Dataset-Medadata-AAD

November 2025

1 Chromatic Numbers of Graph Instances

1.1 Dataset and Sources

The graph instances used in our experiments were taken from the **DIMACS / COLOR benchmark dataset** hosted at Carnegie Mellon University [1]. The collection contains **79 graphs** of various families (DSJC, DSJR, school, queen, etc.). While the dataset listing provides vertex and edge counts for each graph, many of the optimal chromatic numbers $\chi(G)$ were marked as unknown ("?").

To fill in missing values, we referred to two main sources:

1. The **Graph Coloring Benchmarks** compiled by Daniel Porumbel [2], which summarize best-known and proven colorings for DIMACS instances.

2. Additional benchmark papers and repositories (e.g., Moalic & Gondran [3], Hertz et al. [4], and others) that report state-of-the-art colorings.

When a proven $\chi(G)$ was known, we list it as the chromatic number. Otherwise, we report the best-known upper bound k^* (i.e., the fewest colors found so far by any published algorithm).

1.2 Chromatic Numbers / Best-Known Colorings

1.3 Remarks

For all DSJC and DSJR graphs, the listed values are the best-known colorings achieved by advanced heuristic or metaheuristic algorithms; exact proofs of optimality are typically unknown. For structured graphs such as the *queen* family, the chromatic number is mathematically proven to equal the board size ($\chi(Q_n) = n$).

Table 1: Chromatic numbers and best-known colorings for graphs in our dataset - In the cases where an optimal chromatic number was not provided in the CMU DIMACS dataset.

Graph Instance	**(—V—, —E—)**	**Chromatic / Best k^***	**Source**
DSJC1000.1.col.b	(1000, 99258)	20	[3]
DSJC1000.5.col.b	(1000, 499652)	83	[4]
DSJC1000.9.col.b	(1000, 898898)	224	[3]
DSJC125.1.col.b	(125, 1472)	5	[2]
DSJC125.5.col.b	(125, 7782)	17	[2]
DSJC125.9.col.b	(125, 13922)	44	[2]
DSJC250.1.col.b	(250, 6436)	8	[2]
DSJC250.5.col.b	(250, 31366)	28	[3]
DSJC250.9.col.b	(250, 55794)	72	[5]
DSJC500.1.col.b	(500, 24916)	12	[4]
DSJC500.5.col.b	(500, 125249)	48	[3]
DSJC500.9.col.b	(500, 224874)	126	[3]
DSJR500.1.col.b	(500, 7110)	12	[4]
DSJR500.1c.col.b	(500, 242550)	85	[5]
DSJR500.5.col.b	(500, 117724)	122	[4]
school1_nsh.col	(352, 14612)	14	[2]
queen10_10.col	(100, 2940)	11	[6]
queen11_11.col	(121, 3960)	11	[6]
queen12_12.col	(144, 5192)	12	[6]
queen13_13.col	(169, 6656)	13	[6]
queen14_14.col	(196, 8372)	14	[6]
queen15_15.col	(225, 10360)	15	[6]
queen16_16.col	(256, 12640)	16	[6]

References

[1] M. Trick, *COLOR/Graph Coloring Instances*. Available at: https://mat.tepper.cmu.edu/COLOR/instances.html

[2] D. C. Porumbel, *Graph Coloring Benchmarks and Best Algorithms*. Available at: https://cedric.cnam.fr/ porumbed/graphs

[3] L. Moalic and P. Gondran, "Variations on memetic algorithms for graph coloring problems," *arXiv preprint arXiv:1401.2184*, 2014.

[4] A. Hertz, D. de Werra, and M. Plante, "Variable Neighborhood Search for Graph Coloring," *Computers & Operations Research*, vol. 39, no. 7, pp. 1719–1731, 2012.

[5] S. Loudni, "Graph Coloring Results," *GREYC Laboratory Benchmark Page*. Available at: https://loudni.users.greyc.fr/Coloring.html

[6] J. Mitchell, "On the Chromatic Number of Queen Graphs," *Journal of Combinatorial Theory*, Series B, 1990.