An Exact Algorithm with a New Upper Bound and Reductions for Maximum Edge Weighted Clique in Massive Sparse Graphs

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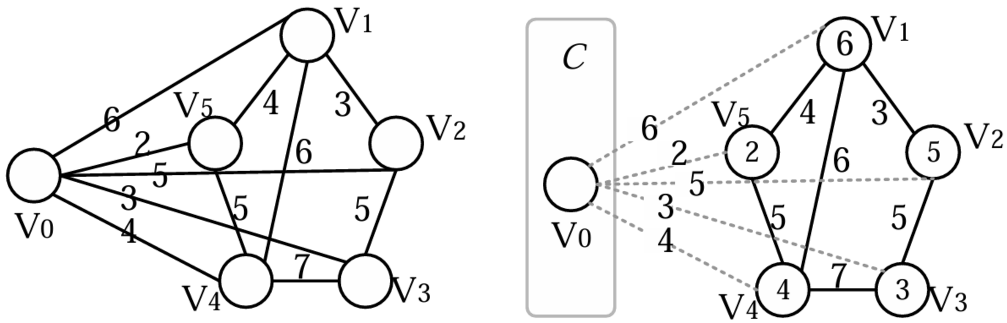
Problems & Ideas

- Maximum Edge Weighted Clique Problem:
  - As a generlization of the maximum clique problem, MEWC has the stronger modeling capability
  - Existing exact approacehes are not efficent to solve the massive graphs and fail to solve graphs exceed 30,000 vertices
- Ideas: Applying the two-level independent set partition a tighter upper bound is proposed to prune branches and improve the efficiency. To remove as many redundant vertices as possible, a fast reduction mechanism is applied during the search.

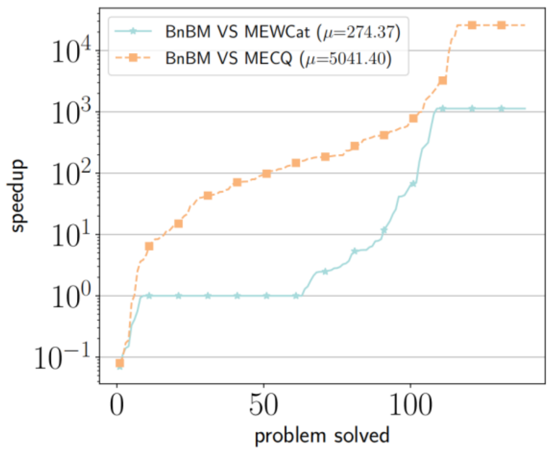


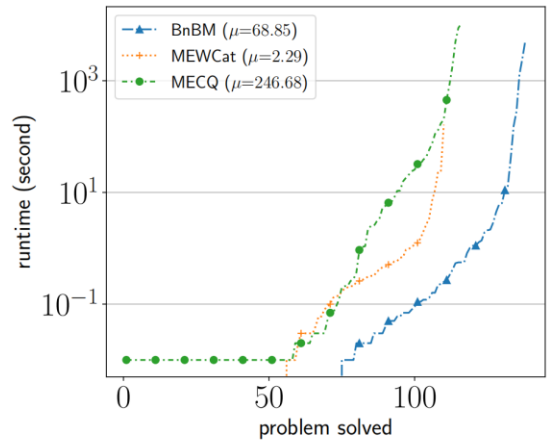
(a) (b)

The figure (a) is an example of edge weighted graphs, and the MEWC is to find the clique with the maximum sum edge weight. The figure (b) is an exmaple of vertex-edge weighted graphs, when computing the upper bound we can shift the weights of edges from vertices in the clique and vertices in the candidates set to the vertex.

Main Contributions

- Contributions:
  - We propose a method by applying the two-level independent set partition to obtain a tighter upper bound ,which can to improve the efficiency of pruning branches.
  - To remove as many redundant vertices as possible, a fast reduction mechanism is applied during the search.
  - On the 139 real-world large instances, within the same cutoff time, our proposed BnBM solves 24 instances more than the state-of-the-art exact solvers, and BnBM achieves a speedup on 75 out of 139 instances.





The left figure: Speedup of (BnBM VS MEWCat) and (BnBM VS MECQ), and the μ is the average speedup. The right figure: Runtime plot for the comparative algorithm, and the μ is the average time over the solved instances