Quantification and Commonsense Reasoning

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Abstract

Traditional approaches to the resolution of quantifier scope ambiguity are based on devising syntactic and semantic rules to eliminate a multitude of otherwise equally valid readings. This approach is neither cognitively nor computationally plausible. Instead we suggest a cognitively plausible model to quantifier scope using a "quantificational restriction" which we assume speakers of ordinary language compute in appropriately defined contexts[1].

Introduction

Computational approaches to quantification are based on the compositional semantic framework of (Montague 1974). Quantifier scope ambiguity in the standard model is translated into a scope neutral (Allen 1987; Alshawi 1991) logical form. Scope ambiguities are typically resolved in an incremental fashion by applying "preference rules" that are for the most syntactic in nature. See, (Hobbs and Shieber 1987), (Moran 1988) and (Park 1995).

While some important results have been achieved, the problem of quantifier scope remains largely unresolved. Moreover, these approaches do not seem to provide an answer to a "combinatorial puzzle." Essentially the problem is that a logical form with n quantifiers has $n!$ readings, all of which are syntactically and semantically valid. Considering all possible readings is neither cognitively nor computationally plausible since it assumes speakers of ordinary English consider hundred of thousands of readings for a sentence with just a handful of quantifiers. What we suggest instead is that the resolution of scope ambiguity is an inferencing problem that require *defeasible* commonsense reasoning.

Quantificational Restriction

We are currently in the process of formalizing a cognitively plausible model for quantification that is based on the assumption that quantifier scope ambiguities are resolved in an inferencing process that uses a "quantificational restriction" (QR), which is a piece of commonsense knowledge that we assume speakers of ordinary language compute in appropriately defined contexts. For example, $QR(Submit, Person, Paper) = \langle 2-, 1 \rangle$ is a QR that reflects some individual's belief that, on average, two or less co-author a paper. Similarly, $QR(On, House, Street) = \langle many, 1 \rangle$ reflects a belief that a house can not be on more than one street, where there could be many. QR, as we defined it, is clearly a function of a possible world, since in some fictional world a house might exist on several (or indeed all) streets. QR is also a function of temporal and modal aspects. For example, the $QR(Lift, Person, Piano) = \langle 2+, 1 \rangle$, reflecting some individual belief that it takes at least two to lift a piano assumes that we are speaking of a single event, since two men can lift a number of pianos at points in time. Similarly, a QR that defines a many-to-1 "located on" relation between a book and a shelf, while similar to the "located on" relation between a house and a street (both are many-to-1), differ in that while it is *necessary* for a house to be on some street, it is only *typical* for a book to be on a shelf. A QR that is dynamically computed using as context the index of interpretation, as well as modal and temporal aspects, is used in a quantifier scope rule that determines the most "plausible" reading, given the overall context.

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