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Permutahedra and Generalized Associahedra

Given a finite Coxeter system (W, S) and a Coxeter element c, we construct a simple polytope whose outer normal fan is N. Reading's Cambrian fan $\mathcal{F}_c$, settling a conjecture of Reading that this is possible. We call this polytope the c-generalized associahedron. These polytopes are combinatorially isomorph to the generalized associahedra related to cluster algebras and introduced by S. Fomin and A. Zelevinsky.

Our approach generalizes Loday's realization of the associahedron (a type A c-generalized associahedron whose outer normal fan is not the cluster fan but a coarsening of the Coxeter fan arising from the Tamari lattice) to any finite Coxeter group. A crucial role in the construction is played by the c-singleton cones, the cones in the c-Cambrian fan which consist of a single maximal cone from the Coxeter fan.