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Handling temporality in human activity reasoning

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Abstract. Human-aware Artificial Intelligent systems are goal directed autonomous systems that are capable of interacting, collaborating, and teaming with humans. Activity reasoning is a formal reasoning approach that aims to provide common sense reasoning capabilities to these interactive and intelligent systems. This reasoning can be done by considering evidences –which may be conflicting– related to activities a human performs. In this context, it is important to consider the temporality of such evidence in order to distinguish activities and to analyse the relations between activities. Our approach is based on formal argumentation reasoning, specifically, Timed Argumentation Frameworks (TAF), which is an appropriate technique for dealing with inconsistencies in knowledge bases. Our approach involves two steps: local selection and global selection. In the local selection, a model of the world and of the human's mind is constructed in form of hypothetical fragments of activities (pieces of evidences) by considering a set of observations. These hypothetical fragments have two kinds of relations: a conflict relation and a temporal relation. Based on these relations, the argumentation attack notion is defined. We define two forms of attacks namely the strong and the weak attack. The former has the same characteristics of attacks in TAF whereas for the latter the TAF approach has to be extended. For determining consistent sets of hypothetical fragments, that are part of an activity or are part of a set of non-conflicting activities, extension-based argumentation semantics are applied. In the global selection, the degrees of fulfillment of activities is determined. We study some properties of our approach and apply it to a scenario where a human performs activities with different temporal relations.

Keywords: Formal argumentation, intention recognition, activity recognition, activity reasoning, timed argumentation frameworks

1. Introduction

Human-aware Artificial Intelligent systems are goal directed autonomous systems that are capable of interacting, collaborating, and teaming with humans. The perceptions obtained by these systems can be useful for activity reasoning, intention recognition, activity verification, and activity support. This article tackles the problem of reasoning about activities a human is performing considering the temporality and durability of the activities and possible overlappings between them.

Nieves et al. [11] and Morveli-Espinoza et al. [10] used argumentation for determining inconsistent (and therefore different) activities from a set of hypothetical fragments of activities (henceforth, hypothetical fragments). In their approaches, all the perceived hypothetical fragments are analysed together as they happen at the same time and without considering their durability. However, the activities a human performs

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