

# Exercise 1: Results & Comparison (RLS, (1+1) EA, GA)

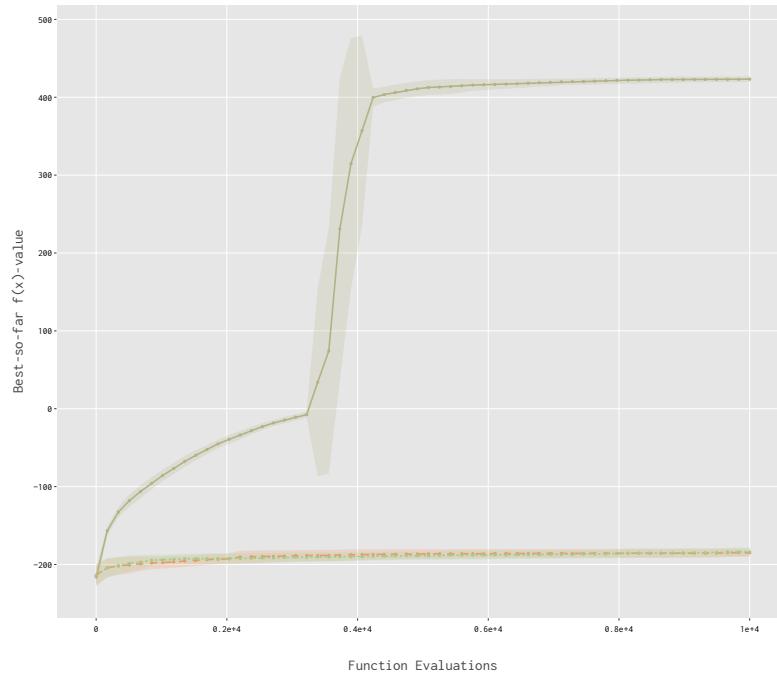
## Setup

Each algorithm ran for 10,000 fitness evaluations, multiple independent runs per instance. Figures below show mean and  $\pm 1$  SD for RLS, (1+1) EA, and GA.

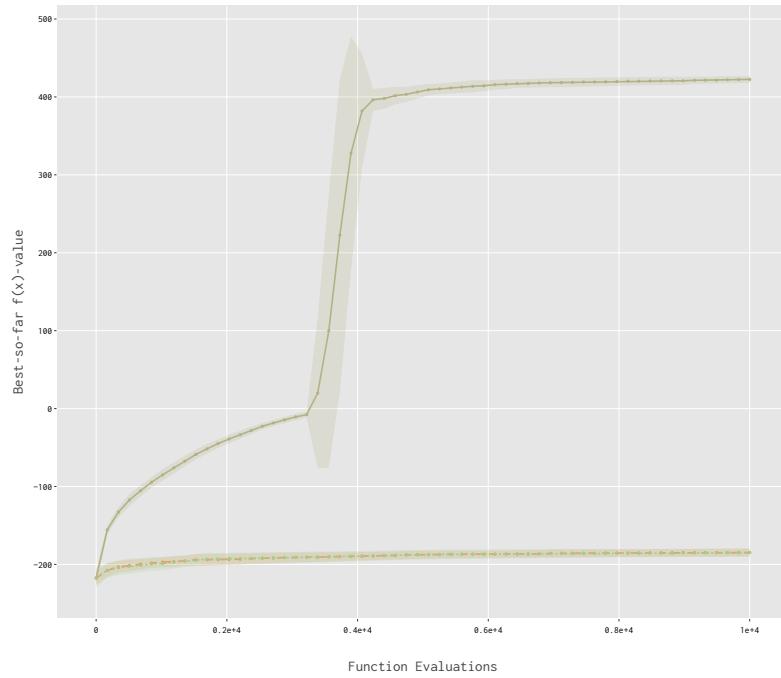
## MaxCoverage

Across all four coverage instances, GA achieves the strongest end-of-budget quality, with (1+1) EA typically ahead of RLS by mid-to-late budget. Variability is consistently lowest for RLS, moderate for (1+1) EA, and higher early for GA that tightens by the end.

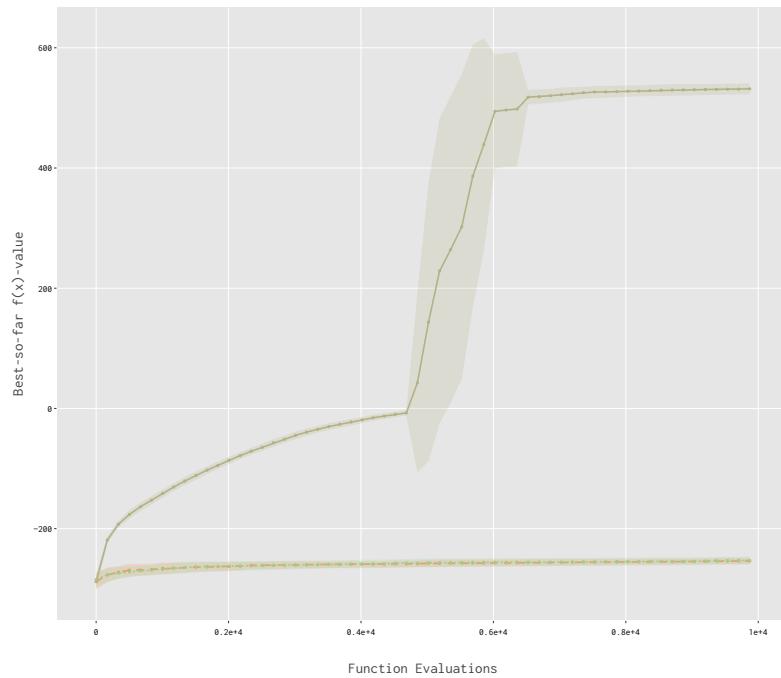
Coverage is monotone submodular with recombinable building blocks (semi-disjoint neighborhoods). Crossover in GA effectively assembles complementary partial covers, something mutation-only methods reach more slowly; (1+1) EA still improves over RLS via occasional multi-bit flips that jump local plateaus.



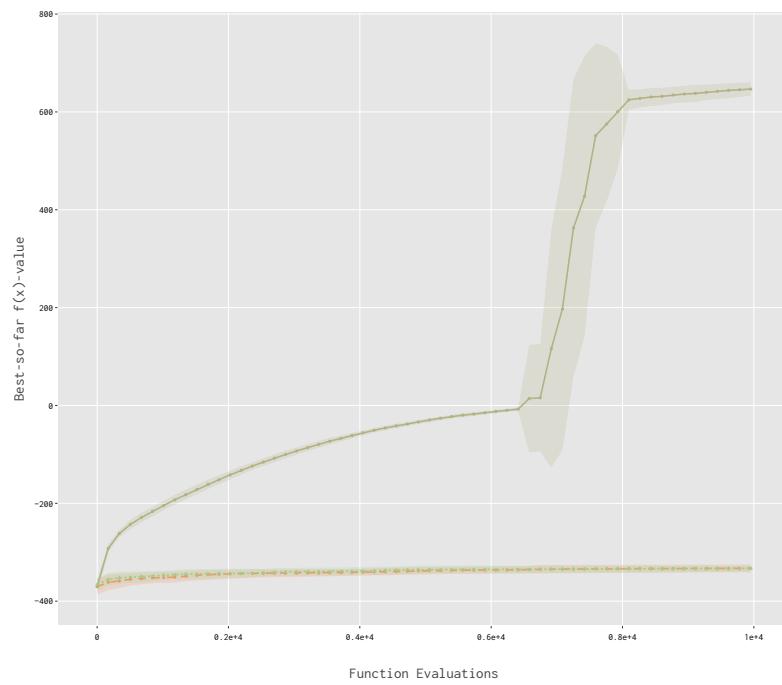
Fixed\_budget\_EX1\_f2101\_MaxCoverage



Fixed\_budget\_EX1\_f2102\_MaxCoverage



Fixed\_budget\_EX1\_f2103\_MaxCoverage

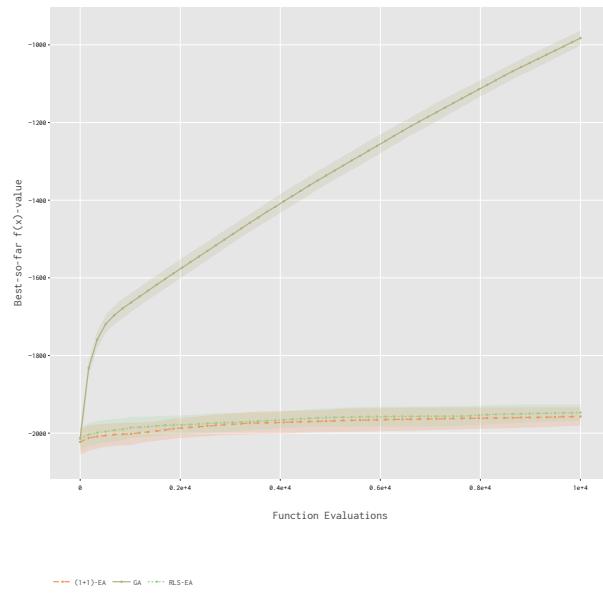


Fixed\_budget\_EX1\_f2104\_MaxCoverage

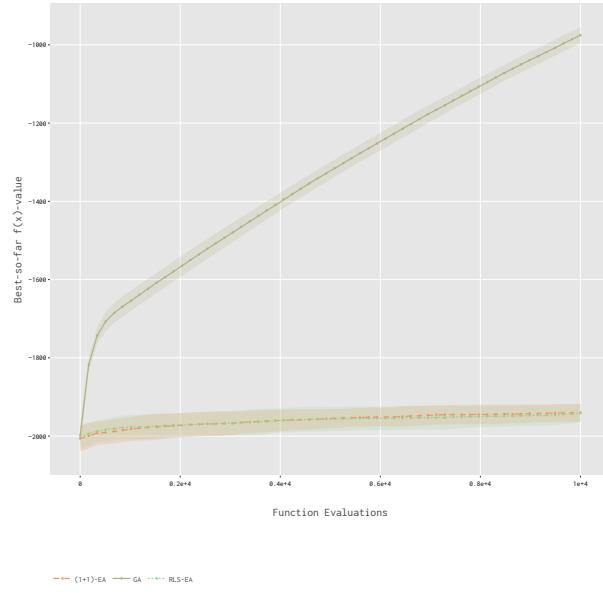
## MaxInfluence

On these influence graphs, (1+1) EA generally matches or beats RLS at the end of the budget, while GA is not consistently superior. Instance-to-instance variability is visible (especially on harder graphs), driven by seed-interaction effects.

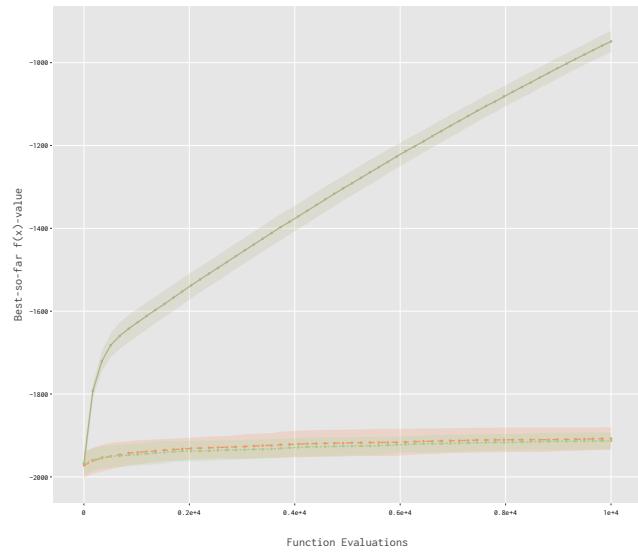
Influence spread depends on interacting seeds and community structure. Mutation-only search (RLS / (1+1) EA) reliably performs incremental seed replacement; (1+1) EA's rare multi-bit moves improve over RLS. GA needs community-preserving crossover or seed-aware operators to realize a clear advantage; without those, recombination can disrupt good seed sets.



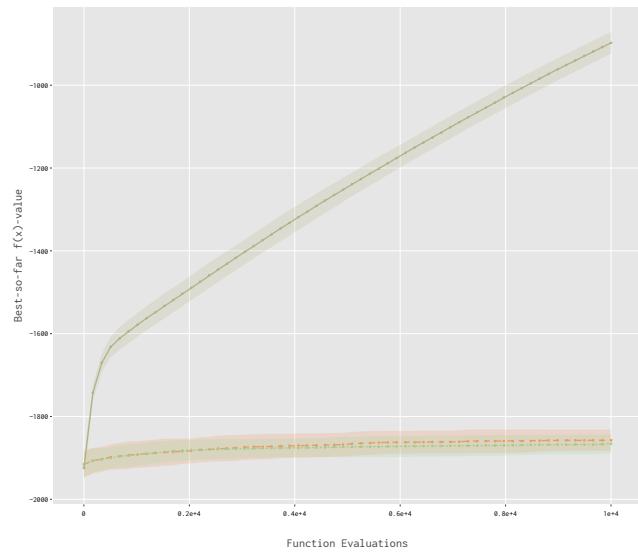
Fixed\_budget\_EX1\_f2201\_MaxInfluence



Fixed\_budget\_EX1\_f2202\_MaxInfluence



Fixed\_budget\_EX1\_f2203\_MaxInfluence

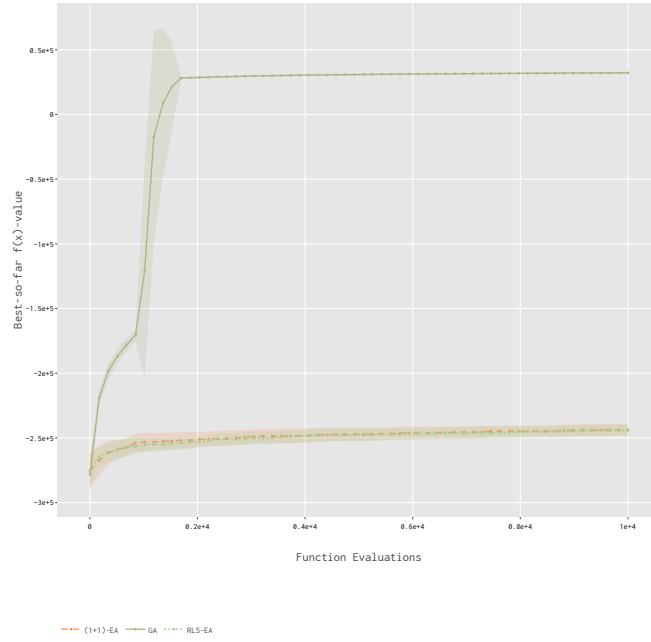


Fixed\_budget\_EX1\_f2204\_MaxInfluence

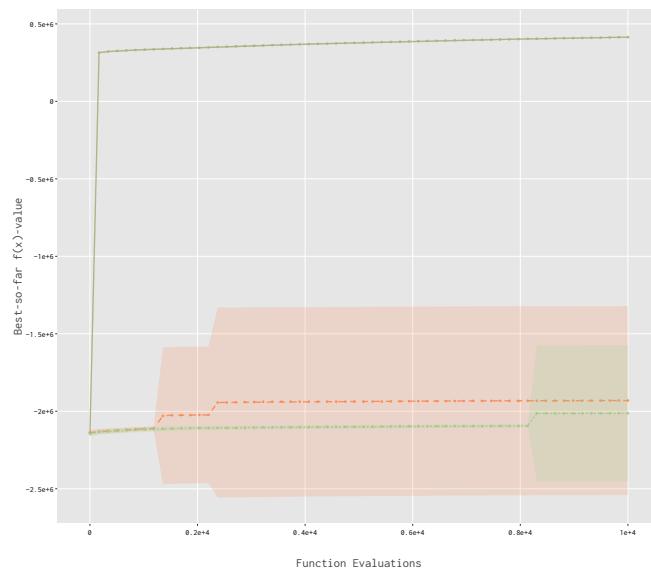
## PackWhileTravel

RLS  $\approx$  (1+1) EA deliver the most reliable final quality; GA is inconsistent across instances.

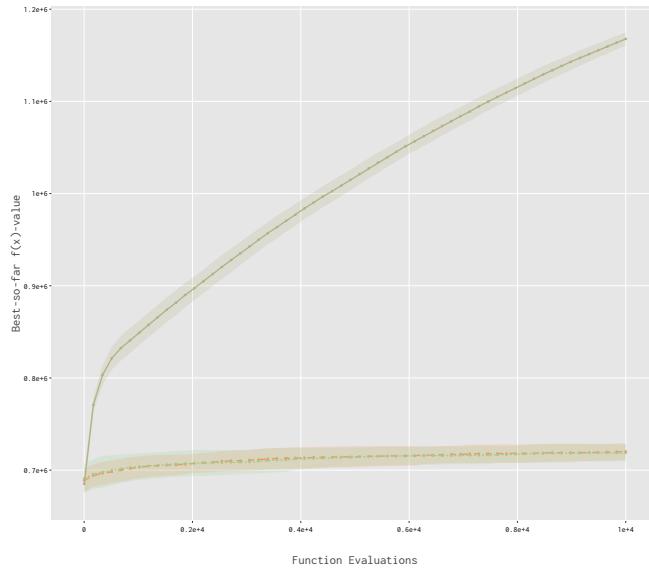
Pack While Travel couples feasibility and route-dependent profit; progress is dominated by local feasible improvements. Mutation-only search exploits these reliably. Crossover helps only if it preserves feasible, profitable route segments or is paired with diversity; otherwise GA's advantage doesn't materialize within the 10k budget.



Fixed\_budget\_EX1\_f2301\_PackWhileTravel



Fixed\_budget\_EX1\_f2302\_PackWhileTravel



Fixed\_budget\_EX1\_f2303\_PackWhileTravel

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## Summary

- **RLS**: most stable early progress; baseline for consistency.
- **(1+1) EA**: overtakes RLS on harder instances via multi-bit jumps over plateaus.
- **GA**: best on Coverage (recombination of building blocks), but not consistently better on Influence/PWT without structure-aware operators.