Representing Natural Language Causality in Conceptual Graphs: the Higher Order Conceptual Relation Problem

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Abstract

This paper studies the conceptual relations expressed in NL-texts in order to represent texts meaning in Conceptual Graphs. Causality is taken as a working example. Representation is considered first. Causal connectors are defined in terms of CGs, and algorithms show how these definitions combine with the connected constituent graphs. As conceptual relations hold between situations or events rather than between simple concepts, their arguments in connector definitions are constrained to be situation concepts. After this the specific case of argumentative relations involving speech situation is examined. A simple representation of these situations is proposed and an additional constraint is introduced in argumentative connector definitions (e.g. since). A second aspect, interpretation, is also looked at so as to tackle the problem of implicit yet informative relations. A partial order on relations is used to simulate human understanding of implicit links in the light of our propensity to interpret everything in causal terms.

1 Introduction

KALIPSOS is an Natural Language understanding system [1] which represents the meaning of texts in terms of Conceptual Graphs (CGs) [2]. It has composition rules to build the graph of a phrase out of constituent graphs, word
definitions being the final constituent graphs. Like Sowa, KALIPSOS encodes in CG-relations both those relations that are expressed by syntactic and semantic cases or word order and complex conceptual relations (causal, temporal, conditional, etc.) that Natural Language (NL) typically expresses through subordination.

This paper shows that representing these relations raises difficulties which come from the relations themselves and their NL encoding. As such relations are not part of a situation description but usually hold between two situations or events, they may involve the speech situation itself and have an argumentative function. They may also be implicit in texts and naturally inferred by interpretation.

To solve such difficulties, this work takes advantage of two of Sowa's suggestions. In [2] and [3], he gives examples of relations (PAST, NEG) which must have specific arguments (either propositions or situations). The present paper shows how such a constraint on arguments may be justified and expressed in the definition of conceptual relations. Sowa also introduces the idea of a relation hierarchy although it has not been much studied since then [4]. I suggest here that such an order may help to interpret implicit NL relations.

Among the conceptual relations, this paper studies the example of causality. Causal information is central to many application domains (medicine, justice, equipment failure diagnosis ...). However, it has often been noted that causal reasoning is based on approximation and highly depends on point of view [5]. Representing and understanding NL causal relations is therefore both important and challenging.

This paper show how causal information expressed in NL texts can be represented in CGs. It focuses on structural aspects rather than on the distinction between refined causal relations. The causal words are defined in terms of CGs and composition algorithms are given.

Section 2 considers causal relations as second order relations whose arguments are situations rather than simple concepts. The argumentative relations which have a speech situation as an argument constitute a specific case and must be further constrained. They are studied in section 3. Section 4 focuses on interpretation rather than representation. It describes how implicit causal relations can be interpreted thanks to a relation hierarchy.