Abstract

Oberwolfach Workshop:

Computation and Learning in High Dimensions

Dates:

17 August - 22 August 2025 (Code: 2534)

Organizers:

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Computations with functions depending on a large numbers of variables are at the core of many problems in science and engineering. They arise naturally in physical models described by partial differential equations (PDEs) depending on many parameters, in purely data-driven tasks such as optimization and machine learning, and in hybrid contexts combining physical models with data. Traditionally, dealing with such high dimensionality was avoided by the use of simplified models. With the availability of more computational power and the development of sophisticated approximation schemes and algorithms, however, such tasks in high dimensions are increasingly treated directly on the basis of general mathematical principles.

The naive use of classical approximation methods for such problems typically leads to computational costs that scale exponentially with respect to the dimension, an effect known as the *curse of dimensionality*. To make computations tractable, *nonlinear strategies* that leverage in more subtle ways inherent properties of the problem are inevitably required. In recent years, many new and diverse approaches have emerged from different fields. Building a cohesive, overarching theory requires new interactions between approximation theory, numerical analysis, probability theory, mathematical and statistical learning theory, and optimization. This workshop aims to deepen the mathematical foundations of the underlying numerical concepts that drive this new evolution of computational methods, and to promote the exchange of ideas arising from various disciplines about how to treat high-dimensional problems.

MSC Classification: 65 (Numerical Analysis), 41 (Approximations and Expansions)