications to Engineering and Computer Science DEO, NARSINGH, 2004-10-01 Because of its inherent simplicity graph theory has a wide range of applications in engineering and in physical sciences It has of course uses in social sciences in linguistics and in numerous other areas In fact a graph can be used to represent almost any physical situation involving discrete objects and the relationship among them Now with the solutions to engineering and other problems becoming so complex leading to larger graphs it is virtually difficult to analyze without the use of computers This book is recommended in IIT Kharagpur West Bengal for B Tech Computer Science NIT Arunachal Pradesh NIT Nagaland NIT Agartala NIT Silchar Gauhati University Dibrugarh University North Eastern Regional Institute of Management Assam Engineering College West Bengal University of Technology WBUT for B Tech M Tech Computer Science University of Burdwan West Bengal for B Tech Computer Science Jadavpur University West Bengal for M Sc Computer Science Kalyani College of Engineering West Bengal for B Tech Computer Science Key Features This book provides a rigorous yet informal

treatment of graph theory with an emphasis on computational aspects of graph theory and graph theoretic algorithms  
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