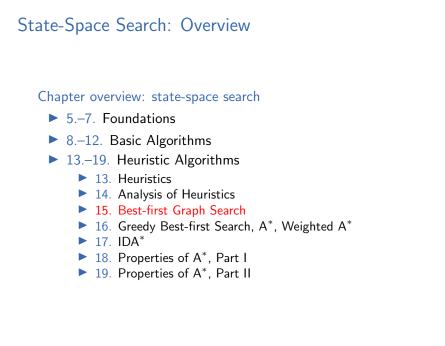


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March 22, 2023

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Foundations of Artificial Intelligence March 22, 2023 — 15. State-Space Search: Best-first Graph Search		
15.1 Introduction		
15.2 Best-first Search		
15.3 Algorithm Details		
15.4 Reopening		
15.5 Summary		
Keller & F. Pommerening (University of B Foundations of Artificial Intelligence	March 22, 2023	2 / 21

15. State-Space Search: Best-first Graph Search

15.1 Introduction

March 22, 2023 1 / 21

Introduction



Heuristic Search Algorithms

Heuristic Search Algorithms Heuristic search algorithms use heuristic functions to (partially or fully) determine the order of node expansion.

this chapter: short introduction

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next chapters: more thorough analysis

Best-first Search

5 / 21

March 22, 2023

Introduction

15. State-Space Search: Best-first Graph Search Best-first Search

Best-first search is a class of search algorithms that expand the "most promising" node in each iteration.

- decision which node is most promising uses heuristics...
- ▶ ... but not necessarily exclusively.

```
15.2 Best-first Search
```

15. State-Space Search: Best-first Graph Search

15. State-Space Search: Best-first Graph Search

Best-first Search

Best-first search is a class of search algorithms that expand the "most promising" node in each iteration.

- decision which node is most promising uses heuristics...
- but not necessarily exclusively.

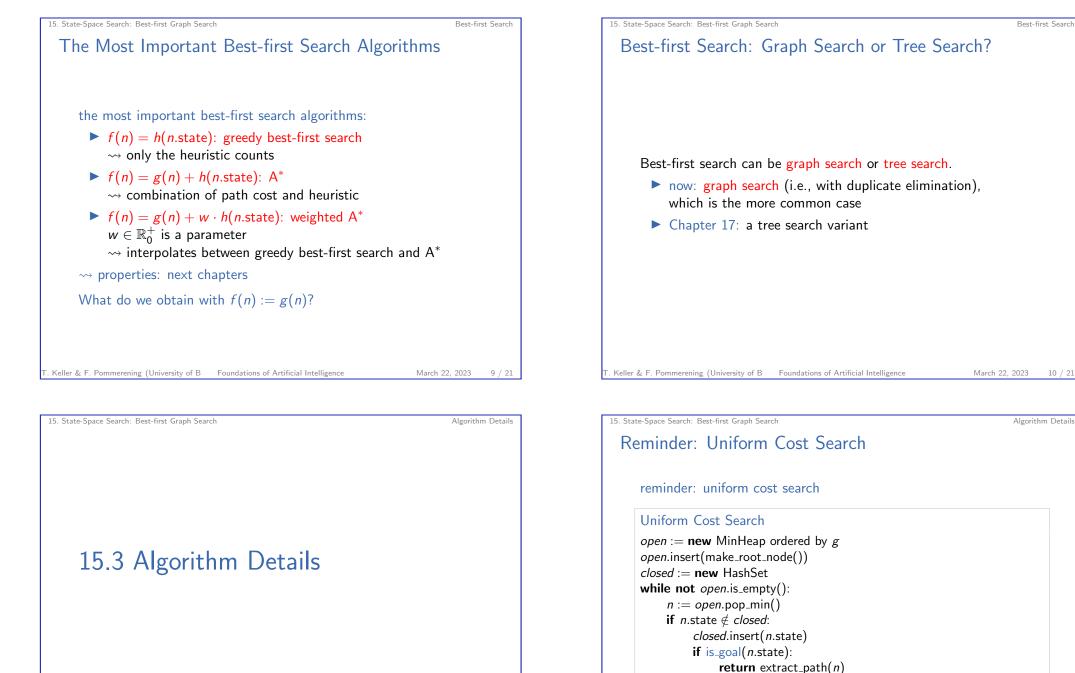
Best-first Search

A best-first search is a heuristic search algorithm that evaluates search nodes with an evaluation function fand always expands a node n with minimal f(n) value.

- implementation essentially like uniform cost search
- different choices of $f \rightsquigarrow$ different search algorithms

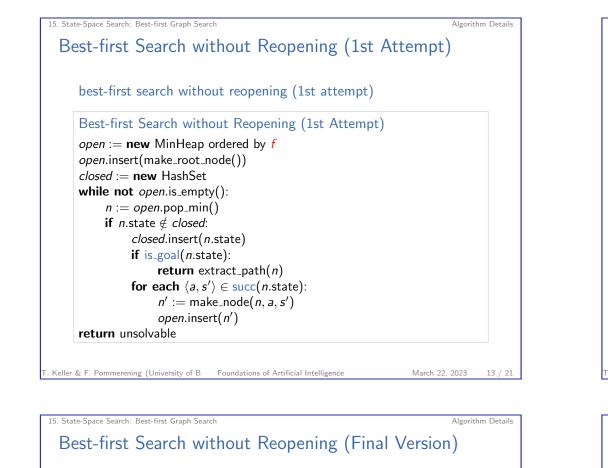
Best-first Search

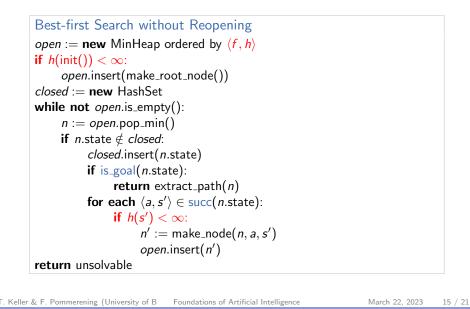
Best-first Search



open.insert(n')

```
.
return unsolvable
```





15	State-Space	Search	Rest_first	Graph	Search
тJ.	State-Space	Jearch.	Dest-mst	Graph	Jearch

Best-first Search w/o Reopening (1st Attempt): Discussion

Discussion:

This is already an acceptable implementation of best-first search.

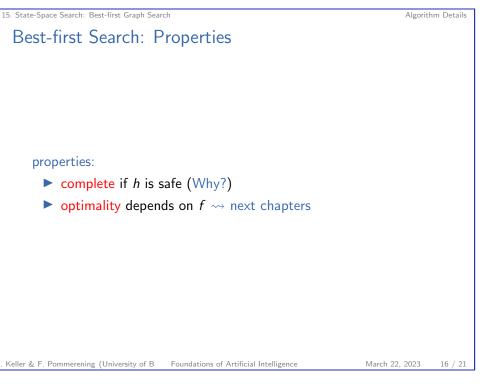
two useful improvements:

- discard states considered unsolvable by the heuristic ~> saves memory in open
- if multiple search nodes have identical f values, use h to break ties (preferring low h)
 - not always a good idea, but often
 - obviously unnecessary if f = h (greedy best-first search)

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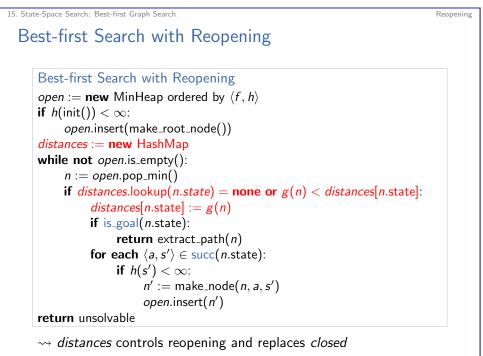
March 22, 2023 14 / 21

Algorithm Details



15.4 Reopening

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March 22, 2023

17 / 21

15. State-Space Search: Best-first Graph Search

Reopening

in order of increasing g values
→ guarantees that cheapest path to state of a node has been found when the node is expanded
with arbitrary evaluation functions f in best-first search this does not hold in general
→ in order to find solutions of low cost, we may want to expand duplicate nodes when cheaper paths to their states are found (reopening)
German: Reopening

reminder: uniform cost search expands nodes

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March 22, 2023 18 / 21





Summary

March 22, 2023 21 / 21

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- **best-first search**: expand node with minimal value of evaluation function f
 - f = h: greedy best-first search

 - *f* = *g* + *h*: A* *f* = *g* + *w* ⋅ *h* with parameter *w* ∈ ℝ₀⁺: weighted A*
- here: best-first search as a graph search
- reopening: expand duplicates with lower path costs to find cheaper solutions