PRESUPPOSITIONS AND ANAPHORA IN A QUESTION ANSWERING SPEECH SYSTEM

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Abstract

The article deals with problems of dialogue handling in a natural speech dialog system. The central aspect of the article is the handling of presuppositions. A concept of presuppositions is defined that fits to questions. The handling of presuppositions by means of cooperative answering is worked out. Also the relation between presuppositions and anaphora will be discussed.

1. Introduction

In asking a question a speaker at the same time makes clear which kind of answer he expects. The form of the answer is fixed by the utterance type of his question. Yes-no-questions are expected to lead either to an affirmation or to a negation; wh-questions are expected to lead to answers which tell the objects, which are asked by the Wh-element.

Within a natural language system the intension is to represent questions by expressions, the evaluation of which leads to the answer in the conventionally expected form.

For yes-no-questions as in (1) a representation is necessary which evaluates to yes or no. In the Spicos system, utterances are represented by logical or set theoretic expressions. Thus yes-no-questions are represented by logical sentences, which are expressions that evaluate to truth values, while most wh-questions are represented as sets, which evaluate to the denotation of these sets (i.e., a set of database objects).

To proceed in this way presupposes that the expected answer is always the conversationally correct one. This is not necessarily so. Questions usually contain presuppositions about the world of the discourse which are not expected to be answered, when someone puts a question. These presuppositions can be wrong or controversial. In this case the question as it is formulated either can’t be answered or the answer leads to misunderstandings. In such cases the normal conventionally expected answers do not represent a conversationally adequate reaction.

In question (1) the speaker wants to know whether it is true that Eibl took part at the mentioned meeting or not.

(1) Hat Eibl an dem Treffen von Spicos im Januar 89 teilgenommen? (Did Eibl take part in the Spicos meeting in January 1989?)

The speaker expects an affirmation or a negation of this question. (2) represents a possible but quite taciturn way to answer. The answer which is produced in the Spicos system is shown by (3). (3) is just a syntactical transformation of the answer. Beside negation, no further information is given.

(2) Nein, das ist nicht der Fall. (No, that is not the case)

(3) Nein Eibl hat nicht an dem Treffen von Spicos im Januar 89 teilgenommen. (No, Eibl didn’t take part in the Spicos meeting in January 1989)

But in the case that in January 1989 there was no Spicos meeting at all, the answer obviously is misleading. Nothing prevents the speaker from continuing the dialog with further questions about a non-existing Spicos meeting.

(4) Hat deVet an dem Treffen von Spicos im Januar 89 teilgenommen? (Did deVet take part in the Spicos meeting in January 1989?)

The reason for this misunderstanding is the following: The speaker presupposes in question (1) the existence of a certain Spicos meeting, a fact that can be inferred from the use of the definite article (dem Treffen). Answer (2) gives no hint to the questioner that he is making a presupposition which doesn’t fit. "Presuppositions are assumed to survive semantically external negation unless there is evidence to the contrary, in which case it is blocked." This is a statement about presupposition in statements (see [1]), but it fits perfectly to yes-no-questions.

By the way, it is worth noting that the answer (3) that would have been performed by the first version of the Spicos system not only fails to block the wrong presupposition but on the contrary affirms it by repeating the mentioned NP.

The concept of presupposition is usually used in connection with statements. Following Strawson [7], presuppositions are propositions which have to be true in order to assign a truth value to a statement. In the article, the concept of presupposition is applied to questions. The presuppositions of yes-no-questions are the propositions which have to be true in order to make it possible to answer with yes or no. Or to put it in other words: Only if the presuppositions of a question are true can yes and no count as satisfactory answers.

The definition for presuppositions of wh-questions is given in section 9.

2. Presuppositions in the Spicos Dialogue

Dialogue handling in the version of Spicos which is now in implementation can be divided into basically four modes: the question mode, the answer mode, the verification mode, and the presupposition mode. In the question mode, the user can ask questions referring to the content of a database. He can perform yes-no-questions wh-questions and imperatives. In verification mode ambiguities are tried to be resolved by asking the user in some cases. This articles deals with the presupposition mode and the answer mode as far as presupposition handling is concerned. The
In the Spicos dialogue not every phenomenon appears that is possible in connection with presuppositions. The reasons for this are on the one hand the limited scope of syntactic constructions that can be performed in Spicos questions, and on the other hand the characteristics of a database-query dialogue.

a) Accomodation for Presuppositions

Basically presuppositions can be used to give the listener information. To (1) the listener could react with (5) in case he has no contrary information.

(5) Oh, ich wusste gar nicht, daß im Januar ein Spicos treffen stattfand. Das will ich mir sofort notieren. (Oh, I didn't know that in January a Spicos meeting took place. I will record that.)

In the Spicos dialogue, non-existence is assumed to be the same with not being contained in the database (closed-world assumption). After all, the system is expected to answer no to the question (6) and not I don't know, in case the meeting is not in the content of the database. To perform an accommodation for presupposition [2], would mean to perform database updating, which should not be done within a database query.

(6) Hat im Januar 89 ein Spicos treffen stattgefunden? (Did a Spicos meeting take place in January 1989?)

It is feasible to start from the assumption that the user will not try to use presupposition as a method to inform about new facts. This is why in the following it is not necessary to divide between speakers presuppositions and utterance presuppositions [3]. (The first are presuppositions which are supposed to be shared by the dialogue partner, the latter are presuppositions the listener can infer from the utterance. The speaker doesn't necessarily suppose the presuppositions to be shared by the listener but he expects the listener to accept them.)

b) Presuppositions with Complement Sentences

(7) Hat Wilma aufgehört Fred zu schlagen? (Did Wilma stop beating Fred?)

Question (7) presupposes that Wilma has beaten Fred. But complement sentences are not covered in the Spicos syntax. Presupposition handling in the Spicos dialogue only has to deal with presuppositions connected to NPs.

c) The Projection Problem

The Projection Problem means that presuppositions of a constituent of a sentence are not always presuppositions of the whole sentence. In (8) it isn't presupposed that Wilma beat Fred, although the first constituent - considered in isolation - does so.

(8) Entweder Wilma hat aufgehört Fred zu schlagen oder Wilma hat Fred nie geschlagen. ('Either Wilma stopped beating Fred or Wilma never has beaten Fred.)

The relevant constructions in which the projection problem appears do not occur in the limited dialogue of the Spicos system. Therefore we can start from the assumption that the projection of presuppositions is trivial in the Spicos questions.

3. Implications

One of the remarkable features of presuppositions is that they usually can't be defeated by negation. In a dialogue however a kind of proposition has to be regarded that seems to be true to the speaker only if his question is affirmed. In the following such propositions will be referred to as implications. In the Spicos dialogue they occur with indefinite NPs.

(9) Hat Tropf einen Artikel über Syntax geschrieben? (Has Tropf written an article about syntax?)

(10) Ja. (Yes)

(11) Hat er den Artikel veröffentlicht? (Did he publish the article?)

Suppose that Tropf in fact hadn't written only one article about syntax but seven. First I want to point out that no cannot be answered to (9). The answer no might be justified with question (12), where cardinality is in the focus of the question.

(12) Hat Tropf nur einen (oder: genau einen) Artikel über Syntax geschrieben? (Did Tropf write only one (exactly one) article about syntax?)

But even the cooperative answer no, he has written seven articles sounds strange in connection with (9). On the other hand one cannot argue, that yes is an inadequate answer to (9) as it would be the case of a wrong presupposition. In natural dialogue yes is a quite normal answer. This holds, because the affirmative answer in this case only refers to the mere existence of an article by Tropf on the subject of syntax. Nevertheless the user usually infers from (10) that it is felicitous to assume that there is just one article, to which he can refer by an anaphoric singular NP. In fact the case is more subtle: If an indefinite NP is in the scope of a quantifier there are different implications.

Wrong implications lead to wrong presuppositions concerning the number of anaphoric NPs. To correct a wrong implication human listeners sometimes wait till a wrong presupposition, triggered by the wrong implication, occurs in the dialogue. In Spicos a cooperative answer will be given like (13).

(13) Ja, Tropf hat Artikel über Syntax geschrieben. (Yes, Tropf has written articles about syntax.)

4. A Scheme for Handling Presuppositions

The presuppositions relevant in Spicos are propositions concerning the existence and cardinality of database objects which are referred to by NPs. In (14) the uniqueness presupposition is expressed, that occurs in (1) with the NP dem Treffen von Spicos im Januar 89. (We do not account at anaphors on this stage.)

(14) card( { x € Treffen von Spicos | von(x,JANUAR89) } ) = 1

For the handling of presupposition, at least the following steps are necessary

1.) The system has to recognize which NP contains which presuppositions.

2.) The system has to look the presuppositions up in the database.

3.) The system answers wrong presuppositions:

a) If the presupposition is wrong, the system regards it as a yes-no-question. The answer is given to this yes-no-question instead of the original one.

b) If one NP includes more than one presupposition, the strongest one is answered.
Presuppositions occur with definite NPs. (16) definite NPs are often anaphoric. With anaphoric NPs one refers to objects which are partly described within the former dialogue.

A wrong presupposition of existence is fatal in this case. The system will give the answer (21), where CN means the common noun phrase of the NP in question. (21) Es gibt diesen CN nicht. (That CN doesn't exist.)

The presupposition of existence is not anaphoric its reference set is just the extension of its common noun phrase. In the anaphoric case, we need representation of a kind mentioned in section 7.

Presuppositions occur with definite NPs. Definite NPs are often anaphoric. With anaphoric NPs one refers to objects which are partly described within the former dialogue.

The presupposition of existence included in the NP den Vortrag über Relativsätze (the lecture about relative clauses) differs from the extension of the common noun phrase Vortrag über Relativsätze (lecture about relative clauses). The reference set can be paraphrased by lectures by Tropf about syntax which deals with relative clauses.

The presupposition faults have to be answered. (15) a) Definite and Quantified NPs

With definite and quantified NPs the presupposition of existence means that the reference set of the NP is not empty.

When the NP is not anaphoric its reference set is just the extension of its common noun phrase. In the anaphoric case, we need representation of a kind mentioned in section 7.

Presuppositions occur with definite NPs. Definite NPs are often anaphoric. With anaphoric NPs one refers to objects which are partly described within the former dialogue.

With indefinite NPs the situation is more complicated, even when anaphorcity is ignored. With indefinites one has to distinguish between the extension of the common noun phrase of the NP and the referential aspect of the NP. In dialogue (22) to (24) the extension of the common noun phrase lecture about syntax is every lecture about syntax (as far as it is contained in the database). The referential aspect of the NP lectures about syntax can be paraphrased by lectures about syntax, given by a coworker of spicos. Anaphors which have as antecedent this NP actually refer to the referential aspect, as the reader may infer from the dialogue (22) to (24). To put in other words: the reference set of a pronoun is the referential aspect of

The order of presuppositions with regard to strength is: Presupposition of existence, presupposition of uniqueness, presupposition of explicit cardinality, presupposition of plurality. (The presupposition of explicit cardinality is not discussed in the following.)

Using this method the user has to reformulate his question. In the following will be discussed to what extent the reformulation of the question can be avoided.

A wrong presupposition of existence is fatal in this case. The system will give the answer (21), where CN means the common noun phrase of the NP in question. (21) Es gibt diesen CN nicht. (That CN doesn't exist.)

The presuppositions that are handeled in the Spicos system turn out as propositions about the reference set of the NP which contains the presuppositions. For a formal semantic representation of the reference set of a NP see [4].

5. Cooperative Answers

A answer will be called cooperative if it doesn't answer the original question but a modified version of it. It is important that the user is able to realize which modification has been made.

(15) Hat Schmidbauer die Berichte über Koarikulation an Hoege geschickt? (Did Schmidbauer send the reports about coarticulation to Hoege?)

Suppose that there exists only one report of this kind. In this case (16) would be a cooperative answer to (15), that is, an answer to the modified question (17).

(16) Ja, Schmidbauer hat den Bericht über Koarikulation an Hoege geschickt. (Yes, Schmidbauer sent the report about coarticulation to Hoege.)

(17) Hat Schmidbauer den Bericht über Koarikulation an Hoege geschickt? (Did Schmidbauer send the report about coarticulation to Hoege?)

It is obvious that cooperative answering includes presupposition handling. The scheme for the presupposition handling is modified as follows:

1.) see section 4
2.) see section 4
3.) The presupposition faults have to be classified according to whether they make a cooperative answer possible or not.
4.) The question has to be modified or the presupposition has to be answered.

6. Fatal presuppositions

Wrong presuppositions that do not allow cooperative modification of the question are called fatal. Thus fatality depends in return on the facility of the system to modify the question.

Questions which include presuppositions of existence cannot in general be modified successfully. Therefore they are regarded as fatal.

7. Presupposition and Anaphora

Presuppositions occur with definite NPs. Definite NPs are often anaphoric. With anaphoric NPs one refers to objects which are partly described within the former dialogue.

(18) Wieviele Vorträge über Syntax hat Tropf gehalten? (How many lectures about syntax did Tropf give?)

(19) Tropf hat sieben Vorträge über Syntax gehalten. (Tropf gave seven lectures about syntax.)

(20) Hat er den Vortrag über Relativsätze in Einhoven gehalten? (Did he give the lecture about relative clauses in Einhoven?)

We address the set of objects a NP is referring to as its reference set. The lecture mentioned in question (20) is likely to refer to the lectures mentioned in (18) i.e. the lectures by Tropf about syntax. Thus the reference set of the NP den Vortrag über Relativsätze (the lecture about relative clauses) differs from the extension of the common noun phrase Vortrag über Relativsätze (lecture about relative clauses). The reference set can be paraphrased by lectures by Tropf about syntax which deals with relative clauses.
its antecedent. (For a discussion of this topic see [5].)

(22) 
Hat ein Mitarbeiter von Spicos Vor- 
träger über Syntax gehalten? (Did a 
coworker of Spicos give lectures about 
syntax?)

(23) 
Ja, ein Mitarbeiter von Spicos hat 
Vorträge über Syntax gehalten. (Yes, a 
coworker of Spicos has given lectures about 
syntax.)

(24) 
Wurden diese Vorträge veröffentlicht? (Are these lectures published?)

The answer (23) confirms that the common noun phrase as well as the referential aspect of the NP 
Vorträge über Syntax have non-empty extensions.
The same holds for the NP ein Mitarbeiter von Spicos.

In the case of a negative answer the user assumes 
that there is any lecture about syntax which is given by a coworker of Spicos nor that there is any 
coworker of Spicos that has given a lecture about syntax. On the other hand, the user doesn't assume 
that there is no coworker of Spicos, even in the case of a negative answer.
This means that presuppositions of existence with 
 indefinites are concerned with the extension of the 
common noun phrase of the indefinite.

The answer given in case of a failed presupposition of 
existence will be as in (25).

(25) 
Es gibt überhaupt kein CN. (There is no CN at all.)

Regarded more closely, with indefinite NPs the 
speaker does not always presuppose existence. For 
example we cannot infer from the schematic indefinite 
NP lectures about syntax in (25) that the speaker 
assumes anything. On the other hand the listener makes no mistake when he assumes that there is a 
prepossession on the speakers side.

(26) 
No coworker of Spicos has given lectures about syntax.

(27) 
There is no lecture about syntax at all.
Answer (26) implies answer (27), and therefore it is the 
 better answer.

8.2 Presupposition of Uniqueness

The presupposition of uniqueness occurs with definite 
 NPs only. It is regarded as fatal.

(28) 
Did the coworker of Spicos, who is employed by Philips write the report about 
acoustic?

If there is more than one coworker of Spicos who is an 
employee of Philips and more than one report about 
aoustic it is quite unclear how to react in a 
cooperative way. The system could deliver:

a) a list of all the coworker in question that have 
written a report
b) a list of all coworker who didn't write one

c) a list of all reports about acoustics written by other 
persons.

This approach does not seem very attractive.
The Spicos answer will be as given in (29).

(29) 
Es gibt nicht nur diesen CN (That CN is 
not the only one)

8.3 Presupposition of Plurality and Implications

The use of plural presupposes in the case of definite 
 NPs that there is more than one object contained in the 
reference set. In the case of indefinites the use of plural 
implies that there is more than one object contained in the 
referential aspect of the NP and presupposes that 
there is more than one object in the extension of the 
common noun phrase of the NP.

Neither presupposition nor implication of plurality is 
considered as fatal.

With definite and quantified NPs the Spicos answer 
will correct the wrong presupposition by using the 
correct morphological number in respect to the NP in 
question. The same procedure applies to implications 
(Compare section 3).

With indefinites, the presupposition of plurality is not 
fatal, but has to be answered additionally as shown in 
(30).

(30) 
Es gibt überhaupt nur einen CN. (There 
is only one CN at all)

9. Presuppositions with WH-questions

In the following only WH-questions are considered 
which ask for sets of database objects. This type of WH- 
question in German is introduced by wer (who) or 
welche (which).

(31) 
Welcher Mitarbeiter hat das Protokoll 
der letzten Spicositzung an de Vet 
geschickt? (Which coworker sent the 
protocol of the last meeting of Spicos to 
deVet?)

(32) 
a) Niemand (Nobody)
b) Tropf

c) Niedermair und Tropf

(32) shows a possible answers to question (31). To 
transfer the concept of presupposition to WH-questions 
the answer (32) (a) will be defined as negation of (31).

Other answers shall count as affirmation.
With this definition the handling of presuppositions 
occurring in yes-no-questions can be applied to 
implications occurring in WH-questions as far as the 
WH-element is not concerned.

With the WH-element one has to take into account that 
the answer will correct certain implications and 
implication implicitly by delivering the set of 
objects the user has asked for. This topic cannot be 
worked out in this paper.

Footnote

1) Spicos is a speech system, which performs a database query 
dialogue. The system aims at speaker adaptivity and knows a 
vocabulary of over 1000 words. The prototype of the version II 
of the Spicos system, which is currently under development, will 
be finished in 1989. The Spicos system is a cooperation project of 
Siemens München, IPO Eindhoven and Philips Hamburg

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