SITUATIONAL INVESTIGATION OF PRESUPPOSITION

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Abstract

This paper gives a formal theory of presupposition using situation semantics developed by Barwise and Perry. We will slightly modify Barwise and Perry's original theory of situation semantics so that we can deal with non-monotonic reasonings which are very important for the formalization of presupposition in natural language. This aspect is closely related to the formalization of incomplete knowledge in artificial intelligence.

1. Introduction

In constructing a natural language understanding system we face serious problems in syntax, semantics and pragmatics. From a computational point of view, pragmatics especially poses the greatest problem. At present there exists no appropriate theory of pragmatics for natural language. A few approaches proposed so far seem to offer linguistic or computational difficulties in their foundation, for they never give a computational mechanism for pragmatics in an effective way.

In understanding the meaning of a natural language we use both the knowledge for the language and the so-called world knowledge. Most of the inferences used in natural language can be dependent upon the latter. Many researchers, however, have ignored in their formalism this aspect of natural language reasonings.

We believe that a desirable formalism must include two important devices: firstly a representation of world knowledge: secondly, an inference system involved in the world knowledge. The former has already been realized in many AI systems, while the latter cannot be found in most systems. As for the latter, although there are such non-classical systems as non-monotonic logics and fuzzy logic, a more suitable inference system for incomplete knowledge is definitely in need. And linguistic observations have shown that traditional model-theoretic formalisms are inadequate in this respect.

Presupposition is essential in understanding natural language. The possibility of suspending presuppositions of a sentence shows that presupposition has to be understood as an inference in an incompletely perceived world. Hence constructing a theory of natural language reasonings as presupposition calls for one incorporating non-monotonic reasonings.

From such considerations we choose Situation Semantics (henceforth SS) developed by Barwise and Perry (1983) as a basis of our theory. In SS the meaning of a sentence is represented as a relation between the situations in which the sentence is uttered and the situations described by such utterances. We take presuppositions to be information about the described situations consistently restricted by the uttered situations.

In section 2 we review presupposition briefly. The subsequent sections will provide a theoretical foundation for it on the basis of SS.

2. Presupposition

Before formalizing presupposition, we shall consider the important question: "what is a presupposition?" The answer to this question is the key to the construction of a formal theory of presupposition.

We find in the literature several definitions of presupposition. For example, many philosophers and linguists assume the definition generally represented as follows:

(Def 1) A presupposes B iff
(i) A entails B
(ii) -A entails B

This definition leads the undesired conclusion that B is a tautology. Clearly an improved definition is in order. Karttunen (1973) gives the following as an alternative:

(Def 2) A pragmatically presupposes B relative to a set of assumed facts C iff it is not acceptable to utter A in the context C unless C entails B.

This definition says that a presupposition is an entailment of the sentence in a context. Regretably, nowever, there are no formal definitions for such terms as 'entails', 'relative to', 'context, in the above definition.

Gazdar (1979), on the other hand, gives the following definition.

(Def 3) Pragmatic presupposition is entailed by the context in favour of the weaker requirement that they be consistent with the context.

There he further gives the following informal definitions of essential terms in the above definition as follows.

(Def 3.1) A sentence A is entailed by a set of sentence B just in case A is true in every possible world in which all members of B are true.

(Def 3.2) A sentence A is consistent with a set of sentences B just in case A is true in some possible world in which all members of B are true.

Thus Gazdar's definition crucially depends on the notion of consistency.

Although his definition seems to be more plausible than the other definitions based on entailments, as it enables us to accommodate the so-called projection problem at ease, yet it is not entirely free from shortcomings.

His theory is based on possible-world semantics, which is not quite adequate as a natural language semantics. The inappropriateness of such a theory is discussed in Barwise and Perry (1983), Akama (1986) in detail. From a computational point of view, especially many of its deficiencies can be stated. To say the least possible-world semantics seems to fail to deal with partial information in an effective way. And in theories in this tradition only restricted statements can be derived from its model, that is, accessibility relations affect logical structures in the model. Moreover although unrealistic objects may be possible in a model, they are not suitable for a computational paradigm.

In computer science Mercer and Reiter (1982) formulated presupposition, more or less in Gazdar's spirit, as an inference generated from a pragmatic rule, namely, default rule. Since their formalism is based on first-order theory, similar shortcomings as in the case of possible-world semantics can be pointed out. It is, however, interesting to notice its flexibility in the application to knowledge representation.

To overcome the above mentioned difficulties in traditional theories, we introduces SS as an underlying theory for presupposition below.

3. Formal Theory of Presupposition

We are concerned in this section with formalizing the notion of presupposition within the framework of SS.

Our theory is a little different than the version presented in Barwise and Perry (1983) or Barwise (1985), for we introduce some modifications in the theory so that we can accomodate presupposition in natural language.

More specifically, our formalism assumes a non-monotonic relation between events called plausibility ordering, as opposed to the monotonic 'persistence' relation assumed in Barwise and Perry (1983). As a consequence, our theory is not only capable of treating presupposition in an elegant way, but is able to deal with default and autoepistemic reasonings as well.

3.1 Outline of Situation Semantics

In this section we review briefly some basic points of SS. Here we mainly follow the formalism recently introduced in Barwise (1984, 1985) rather than the original one in Barwise and Perry (1983) since it is simpler and more comprehensive.

The most attractive idea of SS is the shift of attention from 'truth conditions to 'information conditions'. SS can be said to be an attempt at explicating the nature of language focussing on the following two aspects:

(1) under what conditions a sentence can be used to convey information.
(2) what information the sentence conveys under those conditions.

A situation S can contain information in virtue of some constraint the holds between types of situations. We denote types of situations as S, S',... We write s:S if situation s is of type S. A type of situation S is realized if there is a real situation s such that, s:S. There are three categories of objects across situations; namely, individuals, denoted as: a, b, ...; relations: r, s, ...; and locations: l, l', ... Corresponding to each category, there are purely abstract, sort of dummy, entities called indeterminates that stand proxy for genuine objects. We represent indeterminates by $a, $b, ...; $r, $r', ...; $l, $l', ... Anchoring is a function that assigns individuals, relations, and locations to the indeterminates.

For example, the following is a type of situation where a is in relation R to be b:

S = [$s|in $s: at $l: R, a, b; 1]

where R, a, and b denote some respectively specific relation and individual, and $s and $l are indeterminates.

Given an anchor that assign l' to $l, the following can be a real situation where a and b are in the same relation R:

in s: at l' : R, a, b; 1.

A Constraint is a relation holding between types of situation, S ⇒ S', we read it as S involves S'. Intuitively this means that if S is realized, that is, there is a real situation s:S, then there is a real situation s' such that s':S'.

Given any constraint and any anchor f for some or all of the parameters in S, the result of replacing the parameters by appropriate values will give rise to an actual constraint.

To wit, if

S ⇒ S'

is actual, then so is

S(f) ⇒ S'(f).

We call the latter an instance of the former. Here we can extend the involves relation to a three-place relation as

S ⇒ S'/B

whhere B is the background conditions on the situations in which constraint between S and S' holds.

Let R be n+1-place relation taking n+1 objects a1, ..., an+1. Suppose parameter-free type

S = [$s|in $s: R, a1, ..., an, $an+1; i] (i = 0 or 1)

is realized. If $an+1 is an environment constant, that is, it is fixed in some way, then it only takes n objects and a truth value to determine the same proposition.

In the above mentioned remark of involves relation, B corresponds to an environment constant. Parametric information is relative to some assignment to parameters in a type of situation.

Barwise (1984) uses the two distinct terms for 'meaning', namely, situation meaning and situation-type meaning. The former is used for talking about the meaning of particular situation, while the latter is for the meaning of a certain type of situation. We can identify situation meaning with information, so a particular state of affairs has a situation meaning. And understanding the situation meaning of particular mental state requires an understanding of the situation-type meaning of that type of state, as it normally functions in the external life of the agent. Here if we take into account a cognitive state of the agent we need two parallel sets of constraints, one on some activity A and the other on cognitive activity about A.

More formally, let #S, #S', .., be types of situation of the mental state for a fixed agent. Also the agent is able to construct #C: #S ⇒ #S'. Usually we assume the following diagram of constraints between mental situations and situations, that is,

$$\begin{array}{ccc} S & \Rightarrow & S' \\ \uparrow & & \uparrow \\ \#S & \Rightarrow & \#S' \end{array}$$

Here we assume there exists a homomorphism F from a collection of types of situation to a collection of corresponding types of situation of mental states, namely there is an F such that F(s) = #S. This generates that an agent can interpret real situations in various ways. Thus involve relation relation between real situations and mental situations can be regarded as an inverse of F, namely $F^{-1}(\#S) = S$. According to the above mentioned definitions we can costruct some types of situation of mental state in the effective way. If there is no agent, as is the case in a knowledge system, #S is considered as self-referential statement on #S. We think its foundations are more or less cotroversial.

In SS an inference is an activity that attempts to use facts about the world to extract additional information, information implicit in the facts. A sound inference then is the appropriate chain of information.

3.2. Formalism of Modified SS

There are two main features to be taken into account when providing an appropriate definition for presupposition in natural language. One thing is to accommodate a lack of complete information. The other thing is to accommodate the agent's belief context. The former is called 'default' and the latter autoepistemic' respectively. Although they appear to be independent of each other in their involvement in presupposition, our formalism is capable of dealing with both of them.

Our modification of SS is mainly concerned with revising the involves relation between situations. As we said at the outset of this chapter, instead of the partial ordering of information, namely, persistence, assumed in the original version of Barwise and Perry (1983), we shall introduce the plausibility ordering, $\prec$, satisfying the following conditions:

(1) $A \prec B$ implies $A \subseteq B$ ($\subseteq$ is an ordinary monotonic relation),
(2) $A \prec A$ (reflexivity),
(3) $A \prec B$ and $B \prec C$ impllies $A \prec C$ (transitivity).

Although the exact nature of the plausibility ordering is rather vague, its intuitive meaning is that any information, whether correct or incorrect in the actual, is of use in the model for SS.

For instance, we presuppose by default in a certain cognitive state towards the world. Presuppositions are appropriate interpretations of information depending on the agent even if it includes both information and misinformation.

We now revise the theory of constraints on the basis of the plausible chain of information introduced above.

We assume the following conditions on the modified involves relation:

(1) If B is fixed, then if S1 ⇒ S2/B and S2 ⇒ S3/B then S1 ⇒ S3/B.
(2) If S ⇒ S'/B and $B' \prec B$, where B' is compatible with S, then S ⇒ S'/B'.
(3) If S ⇒ S'/B and $B' \prec B$, where B' is not compatible with S, then S ⇒ -S'/B'.
(4) If S ⇒ S'/B then S is compatible with B, that is, $S \cup B$ is coherent,
(5) If S ⇒ S'/B and f is a coherent anchor for some of the parameters of B, then S(f) ⇒ S'(f)/B(f).
(6) If S ⇒ S'/B where B has no parameters, and if B is realized by some real situation, then S ⇒ S' is actual.
(7) If S ⇒ S'/B and $B \prec B'$, then S ⇒ S'/B' or S ⇒ -S'/B'.

It is to be noticed that condition (7) means that certain parametric constraints can affect a truth condition as information increases. In the original approach in SS it is nontrivial to represent any nonmonotonicity in the effective way.

We now define presupposition in the framework of SS as below:

(Def 4) A presupposes B in the background condition C iff $A \Rightarrow B/C$ and $-A \Rightarrow B/C$ if $\#A \cap \#B \neq \emptyset$

$A \Rightarrow -B/C$ if $\#A \cap \#B = \phi$

where A, B denote type of situation of the world and #A, #B, types of situation of the agent's mental states relative to A, B.

In the definition we of course assume the involve relation satisfies the above mentioned seven conditions. And if there is no agent in the knowledge system, #A is part of A since any knowledge base is itself coherent structure in the truth condition. In such a case presuppositions correspond to the default as long as we adopt ordinary inference system.

We can formalize various types of presuppositions by making use of this definition. For example, this definition predicts we can do valid inference from misinformation and do invalid inference from correct information. The inferences carried out by human being have many demonstrative characters related to the cognitive processes of information of the world. Here we shall regard any information to be used by the agent as a presupposition in a certain context.

4. Conclusion

Mechanizing presuppositions in natural language is the most important task for pragmatics. For the sake of partiality of information presented in a sentence, SS is more suitable than a model-theoretic semantics. In our treatment every information is considered useful thus we dispense with such an ideal principle as persistence of information.

5. References

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