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K*: A heuristic search algorithm for finding the k shortest paths. (English) Zbl 1238.68148
Artif. Intell. 175, No. 18, 2129-2154 (2011).

Summary: We present a directed search algorithm, called K*, for finding the k shortest paths between a designated pair of vertices in a given directed weighted graph. K* has two advantages compared to current k-shortest-paths algorithms. First, K* operates on-the-fly, which means that it does not require the graph to be explicitly available and stored in main memory. Portions of the graph will be generated as needed. Second, K* can be guided using heuristic functions. We prove the correctness of K* and determine its asymptotic worst-case complexity when using a consistent heuristic to be the same as the state of the art, O(m + n log n + k), with respect to both runtime and space, where n is the number of vertices and m is the number of edges of the graph. We present an experimental evaluation of K* by applying it to route planning problems as well as counterexample generation for stochastic model checking. The experimental results illustrate that due to the use of heuristic, on-the-fly search K* can use less time and memory compared to the most efficient k-shortest-paths algorithms known so far.

MSC:
68T20 Problem solving in the context of artificial intelligence (heuristics, search strategies, etc.)
05C38 Paths and cycles
05C85 Graph algorithms (graph-theoretic aspects)

Keywords:
k-shortest-paths problem; K*; heuristic search; on-the-fly search

Software:
PRISM; DIMACS

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