

Abstract

The aim of this thesis is to address the problem of capability brokering. A capability-brokering agent receives capability advertisements from problem-solving agents and problem descriptions from problem-holding agents. The main task for the broker is to find problem-solving agents that have the capabilities to address problems described to the broker by a problem-holding agent. Capability brokering poses two problems: representing capabilities, for advertisements, and matching problems and capabilities, to find capable problem-solvers.

For the representation part of the problem, there have been a number of representations in AI that address similar issues. We review various logical representations, action representations, and representations for models of problem solving and conclude that, while all of these areas have some positive features for the representation of capabilities, they also all have serious drawbacks. We describe a new capability description language, CDL, which shares the positive features of previous languages while avoiding their drawbacks. CDL is a decoupled action representation into which arbitrary state representations can be plugged, resulting in the expressiveness and flexibility needed for capability brokering.

Reasoning over capability descriptions takes place on two levels. The outer level deals with agent communication and we have adopted the Knowledge Query and Manipulation Language (KQML) here. At the inner level the main task is to decide whether a capability description subsumes a problem description. In CDL the subsumption relation for achievable objectives is defined in terms of the logical entailment relation between sentences in the state language used within CDL. The definition of subsumption for performable tasks in turn is based on this definition for achievable objectives. We describe algorithms in this thesis which have all been implemented and incorporated into the Java Agent Template where they proved sufficient to operationalise a number of example scenarios.

The two most important features of CDL are its expressiveness and its flexibility. By expressiveness we mean the ability to express more than is possible in other representations. By flexibility we mean the possibility to delay decisions regarding the compromises that have to be made to knowledge representation time. The scenarios we have implemented illustrate the importance of these features and we have shown in this thesis that CDL indeed possesses these features.

Thus, CDL is an expressive and flexible capability description language that can be used to address the problem of capability brokering.