# BE BRTKF, BE TO THE POINT, ... BE SEATED
# or RELEVANT RESPONSES IN MANMACHINE CONVERSATION

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ABSTRACT

In the dialogue part of our system, we have tried to increase the user's possibilities to criticize the machine's results flfd require explanations of them. The system must then provide a clear justification : either by furnishing the chain of reasoning or by asking a "good question" when it failed. The system must also be able to engage in a real dialogue, with more than one question / one answer. To do that, the system must build and use several kinds of representation : the reasoning, the topics and a mode] of the user, which is used to tailor the system's responses.

## I. Introduction.

Artificial Intelligence systems developed during the 70's were based on Knowledge Representation. The applications were supposed to showcase the different types of representation, such as frames, scripts, scenarios, or expert-systems. The dialogue problem was partly neglected. Some programs (6) were then related to written dialogues; their primary purpose was to really understand the attitudes of both participants, but they didn't mind engaging in dialogue. At the same time, theoretical research has been pursued on this point, but has not always given rise to practical applications (5), (2),...

Following this path, we have tried to determine the types of knowledge implicated in human conversation. Even if they are not always well defined, there are some rul-es which govern the elaboration of the sentences uttered in conversation. In this paper we will focus on the knowledge a program needs to cooperate in a dialogue. After a brief overview of the works that have influenced our research, the paper presents examples of possible dialogues. We then describe how the different kinds of knowledge representations are built and used.

## II. The role of the machine in a dialogue.

Most studies in the theory of Speech Acts (li), (1) agree on Grice's cooperation principle for analysis of human dialogues (A). A conversation is a relational act in which each participant is required to take an active part : else it would be a monologue or a dictatorial lecture! Each interlocutor must take into account the other's goal. No one can be engaged in a dialogue if he can't explain his own utterances, or cannot specify what he couldn't understand in someone else's previous statements.

To detail his principle, Grice proposes some axioms that must be respected, otherwise, as your interlocutor assumes your statement was intentional, he will make incorrect inferences.

We have established that to be considered as a help, a question-answering system must respect the three following principles :

- be able to participate in a real dialogue, with more than just "one question - one response",
- be able to restart the dialogue when some problem prevents the successful operation of the system
- be able to justify itself,i.e. the chain of reasoning it used to produce a previous answer.

## 111» Examples of di alogues.

In this paper, we describe dialogues where both participants are involved; the user expects from the machine a well-formed answer (i.e. not in some jargon), and the machine doesn't limit the user's part to a choice among a set of predefined questions. We are currently working on an application in which a program takes the place of the"yellow pages" of the french telephone directory (the professional listings : suppliers of goods and services).

This system assumes that the user's goal is to obtain a phone number; when a problem is posed, it searches for someone who might solve it. The system has a deterministic parser (7) which analyzes the user's utterances; it uses a semantic network with different kinds of links. Each listing is represented by its name, i.e. a concept and a list of sentences describing the activity of the supplier (8).

Example EI (illustrates the explanation process)

UI : T would like to move my safe.
S1 : I suggest an art mover or a piano mover.
U2 : Why a piano mover ?
S2 : Because, both your safe and a piano are very heavy.
U3 : Why an art mover ?
S3 : Because your safe may contain valuable objects, and an art mover handles things of value.

In UI, the topic recognized is "to move a safe". Then, the reasoning process (REASON) looks for an answer to this request : first it chooses the listings whose name contains the concept "move" or the concept "safe", then it searches the list of sentences describing the activity of the supplier. Here it finds nothing, so it uses the "synonym" reasoning process (it examines the links between the concepts in the semantic network, and their possible combinations, e.g. "sort of" and "part of" give "part of"). REASON finds that safe is the "approximate synonym" of "piano" (both heavy) and "valuables" (safe may contain objects of value). Then it verifies that the listing "piano mover" and the listing "art mover" contain information which agrees with the question the user asks, and generates S1. The user suprised (and he has reason to be!) questions in U2. The internal representation of this question is passed to the dialogue process (DIALOG). It recognizes a causal question, concerning a prior topic : to move a piano. Then it must find the path that led it to this result and it must constitute an explanation which is, as much as possible, tailored for the user. In order to carry on the dialogue with good results, the system must incorporate the following three representations : the topics that have already been mentioned, the different chains of reasoning the system has used, and the knowledge level we suppose the user has. We will develop below the methods used to build these representations. Using them, the system can give coherent explanations. When it is asked about the piano mover, it uses its topic knowledge to selection only the relevant information from the reasoning (S2), and the same process with S3. In building these answers, the system must take into account the knowledge we suppose the user to have, so as to avoid an overly detailed explanation.

Example E2 (underlines the capacities to follow the changes of subject, and restart the dialogue).

U1 : I would like the phone number of an oriental restaurant.
S1 : Would you prefer a vietnamese, a japanese or a chinese one?
U2 : I don't care.
S2 : In which part of town?
U3 : First give me a phone number for a radio taxi
S3 : You have the following listings under Taxi : Hello Taxi (111-11-11), Night Taxi(222-22-22).
U4 : In that case, I would like a restaurant in the 5th district.
S4 : You have :
chinese restaurant :"The Mandarin" 333-33-33
japanese restaurant :"The rising sun"444-44-44

After analysis, we know that U1 is an "object" demand for an oriental restaurant. REASON works only on the couple (predicate, object): dine at a restaurant. Thus, it finds the following listings : chinese, russian, japanese restaurant, fast food,... DIALOG obtains this list. To make a selection, it begins by looking for a modifying criterion in the user's request. It finds : oriental, which qualifies the type of restaurant. There remain the chinese, vietnamese restaurants, which are proposed to the user (S1). As he refuses to make a choice, another question must be constituted. First, we try to use the criteria (topics) which allowed us to determine the current listings. Then we make a search on the information known about the listings. But these procedures fail. If the system contained the fact that vietnamese food was "spicy" and japanese food was "non-spicy", the system would have been able to offer a further choice. In this case, the criteria were "richer" than the first choices presented; but not in our example E2. The last solution we have foreseen is to ask a question about the restaurant location (S2). In U3, the user changes the topic, he asks for a radio taxi. After a new search, REASON finds the listing taxi. DIALOG verifies that it operates by radio call, and proposes S3. The user may then answer S2, and asks for a restaurant in the 5th district. The system then recognizes a topic already discussed, it doesn't make a new search, but makes a selection among three types of restaurant chosen before. It is possible to compose S4.

## IV. The representations built by the system.

The first representation we show here is the chronological record (CR). It connects all the others which we present below. It establishes the link between the different utterances and indicates "who" says "what", and in which context an utterance has been said.

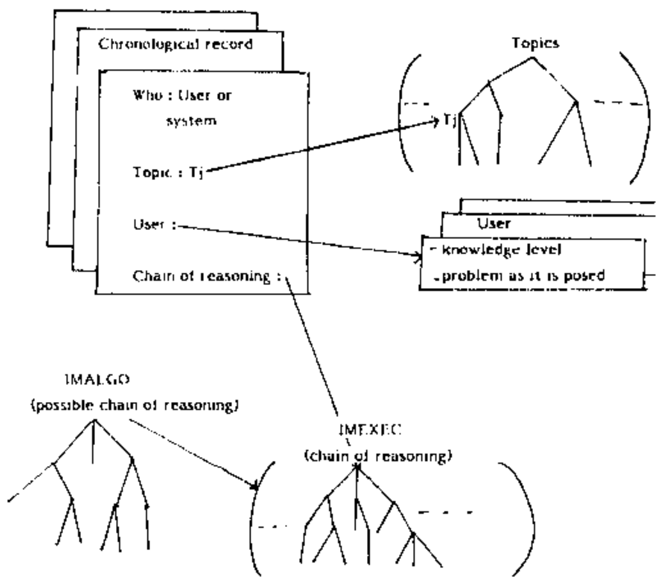



Fig 1 : Chronological record

In this structure, we find, for each utterance :

1) who said it, the user or the system.

2) the topics developed in this utterance. By topic, we mean the subject of the dialogue, what we are speaking about. In this part, we used the results obtained by Grau's system (3). In her work, the topic is represented by a set of schemas which are connected by different kinds of links (hierarchical, descriptive,..) Her system offers the possibility of integrating a sentence in its context, that is to relate it to the topics which have already been discussed. During the dialogue, the different topics are developed both by the user, when he introduces a request or further specifies it, and by the system when REASON makes approximations. Among these topics, we establish a hierarchy, which underlines the fact that some "detours" may appear after a user request without a complete change of subject. This hierarchy leads us to build a tree whose root is the user's initial request. We have considered that REASON can't introduce a completely new topic; it can only produce different kinds of "detours". The topics developed during the dialogue constitute a list of trees (cf Fig 1). Each entry of CR points to a node inside one of these trees.

3) the system's chain of reasoning. Tn the examples we demonstrate the necessity of different levels of detail in the chain of reasoning so as to present a "good" justification. In an order to obtain those levels, we have represented the reasoning as a tree, The sets of procedures which form REASON constitute an implicit hierarchy; this hierarchy is reflected in the structure of the "reasoning tree" we produce. As a one-time procedure (for each version of REASON) we build a tree which represents all the possibilities of REASON ( the image of the algorithm : IMALGO) . Each time REASON is called, a new sub-tree is extracted, corresponding to the particular execution (the image of the execution : IMEXEC). 1MEXEC is the trace of the reasoning used to solve a certain problem. J t will be used by the explanation process (EXPLAIN).

4) the user's representation. In CR, we store a pointer towards a representation of the user as we currently define it (it is dynamic). It is composed of two elements : the knowledge level the system attributes to the user, and our current definition of the user's problem. The knowledge level is used to avoid to drown the user in details when the system explains its reasoning. It is based on TMALCO. The representation of the user's problem is composed of the couple (predicate, object) which was used to call REASON. Joined to this is a list of concepts which modify one of the couple's two elements. We see in E2 that it is used to solve some cases of ambiguity.

It is the set of all these representations interconnected byCR which allow us to manage a dialogue, taking into account as best we can the three points underlined above :

- participation in more than "one question - one answer" dialogue,
- restart the dia1ogue,
- se1f-justification.

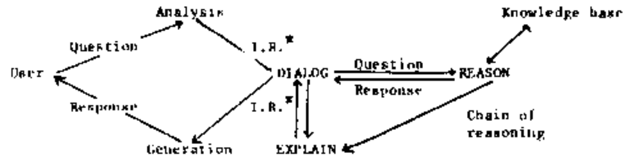
## V• The use of these representations for the dialogue

To enable us to accept questions regarding the whole dialogue, the CR is updated at each utterance, A new entry is created showing who spoke, the topic developed, the user's representation as it is currently perceived and the chain of reasoning.

Let us examine what happens when a user's utterance is addressed to the system. Tt is first analyzed. Then DIALOG acts in different ways, depending on the kind of question and the topic developed If the question contains a topic change, REASON is called to search the knowledge base (in E2 : 111 and U3) . If it is a question concerning a prior topic, EXPLAIN is called (in El : 112). Otherwise it is treated as information to resolve an ambiguous point (in E2 : U4) . At the end of the reasoning process, a good answer either has or has not been found.DIALOG will then transmit the good answer to the generation process, otherwise it tries to determine a question, in order to pursue the dialogue (see E2).

When EXPLAIN is called, it first decide^, by referring to topic and CR,where this problem has been solved. Then it retrieves the part of IMEXEC concerned by the question, and taking into account the knowledge we assumes the user has, it builds an explanation. After that, the user's representation is modified so if he asks again for an explanation we may give him more details.

We find in the following diagram a resume of this process.




DIALOG : manages the dialogue
REASON : searches the knowledge base
EXPLAIN : explains the reasoning

(*) Internal representation

Fig 2 Representation of the system

## V1 . Conc1 us i on

Our goal is to give control of the dialogue back to the user, to permit him to change the subject, to backpedal, and to question the system's responses. In any case, if the system can't solve the whole problem, it must be able to efficiently aid the user to modify the request. To this end, the system's questions take into account the work already accomplished and indicate to the user the various paths possible to arrive at their goal.

During a conversation, each participant assumes an enormous amount of knowledge on the part of the other(s). This is what is shown in Grices's maxims. He points out that the violation of any of the axioms derived from the cooperation principle is given significance equal to that of the actual contents of the utterance. This is why our system is constructed to act in accordance with these principles. The system's utterance must be clear so that the user doesn t have to search for hidden meanings.

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