# Efficient Reasoning

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Many tasks require "reasoning"—i.e., deriving conclusions from a corpus of explicitly stored information—to solve their range of problems. An ideal reasoning system would produce all-and-only the *correct* answers to every possible query, produce answers that are as *specific* as possible, be *expressive* enough to permit any possible fact to be stored and any possible query to be asked, and be (time) *efficient*. Unfortunately, this is provably impossible: as correct and precise systems become more expressive, they can become increasingly inefficient, or even undecidable. This survey first formalizes these hardness results, in the context of both logic- and probability-based reasoning, then overviews the techniques now used to address, or at least side-step, this dilemma.

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General Terms: Performance, Algorithms

Additional Key Words and Phrases: Efficiency trade-offs, soundness/completeness/expressibility

## 1. INTRODUCTION

Many information systems use a corpus of explicitly stored information (a.k.a. a "knowledge base," *KB*) to solve their range of problems. For example, medical diagnostic systems use general facts about diseases, as well as the specific details of a particular patient, to determine which diseases the patient might have, and which treatment is appropriate. Similarly, configuration and synthesis systems use their stored descriptions of various components, along with the specifications for a proposed device (VLSI chip, software program, factory, or whatever), to design a device that satisfies those requirements. Scheduling and planning systems likewise

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