Search and Reasoning in Problem Solving*

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0. Introduction

In the course of the extensive research that has been done on problem solving in AI, several rather distinct ways have emerged for representing and thinking about problem solving tasks. One way to view problem solving is as search. We postulate some kind of space in which treasures are hidden. We build symbol structures (nodes) that model this space, and 'move' operators that alter these symbol structures, taking us from one node to another. In this metaphor, solving a problem consists in searching the model of the space (selectively), moving from one node to another along links that connect them until a treasure is encountered.

A second way of viewing problem solving is as reasoning. We postulate a system of logic that allows us to deduce new statements from axioms and previously deduced statements. We represent a problem by a set of axioms in the formal language of our logic. In this metaphor, solving the problem consists in accumulating more and more information (more and more statements) by inference until the answer to the problem has been found.

A third way of viewing problem solving is as constraint satisfaction. We postulate a set of objects and various subsets defined by the constraints they satisfy. In this metaphor, solving a problem consists in narrowing down the original set to a subset or unique object that satisfies all of the constraints.

In no sense are the metaphors mutually exclusive; metaphors seldom are. The same problem-solving algorithm can be viewed, now as search, now as reasoning, now as constraint satisfaction. Consider, for example, a simple theorem-proving program that works forward from a set of axioms, applying its rules of inference to these to obtain new expressions that can be added to the

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