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Skeletal Uniform Polyhedra

A skeletal polyhedron in ordinary space is a finite or infinite discrete structure made up of finite or infinite polygons as faces, with two faces on each edge and a circular vertex-figure at each vertex. Finite faces can be planar or skew, and infinite faces can be linear, zigzag, or helical. A skeletal polyhedron is said to be uniform if its faces are (finite or infinite) regular polygons and its geometric symmetry group is transitive on the vertices. The classification of arbitrary uniform skeletal polyhedra is a rather challenging open problem, but partial results are known. The convex uniform polyhedra are precisely the Archimedean solids and the prisms and anti-prisms. The classification of the finite uniform polyhedra with planar (convex or star-polygon) faces was essentially obtained in a classical paper by Coxeter, Longuet-Higgins and Miller in 1954, although the completeness of the enumeration was only proved years later, independently, by Skilling and Har'El. We explain how variants of Wythoff's construction applied to the regular or chiral skeletal polyhedra in ordinary space can be exploited to produce highly symmetric, vertex-transitive skeletal polyhedra, which in many cases are new uniform polyhedra. We describe the blueprint for the construction and discuss interesting examples including new skeletal snub polyhedra. This is joint work with Abigail Williams and Tomas Skacel.