

Research Project

Beyond Distance Estimates (BDE)

Third-party funded project

Project title Beyond Distance Estimates (BDE)

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Project Website <https://ai.dmi.unibas.ch/research/>

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Many problems in computer science can be cast as state-space search, where the objective is to find a path from an initial state to a goal state in a directed graph called a state space. State-space search is challenging due to the state explosion problem a.k.a. curse of dimensionality: interesting state spaces are often astronomically large, defying brute-force exploration.

State-space search has been a core research problem in Artificial Intelligence since its early days and is alive as ever. Every year, a substantial fraction of research published at the ICAPS and SoCS conferences is concerned with state-space search, and the topic is very active at general AI conferences such as IJCAI and AAAI.

Algorithms in the A* family, dating back to 1968, are still the go-to approach for state-space search. A* is a graph search algorithm whose only “intelligence” stems from a so-called heuristic function, which estimates the distance from a state to the nearest goal state. The efficiency of A* depends on the accuracy of this estimate, and decades of research have pushed the envelope in devising increasingly accurate estimates. In this project, we question the “A* + distance estimator” paradigm and explore three new directions that go beyond the classical approach:

1. We propose a new paradigm of *declarative heuristics*, where heuristic information is not represented as distance estimates, but as properties of solutions amenable to introspection and general reasoning.
2. We suggest moving the burden of creativity away from the human expert by casting *heuristic design* as a *meta-optimization problem* that can be solved automatically.
3. We propose abandoning the idea of exploring sequential paths in state spaces, instead transforming state-space search into combinatorial optimization problems with no explicit sequencing aspect. We argue that the *curse of sequentiality* is as bad as the curse of dimensionality and must be addressed head-on.

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