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Nonnegative Matrix and Tensor Factorizations: Applications to Exploratory Multi-way Data Analysis and Blind Source Separation

Andrzej Cichocki, Rafal Zdunek, Anh Huy Phan, Shun-ichi Amari

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This book provides a broad survey of models and efficient algorithms for Nonnegative Matrix Factorization (NMF). This includes NMF's various extensions and modifications, especially Nonnegative Tensor Factorizations (NTF) and Nonnegative Tucker Decompositions (NTD). NMF/NTF and their extensions are increasingly used as tools in signal and image processing, and data analysis, having garnered interest due to their capability to provide new insights and relevant information about the complex latent relationships in experimental data sets. It is suggested that NMF can provide meaningful components with physical interpretations; for example, in bioinformatics, NMF and its extensions have been successfully applied to gene expression, sequence analysis, the functional characterization of genes, clustering and text mining. As such, the authors focus on the algorithms that are most useful in practice, looking at the fastest, most robust, and suitable for large-scale models.

Key features:

- Acts as a single source reference guide to NMF, collating information that is widely dispersed in current literature, including the authors' own recently developed techniques in the subject area.
- Uses generalized cost functions such as Bregman, Alpha and Beta divergences, to present practical implementations of several types of robust algorithms, in particular Multiplicative, Alternating Least Squares, Projected Gradient and Quasi Newton algorithms.
- Provides a comparative analysis of the different methods in order to identify approximation error and complexity.
- Includes pseudo codes and optimized MATLAB source codes for almost all algorithms presented in the book.

The increasing interest in nonnegative matrix and tensor factorizations, as well as decompositions and sparse representation of data, will ensure that this book is essential reading for engineers, scientists, researchers, industry practitioners and graduate students across signal and image processing; neuroscience; data mining and data analysis; computer science; bioinformatics; speech processing; biomedical engineering; and multimedia.

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