SS2021: Tensor Networks

Website: https://tu-dresden.de/mn/physik/itp/ket/studium/lehre/tn_ss21

OPAL: https://bildungsportal.sachsen.de/opal/auth/RepositoryEntry/29985308674/CourseNode/1618108323446632005

Lectures/Tutorials: Monday and Thursday 14:50 - 16:20, via Zoom

Lecturer: Hong-Hao Tu (hong-hao.tu@tu-dresden.de)

Assistant: Sreejith Chulliparambil (sreejith.chulliparambil@tu-dresden.de)

Topics: Tensor networks for quantum many-body systems, including matrix product states, density matrix renormalization group, projected entangled pair states, tensor network contractions, etc.

Office hours: Friday 13:00 - 14:00 (Zoom), with appointment.

Exercises: The exercises include both analytical and coding problems. They will be discussed during the tutorials. Some Matlab sample codes will be provided, but it is free to use any programming languages (Python, Julia, C++, ...) and/or libraries (iTensor, TeNPy, ...). It is also encouraged to pair up in teams (2-3 persons in each team) to solve the exercise problems.

Final exam: There is no written exam. For Bachelor and Master students who need a grade, it is required to give a short oral presentation (15 minutes). Possible topics should be discussed with the lecturer.

Oral exam: Master students can choose this course (as one of the two topics) for the oral exam "Vertiefung Theoretische Physik". Doctoral candidates may take the oral exam in replacement for the Rigorosum or choose this course to be examined in the Rigorosum. Note that the grade earned by oral presentations *cannot* be used for replacing such oral exams.

Reference:

1. F. Verstraete, V. Murg, and J. I. Cirac, *Matrix product states, projected entangled pair states, and variational renormalization group methods for quantum spin systems*, Adv. Phys. 57, 143 (2008).
2. U. Schollwöck, *The density-matrix renormalization group in the age of matrix product states*, Ann. Phys. 326, 96 (2011).
3. R. Orús, *A practical introduction to tensor networks: matrix product states and projected entangled pair states*, Ann. Phys. 349, 117 (2014).
4. J. I. Cirac, D. Perez-Garcia, N. Schuch, and F. Verstraete, *Matrix product states and projected entangled pair states: concepts, symmetries, and theorems*, arXiv:2011.12127.
5. J. von Delft, Lecture on Tensor Networks (SS2020); see link.