Anytime Heuristic Search: Frameworks and Algorithms

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Which bounded suboptimal search performs best when converted to an anytime search?

Previously Proposed Frameworks

Continued Search
Hansen & Zhou 2007

Best first search stops here,
but continued search keeps going!

Trouble

Continued search is biased towards nodes near the goal.

Contribution: Improved Anytime Window A*

Window A* expands nodes within a fixed distance of the deepest node expanded. It assumes nodes at similar depths are the same distance from the goal and similarly informed.

d-Fenestration

Not all nodes progress towards the goal at the same rate. We can estimate their distance using d.

Basing the windows on d rather than depth leads to large speedups!

Main Contribution: Framework Is Key

There are enormous differences between the performance of bounded suboptimal search algorithms.

There is little difference when placed within anytime search frameworks.

Of all the tested algorithms, repairing and restarting anytime search consistently perform well. Other approaches have domains where they perform quite poorly.

Repairing Search
Likhachev, Gordon, & Thrun 2003

We change the algorithm parameters between goals and revert.

Repairing reduces the bias to a great extent.

Restarting Search
Richter, Thayer, & Rumml 2010

Run a series of bounded suboptimal searches ending with an optimal search.

Restarting removes the bias entirely.

Scaling window size

The window size of an iteration of anytime window A* greatly impacts performance. We grow the window quickly when no solution is found, and slowly otherwise.

Framework has a larger impact on performance than underlying algorithm.

Repairing search is frequently better than restarting search, and these techniques consistently outperform other approaches.