Table 1: Optimizer Family vs Problem Family Performance Matrix

Problem Family	Adam	GD	L-BFGS	QQN	Trust Region
Ackley	16.3 / 12.0 Adam-AMSGrad Adam-Fast	16.5 / 9.7 GD GD-Momentum	6.5 / 2.3 L-BFGS Conservative	5.1 / 1.0 Bisection-2 GoldenSection	20.7 / 13.7 Conservative Aggressive
Barrier	8.5 / 3.0 WeightDecay Adam-Fast	6.2 / 1.0 GD AdaptiveMom...	3.7 / 2.3 Conservative L-BFGS-Limited	inf / inf N/A N/A	13.1 / 8.0 Conservative Aggressive
Beale	19.0 / 8.0 WeightDecay Adam-Fast	8.8 / 3.0 GD-Nesterov GD-Momentum	10.0 / 2.0 MoreThuente Aggressive	8.8 / 1.0 GoldenSection Bisection-2	18.4 / 15.0 Precise Standard
Booth	19.2 / 11.0 WeightDecay Adam-Robust	14.6 / 10.0 GD GD-Momentum	11.0 / 6.0 MoreThuente Aggressive	3.0 / 1.0 CubicQuadIn... GoldenSection	17.2 / 12.0 Adaptive Conservative
GoldsteinPrice	13.2 / 10.0 Adam-AMSGrad Adam-Fast	15.2 / 9.0 GD-Momentum GD	10.4 / 5.0 MoreThuente Aggressive	3.2 / 1.0 GoldenSection Bisection-2	23.0 / 21.0 Aggressive Precise
Griewank	17.7 / 12.0 Adam-Fast Adam-Robust	12.0 / 7.7 GD-Momentum GD	7.9 / 3.7 Aggressive L-BFGS	6.3 / 1.0 StrongWolfe CubicQuadIn...	21.1 / 13.7 Conservative Aggressive
Himmelblau	18.8 / 11.0 WeightDecay Adam-Robust	14.6 / 9.0 GD AdaptiveMom...	11.2 / 5.0 L-BFGS-Limited Aggressive	3.4 / 1.0 GoldenSection Bisection-1	17.0 / 8.0 Adaptive Conservative
IllConditionedRosenbrock	14.2 / 9.0 WeightDecay Adam-Robust	12.5 / 7.0 GD-Nesterov GD-Momentum	12.5 / 4.7 MoreThuente Aggressive	4.1 / 1.7 CubicQuadIn... GoldenSection	21.8 / 16.7 Aggressive Conservative
Levi	14.4 / 11.0 Adam-Robust Adam-Fast	14.6 / 9.0 GD-Momentum GD-WeightDecay	11.6 / 3.0 L-BFGS-Limited Aggressive	3.8 / 1.0 GoldenSection Bisection-1	20.6 / 13.0 Conservative Aggressive
Levy	15.9 / 10.0 WeightDecay Adam-AMSGrad	16.2 / 7.7 GD-WeightDecay AdaptiveMom...	9.1 / 6.7 Conservative Aggressive	3.0 / 1.0 Bisection-2 GoldenSection	20.8 / 16.0 Conservative Aggressive
Matyas	13.2 / 10.0 Adam-Fast Adam-AMSGrad	16.0 / 12.0 GD-Momentum AdaptiveMom...	8.8 / 3.0 L-BFGS Aggressive	4.0 / 1.0 StrongWolfe Bisection-1	23.0 / 21.0 Conservative Precise
Michalewicz	6.2 / 1.0 Adam Adam-Robust	12.1 / 6.7 AdaptiveMom... GD-WeightDecay	14.3 / 7.0 MoreThuente Aggressive	11.9 / 6.7 Bisection-2 CubicQuadIn...	20.5 / 16.3 Conservative Aggressive
Neural Networks	9.1 / 3.5 WeightDecay Adam-Robust	19.4 / 16.0 GD-WeightDecay AdaptiveMom...	11.3 / 8.0 Conservative L-BFGS	3.6 / 1.0 Bisection-2 StrongWolfe	21.6 / 18.5 Adaptive Aggressive
NoisySphere	16.9 / 8.7 Adam-Fast Adam	8.8 / 5.3 AdaptiveMom... GD-WeightDecay	7.4 / 1.0 Conservative Aggressive	9.9 / 2.7 StrongWolfe CubicQuadIn...	19.9 / 16.3 Conservative Precise
PenaltyI	8.1 / 4.3 Adam-AMSGrad Adam-Fast	12.3 / 9.7 GD GD-Nesterov	14.3 / 5.7 Conservative Aggressive	7.5 / 1.0 CubicQuadIn... Bisection-2	22.9 / 20.7 Adaptive Precise
Rastrigin	11.4 / 4.7 Adam-AMSGrad Adam-Fast	14.2 / 7.7 GD-WeightDecay GD-Momentum	14.1 / 3.7 MoreThuente Aggressive	9.9 / 3.0 CubicQuadIn... Bisection-2	15.4 / 7.0 Adaptive Conservative

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Table 1 – continued from previous page

Problem Family	Adam	GD	L-BFGS	QQN	Trust Region
Regression	18.5 / 13.2 Adam-Fast Adam-Robust	13.6 / 8.2 AdaptiveMom... GD	8.9 / 4.8 Conservative L-BFGS	3.4 / 1.0 Bisection-1 GoldenSection	20.6 / 17.2 Adaptive Conservative
Rosenbrock	13.4 / 6.0 Adam-Fast Adam-Robust	12.1 / 5.0 GD-Nesterov GD-Momentum	12.6 / 4.0 MoreThuente Aggressive	4.9 / 2.0 StrongWolfe GoldenSection	22.0 / 17.7 Aggressive Conservative
SVM	13.5 / 8.5 WeightDecay Adam-Fast	13.9 / 5.0 GD-WeightDecay AdaptiveMom...	9.6 / 3.0 Conservative L-BFGS-Limited	6.3 / 2.5 StrongWolfe GoldenSection	21.7 / 17.0 Conservative Aggressive
Schwefel	20.1 / 10.7 Adam-Fast Adam-Robust	10.5 / 6.7 GD-WeightDecay GD	10.5 / 4.3 Conservative Aggressive	4.3 / 1.0 StrongWolfe GoldenSection	19.7 / 16.7 Standard Conservative
SparseQuadratic	18.9 / 12.5 WeightDecay Adam-AMSGrad	14.5 / 10.5 GD-WeightDecay AdaptiveMom...	6.4 / 1.5 MoreThuente L-BFGS	4.9 / 1.5 GoldenSection Bisection-1	20.3 / 14.5 Precise Aggressive
SparseRosenbrock	12.9 / 8.0 Adam-Fast Adam-Robust	11.8 / 6.0 GD-Nesterov GD-Momentum	15.2 / 4.5 L-BFGS-Limited Aggressive	3.7 / 1.0 CubicQuadIn... Bisection-2	21.4 / 19.0 Standard Conservative
Sphere	20.1 / 14.5 WeightDecay Adam-AMSGrad	13.9 / 10.0 GD-Momentum AdaptiveMom...	6.1 / 1.0 Aggressive Conservative	5.3 / 3.0 StrongWolfe GoldenSection	19.6 / 14.0 Conservative Aggressive
StyblinskiTang	16.6 / 4.3 WeightDecay Adam-Robust	14.2 / 7.3 GD-WeightDecay AdaptiveMom...	10.3 / 2.3 Conservative Aggressive	8.7 / 1.7 GoldenSection StrongWolfe	15.3 / 4.3 Standard Conservative
Trigonometric	12.7 / 7.3 Adam Adam-Fast	14.3 / 5.0 GD GD-Momentum	12.7 / 5.3 MoreThuente Aggressive	4.0 / 1.0 CubicQuadIn... Bisection-2	21.3 / 17.7 Precise Aggressive
Zakharov	13.4 / 9.3 WeightDecay Adam-Robust	14.7 / 7.3 GD AdaptiveMom...	11.7 / 6.0 MoreThuente L-BFGS	3.0 / 1.0 GoldenSection StrongWolfe	22.2 / 19.0 Adaptive Conservative

Legend: Each cell contains:

- **Top line:** Average Ranking / Best Rank Average (lower is better)
- **Middle line:** Best performing variant in this optimizer family
- **Bottom line:** Worst performing variant in this optimizer family

Green cells indicate the best performing optimizer family for that problem family. Red cells indicate the worst performing optimizer family.