Max-Cut Heuristics Evaluation Report

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Overview

This report presents a comparison of the five heuristic algorithms for solving the Max-Cut problem on a set of graphs. The implemented algorithms are:

- Randomized

- Greedy

- Semi-Greedy

- Local Search

- **GRASP** (Greedy Randomized Adaptive Search Procedure)

Algorithm Descriptions

Randomized Algorithm: Each vertex is randomly assigned to one of the two partitions with equal probability. This process is repeated multiple times and the average or best cut value is reported.

Greedy Algorithm: Starts with the heaviest edge and places its endpoints into opposite partitions. Remaining vertices are assigned to the partition where they contribute more to the current cut weight.

Semi-Greedy Algorithm: Like greedy, but instead of always picking the best option, it selects from a restricted candidate list (RCL) based on a tunable parameter α. This introduces randomness to the solution.

Local Search: Starting from a solution (e.g., from Semi-Greedy), iteratively moves vertices between partitions to locally improve the cut weight. Stops when no single move improves the solution.

GRASP: Combines semi-greedy construction with local search. Repeats the entire process multiple times and returns the best solution found across iterations.

Performance Comparison

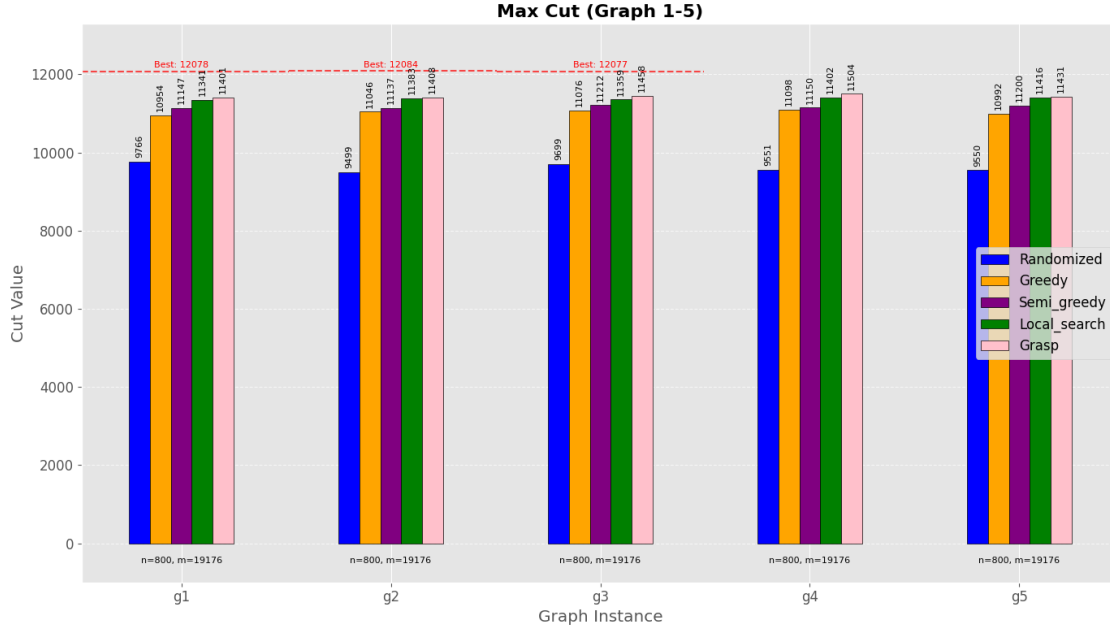The following figure shows the Max-Cut values obtained by each algorithm across Graphs G1 to G5.

Figure 1: Comparison of Max-Cut values for different algorithms on G1–G5

Observations:

- GRASP consistently performs the best among all methods across all graphs.

- Local Search significantly improves solutions obtained from initial greedy or semi-greedy constructions.

- The greedy approach performs better than the randomized one but is often outperformed by semi-greedy.

- Randomized solutions are the least consistent and have the highest variance.

Conclusion

GRASP emerges as the most effective heuristic among those implemented, achieving the highest cut values across the graphs. While greedy methods provide a good baseline, combining them with local search improves results to a great extent.