Interactive Tools for Learning Artificial Intelligence

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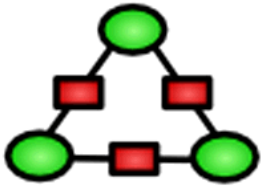
Outline

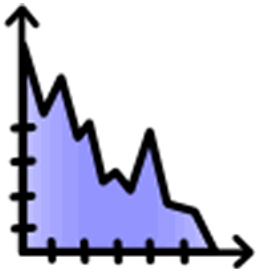
Roadmap

What is AIspace?

Graph searching



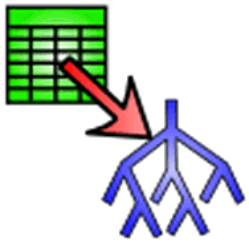
Consistency for CSPs



SLS for CSPs

Deduction

Decision and belief networks

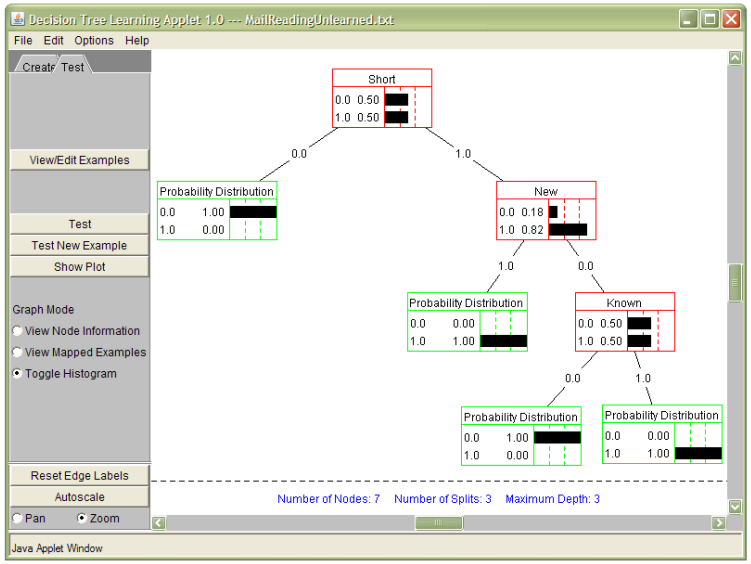


Decision trees

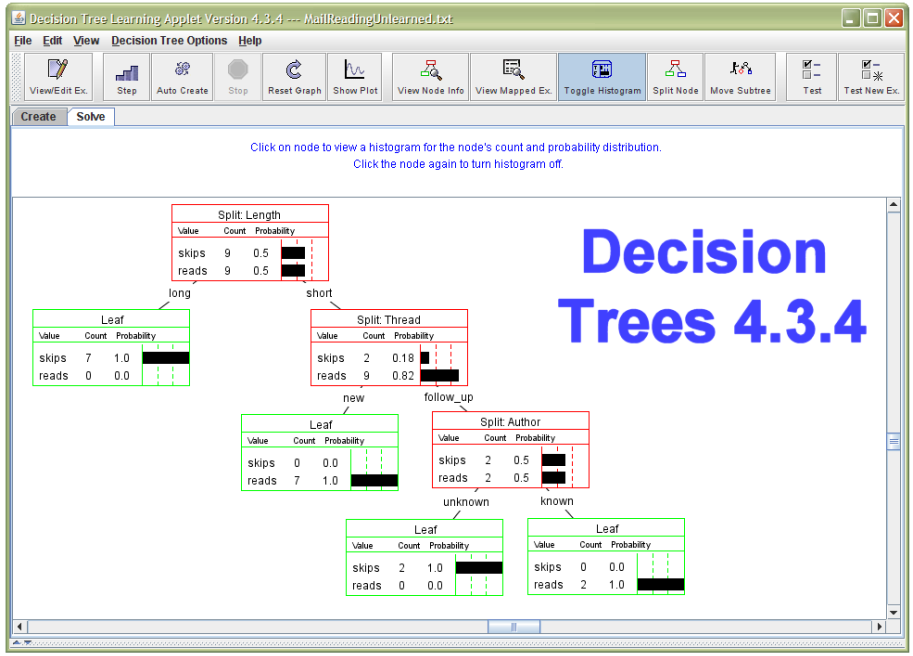
Neural networks

- It is a collection of interactive algorithm visualization tools (Java applets) for demonstrating the dynamics of common Artificial Intelligence algorithms.

What is AIspace?



Decision Trees 1.0



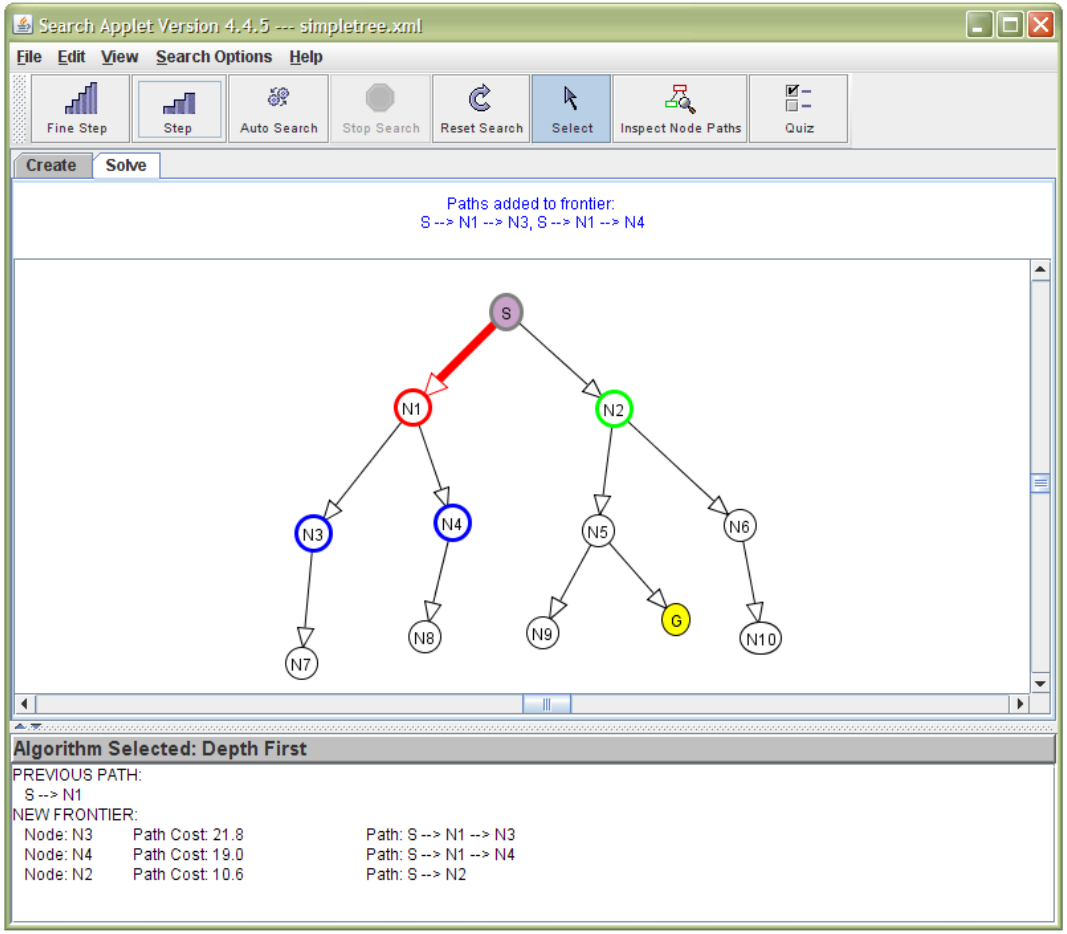
Decision Trees 4.3.4

- It is an ongoing project, since 1999, at the Laboratory for Computational Intelligence at the University of British Columbia under the direction of Alan Mackworth and David Poole.

What is AIspace?

- AIspace applets have been used in undergraduate and graduate AI courses at UBC and elsewhere for many years.

What is interactive algorithm visualization?



- type of software visualization
- the use of images, animation, and interface elements to interactively demonstrate algorithm dynamics

Roadmap

AIspace goals

- Our ultimate goal is to enhance traditional approaches to teaching and learning AI.
- We decomposed this objective into five pedagogical and three usability goals.

AIspace goals - pedagogical goals

- Aspects of a learning aid that provide clear and definite pedagogical benefits over traditionally accepted methods.
- AIspace pedagogical goals:
  1. Increase student understanding of the target domain.
  2. Support different learning abilities, learning styles and levels of knowledge.
  3. Motivate and generate interest in the subject matter.
  4. Promote active engagement.
  5. Support various scenarios of learning.

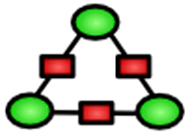
AIspace goals - usability goals

- Usability deficiencies are the most cited reasons preventing educators form adopting visualization tools.
- AIspace usability goals:
  1. Tools should be easy to learn.
  2. Tools should be straightforward and efficient to use.
  3. Tools should be easy to integrate into a course.

Roadmap

AIspace coverage and modularity


Graph searching


Consistency for CSPs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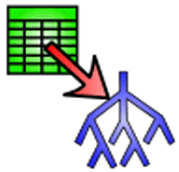
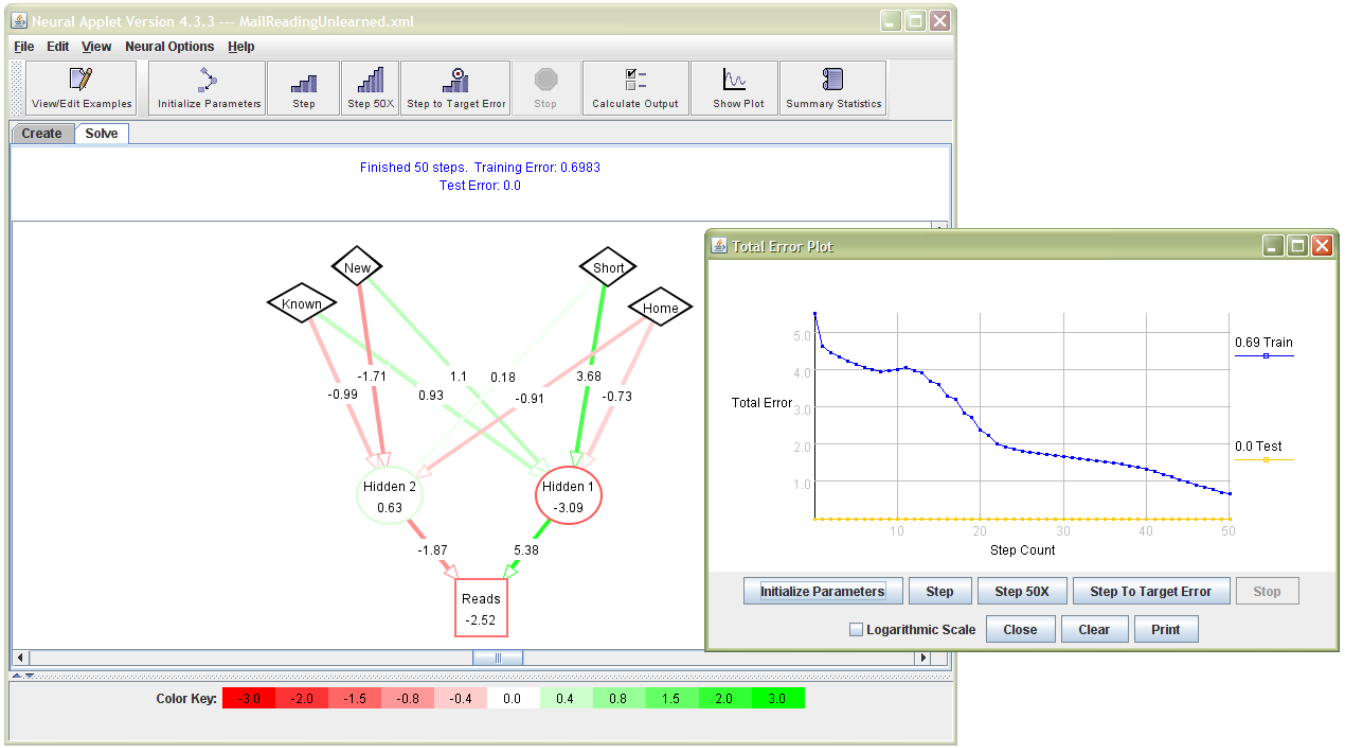
Decision and belief networks


Decision trees


Neural networks

- Coverage of seven different topics
  - helps reduce time and effort needed to search for visualizations for each new topic;
  - enables AIspace to be used as a resource through a course.
- Each applet encapsulates a unified and distinct set of concepts.
  - Can be used to support different textbooks.
  - Gives instructors flexibility in choosing other course resources.

Visual Representations

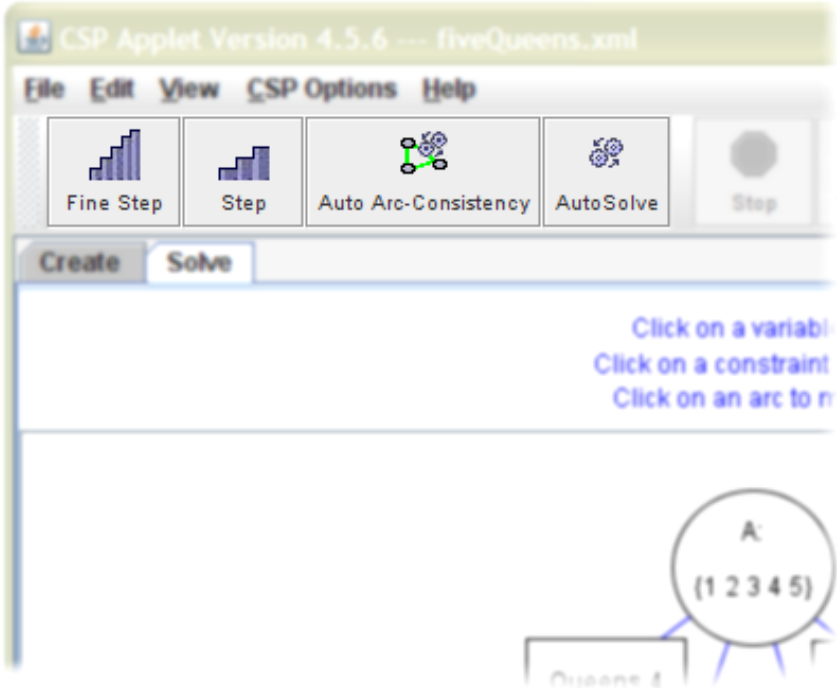


- An appropriate graphical representation forms the foundation of every applet.
- Separating visualizations from textual explanations gives instructors flexibility in choosing other supporting resources and tailoring explanations.

Interactive Simulations

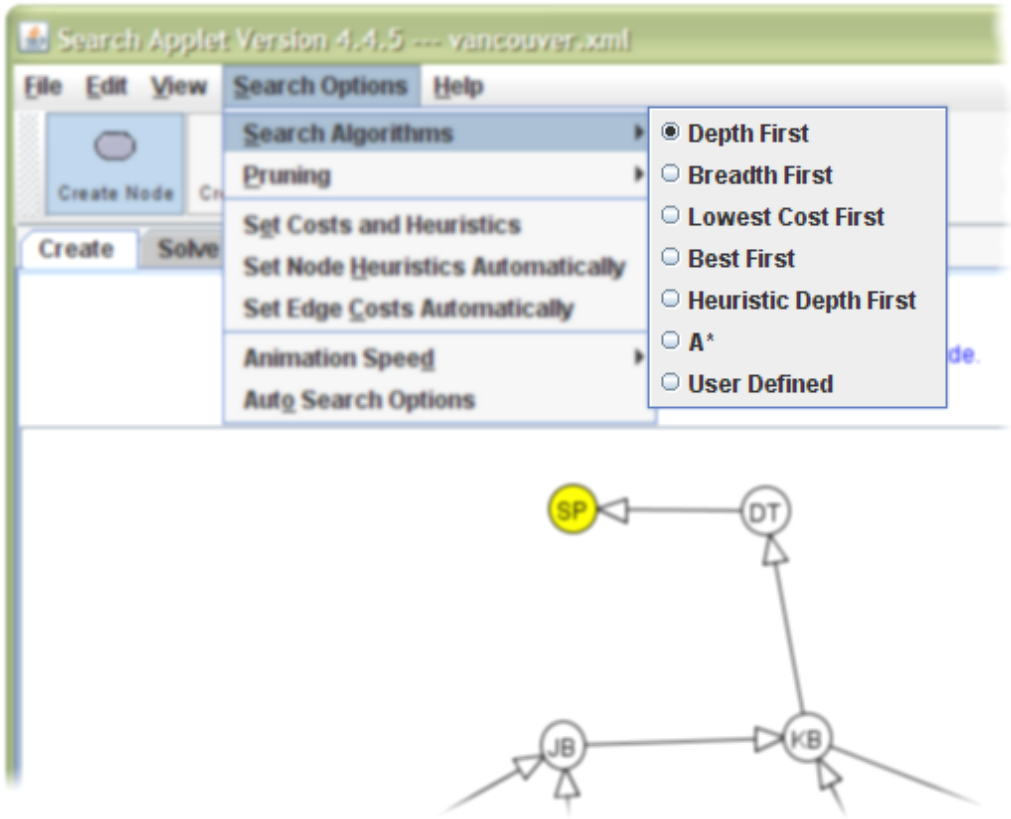
- Simulations:
  - color and highlighting
  - movement
  - short textual messages
  - engaging for in-class demonstrations
- Interactive simulations:
  - allow direct manipulation of the visualization;
  - allow control of the simulation;
  - support active engagement;
  - support individual exploration.

Control of Algorithm Pace



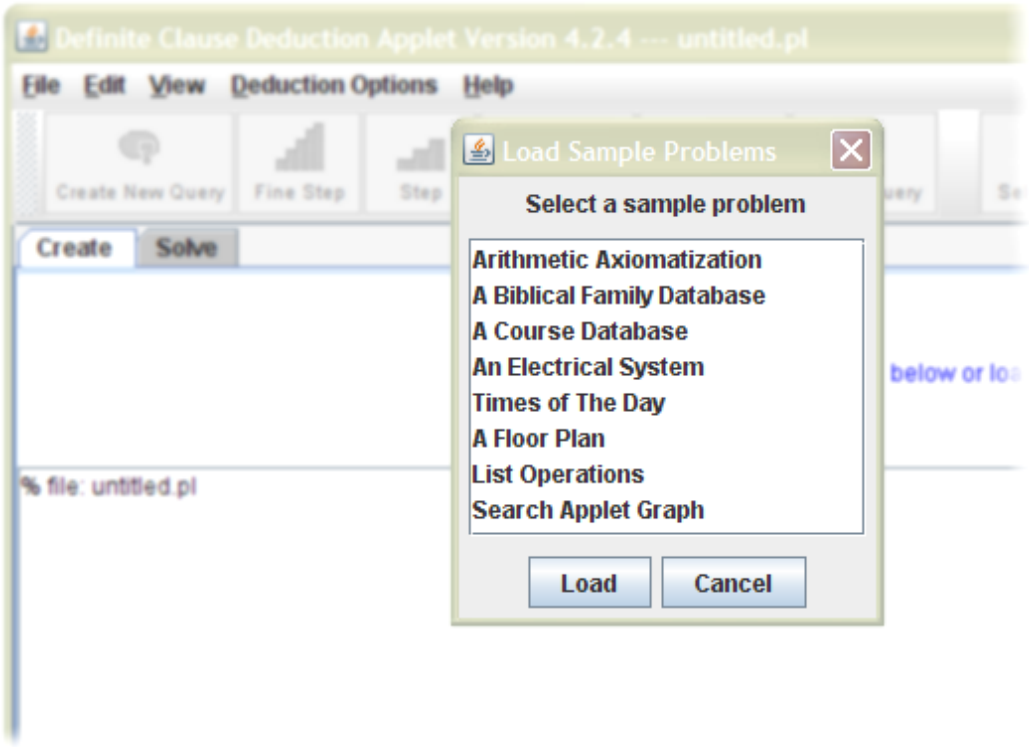
- Multi-scaled stepping mechanisms range from fine scale stepping to batch runs.
- Enables students to learn at their own pace.

Comparison of Algorithms



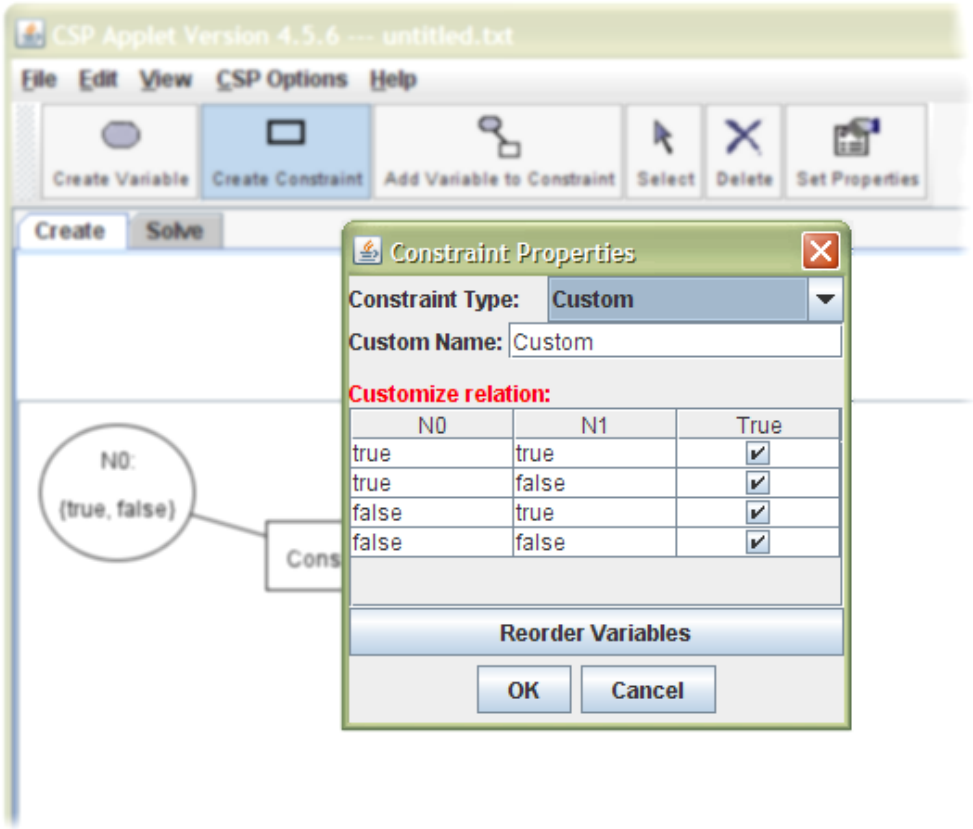
- Where appropriate the tools promote comparison of different ways of solving the same problem.
- Such analysis maps to a high level of understanding.

Sample Problems



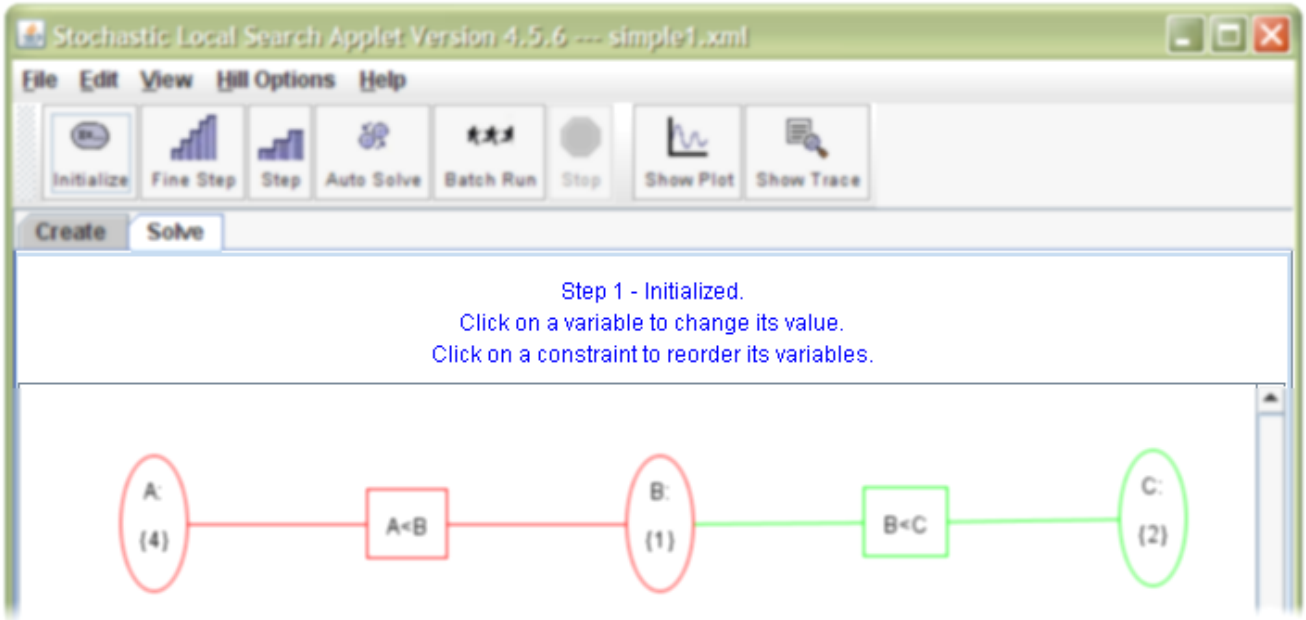
- Each tool is equipped with sample problems.
  - They are helpful for beginner students.
  - For instructors, this means less time searching for examples.

Creation of New Problems



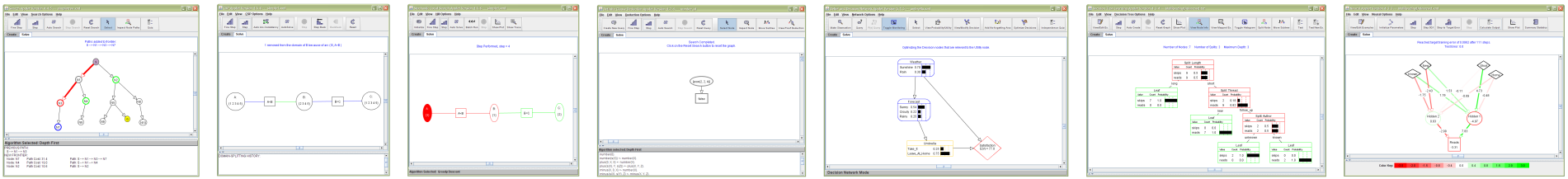
- Supports active engagement.
- Supports more advanced students.
- Enables instructors to create their own problems for students.

Help



- Carefully placed messages in the applet window guide users in using a tool.
- Help pages and video tutorials are available from AIspace website.

Consistency



- Includes:
  - common applet layout;
  - common menu content and layout;
  - similar graphical entities;
  - modes for creating and solving;
  - analogous methods for executing algorithms.
- Minimizes learning time and facilitates use.

Roadmap

Evaluation

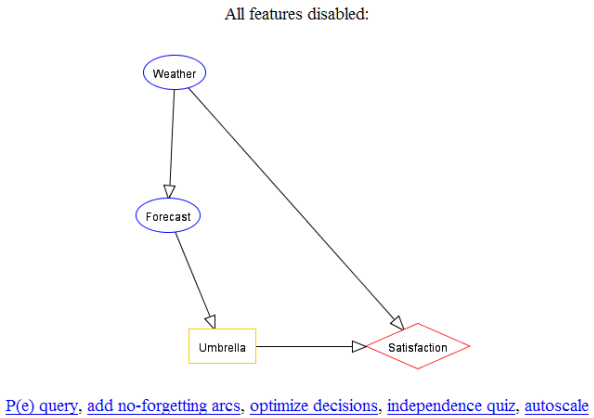
- Feedback from users
- Usability inspection:
  - testing during development
  - heuristic evaluations
- Laboratory studies (Amershi et al., 2008)
  - comparing studying with CSP applet to studying with sample problems on paper.
  - measuring effectiveness in terms of knowledge gain
  - assessing user preference and motivation
- Fielded evaluations (this workshop proceedings)

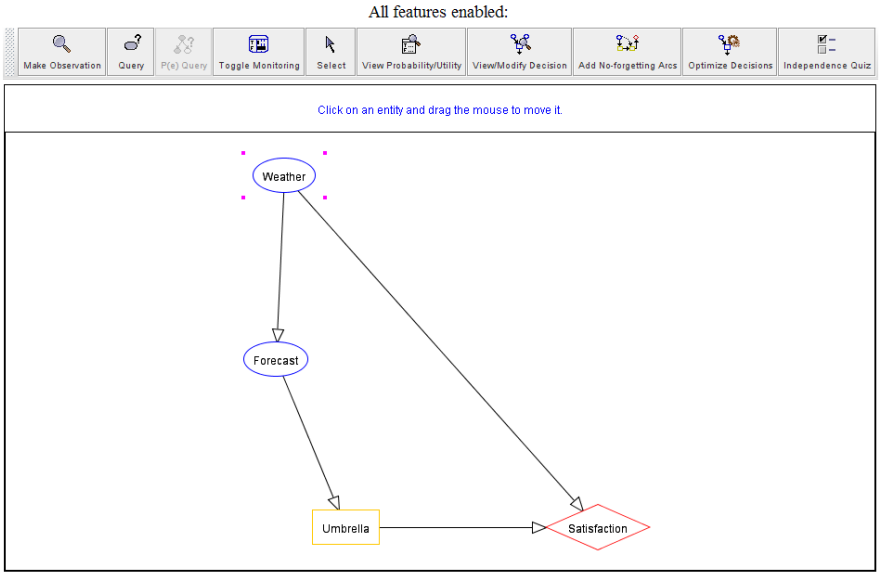
Results from User Studies

- Laboratory studies:
  1. studying with our interactive algorithm visualizations (AVs) is at least as effective at increasing student knowledge as studying with carefully designed paper-based materials;
  2. students like using our interactive AVs more than studying with the paper-based materials;
  3. students use both our interactive AVs and paper-based materials in practice although they are divided when forced to choose between them;
  4. students find our interactive AVs generally easy to use and useful.
- Preliminary results from fielded evaluations are also encouraging.

Roadmap

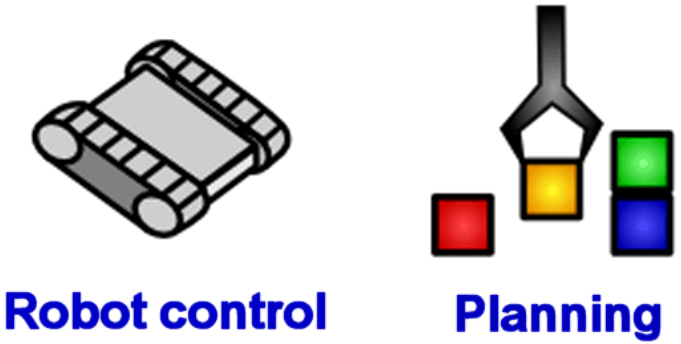
Author-customizable applets





- the newest addition to the AIspace project
- tailored for users with different levels of domain knowledge
- useful for presentations and online tutorials
- demo later

Ongoing and future work



- prototype applets under development:
  - robot control applet
  - planning applet
  - STRIPS to CSP applet
- new problem sets
- AI tutorials using the customizable applets

Acknowledgments

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