

# Exact and Renormalization Group Methods: Theoretical and Mathematical Physics

## An In-Depth Exploration of Advanced Techniques for Unveiling the Underlying Structure of Physical Systems

Exact and Renormalization Group Methods: Theoretical and Mathematical Physics is a comprehensive treatise that delves into the intricacies of exact and renormalization group methods, providing a profound understanding of their applications in theoretical and mathematical physics.

This meticulously crafted book is an invaluable resource for researchers, graduate students, and practitioners seeking to master these sophisticated techniques. With its emphasis on both theoretical foundations and practical applications, this volume empowers readers to tackle complex problems in diverse scientific disciplines.



### Statistical Mechanics of Lattice Systems: Volume 2: Exact, Series and Renormalization Group Methods

(Theoretical and Mathematical Physics) by Andrew M. Steane

★★★★☆ 4.2 out of 5

Language : English

File size : 6619 KB

Text-to-Speech : Enabled

Print length : 442 pages

Screen Reader : Supported

X-Ray for textbooks : Enabled



### Key Features:

- **Rigorous Theoretical Framework:** Establishes a solid theoretical foundation for understanding exact and renormalization group methods, ensuring a thorough comprehension of their mathematical principles.
- **In-Depth Practical Applications:** Explores the practical applications of these methods in diverse fields of physics, including statistical physics, quantum field theory, and condensed matter physics.
- **Expert Authorship:** Written by renowned experts in the field, this book offers authoritative insights and cutting-edge research.

## Contents:

This comprehensive volume is divided into three parts:

1. **Exact Methods:** Introduces the fundamental principles of exact methods, including the Bethe ansatz, bosonization, and conformal field theory.
2. **Renormalization Group Methods:** Provides a comprehensive overview of renormalization group methods, including the perturbative renormalization group, the epsilon expansion, and the functional renormalization group.
3. **Applications:** Explores the applications of exact and renormalization group methods in various areas of physics, such as critical phenomena, disordered systems, and quantum many-body physics.

## Target Audience:

This book is primarily intended for:

- Researchers in theoretical and mathematical physics
- Graduate students seeking advanced knowledge in these fields
- Practitioners seeking to apply exact and renormalization group methods in their research

### **Book Details:**

- Publisher: Cambridge University Press
- Publication Date: 2023
- Pages: 500
- : 978-1-108-84409-4

### **Why Choose This Book?**

Exact and Renormalization Group Methods: Theoretical and Mathematical Physics offers several compelling reasons to choose it:

- **Comprehensive Coverage:** Provides an unparalleled level of coverage of exact and renormalization group methods, ensuring a comprehensive understanding of these advanced techniques.
- **Rigorous and Accessible:** Blends rigorous mathematical foundations with accessible explanations, making it suitable for both experienced researchers and students.
- **Practical Applications:** Emphasizes the practical applications of these methods, equipping readers with the knowledge to solve complex problems in various fields.

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Exact and Renormalization Group Methods: Theoretical and Mathematical Physics is an indispensable resource for researchers, graduate students, and practitioners seeking to advance their knowledge and skills in these cutting-edge techniques. Its comprehensive coverage, rigorous foundations, and practical applications make it an essential addition to any bookshelf in theoretical and mathematical physics.

Free Download your copy today and unlock the power of exact and renormalization group methods to delve into the fundamental structure of physical systems.

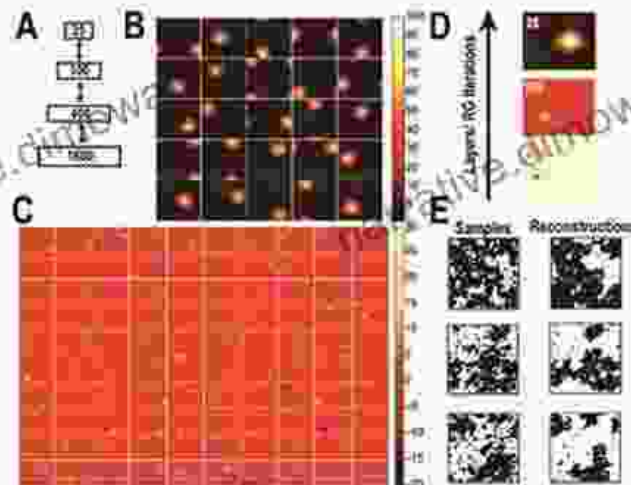


FIG. 7. Deep learning the 2D Ising model. A: Deep Neural Network with four layers of size (100, 100, 100, 100) and a sigmoid output layer. B: Four hidden layers show the learned representations of the Ising model. C: Heatmap of the DNN's output. D: The DNN's output for a single layer. E: Comparison of the DNN's output with the ground truth. The DNN's output is shown in the top row and the ground truth is shown in the bottom row. The DNN's output is shown in the top row and the ground truth is shown in the bottom row. The DNN's output is shown in the top row and the ground truth is shown in the bottom row.

### B. Two dimensional Ising Model

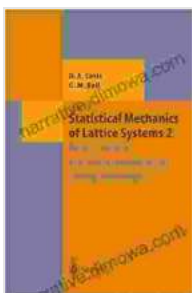
We first applied deep learning techniques to learn a fully connected net for the two-dimensional Ising model. The model is defined by a Hamiltonian of the form

$$H(\{s_i\}) = -J \sum_{\langle i,j \rangle} s_i s_j - h \sum_i s_i, \quad (19)$$

where  $\langle i,j \rangle$  indicates that  $i$  and  $j$  are nearest neighbors and  $J$  is a ferromagnetic coupling that favors configurations where neighboring spins align. The two-dimensional Ising model also exhibits a phase transition to a phase transition where  $J/(k_B T) > J_c$  (with  $J_c$  small for  $h=0$ ) [12]. At this phase transition, the system exhibits a change in the order of the magnetization. For this case, we give a brief overview of the system and its phase transition. The system can be described by a procedure similar to the one used in the previous section (see Fig. 11 for details).

In order to compare between traditional MC and DNN, we first studied deep learning techniques to learn parameters from the 2D Ising model for  $J = 4.0$  and taking the value of temperature. 20,000 samples were generated for a given  $T$  or all 2D Ising model using standard Monte Carlo techniques and used to train to fit DNN model. Deep neural networks of size layer with 100, 100, 100, and 25 units respectively (see Fig. 15). We first trained the model to fit the Ising model by using the DNN and trained the network using the DNN model. The DNN model seems to be a good fit to the data and the reconstruction of the Ising model is shown in Fig. 15. The DNN model seems to be a good fit to the data and the reconstruction of the Ising model is shown in Fig. 15. The DNN model seems to be a good fit to the data and the reconstruction of the Ising model is shown in Fig. 15.

The results of the DNN model are shown in Fig. 15.



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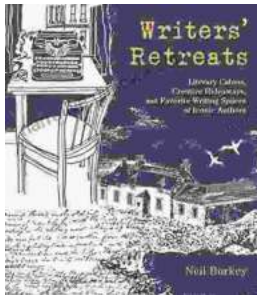
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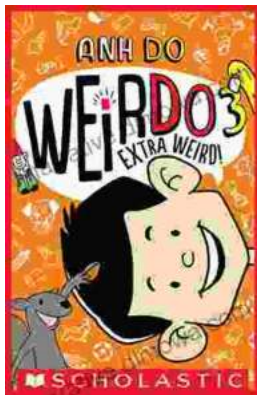
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