Generation of generalized cubic graphs

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In this talk we describe a generator for generalized classes of cubic graphs, like cubic graphs with loops, cubic multigraphs, cubic graphs with semi-edges (i.e. dangling edges) and any combination of these.

We will describe how the cubic pregraphs can be constructed from simple graphs and will describe the isomorphism rejection methods which are based on McKay's canonical construction path method and the homomorphism principle. The generation uses a set of construction operations which take the graph and a set of elements (edges or vertices) as input.

The problem is first translated to the generation of (multi)graphs with degree 1 and 3. In a later phase the vertices with degree 1 give rise to the loops and/or the semi-edges. Two construction operations for graphs with degree 1 and degree 3 vertices are shown in the image below. Starting from all the cubic simple graphs and K_2 all simple cubic graphs with loops and/or semi-edges can be constructed using just these two operations. Another set of operations is needed to also construct multigraphs.

For the first (resp. second) operation we make sure that it is only applied once for a certain graph and a certain orbit of pairs of vertices with degree 1 (resp. a certain orbit of bridges). This way we are sure that we will never construct the same (intermediate) graph from the same input. We also define for each (intermediate) graph a canonical parent graph and only accept an (intermediate) graph if it is constructed from that canonical parent. This is the basic principle of the canonical construction path method.

We will also present the results of our generation.