

**ELEMENTARY CONTRACTS
AS A PRAGMATIC BASIS OF LANGUAGE INTERACTION**

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ABSTRACT

Language interaction (LI) as a part of interpersonal communication is considerably influenced by psychological and social roles of the partners and their pragmatic goals. These aspects of communication should be accounted for while elaborating advanced user-computer dialogue systems and developing formal models of LI. We propose here a formal description of communicative context of LI-situation, namely, a system of indices of LI agents' interest in achieving various pragmatic purposes and a system of contracts which reflect social and psychological roles of the LI agents and conventionalize their "rights" and "duties" in the LI-process. Different values of these parameters of communication allow us to state possibility or/and necessity of certain types of speech acts under certain conditions of LI-situation.

1. INTRODUCTION

We consider interpersonal communication as joint activity of LI agents (X and Y). Each agent has his own plan of behaviour which is represented here by a system of goals (G.X or G.Y), i.e. certain pragmatic and communicative tasks to be realized. The system of goals of the agent, for instance, G.X, may contain both the goals initiated by X himself and the goals initiated by his partner Y. Formation of the system of goals by the agent X is associated with the two following communicative metagoals:

-k1 is an inclusion of a goal g into the partner's system of goals G.Y;

-k2 is an inclusion of a goal g into X's own system of goals G.X.

Language interaction is considered as a process aimed at accomplishing one of these metagoals. Each agent chooses a mode of achieving metagoals in response to socially determined relations between him and his partner. These relations are described by a system of contracts ([1],[2],[3]). In this paper we propose a formal description of some elementary contracts formed by combination of basic relations between the partners.

2. THE SYSTEM OF RELEVANCY INDICES.

In order to describe agents' positions with respect to a potential goal g we introduce three indices being individual for each agent:

-INT(X,g) is a degree of X's interest (necessity, desirability) in achieving the goal g; this index may be either positive or negative;

-CST(X,g) is a cost of achieving the goal g, i.e. the efforts to be made by X for achieving g; this index is always positive;

-BEN(X,g) is a benefit which may be derived by X from achieving g; $BEN(X,g) = INT(X,g) - CST(X,g)$.

We consider some threshold t which, in general case, should be exceeded by BEN(X,g) ($BEN(X,g) > t$) for including the goal g into the X's system of

goals. The value t of this threshold is individual for each agent in different communicative situation.

The values of these indices are generated under the influence of different psychological, ethical, pragmatical and other factors. The degree of importance of each factor is determined by individual characteristics of each agent and may vary during the LI-process. Hence the values of relevancy indices may also vary.

3. DOMINATION AND DEPENDENCY

3.1. In order to map contracts onto communicative level of the LI we introduce several types of elementary contracts formed by combination of basic domination and dependency relations between the partners. These relations control over the process of forming the system of goals, i.e. they influence upon the choice of the mode of achieving the metagoals. The domination relation fixes LI agent's "rights" and "duties" in achieving metagoal k1, i.e. in including a goal into the partner's system of goals. Dependency controls over achieving the metagoal k2. The "rights" and "duties" of the agent in the process of goal formation are represented by a set of rules known to both the agents. These rules belong to a set M which represents the agents' mutually coordinated beliefs about the world.

3.2. Elementary contracts of the first type are based on the domination of X over Y for all the goals of the class G'. This relation allows X to oblige Y to include any goal $g \in G'$ into Y's system of goals, if the proposition $BEN(Y,g) > t_1$ belongs to the set M, t_1 being the minimum value of index $BEN(Y,g)$ which is necessary for X to achieve the metagoal $k1 = (g \in G.Y)$. The value of t_1 is determined by the whole complex of constituents of complete contract which determines the level of cooperation, i.e. the degree of coordination of agents' actions, coincidence or conflict of their interests. So, provided that $(X > Y, G', t_1)$, $g \in G'$ and $BEN(Y,g) > t_1$, it is sufficient for X to let Y know of metagoal $k1 = (g \in G.Y)$ being included in the system G.X for the goal g to be included into the Y's system of goals.

The second type of elementary contracts is characterized by the absence of domination of X over Y ($X \nrightarrow Y, G', t_2$): in general case it is not sufficient for X to let Y know of metagoal $k1 = (g \in G.Y)$ being included in G.X. For X another way of achieving k1 based on the values of some other constituents of the contract should be chosen.

3.3. Elementary contracts which regulate achievement of the metagoal k2 are based on the dependency relation: $(X < Y, G', t_3)$. If X depends on Y, it is necessary for him to get Y's permission for inclusion of a goal $g \in G'$ into the X's system of goals, or the proposition $BEN(Y, g \in G.X) > t_3$ should belong to the set M, where t_3 is the necessary value of index BEN for Y to include a goal into his system of goals.

The absence of dependency ($X \nrightarrow Y, G', t_4$) allows X to include any goal $g \in G'$ into his system of goals without Y's permission. But the index $BEN(Y, g \in G.X)$ has to exceed the value t_4 being determined by the level of cooperation between the partners.

3.4. The basic relations aren't mutually exclusive or interdependent: the domination of X over Y in the class G' doesn't exclude the domination of Y over X in the same class G' and doesn't presuppose the Y's dependency on X. The complete contract includes decomposition of the set of potential goals into classes, for each of which the given relations are defined on the part of X as well as on the part of Y.

4. NEUTRALITY, COOPERATION AND CONFLICT

4.1. Basic relations reflect certain social and psychological roles of the LI agents. The absence of these relations between the partners leaves the modes of achieving the metagoals to LI agents' choice. These modes are divided into three groups, according to the degree of mutually accounting for each other's interests. These groups determine three types of contracts: neutral, cooperative and conflicting ones. There exists the following set of modes: admissibility/inadmissibility of deformation of the basic relations, possibility of reciprocal concessions, usage of additional information stimulating a successful achievement of the agent's goal. This stimulus may be positive (plus-stimulus) or negative (minus-stimulus).

4.2. The neutral contract presupposes the inadmissibility of deformation of the basic relations.

In case of absence of domination of X over Y ($X \nrightarrow Y, G', t_2$) it is necessary for X to make Y be interested in achievement of a goal $g \in G'$ for realizing the metagoal $k_1 = (g \in G.Y)$, i.e. to make the value of index $BEN(Y, g) > t_2$. Neutral contracts allow X to use one of two possible means: a) to let Y know of some information increasing the value of the index $BEN(Y, g)$; and b) to let Y know of a goal g' being included in the X's system of goals, with $BEN(Y, g') + BEN(Y, g) > t_2$. Provided that the proposition $BEN(Y, g) < t_2$ belongs to the set M and it is impossible for X to use one of the two means mentioned above, X has to give up the metagoal $k_1 = (g \in G.Y)$.

In case of ($X \nrightarrow Y, G', t_4$) the neutral contract commits X to take Y's interests into account. X may include a goal g into $G.X$ if this goal is harmless for Y ($INT(Y, g) > 0$). If the value of the index $INT(Y, g)$ is negative, it is necessary for X to guarantee some compensation for presupposed damage, i.e. to include a goal g' into $G.X$ with $BEN(Y, g \in G.X) + BEN(Y, g' \in G.X) > t_4$. Otherwise X has to give his goal g up.

So neutral contracts provide the accomplishment of the metagoals by means of basic relations and by using plus-stimuli.

4.3. Cooperative contracts are characterized by reciprocal "credit", i.e. mutual concessions are possible. Each agent may allow infringement of his interests. The degree of infringement is determined by the level of cooperation and is fixed in the values t_i of relevancy indices. Cooperative contracts allow modification of basic relations, it is possible for any agent not to do his duty or to

exceed his rights.

In case of $X > Y$ the inclusion of a goal into the system $G.Y$ is possible if the value of the index $CST(Y, g)$ is far less than t_5 and the value of the index $BEN(X, g)$ is more than t_6 , where t_5 and t_6 are determined by the level of cooperation. If the value of index $CST(Y, g)$ is more than t_5 but X doesn't give up the metagoal $k_1 = (g \in G.Y)$, then X may use plus-stimulus, i.e. compensation of presupposed damage.

In case of $X \nrightarrow Y$ it is possible for X to achieve the metagoal $k_1 = (g \in G.Y)$ without using any stimulus, if the value of the index $CST(Y, g)$ is less than t_5 . Provided that $CST(Y, g) > t_5$, X has to use plus-stimulus for including the goal g into the $G.Y$ system. The partner Y, on his turn, has to include the goal g into his system of goals, if $CST(Y, g) < t_5$ and $BEN(X, g) > t_6$.

Cooperation permits the modification of the basic relation $X < Y$, it means that it is possible for X to include a goal g into his system of goals in spite of the value of the index $BEN(Y, g \in G.X)$ being less than t_2 . In other words, Y may give permission for X's inclusion of the goal g into the system $G.X$ in spite of $BEN(Y, g \in G.X) < t_2$. If the value of the index $BEN(Y, g \in G.X)$ is far less than t_2 then it is necessary for X to use plus-stimulus: to promise the inclusion of the goal g' , with $BEN(Y, g \in G.X) + BEN(Y, g' \in G.Y) > t_2$.

In case of $X < Y$ it is necessary for X to take into account Y's interests: to include a goal with $INT(Y, g \in G.X) > 0$. Provided that $INT(Y, g \in G.X) < 0$, it is necessary for X to guarantee compensation for success of the metagoal $k_2 = (g \in G.X)$. As for Y, it is possible for him to allow some infringement of his interests: X may include a goal g into $G.X$, if the value of index $BEN(Y, g \in G.X)$ is not much less than t_2 . In this case X may succeed in achievement of the metagoal $k_2 = (g \in G.X)$ without using of plus-stimulus.

4.4. The conflicting contracts allow agents to use minus-stimulus and to break the basic relations.

The break of elementary contracts based on X's domination over Y is characterized by Y's refusal of including the goal g into his system of goals in spite of X's demand, if the value of the index $BEN(Y, g)$ is less than t_1 .

As for, X it is possible for him to use a minus-stimulus for achieving the metagoal $k_1 = (g \in G.Y)$ in both the cases $X > Y$ and $X \nrightarrow Y$. Minus-stimulus is X's promise to include a goal g' into $G.X$ with $BEN(Y, g' \in G.X)$ being far less than t_2 . This promise induces Y to include the goal g into $G.Y$ in order to avoid accomplishment of the goal g' . Under a conflict for achieving the metagoal $k_2 = (g \in G.X)$ it is possible for X not to get Y's permission for including a goal g into $G.X$ in both the cases $X < Y$ and $X \nrightarrow Y$. Conflicting contracts allow X to include any goal without taking into account Y's interests. If it is necessary for X to get Y's permission for achieving the goal g , he may use minus-stimulus to force assent out of Y.

5. CONCLUSION

Above we have discussed certain aspects of communicative context of LI: the agents' systems of indices of relevancy, basic relations forming elementary contracts and three types of contracts regulating the process of goal formation. These aspects of goal formation reflect some social and psychological roles of the LI agents.

It is convenient for us to consider LI to be aimed at forming agents' systems of goals in order to map "rights" and "duties" of agents onto communicative level and to state possibility or/and necessity of a certain type of speech acts in the process of goal formation.

For accomplishment of the metagoal k1 (inclusion of a goal into Y's system of goals) it is necessary for X to perform a speech act which may be named "inducing". The particular type of inducing speech act is determined by the relation which holds between X and Y. X's domination over Y allows X to perform a speech act which may be named "order", otherwise X performs a speech act "request". If it is necessary for X to use additional information, the type of speech act performed by X is determined by the type of information to be chosen in accordance with the type of contract: neutral and cooperative contracts allow X to use only plus-stimulus, that is X performs a speech act of the type "temptation". Conflicting contract allows X to perform a speech act "threat" which is characterized by use of minus-stimulus.

X's dependency upon Y makes it necessary for X to perform a speech act of the type "asking permission" for inclusion of a goal into his system G.X. If this goal g is relevant for X, then "asking permission" may be X's "asking permission" for doing something in favour of X ("May I come in?"). If the goal is relevant for Y, then X performs an "offer" ("What about a cup of tea?", "May I see you home?")

The proposed system of notions is a first step towards formalization of the aspects of communicative context discussed above. The task for future work is to extend the nomenclature of elementary contracts and to specify formal means for representation of social and psychological roles of the LI agents.

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