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Cohen-Macaulay Toric Ideals of Graphs and Geometric Vertex Decomposition

Understanding when the toric ideal of a graph defines a Cohen-Macaulay variety remains an open problem which is related to whether the ideal is geometrically vertex decomposable (GVD). Toric ideals of graphs which are GVD are automatically glicci and Cohen-Macaulay, but it can be difficult to check the GVD property directly. Alternate versions of the property, like being weakly GVD or GVD allowing substitution, are easier to check and still imply the Cohen-Macaulay property. I will provide a brief overview of geometric vertex decomposition and how its various formulations can be used to find graphs whose toric ideals are Cohen-Macaulay. I will also provide an update on topics related to the interaction of GVDs with toric ideals of graphs, including graph coloring, Hamiltonian cycles, and the GVD classification problem.