

A Planning.Domains Plugin for Heuristic Visualization



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*: Equal contribution, and listed alphabetically.



Background

Planning methods use heuristics to speed up calculation of the optimal path to the goal. There has been a great deal of work in designing and implementing different heuristic techniques, but very little in terms of visualizing them (with specific ties to AI Planning).

These heuristic techniques can be difficult to design. As such, a visualization would prove useful in expediting the process. The challenge of creating a heuristic visualization, tied to the dynamic exploration of the state space, is what this work addresses.

Solution

Developed an interactive forward search planner within the pre-existing editor, Planning.Domains. Our solution includes a state space interactive visualization using D3's tree diagram functionality and a heuristic visualization using D3's force directed graph functionality.

The state space visualization allows for dynamic loading, which is essential given the size of many PDDL files. Zooming, panning and tooltip capabilities were implemented to create a better interactive experience for the user

The heuristic visualization is triggered when invoked from details on a node in the state. The heuristic performs its computation on this node. During this time, the heuristic graph indicates what states are being updated by highlighting each node until no more updates can be made. This graph also utilizes the zoom, panning and tooltip capabilities of D3

Purpose

This project aims to fill the gap in the field of automated planning for educational experiences explaining core concepts of modern planners and to construct a flexible framework for researchers to visualize and test their ideas for new heuristics and search procedures

Methods



D3 is a JavaScript library that provides data driven visualization capabilities. This tool was essential in creating and designing both the state space and heuristic visualizations as well as their interactive capabilities.

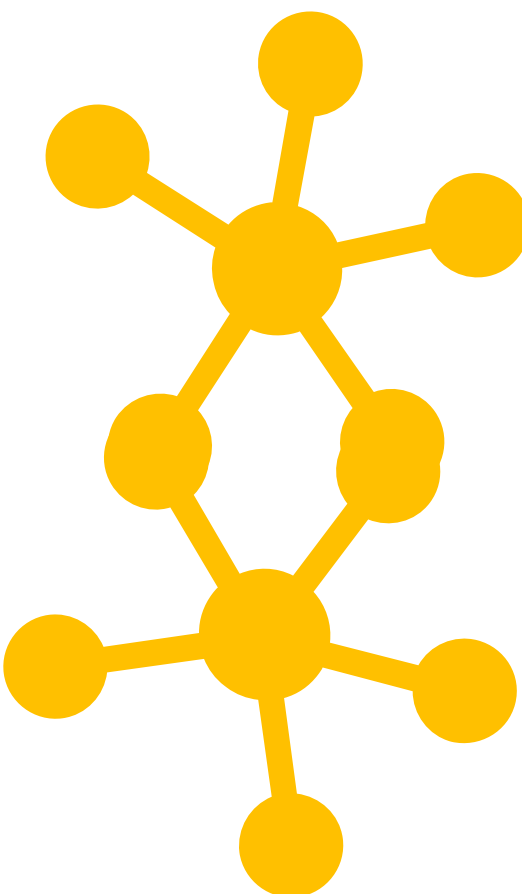
Tarski is an automated planning library written in Python, included for client-side usage via WebAssembly technology.

Domain consists of finite objects, actions, preconditions, **Problem** consists of an initial state and goal node.

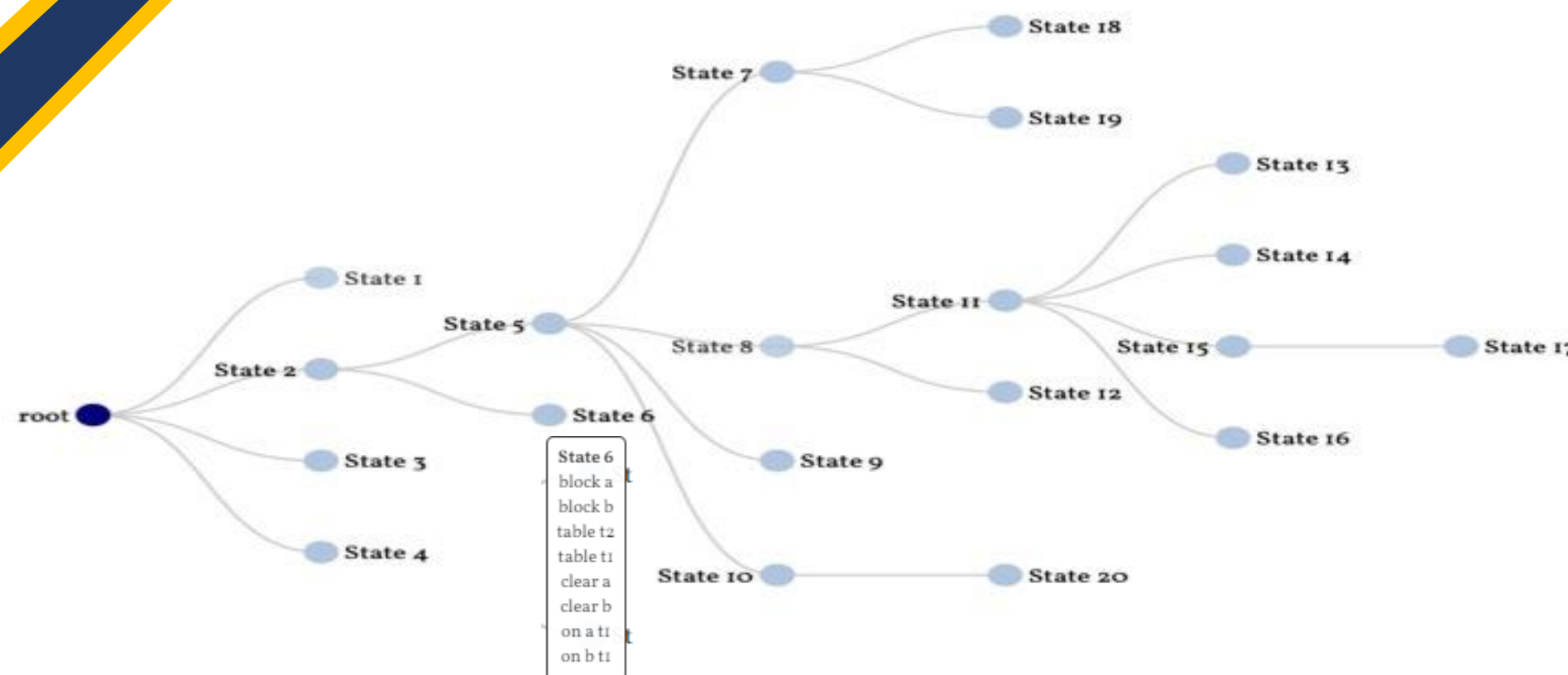


Hadd Heuristic

The hAdd heuristic works by creating a graph of all the possible fluents and all the possible ground actions. Values of fluents are updated by taking the minimum adding action and values of actions are updated by taking the sum of precondition fluents. The updates are then slowly propagated to the goal node until no more updates can be made.



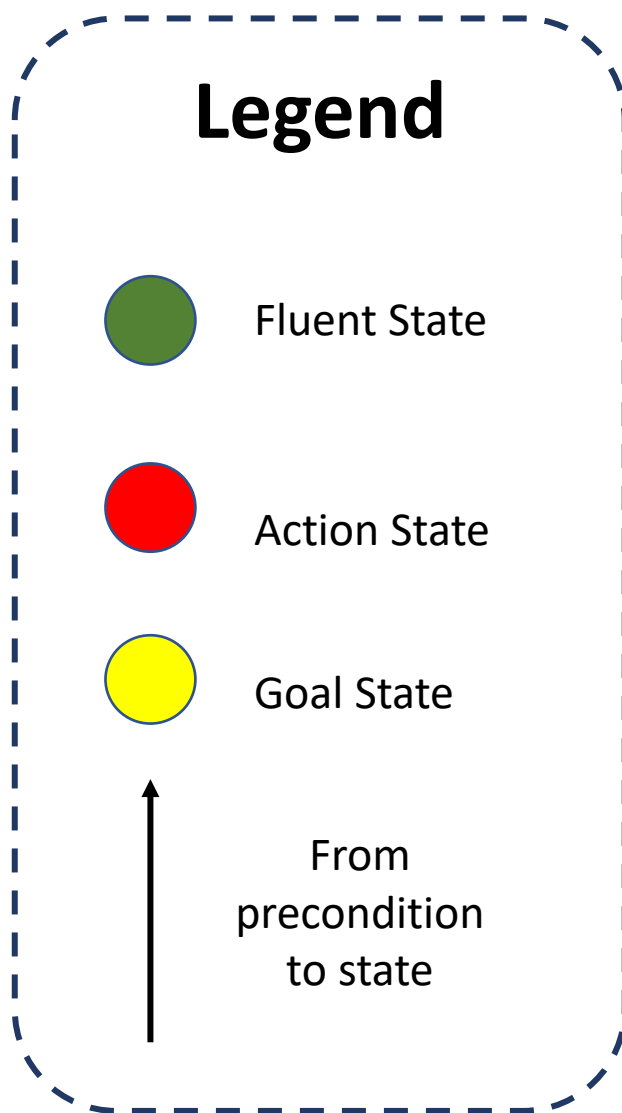
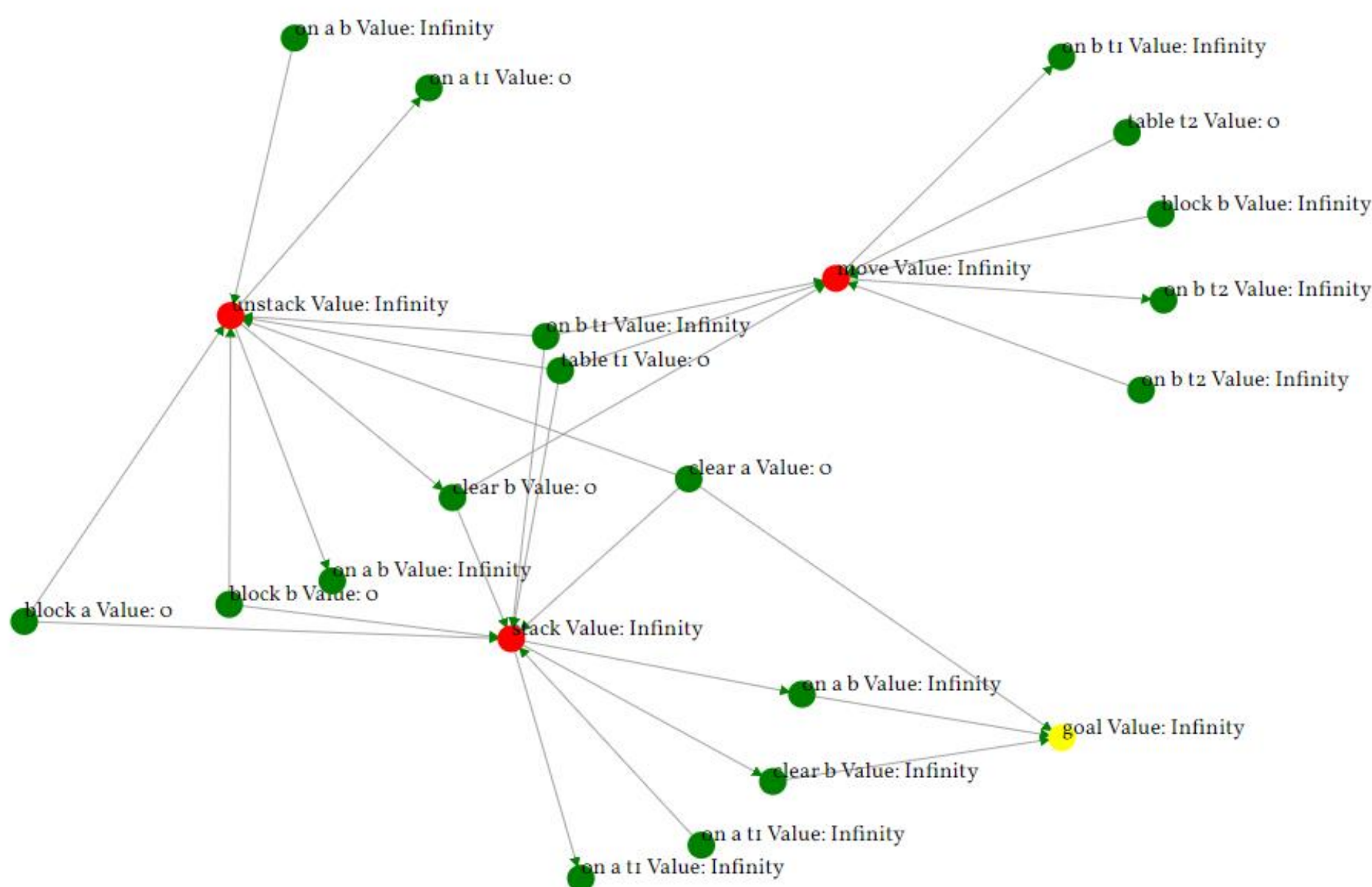
State Space



Uses dynamic loading of node children on click, so the visualization is not required to load all children at the initialization.

State fluents are displayed along with the preceding action when the node is selected.

Heuristic Visualization



Once a state in the State Space is clicked, a new tab with a similar graph to above will appear indicating the heuristic evaluation performed on that selected state.

Conclusion

Using the pre-existing Planning.Domains editor, we were able to create a Plugin that allows all users to interactively go through each planning and heuristic step. The communication between both visualizations allows users to select and explore each state in the state space heuristically and see how the graph changes based on the state selected. Our solution provides an excellent interactive educational experience as well as allows researchers to experiment with different heuristics and search procedures by simply implementing new heuristics into the plugin and utilizing the visualization structure that is already implemented.

