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From PDEs to data science: an adventure with the graph Laplacian

In this talk we briefly review some basic PDE models that are used to model phase separation in materials science. They have since become important tools in image processing and over the last years semi-supervised learning strategies could be implemented with these PDEs at the core. The main ingredient is the graph Laplacian that stems from a graph representation of the data. This matrix is large and typically dense. We illustrate some of its crucial features and show how to efficiently work with the graph Laplacian. In particular, we need some of its eigenvectors and for this the Lanczos process needs to be implemented efficiently. Here, we suggest the use of the NFFT method for evaluating the matrix vector products without even fully constructing the matrix. We illustrate the performance on several examples.