What can cognitive architectures do for robotics?

Unmesh Kurup, Christian Lebiere

Carnegie Mellon University

Biologically Inspired Cognitive Architectures

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Abstract

Research in robotic systems has traditionally been identified with approaches that are characterized by the use of carefully crafted representations and processes to find optimal solutions. The use of such representations and processes, which we refer to as the algorithmic approach, is uniquely suited for problems requiring strong models, i.e., tasks and domains that are well defined, and/or involve close interaction with the environment. These problems have historically been the focus of robotics research because they exercise perceptual, motor and manipulation capabilities that form the basic foundational abilities required for every robotic agent. Recent work (for example ROS and Tekkotsu) on the abstraction and encapsulation of perception and motor functionality has standardized the above mentioned foundational abilities and allowed researchers to study problems in less clearly defined and open-ended domains: problems that have previously been considered the province of AI and Cognitive Science. In this paper, we argue that the study of these problems (examples of which include multi-agent inter- action, instruction following and reasoning in complex domains) referred to under the rubric of Cognitive Robotics is best achieved via the use of cognitive architectures - unified computational frameworks developed specifically for general problem solving and human cognitive modelling. We lay out the relevant architectural concepts and principles and illustrate them using nine cognitive architectures that are under active development - Soar, ACT-R, CLARION, GMU-BICA, Polyscheme, Co-JACK, ADAPT, ACT-R/E, and SS-RICS.[1]

I. Keywords & Concepts

- Cognitive Architectures
- Cognitive Robotics
- Artificial Intelligence
- High Level Planning
- Biologically Inspired
- Autonomous Robots
- Better understand cognition, to build smarter robots
- Requirements to achieve robots capable of high level cognition
- Implementing cognitive architectures
- High level cognitive tasks on robotics

II. Thoughts & Summary

- Current and past cognitive architectures are introduced.
- Attempt is made to define what requirements a robot must meet to have 'high level cognition', includes: Represent large amount of knowledge, Learning and Recognition, Problem solving & Reasoning, Adaptive, Natural human interaction.
- Provides an overview of the terms Architecture and Content from Cognitive Science prospect. Architecture is shared by all similar agents, Content is individual.
- In conclusion addresses drawbacks to cognitive architectures, including: computer algorithms and computer hardware have always been developed together, our current hardware is very different from the natural hardware seen in biology.

References

[1] Unmesh Kurup and Christian Lebiere. What can cognitive architectures do for robotics? *Biologically Inspired Cognitive Architectures*, 2:88–99, October 2012.