

# Inter-Diagrammatic Reasoning System Demonstrations

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The theory of *inter-diagrammatic reasoning* [Anderson and McCartney 1995; Anderson and McCartney 1996; Anderson and McCartney 1997] defines an approach to computation with diagrammatic representations that strives for generality. It provides a simple diagram syntax and a general set of operators that can be used to reason with collections of related diagrams in a wide range of domains.

Most generally, the method employed by the current system demonstrations can be classified as "direct manipulation of the visual representation." The domains represented by these demonstrations include game playing, propositional logic, guitar chord notation, and the n-queens problem. Tasks performed include heuristic development, spatial configuration, inductive learning, case-based reasoning, and proof support.

More specifically, the following demonstrations are provided:

### *Battleship*

System develops heuristic by constraining a set of diagrams of all possible battleship positions to conform to "hit" information attained and presents heuristic as the gray scale diagram comprised of the diagrams of this constrained set overlaid upon themselves.

### *n-Queens Best Solution Problem*

System uses diagrams of previous solutions as cases in a case-based reasoning system to improve its performance at finding a solution to a given n-queens problem that keeps the most number of queens unmoved.

### *Guitar Chord Fingering*

System inductively learns, under supervision, to finger guitar chords diagrams presented to it by abstracting diagrammatic input into diagrammatic representations that model constraints of human hand.

### *Propositional Logic*

Bitmaps of Venn diagrams are used to perform various tasks in propositional logic using image processing operators including showing formulas to be tautological, satisfiable, or contradictory, showing arguments to be valid or invalid, and showing consistency or inconsistency of a new proposition with a consistent set of propositions.

This work has, in part, been motivated by a desire to explore the boundaries of what can be computed via diagrammatic representations alone. We take this extreme position fully aware that diagrammatic representations may need to be augmented by others representations to completely represent many problem domains. We believe that a sharply focused exploration of the limits of diagrammatic representations is necessary to bring our understanding of them on par with other, better understood representation schemes.

Also motivating this work is our interest in investigating general approaches to computing with diagrammatic representations that prove useful across wide varieties of domains. Although any one such approach will not necessarily be all-inclusive, development of a number of such approaches can only serve to illuminate the dimensions of the problem.

### References

- Anderson, M. and McCartney, R. 1995. Inter-diagrammatic Reasoning. In Proceedings of the 14th International Joint Conference on Artificial Intelligence.
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