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The complexity of signed graph homomorphisms

Given a graph $G = (V, E)$, a *signing* of E is the assignment of $+$ or $-$ to each edge of G. Let $\Sigma \subseteq E$ be the set of negative. We call (G, Σ) a *signed graph*. To *switch* at a vertex v is a resigning of all the positive edges incident at v to negative and vice versa. Two signed graphs (G, Σ) and (G, Σ') are equivalent if one can be obtained from the other by a sequence of switches. The class of all signed graphs equivalent to (G, Σ) is denoted $[G, \Sigma]$.

A *homomorphism* of $(G, \Sigma) \to (H, \Pi)$ is a vertex map that preserves edges and their signs. A homomorphism of equivalence classes $[G, \Sigma] \to [H, \Pi]$ exists if some member $(G, \Sigma') \in [G, \Sigma]$ admits a homomorphism to some member $(H, \Pi') \in [H, \Pi]$. In this talk we examine and contrast the computational complexity of determining the existence of signed graph homomorphisms in the case that switching is not allowed, i.e. viewing the objects as edge-coloured graphs, and where switching is allowed, i.e. homomorphisms of equivalence classes. In particular, we give a dichotomy theorem for the latter case.