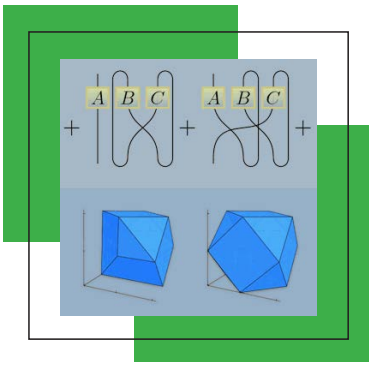
ipam institute for pure & applied mathematics

Efficient Tensor Representations for Learning and Computational Complexity

May 17 - 21, 2021



Scientific Overview

Tensors are well-suited to capture higher order correlations or complex relations in data. Unfortunately, the number of parameters describing a tensor scales exponentially with its order. Naive tensor estimation methods would thus require an impractical amount of samples. To counter this problem, a number of efficient tensor representations have been introduced. These include low-rank decompositions which capture latent structures, or tensor networks that are tailored to quantum many-body systems with local interactions. The first emphasis of this workshop will be on the theory of recovering efficient tensor representations from empirical data, as studied e.g. in the context of low-rank tensor completion or matrix-product state learning. We will focus both on algorithmic and on statistical aspects.

In addition to describing data, tensors can also represent computational problems, such as the problem of multiplying large matrices or the evaluation of permanents. In this context, low-rank decompositions correspond to efficient algorithms, while the non-existence of such decompositions amounts to lower bounds. The second emphasis of the workshop will thus be on applications of efficient tensor representations to theoretical computer science, particularly computational complexity theory. A closely related area that will also be covered is the resource theory of tensors in quantum information theory.

This workshop will include a poster session; a request for posters will be sent to registered participants in advance of the workshop.

Long Program Schedule

This workshop is part of the long program on "Tensor Methods and Emerging Applications to the Physical and Data Sciences."

- Opening Day: March 8, 2021.
- Tensor Methods and Emerging Applications to the Physical and Data Sciences Tutorials. March 9-12, 2021.
- Workshop I: Tensor Methods and their Applications in the Physical and Data Sciences. March 29 - April 2, 2021.
- Workshop II: Tensor Network States and Applications. April 19-23, 2021.
- Workshop III: Mathematical Foundations and Algorithms for Tensor Computations. May 3-7, 2021.
- **Workshop IV: Efficient Tensor Representations for Learning and Computational Complexity. May 17-21, 2021.**
- Culminating Workshop at Lake Arrowhead. June 6-11, 2021.

Participation

Additional information about this workshop including links to register and to apply for funding, can be found on the webpage listed below. Encouraging the careers of women and minority mathematicians and scientists is an important component of IPAM's mission, and we welcome their applications.

Organizers

Anima Anandkumar (Caltech), Fernando Brandao (Caltech), Rong Ge (Duke University), David Gross (University of Cologne), Michael Walter (University of Amsterdam), and Ming Yuan (Columbia University).

Speakers

A list of confirmed speakers will be forthcoming.

NSF UCLA

For more information, visit the program webpage:

www.ipam.ucla.edu/tmws4