PRACTICAL ARTIFICIAL COMMONSENSE

Practical Artificial Commonsense

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Abstract

While robots and software agents have been applied with spectacular success to challenging problems in our world, these same successes often translate into spectacular failures when these systems encounter situations that their engineers never conceived. These failures stand in stark contrast to the average person who, while lacking the speed and accuracy of such machines, can draw on commonsense intuitions to effortlessly improvise novel solutions to unexpected problems. The objective of artificial commonsense is to bring some measure of this powerful mental agility and understanding to robots and software systems.

In this dissertation, I offer a practical perspective on the problem of constructing systems with commonsense. Starting with philosophical underpinnings and working through formal models, object-oriented design and implementation, I revisit prevailing assumptions with a pragmatic focus on the goals of constructing effective, efficient, affordable and real commonsense reasoning systems.

I begin with a formal analysis—the *first* formal analysis—of the Symbol Grounding Problem, in which I develop an ontology of representational classes. This analysis serves as motivation for the development of a hybrid reasoning system that combines iconic and symbolic representations.

I then proceed to the primary contribution of this dissertation: the development of a framework for constructing commonsense reasoning systems within constrained time and resources, from present-day technology. This hybrid reasoning framework, named *Comirit*, integrates simulation, logical deduction and machine learning techniques into a coherent whole. It is, furthermore, an open-ended framework that allows the integration of any number of additional mechanisms.

An evaluation of Comirit demonstrates the value of the framework and highlights the advantages of having developed with a practical perspective. Not only is Comirit an efficient and affordable working system (rather than pure theory) but also it is found to be more complete, elaboration tolerant and capable of autonomous independent learning when applied to standard benchmark problems of commonsense reasoning.

Declaration

I hereby declare that, except where referenced or acknowledged, this dissertation and the research described within are entirely my own work.

No part of this dissertation has been previously submitted towards the award of a degree at any institution.

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