

Introduction to Tensor Network Methods

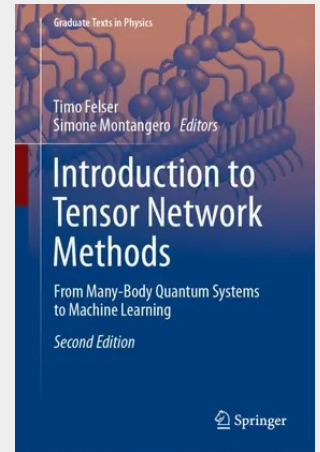
From Many-Body Quantum Systems to Machine Learning

This second edition of the textbook contains more advanced and technical parts as new topics related to tensor network algorithms that have been developed in the last few years. The reader finds new chapters dedicated to tree tensor networks for high-dimensional systems as applications to lattice gauge theory. The implementation of tensor networks for machine learning is also presented in detail.

This textbook gives an in-depth overview on the numerical simulation technique of tensor networks (TNs) with hands-on technical descriptions, work exercises and computation results. TNs have originally been developed for solving the quantum many-body problem and simulating quantum systems on a classical computer. However, as a mathematical tool, TNs have emerged as powerful theoretical and numerical versatile tools to attack more generally hard mathematical problems. In particular, their range application has expanded to combinatorial optimization and even as an alternative tool for machine learning in the field of artificial intelligence. This textbook introduces the reader to the field, describing the main principles and core mathematical concepts in the light of its application in quantum physics and, along the way, touches on the application of TNs to problems from various fields, ranging from low-energy to high-energy physics up to medical physics and machine learning.

It is designed for graduate courses in computational physics, where a student learns how to write a tensor network program and can begin to explore the physics of many-body quantum systems.

This second edition of the textbook Introduction to Tensor Network Methods contains more advanced and technical parts as new topics related to tensor network algorithms that have been developed in the last few years. The reader finds new chapters dedicated to tree tensor networks for high-dimensional systems as applications to lattice gauge theory. The implementation of tensor networks for machine learning is also presented in detail. This textbook gives an in-depth overview on the numerical simulation technique of tensor networks (TNs) with hands-on technical descriptions, work exercises and computation results. TNs have originally been developed for solving the quantum many-body problem and simulating quantum systems on a classical computer. However, as a mathematical tool, TNs have emerged as powerful theoretical and numerical versatile tools to attack more generally hard mathematical problems. In particular, their range application has expanded to combinatorial optimization and even as an alternative tool for machine learning in the field of artificial intelligence. This textbook introduces the reader to the field, describing the main principles and core mathematical concepts in the light of its application in quantum physics and, along the way, touches on the application of TNs to problems from various fields, ranging from low-energy to high-energy physics up to medical physics and machine learning. It is designed for graduate courses in computational physics, where a student learns how to write a tensor network program and can begin to explore the physics of many-body quantum systems.



96,29 €

89,99 € (zzgl. MwSt.)

vorbestellbar, Erscheinungstermin ca. Juli 2026

Artikelnummer: 9783032176349

Medium: Buch

ISBN: 978-3-032-17634-9

Verlag: Springer Nature Switzerland AG

Erscheinungstermin: 13.07.2026

Sprache(n): Englisch

Auflage: 2. Auflage 2026

Serie: Graduate Texts in Physics

Produktform: Gebunden

Seiten: 332

Format (B x H): 155 x 235 mm

