Log-determinant Non-Negative Matrix Factorization via Successive Trace Approximation

Andersen Ang
Department of Mathematics and Operational Research
Faculté Polytechnique, Université de Mons
Rue de Houdain 9, 7000 Mons, Belgium
manshun.ang@umons.ac.be

Nicolas Gillis
Department of Mathematics and Operational Research
Faculté Polytechnique, Université de Mons
Rue de Houdain 9, 7000 Mons, Belgium
nicolas.gillis@umons.ac.be

Non-negative matrix factorization (NMF) is the problem of approximating a non-negative matrix X as the product of two smaller nonnegative matrices W and H so that X = WH. In this talk, we consider a regularized variant of NMF, with a log-determinant (logdet) term on the Gramian of the matrix W. This term acts as a volume regularizer: the minimization problem aims at finding a solution matrix W with low fitting error and such that the convex hull spanned by the columns of W has minimum volume. The logdet of the Gramian of W makes the columns of W interact in the optimization problem, making such logdet regularized NMF problem difficult to solve. We propose a method called successive trace approximation (STA). Based on a logdet-trace inequality, STA replaces the logdet regularizer by a parametric trace functional that decouples the columns on W. This allows us to transform the problem into a vector-wise non-negative quadratic program that can be solved effectively with dedicated methods. We show on synthetic and real data sets that STA outperforms state-of-the-art algorithms.