Structural Rounding - Brian Lavallee

We describe a new framework for generalizing approximation algorithms for structural graph classes so that they apply to graphs "close" to a class (a scenario we expect is common when working with real-world networks) while still guaranteeing approximation ratios. The so-called structural rounding framework edits graphs into a nearby algorithmically tractable class, applies a class-specific approximation algorithm, then lifts the partial solution to the original graph. We give a general characterization of when an optimization problem is amenable to this approach, and show that it includes many well-studied graph problems, such as Independent Set, Vertex Cover, Feedback Vertex Set, Minimum Maximal Matching, Chromatic Number, (l-)Dominating Set, Edge (l-)Dominating Set, and Connected Dominating Set. Further, we describe an experimental evaluation of the frameworks efficacy for Vertex Cover on near-bipartite graphs (using the exact poly-time algorithm on the edited instances). In addition to the naive lifting strategy for Vertex Cover, we introduce a suite of new lifting strategies and measure their effectiveness on a large corpus of synthetic graphs. We find that in this setting, structural rounding significantly outperforms standard 2-approximations.