The Representation of Presuppositions Using Defaults*

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ABSTRACT

This paper is a first step towards the computation of an inference based on language use, termed presupposition. Natural languages, unlike formal languages, can be semantically ambiguous. These ambiguities are resolved according to pragmatic rules. We take the position that presuppositions are inferences generated from these pragmatic rules. Presuppositions are then used to generate the preferred interpretation of the ambiguous natural language sentence. A preferred interpretation can be circumvented by an explicit inconsistency. This paper discusses the appropriateness of using default rules (Reiter(1980)) to represent certain common examples of presupposition in natural language. We believe that default rules are not only appropriate for representing presuppositions, but also provide a formal explanation for a precursory consistency-based presuppositional theory (Gazdar(1979)).

The Representation of Presuppositions Using Defaults

INTRODUCTION

The meaning of a natural language sentence includes the inferences that can be generated from the sentence together with knowledge about the world and knowledge about language use. One type of inference which can be generated in this manner is called a presupposition. What typifies this kind of inference is that both the sentence and its negation imply the same presuppositions. Originally proposed to infer the existence of a referent, it is now used to define those inferences, generated from a number of linguistic situations, which pass this negation test. The following sentences show some prototypical examples of presuppositions. In each of these examples the positive a-sentence entails and the negative b-sentence presupposes the c-sentence.

(1a) The present king of France is bald.

(1b) The present king of France is not bald.

(1c) There exists a present king of France.

(2a) Jack's children are bald.

(2b) Jack's children are not bald.

(2c) Jack has children.

(3a) Mary is surprised that Fred left.

(3b) Mary is not surprised that Fred left.

(3c) Fred left.

(4a) John stopped beating the rug.

(4b) John did not stop beating the rug.

(4c) John has been beating the rug.

This negation test led to one of the early definitions of presupposition:

If A and B are sentences then

A <u>presupposes</u> B iff

(i) A entails B, and

(ii) ¬A entails B.

It can easily be seen that under a bivalent semantics this definition leads to the unacceptable conclusion that B is a tautology. This observation subsequently led to attempts using multivalued semantics. Both Kempson(1975) and Gazdar(1979) give examples in which this semantics also fails to generate the appropriate presuppositions. In parallel with these attempts at a semantic definition of presupposition, there were candidates for pragmatic definitions as well. There were two sorts of presupposition suggested. First, speaker presuppositions are those that the speaker assumes the listener knows. Second, "plugs, holes, and filters" (categories of lexical items and the connectives and, or, and if...then, which stopped, permitted, and filtered out presuppositions) were considered in Karttunen(1973,1974) as explanations for the presuppositional behaviour of compound sentences. Both of these approaches are convincingly argued against in Gazdar(1979).

The persistent theme in these early attempts by linguists at defining presuppositions, as summarized in Kempson(1975), Wilson(1975), and Gazdar(1979) was that presuppositions are entailments of the sentence (and context in the case of the pragmatic definitions). Gazdar(1979) makes a major shift when he argues that presuppositions should be defined in terms of consistency rather than entailment. His arguments centre around the other main issue for linguists, the projection problem: given the presuppositions of a simple sentence, which ones survive the embedding of this sentence in a more complex sentence. More generally, how does the context affect a sentence's presuppositions.

An example of this contextual sensitivity follows: Under a "normal" interpretation, (4c) in the example above can be "inferred" from (4b). But this inference is not an entailment since (4b) can be placed in a context which does not allow this inference.

(4d) John did not stop beating the rug because he hadn't started.

Hence, a presupposition of a sentence is consistent with that sentence, but when the sentence is placed in a larger context, the presupposition may be inconsistent; hence it can no longer be inferred. Presuppositions involve notions of incomplete knowledge and consequently non-monotonic systems of logic.

We essentially agree with Gazdar's approach; however we feel that his solution is somewhat ad hoc in that it is not a suitably formalized theory. In addition his theory uses a modal sentential logic. We prefer a first order representation of sentences. Also some of the questions that he poses cannot be answered within his framework, in particular: why are the lexical and syntactic sources of presuppositions as they are. In all fairness it should be pointed out that Gazdar(1979) is primarily interested in convincing the linguistic community of a certain pragmatic solution to the projection problem.

The main issue for us is the representation of presuppositions and the inferencing mechanisms required for generating these inferences in a coherent fashion. In doing so we feel that our representation can provide the extra insight needed to answer the above question. In particular, we view presuppositions in a more general sense: as inferences generated in the absence of complete knowledge. Our proposal is intended to provide the required formalism but keeps the essence of Gazdar's theory intact.

This paper presents a framework for representing presuppositions of <u>asserted</u> <u>declarative</u> <u>sentences</u>.

<u>REPRESENTING PRESUPPOSITIONS USING DEFAULT RULES</u>

This paper has a twofold purpose:

(1) to provide a computational mechanism for computing presuppositions,

(2) to furnish a formal explanation for a portion of the presuppositional theory in Gazdar(1979).

In reference to (1) the only other attempts to compute presuppositions of natural language utterances have been Joshi and Weischedel(1977) and Kaplan(1979). Since the algorithms contained therein are based upon a theory of presupposition (Karttunen(1973,1974)), which has been refuted by Gazdar(1979), these approaches are no longer serious candidates for computing presuppositions.

In reference to (2) the theory of Gazdar(1979) uncouples the generation of (potential) presuppositions from the checking of their consistency. In contrast, our theory represents each potential presupposition by a default rule. The proof theory for default logic provides the consistency checks required by Gazdar.

This is a novel use of default rules as a representational device. Reiter(1980) was motivated by a desire to represent beliefs about incompletely specified worlds. He also pointed out that default rules could be used to represent prototypical situations. The novelty of the current application is that we are using default rules to represent preferred interpretations of ambiguous linguistic forms.

A <u>default</u> <u>rule</u> is a rule of inference denoted

$$\frac{\alpha(x) : M\beta(x)}{w(x)}$$

where $\alpha(x)$, $\beta(x)$, $w(x)$ are all first order formulae whose free variables are among those of $x = x1,\ldots,xm$. Intuitively, a default rule can be interpreted as "For all individuals x1,...,xm, if $\alpha(x)$ is believed and if $\beta(x)$ is consistent with our beliefs, then $w(x)$ may be believed". (Reiter(1980))

Some examples should point out the salient features. The first example will be given in some detail in order to describe the inferencing that leads to the <u>preferred</u> <u>interpretation</u>

(Wilson(1975)) of an ambiguous lexical item (or syntactic construct in later examples). (Kempson(1975) uses the term natural interpretation.) Our solution is to represent the preferred interpretation of an ambiguous linguistic form as the inferences obtained as a result of deducing the consequent, w(x), of a default rule. The formal definition of "a presupposition of a preferred interpretation" is then the consequent of a default rule.

Example 1 - Stop

In this example e represents an event, and t1 and t2 are time parameters meant to represent times relevant to the event, e. Even though a proper represention for continuous actions has yet to be obtained let us assume here that the following meets our requirements for a definition of "stop":

$$STOP(e) \leftrightarrow (Et1\ t2).t1<t2\ \&\ DO(e,t1)\ \&\ \neg DO(e,t2).$$

That is, for our purposes, an event stops iff there is a time t1 at which the event was being done and a later time t2 at which the event was not being done. We can then generate the definition of "not stop" by a simple negation to obtain

$$\neg STOP(e) \leftrightarrow (t1\ t2).(t1<t2\ \&\ DO(e,t1)) \rightarrow DO(e,t2). \qquad (*)$$

For this particular example the default rule for "not stop" would be

$$\frac{\neg STOP(e)\ :\ M(Et)DO(e,t)}{(Et)DO(e,t)}$$

This default rule now plays a crucial role in generating the preferred interpretation. If E is an event and ¬STOP(E) is given, for example

John did not stop beating the rug.

then using the default rule we can deduce

(Et)DO(E,t).

Using this inference, (*), and the given fact ¬STOP(E), we can also deduce

(Et).DO(E,t) & (t').t<t' -> DO(E,t'),

that is, there is some time at which the event E was being done and it continues to be done at all future times. This matches our intuitions about the preferred interpretation of "not stopping E".

On the other hand,

John did not stop beating the rug because he was never doing it.

uses the "because clause" to indicate the extra qualification

(t).¬DO(BEAT-RUG(John),t)

Using this qualification and (*) we can deduce

¬STOP(BEAT-RUG(John)),

as required. Now the default rule cannot be invoked because its consistency condition is violated by the qualification.

Example 2 - Criterial and Noncriterial properties

In this example we look at a type of lexical presupposition which is based on the deciding criterion for a lexeme's meaning. Say then for purposes of this example, that the definition of "bachelor" is represented by the following first order sentence:

BACHELOR(x) <-> MALE(x) & ADULT(x) & ¬MARRIED(x)

Then the negation of "bachelor" would be:

¬BACHELOR(x) <-> ¬MALE(x) V ¬ADULT(x) V MARRIED(x).

Thus if the knowledge base contained:

MALE(John)

ADULT(John)

and it was subsequently provided with the knowledge that

¬BACHELOR(John)

then it would be possible to derive MARRIED(John) from the definition of ¬BACHELOR(x). But if either of the first two formulae are absent the definition of ¬BACHELOR(x) is inadequate to deduce any of the remaining disjuncts. When used in a normal manner, however, "not a bachelor" typically means "a married adult male" whether or not ADULT(x) and MALE(x) are *a priori* knowledge. Being married or not married is then the typical criterion used to decide one's bachelor status. The noncriterial parts of the definition have been referred to as the presuppositions of the lexical item. Hence the noncriterial parts of the definition are entailed in the positive and presupposed in the negative uses of the lexeme. This knowledge of noncriterial parts of definitions of lexemes would thus be part of the knowledge base and could be represented as:

NONC(BACHELOR,MALE)

NONC(BACHELOR,ADULT)

In the same manner as Example 1, we capture the pragmatic rule for generating presuppositions in the following default rule *schema*:

$$\frac{\neg P(x)\ \&\ NONC(P,P1)\ :\ M\ P1(x)}{P1(x)}$$

Hence in situations where the age and sex of the non-bachelor are not known, the age and sex can be presupposed. For example

My cousin is not a bachelor.

would be represented as:

¬BACHELOR(c1). (*)

One instance of the default rule schema above is:

$$\frac{\neg BACHELOR(c1)\ \&\ NONC(BACHELOR,MALE)\ :\ M\ MALE(c1)}{MALE(c1)}$$

which would generate MALE(c1) and similarly a second instance would give ADULT(c1). Hence these are the presuppositions of ¬BACHELOR(c1). From (*), these two default consequences, and the definition of ¬BACHELOR, the desired MARRIED(c1) can be derived.

<u>Example 3 - Factive verbs</u>

Factives are a subcategory of verbs which can take a relative clause and which presuppose that clause, that is, normally imply the relative clause whether the verb is negated or not. For example

John regrets that Mary came to the party.

John does not regret that Mary came to the party.

Under normal circumstances, both of these sentences imply that

Mary came to the party.

We need the following axiom schema:

FACTIVE(P) & P(x,ϕ) -> ϕ (*)

where ϕ is any proposition. In addition, we propose the following default rule schema to provide the necessary presuppositions of factives:

$$\frac{\text{FACTIVE}(P)\ \&\ \neg P(x,\phi)\ :\ M\phi}{\phi}$$

where ϕ is a proposition. Suitable instances of these schemata for the above example would take REGRET for P, John for x, and COME(Mary,party1) for ϕ. Note that the knowledge base must contain the linguistic fact FACTIVE(REGRET).

Thus in its positive occurrence, the factive verb entails its complement, whereas in its negative, the factive verb presupposes its complement. This presupposition can be blocked in a context that blocks application of the default rule. For example

John does not regret that Mary came to the party because she didn't come.

Formally, we view this sentence as providing the information

$$\neg\text{COME}(\text{Mary},\text{party1}). \quad (**)$$

From (**) and a suitable instance of the axiom schema (*) we are able to deduce

$$\neg\text{REGRET}(\text{John},\text{COME}(\text{Mary},\text{party1})).$$

Moreover, the given fact (**) blocks the application of the default rule schema thereby preventing the derivation of the "normal" presupposition COME(Mary,party1).

Example 4 - Focus

Two methods of focusing parts of sentences which produce presuppositions are: (1) a syntactic method called clefting (clefts and pseudoclefts), and (2) an intonational method called contrastive stress.

Clefts and pseudoclefts. We do not define these two notions; instead we give an example which points out their important features.

Cleft of "John came (did not come).":

It was (not) John who came.

Presupposition: Someone came.

Pseudocleft of "John wanted (did not want) the dog.":

What John wanted was (not) the dog.

Presupposition: John wanted something.

Contrastive stress. Normal stress occurs at the end of a sentence, but any of the constituents in a sentence can be stressed with certain presuppositional consequences. If we have the normally stressed

Bill did not wreck this truck.

this could be represented as

$$\neg WRECK(Bill,truck1).$$

But we need some method for representing focused items wherever they occur. We will use λ-abstracted predicates as in Nash-Webber and Reiter(1977). The representations (disregarding tense) for the focused sentences are then:

Cleft: It was not John who came.

$$\neg[\lambda x\ COME(x)]John$$

Pseudocleft: What John wanted was not the dog.

$\neg[\lambda x\ WANT(John,x)]dog1$

Contrastive stress: Bill did not wreck this truck.

(Underlining signifies stress.)

$\neg[\lambda x\ WRECK(x,truck1)]Bill$

We propose the following pragmatic rule:

$$\frac{\neg[\lambda x \phi(x)]u\ :\ M(Ey)\phi(y)}{(Ey)\phi(y)}.$$

The presuppositions for each of the above focused sentences would then be generated appropriately. For example, given

Bill did not wreck this truck.

which is represented as

$\neg[\lambda x\ WRECK(x,truck1)]Bill$

we can derive the presupposition

$(Ey)WRECK(y,truck1)$

that is,

Someone wrecked this truck.

CONCLUSION

This paper regards presuppositions as inferences derived partly from pragmatic rules (conventions of language use), and discusses the suitability of using default rules to represent such rules. The preferred interpretation of an ambiguous lexical item or syntactic construct can then be inferred using the derived presuppositions.

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