Best-Case and Worst-Case Behavior of Greedy Best-First Search

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Motivation

A* [Hart et al.,1968]

- many potentially expanded states on last f-layer
- tie-breaking is important
- best case: shortest path
- worst case: all potentially expanded states
- polynomial-time computable in size of state space

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Greedy best-first search [Doran and Michie, 1966]

- large heuristic plateaus
- tie-breaking assumed to be important
- best case: ?
- worst case: ?
- tractable?

Complexity Results

Given a state space and a heuristic:

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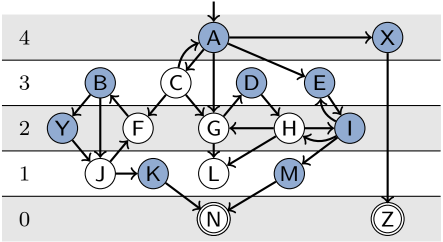
polynomial-time computable

- in size of the state space
- undirected edges
- overlap-free craters and benches

Background

- locally characterized progress states
- based on high-water mark



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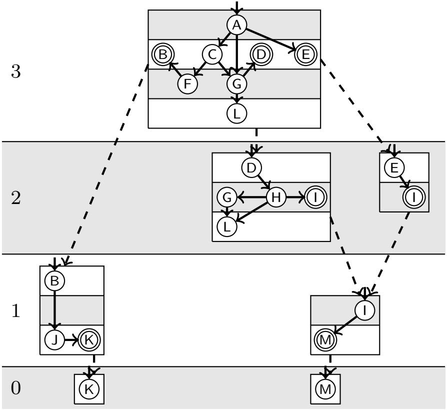

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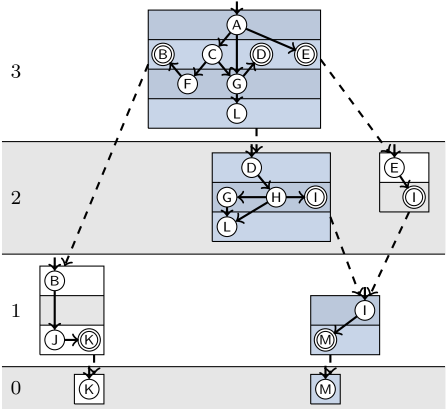
- search run is sequence of episodes
- episode searches on single bench along a bench path



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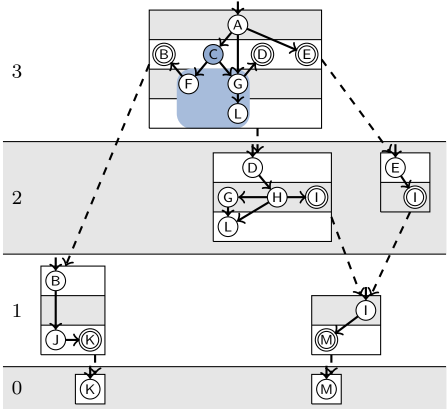
- directed acyclic graph of benches
- search run is sequence of episodes
- episode searches on single bench along a bench path
- crater relates to local minimum



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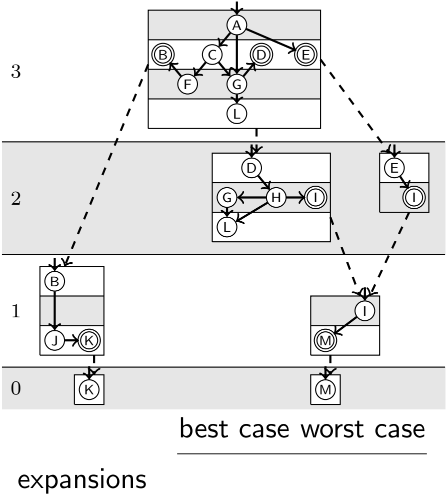
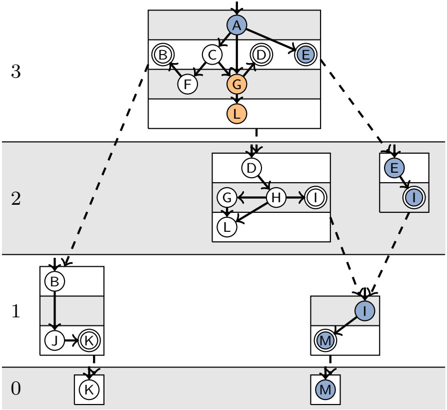


Best-Case and Worst-Case Behavior

- best case: minimize along state path including all necessarily expanded crater states



	best case	worst case
expansions	6	

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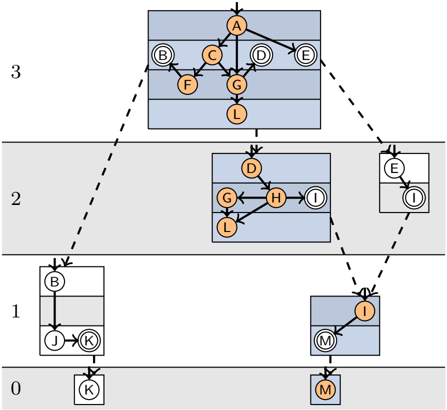

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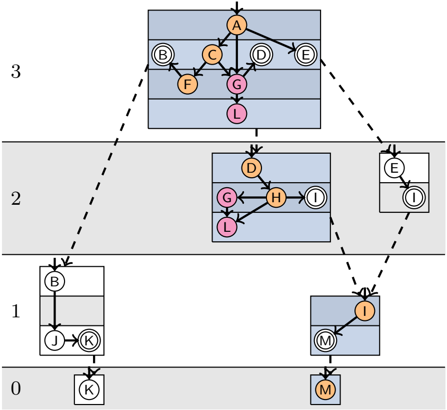
Best-Case and Worst-Case Behavior

- best case: minimize along state path including all necessarily expanded crater states
- worst case: maximize along bench path including all potentially expanded bench states
- beware of overlapping benches and craters



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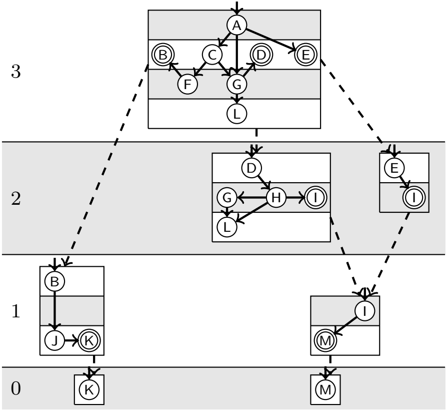

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Experimental Results

- implemented algorithms for computing best and worst cases
- state spaces of planning tasks from international planning competitions
- Fast Forward heuristic

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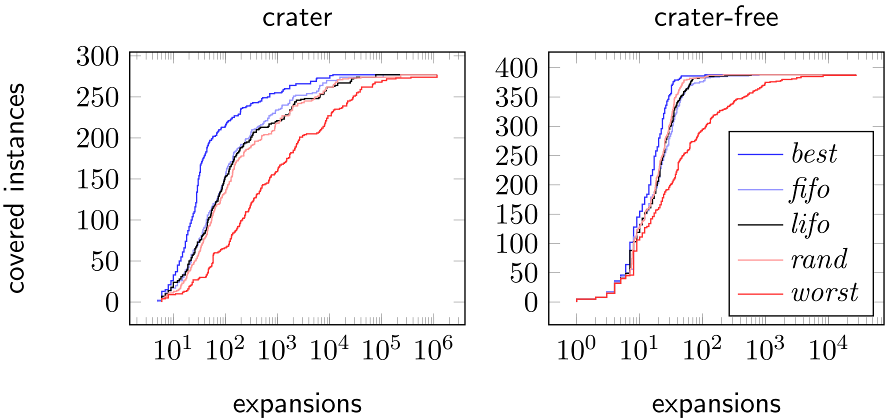
- worst cases for 739 instances

Standard Tie-Breaking Strategies



Conclusion

- NP-complete in general
- computing best and worst cases is often feasible
- large impact of tie-breaking for less informed heuristics
- room for improvement over standard tie-breaking strategies

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Thank you for your attention!