

A Research Proposal toward Metaheuristics Explainability and Comparability

In Brief

Metaheuristics are used to explore the search space and find (near) optimal solutions.

Despite their success, disquisitions highlight problems related to explainability and comparability.

Thus, we present current research trends and a possible work direction involving knowledge engineering.

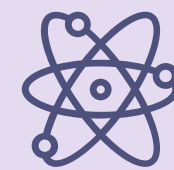
Metaheuristic Algorithms



High-level strategies for search and optimization problems



Great **success** in different application fields (e.g., scheduling, facility location, and WalkSAT)



Inspired by **metaphors** (e.g., bio-inspired metaheuristics)

Issues & Motivation

Explainability, comparability, and replicability issues

- ✗ *Performance-based approach*
- ✗ *Focus on short-term optimization goal*
- ✗ *Definition of novel algorithm*
- ✗ *Usage of metaphors as justification*

Current Research Trends



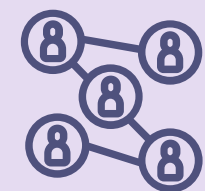
Explainability beyond metaphors

e.g., literature reviews, methods classification, algorithms decomposition, and metaphor-free description



Knowledge discovery

e.g., MAP-Elites, surrogate models, instance space analysis, reactive search, and guided local search



Network analysis

e.g., local optima networks and search trajectory networks



Automated design

e.g., hyper-heuristics and programming by optimization

Research Proposal

Explore and evaluate methods to guarantee explainability, comparability, replicability, and transparency



How are the following concepts defined in the metaheuristic field?

Explainability, communicability, reproducibility, replicability, online knowledge, offline knowledge



What techniques are currently used to enhance explainability, communicability, reproducibility, and transparency?

Aim, application, possible extensions, black- or white-box approach, machine learning integration

Development of methodological, conceptual, and practical tools that enable explainability, comparability, replicability, and transparency



How can knowledge engineering be used to exploit metaheuristic search processes?

Is it possible to incorporate both online and offline knowledge? Can machine learning be useful in this case?