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Graph Isomorphism Testing

The computational complexity of graph isomorphism has remained unresolved for decades. Research is conducted on the complexity of the problem in general, and usually efficient algorithms on restricted graph classes are designed. Although, it is not easy to devise difficult graph isomorphism instances, combinatorial constructions have provided the most difficult, notably point-line incidence graphs of finite projective planes and graphs by the -Cai-Furer–Immerman construction.

In this talk, we show a novel approach for a polynomial time Graph Isomorphism tester. The key part of this scheme produces labelled trees (which are invariant), by decomposing the given graphs via a particular ordering. To date, the GI tester has not failed to distinguish any non-isomorphic graphs tested. It is known that the Weisfeiler–Lehman algorithm subsumes almost all combinatorial graph algorithms that are not based on group theoretic methods. It is also true that for any fixed k, the k-dimensional Weisfeiler–Lehman algorithm solves graph isomorphism only for a subclass of graphs. It has not been determined if the GI tester using the labelled cycle decomposition tree scheme is subsumed by some k-dim W–L refinement.