

Search Algorithms

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Contents

- I. Introduction
- II. Basic Search Algorithms
- III. Informed Search
- IV. Search Space Representation
- V. Search Theory
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Objectives

- ❑ Understand the mechanics of graph search.
- ❑ Implement best-first graph search efficiently.
- ❑ Model problems as search problems.
- ❑ Understand heuristics as a means to control search.
- ❑ Sensibly vary between optimality and relaxation.
- ❑ Construct domain-specific search algorithms.

Literature

Books on Heuristic Search

- ❑ Edmund K. Burke, Graham Kendall.
Search Methodologies
2nd edition, Springer, 2014.
- ❑ Nils J. Nilsson.
Artificial Intelligence: A New Synthesis
Morgan Kaufmann, 1998.
- * Judea Pearl.
Heuristics
Addison-Wesley, 1984.
- ❑ Stuart Russel, Peter Norvig.
Artificial Intelligence: A Modern Approach
3rd edition, Prentice Hall, 2010.
- ❑ Stefan Edelkamp, Stefan Schrödl.
Heuristic Search: Theory and Applications
Elsevier, 2012. [\[DOI\]](#)

The slides of this course closely follow the book *Heuristics* of Judea Pearl.

Literature

Further Reading

- Chapter I.
 - Daniel Ratner, Manfred Warmuth.
Finding a Shortest Solution for the $N \times N$ Extension of the 15-Puzzle is Intractable.
Proc. AAAI, pp. 168–172, 1986. [\[Link\]](#)

Literature

Further Reading (continued)

- Chapter III.
 - Antti Autere.
Extensions and Applications of the A Algorithm.*
PhD-Thesis, Helsinki University of Technology, 2005. [\[Link\]](#)

Literature

Further Reading (continued)

- Chapter IV.
 - Elaine Rich, Kevin Knight, Shivashankar Nair.
Artificial Intelligence
3rd edition, Tata McGraw Hill, 2009.
 - Michael R. Garey, David S. Johnson.
Computers and Intractability: A Guide to the Theory of NP-Completeness.
W. H. Freeman 1979, ISBN 0-7167-1044-7.

Literature

Further Reading (continued)

□ Chapter V.

- Peter E. Hart, Nils J. Nilsson, Bertram Raphael.
A Formal Basis for the Heuristic Determination of Minimum Cost Paths.
IEEE Transactions on Systems Science and Cybernetics, pp. 100–107, 1968. [\[DOI\]](#)
- Peter E. Hart, Nils J. Nilsson, Bertram Raphael.
Correction to "A Formal Basis for the Heuristic Determination of Minimum Cost Paths".
ACM SIGART Bulletin, pp. 28–29, 1972. [\[DOI\]](#)
- Alberto Martelli.
On the Complexity of Admissible Search Algorithms.
J. Artificial Intelligence, pp. 1–13, 1977. [\[DOI\]](#)
- László Mérő.
A Heuristic Search Algorithm with Modifiable Estimate.
J. Artificial Intelligence, pp. 13–27, 1984. [\[DOI\]](#)
- Robert C. Holte.
Common Misconceptions Concerning Heuristic Search.
Proc. 3rd Annual Symposium on Combinatorial Search (SOCS), pp. 46–51, 2010. [\[Link\]](#)
- Zhifu Zhang, Nathan R. Sturtevant, Robert C. Holte, Jonathan Schaeffer, Ariel Felner.
A Search with Inconsistent Heuristics.*
Proc. 21st International Joint Conference on Artificial Intelligence (IJCAI), pp. 634–639, 2009. [\[Link\]](#)

Literature

Further Reading (continued)

- Chapter V.
 - Rina Dechter, Judea Pearl.
The Optimality of A Revisited*.
Proc. AAAI, pp. 95–99, 1983. [[Link](#)]
 - Rina Dechter, Judea Pearl.
*Generalized Best-first Strategies and the Optimality of A**.
J. Association for Computing Machinery, pp. 505–536, 1985. [[DOI](#)]

Literature

Further Reading (continued)

- Chapter VI.
 - Rüdiger Ebendt, Rolf Drechsler.
Weighted A Search - Unifying View and Application.*
J. Artificial Intelligence, pp. 1310–1342, 2009. [\[DOI\]](#)