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Resolutions of Nerves of Graphs

The nerve $\mathcal{N}(\Delta)$ of a simplicial complex $\Delta$ is a simplicial complex whose vertices correspond to facets of $\Delta$ and whose facets correspond to vertices of $\Delta$. We examine $\mathcal{N}(G)$, considering the graph as a simplicial complex, and identify structures and properties of the original graph $G$ recognizable in the resolutions of the Stanley-Reisner ideal of $\mathcal{N}(G)$. Specifically, via the (multi)graded betti numbers of $I(\mathcal{N}(G))$, we enumerate all spanning trees of $G$, all maximal matchings of $G$, and numerous other features of our graph. Additionally, we produce new classes of edge ideals $I_G'$ with bounded regularity and other highly prescribed invariants.