



LUDWIG-  
MAXIMILIANS-  
UNIVERSITÄT  
MÜNCHEN

CHAIR FOR THEORETICAL SOLID STATE PHYSICS  
PHYSICS DEPARTMENT  
ARNOLD SOMMERFELD CENTER &  
CENTER FOR NANOSCIENCE



## Tensor Networks Summer Semester 2019

**Website:** [www.physik.uni-muenchen.de/lehre/vorlesungen/sose\\_19/tensor\\_networks\\_19/index.html](http://www.physik.uni-muenchen.de/lehre/vorlesungen/sose_19/tensor_networks_19/index.html)

**Lectures:** Mo 14:15-16:00, We 10-12 (Room 450)

**Tutorial:** Th 10:15-12:00 (Room 450)

**Lecturer:** Jan von Delft <[vondelft@lmu.de](mailto:vondelft@lmu.de)>

**Tutorials:** Seung-Sup Lee <[S.Lee@physik.lmu.de](mailto:S.Lee@physik.lmu.de)>, Jheng-Wei Li <[JhengWei.Li@physik.uni-muenchen.de](mailto:JhengWei.Li@physik.uni-muenchen.de)>

**Technical advisor:** Andreas Weichselbaum

**Prerequisites:** Quantum mechanics I

### Topics:

- Tensor Networks: Basic Concepts
- Numerical Renormalization Group (NRG)
- Density-Matrix Renormalization Group (DMRG)
- Symmetries
- Projected Entangled Pair States (PEPS)
- Multiscale Entanglement Renormalization Ansatz (MERA)
- Machine learning...

For a more detailed time table, see course homepage, under “Course Outline”.

### Tutorials:

Will involve hands-on coding: analyzing predesigned example codes for performing various tasks, and combining these to carry out standard tensor network computations.

### Software:

All codes will be based on MATLAB. Every participant will need to run MATLAB scripts. A student version of MATLAB (for 35 €) can be downloaded from here:

[https://de.mathworks.com/academia/student\\_version.html](https://de.mathworks.com/academia/student_version.html)

Save the receipt! At the end of the semester, every student that has passed the course and shows me a receipt for a MATLAB student licence will be reimbursed by 35 €.

An alternative to MATLAB is Octave, <https://www.gnu.org/software/octave/>

This is an open-source version thereof, which purportedly uses the same syntax as MATLAB, and in principle should work on most of our MATLAB scripts. However, students that have tried Octave during a previous version of this course were not too happy and ended up switching to MATLAB.

### Final exam:

Coding exercises, to be performed using the codes studied and developed during the course of the semester.

### Literature:

There is no suitable textbook yet for this course. For introductory topics I will follow various review articles, and for advanced topics the original literature. A bibtex file (to be extended and updated during the course of the semester), containing bibliographic info to these articles, is available on the course homepage under “References”.