

Solving Sudoku with Consistency: A Visual and Interactive Approach

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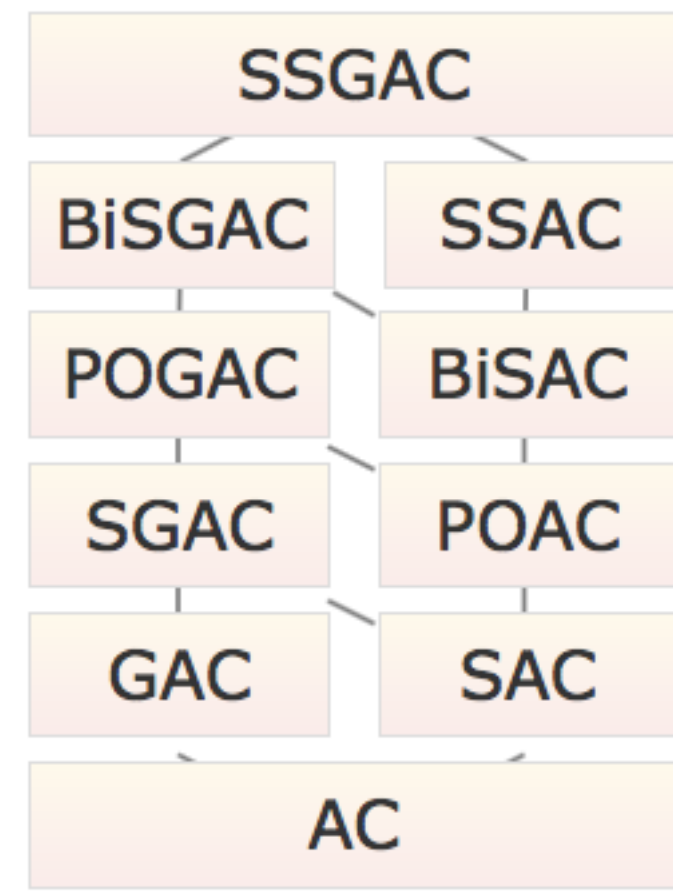
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Goals

- An interactive Sudoku solver to support
 - Research*: Solve a Sudoku without search
 - Education*: Illustrate basic, advanced techniques of Constraint Processing
 - Outreach*: Demystify AI to the public

Features

- Two constraint models: binary, nonbinary
- Five consistency properties (one new) and ten algorithms



- Five algorithms for maintaining consistency after user input
- History (tracking, navigation) of user's actions
- Database storing puzzles along with the number of clues in a puzzle and the weakest consistency property that solves it
- Puzzle recognition from uploaded images
- 375 hardest known puzzles, all of which solved by consistency algorithms alone

Interface

Highlights scope of active constraint

Shows current domain, also reflected in history

Chooses to enforce a given consistency property

Shows in red removed values, also reflected in history

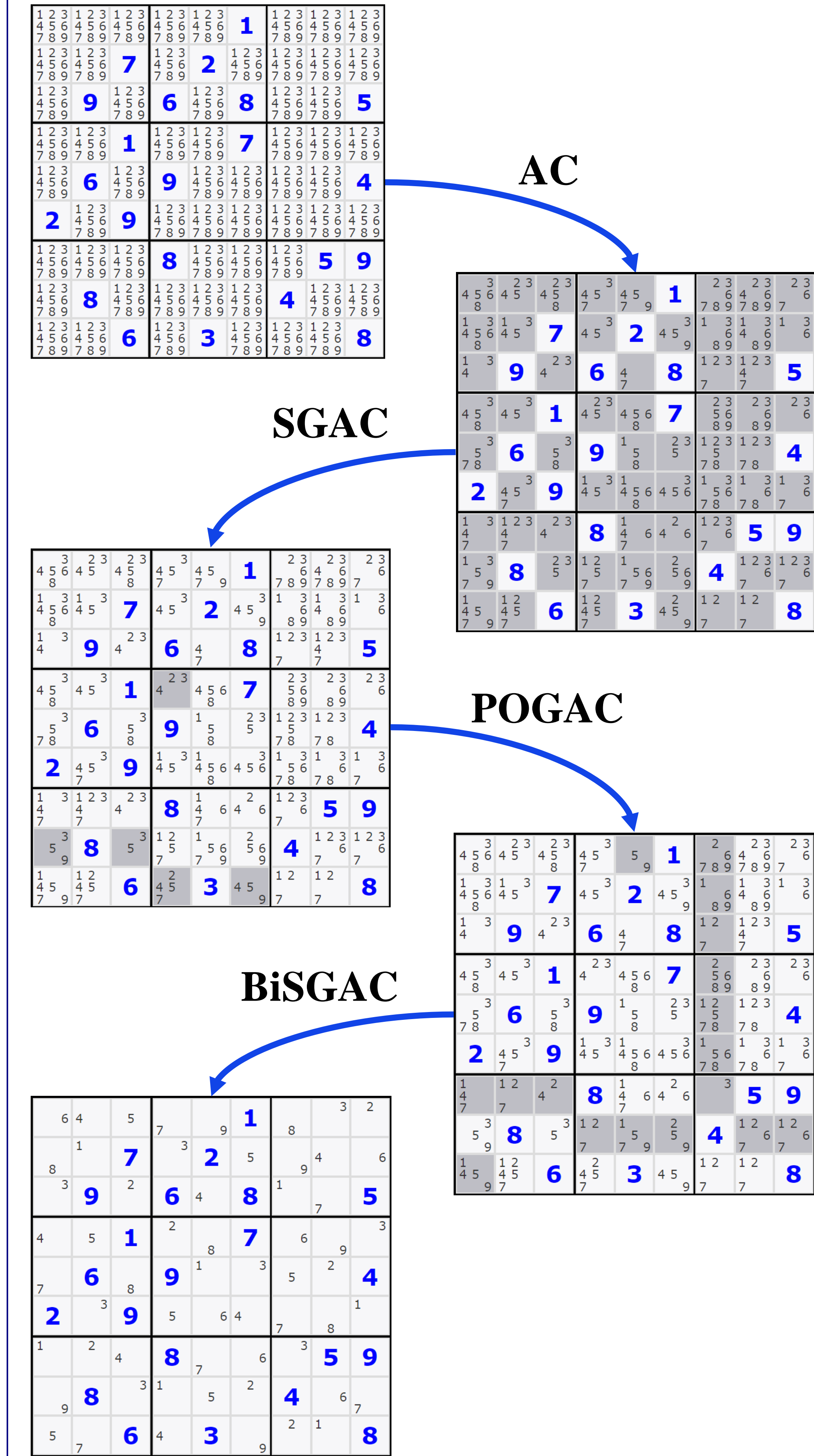
Shows in bold values to be removed in future steps of the consistency algorithms

Navigable history of user actions

Maintains a given consistency when user makes an assignment

Finds and displays all solutions

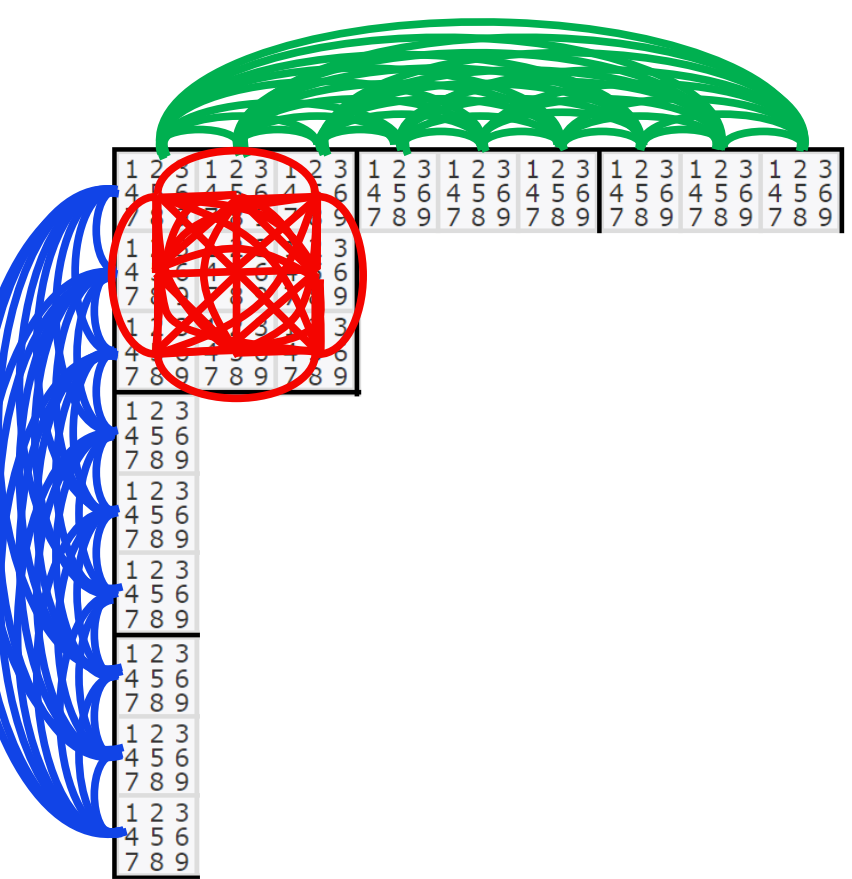
Consistency Algorithms



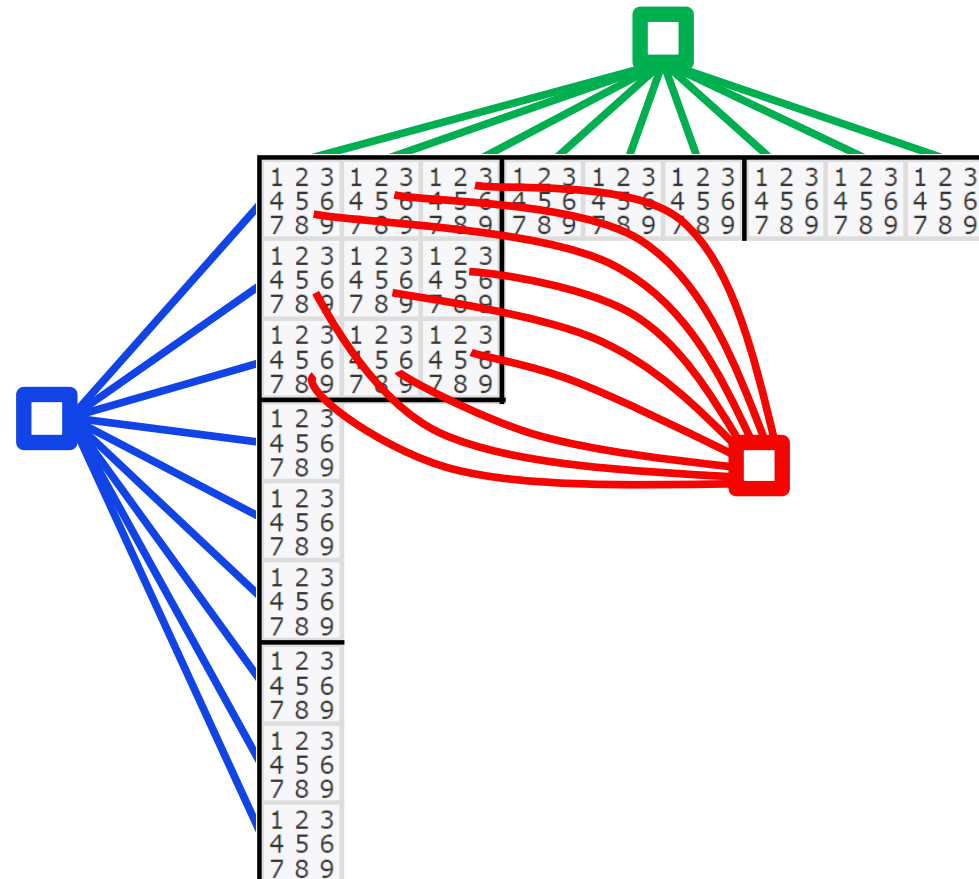
Two Constraint Models

Each cell in the sudoku is a variable whose domain is the numbers 1 to 9. 'Different' constraints prevent cells in the same row, column, or block from taking the same values.

Binary model: one constraint between two cells



Nonbinary model: One constraint of arity 9 for each row, column, block



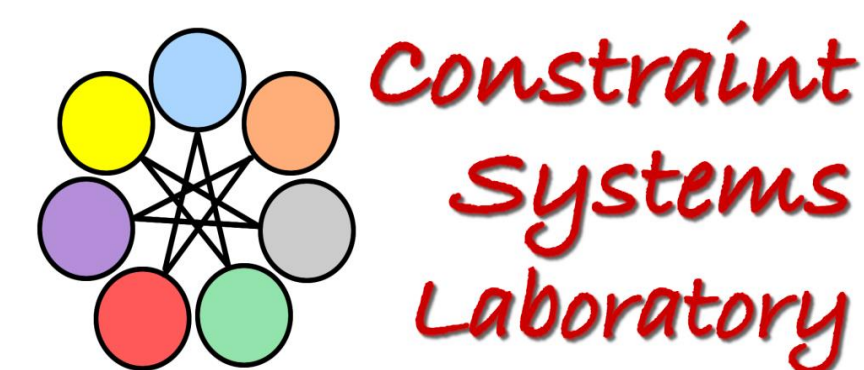
User can interact with each model and test the corresponding consistency algorithms

Load

Puzzle Name	Const	#Clues	#Sol
HardestSudokusThread-00270	SSGAC	23	1
Denis-Manually	GAC	26	1
HardestSudokusThread-00237	SSGAC	21	1
March 24, 2009	GAC	29	1
HardestSudokusThread-00022	SSGAC	21	1
Moderate - Feb. 10, 2007	SAC	28	1
HardestSudokusThread-00240	SSGAC	21	1
08-14-2009-091452	SAC	50	1
HardestSudokusThread-01389	BISGAC + SSAC	22	1
09-28-2009	GAC	30	1
HardestSudokusThread-00470	SSGAC	23	1
November 2, 2009	GAC	31	1

Open Question

SSGAC can solve every 9x9 Sudoku puzzle in our Database including the 375 hardest known instances. However, determining the weakest level of consistency sufficient to solve any 9x9 Sudoku puzzle remains an open question.



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