Parsa Rangriz

Senior Undergraduate Student, Physics, SUT

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Education

Sharif University of Technology (SUT), Tehran, Iran
Bachelor of Science, Physics — *Sep 2018 - Dec 2022 (Expected)*
Minor Degree, Mathematics
Cumulative GPA: 18.51/20 (3.90/4)

Research Interests

Statistical Physics, Spin Glasses, Quantum Information Theory, and Optimization. Precisely: Replica Theory, Networks, Phase Transitions, Causal Inference, Notion of Entropy, Quantum Thermodynamics, Large Deviation, Ergodic Theory, and Combinatorial Optimization

Research Projects

Statistical Physics of Computation Laboratory, EPFL, Switzerland
Supervisor : Prof. Lenka Zdeborová — *From Jul 2022*

To be written...

Department of Mathematical Sciences, SUT, Iran
Supervisor : Prof. Amir Daneshgar — *Oct 2022 - Present*

- **Replica Symmetry and Phase Transitions in Spin Glasses:** Fundamental notions of statistical physics is studied in spin glasses and replica theory which have found applications in the combinatorial optimization problems and graph theory.
- **Graph Bi-Partitioning and Max-Cut Problems:** Tries to find phase transitions in some graphical models such as random regular graphs, stochastic block models, and other networks for well-known problems such as max-cut and bi-partitioning.
- **New Regular Random Graph Generators and its Properties:** Studies on a new method of constructing regular random graphs, named random π-lifts to see what are the differences between the generated graphs and the other methods such as Kim-Vu by studying the min-cut problem using the message passing algorithm.

Noisy Quantum Systems Group, The University of Manchester, UK
Supervisors : Dr. Ahsan Nazir & Dr. Adam Stokes — *Jul 2021 - Mar 2022*

- **Coarse-Grained Entropy (Quantum Observational Entropy):** Worked on the thermodynamics of quantum subsystems with respect to the coarse-grained (observational) entropy in order to study quantum interactions and the measurement process in the quantum regime, especially for incompatible observables.
- **Non-conjugate Subsystems Representation:** Introduces the notion of non-conjugate quantum subsystems as an alternative way to understand the decomposition of a quantum system into interacting parts. The definition is shown to be natural in situations where a conventional decomposition is incompatible with fundamental and operationally motivated identifications of physical subsystem observables, such as in non-relativistic quantum electrodynamics.

Awards & Achievements

Awarded the **Summer@EPFL 2022 Fellowship.**
Ranked 5th in the 26th Iran Universities Physics Olympiad, Sanjesh Organization, Iran.
Silver Medal in the 30th Iran National Physics Olympiad, Young Scholars' Club, Iran.
Member of **Iran National Elites Foundation** since July 2017.

Course Projects

Variational Inference in LDPC Codes
Course : Information Theoretic Methods in High-Dimensional Probability *Fall 2022*

Regarding the problem of LDPC codes, presented a variational approach with the aids of graphical models and iterative algorithms in order to demonstrate a practical way of studying the problem. This can not be done without any knowledge of the background of belief propagation algorithm and the convex optimization. At last, discussed the quantum version of LDPC codes to focus on the these days' attempts. - Report

Belief Propagation for Graph Partitioning
Course : Entropy-Maximization and Variational Optimization *Spring 2021*

Used some methods such as belief propagation algorithm to compute the ground state energy of the minimum bisection of a given graph. After applying this iterative algorithm for random regular graphs and Erdős–Rényi model, it can be seen the BP algorithm's validation region. Then it would be possible to find out about some phase transitions that will raise, giving more intuitions about the behavior of the graph partitioning problem. - Report

Phase Transition of the Transverse-Field Ising Model
Course : Machine Learning in Physics *Spring 2021*

The transverse-field Ising models and their phase transitions are studied in the regimes of condensed matter physics and statistical physics. In this project, it be sought to find the phase transition point in the one-dimensional transverse-field Ising model and classify different phases, using Machine Learning and Deep Learning methods. - Report / GitHub

An Introduction to Quantum Thermodynamics
Course : Quantum Mechanics III *Fall 2020*

In this review letter, it have been mentioned some important remarks of quantum thermodynamics and their relations with quantum information theory. At first, it has been introduced some points of quantum open system and information theory and then applied them to quantum thermodynamics. Then, it has been generalized some materials such as laws and cycles of classical thermodynamics to the quantum mechanical approaches. - Report

Courses & Grades

- Quantum Information Theory (Ph.D. Physics): 19.5/20
- Quantum Computation (Ph.D. Physics): 20/20
- Open Quantum Systems (Ph.D. Physics): 18.0/20
- Entropy-Maximization and Variational Optimization (M.Sc. Computer Science): 20/20
- Information Theory, Statistics, and Learning (M.Sc. Electrical Engineering): 18.5/20
- Machine Learning in Physics (M.Sc./B.Sc. Physics): 17.6/20
- Quantum Mechanics III (M.Sc. Physics): 18.6/20
- Statistical Mechanics III (M.Sc. Physics): 18.8/20
- Group Theory (M.Sc./B.Sc. Physics): NA/20
- Complex Systems (M.Sc./B.Sc. Physics): NA/20
- Mathematical Statistics (B.Sc. Mathematics): 18.1/20

Teaching Assistant Experiences

- Statistical Mechanics III (M.Sc. Physics): Prof. Vahid Karimipour
- Statistical Mechanics III (M.Sc. Physics): Prof. Ali Rezakhani
- Statistical Mechanics II (B.Sc. Physics): Prof. Vahid Karimipour
- Statistical Mechanics I (B.Sc. Physics): Prof. Vahid Karimipour

- General Physics III (B.Sc. Physics): Prof. Omid Akhavan
- Fundamentals of C Programming (B.Sc. Computer Engineering): Dr. Marjan Nikbin

Attended Schools

Quantum Thermodynamics Summer School 2021, ETH Zurich, Switzerland
Organizer: Prof. Lidia del Rio (ETH Zurich) - Certificate

Mini-Course in Quantum Thermodynamics 2021, University of Sao Paulo, Brazil
Organizer: Prof. Gabriel Landi (University of Sao Paulo) - *Certificate*
Lecturers: Dr. Nicole Yunger Halpern (Maryland University), Dr. Matteo Lostaglio (TU Delft)

Selected Talks

Local vs. Global Master Equations
Course: Open Quantum Systems, December 2021

Statistical Physics for Optimization Theory
Sharif's Statistical Physics Seminars, October 2021

Programmability of Covariant Quantum Channels
Sharif's Quantum Information Journal Club, July 2021

Computer Skills

Languages: C, C++, Python, LaTeX, Wolfram Mathematica
Data Tools: Keras, Sci-Kit Learn, BP Algorithm