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Social Balance on Networks: The Dynamics of Friendship and Hatred¹

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We study the evolution of social networks that contain both friendly and unfriendly pairwise links between individual nodes. The network is endowed with dynamics in which the sense of a link in an imbalanced triad—a triangular loop with 1 or 3 unfriendly links—is reversed to make the triad balanced. Thus an imbalanced triad is analogous to a frustrated plaquette in a random magnet, while a balanced triad fulfills the adage: “a friend of my friend is my friend; an enemy of my friend is my enemy; a friend of my enemy is my enemy; an enemy of my enemy is my friend.” With this frustration-reducing dynamics, an infinite network undergoes a dynamic phase transition from a steady state to “paradise”—all links are friendly—as the propensity for friendly links to be created in an update event passes through $1/2$. On the other hand, a finite network always falls into a socially-balanced absorbing state where no imbalanced triads remain. A prominent example of the achievement of social balance is the evolution of pacts and treaties between various European countries during the late 1800’s and early 1900’s. Here social balance gave rise to the two major alliances that comprised the protagonists of World War I.

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