

On the Path-length Matrices of Unrooted Binary Trees

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Abstract

An Unrooted Binary Tree (UBT) is a connected acyclic graph with internal vertices of degree 3. The Path-Length Matrix (PLM) of a UBT with n leaves encodes, for each pair of leaves i and j , the number of edges in the unique path between i and j . PLMs arise naturally in clustering and computational biology. A key example is the Balanced Minimum Evolution Problem (BMEP), an NP-hard optimization problem on PLMs for phylogenetic inference. From a topological standpoint, UBTs correspond to the facets of the simplicial complex obtained by intersecting the tropical Grassmannian with a unit hypersphere. In this talk, we deal with UBTs from a purely combinatorial standpoint. Building upon prior work, we show that one can characterize the PLMs of UBTs for $n \leq 11$. We also describe spectral properties of PLMs by tracing connections between some tree substructures and specific eigenvalues of the associated PLMs.

Keywords

Combinatorial Optimization, Unrooted Binary Trees, Balanced Minimum Evolution