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Graph Relations and Clique Divergence

Given a graph G, its *clique graph* $K(G)$ is the intersection graph of all its (maximal) cliques. *Iterated clique graphs* are defined by $K^0(G) = G$ and $K^{n+1}(G) = K\big(K^n(G)\big)$. A graph G is said to be clique divergent if the sequence of orders $|G|, |K(G)|, |K^2(G)|, \ldots, |K^n(G)|, \ldots$ diverges. A graph relation $f\colon G \to H$ is a relation of sets $f \subseteq V(G) \times V(H)$ such that $f(X)$ induces a complete subgraph of H whenever X induces a complete subgraph of G. Here, we introduce a technique for proving clique divergence of graphs using graph relations. As a consequence we prove that every surface admits a (Whitney) triangulation whose underlying graph is clique divergent.