Graph Coloring Approximation

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§1 Instance Generation

We generated a diverse dataset of **510** graph instances to evaluate the performance of a greedy approximation algorithm for the graph coloring problem. The dataset includes: 1) Varying graph sizes (from small to large).2) A mix of sparse and dense graphs. 3) Graphs with random edge distributions. 4) Various structured graphs.

§2 Approximation Algorithm

We implemented a degree-based greedy coloring algorithm in which Vertices are sorted in descending order of degree. For each vertex in order, we assign the smallest available color not already used by its neighbors. Then, the algorithm returns the total number of colors used, which is at most one more than the maximum color index assigned. This algorithm starts with handling nodes with high degree as they are more likely to cause conflicts. This greedy approach is simple, fast, and often performs well on real-world graphs, despite its worst-case behavior.

§3 Performance Analysis

Below is the histogram of the approximation ratio along with statistics summary that elaborate the efficiency of our algorithm.

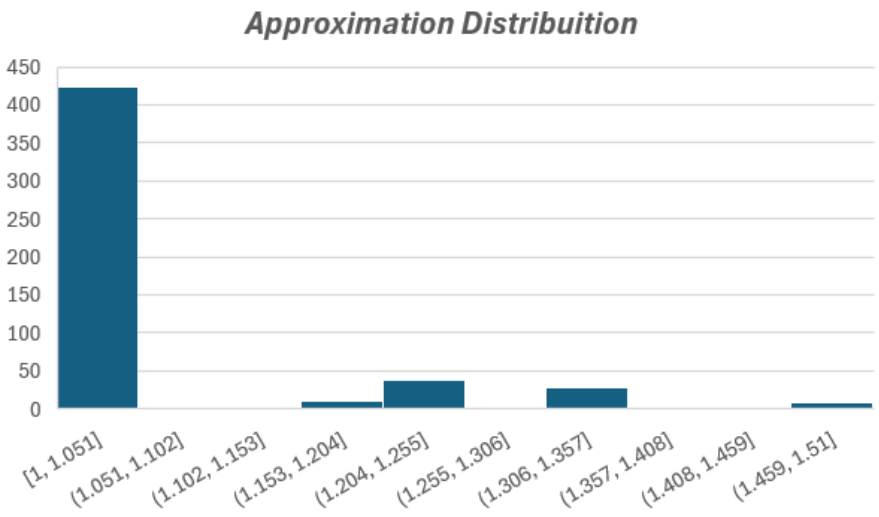

Figure 1: ***Distribution of Approximation Ratios***

Aprroximation Ratio	
Mean	1.049853529
Standard Error	0.005142849
Median	1
Mode	1
Standard Deviation	0.116141878
Sample Variance	0.013488936
Kurtosis	3.733509251
Skewness	2.191541242
Range	0.5
Minimum	1
Maximum	1.5
Sum	535.4253
Count	510

Figure 2: ***Summary Statistics***

§4 AI tool conversations

- https://claude.ai/share/27042c7b-c981-4838-94fb-23dd8665cb55
- https://www.perplexity.ai/search/do-this-same-code-but-for-grap-sDh4OdJ1QiOdrCL3dtqYtw