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Montague style semantics for illocutionary logic

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Abstract. The aim of this paper is to present a semantics for Serale's and Vanderveken's illocutionary logic based on the Mantague pragmatics for intensional logic.

1. Illocutionary Logic.

The considerations in area of illocutionary logic have their roots in well known Austin's book „How to do things with words" They were continued in "Speech acts" by J. Searle and then formalized in J. Searle and D. Vanderveken [95] and Vanderveken [91], where one can find an exhausive disscusion of philosophical intuitions and formalizations of this logic. Some other approaches to illocutionary logics are presented in Malinowski [94] and Malinowski [x].

Here we will present only some basic intuitions of illocutionary logic. In distinction with traditional logic, illocutionary logic aims not only sentences in logical sense, but with much larger class of utterances including sentences for which we cannot correspond any logical value in a natural way. Typical examples of sentences illocutionary logic investigate are commands, requests, commitments, thanks, predictions. Main difference between utterance and sentence in logical sense is based on the fact that utterances can be treated as actions of some special type, actions by means of speech acts.

Any utterance is built up from elementary utterances by means of illocutionary connectives. Elementary utterances are of the form $F(P)$, where F is an illocutionary force, and P is a proposition – content of the utterance. Any illocutionary force in Searle's and Vanderveken formalism is determined by means of following six components:

Illocutionary point – direction to fit between words and worlds. Assertion is to fit word to world, while command or commitment – to fit world to word by someone will take care to change a present state of affairs in appropriate manner.

Mode of achievement of illocutionary point – a modification of an illocutionary point which usually may be achieved by many ways. A mode of achievement distinguish all of modes corresponding to given illocutionary force. Mode of achievement allow us to distinguish between „request" and „command" – illocutionary forces with the same illocutionary point.

Content conditions – define the domain of the operator F of illocutionary force. For example content of predictions should describe some state of affairs in the future.

Preparatory conditions – A special modification of illocutionary point. For example to preparatory conditions of request belong the condition that speaker is convinced that satisfying it will be up to himself.

Sincerity conditions – describe mental states (propositional attitudes) of speaker appropriate for a given illocutionary force. In requests it said that speaker really want hearer will do what speaker ask him to do.

Degree of strengthening the mental states of sincerity occurs with different strengthenings in different illocutionary forces. Degree of strengthenings try to „measure" them.

Illocutionary counterpart of the notion of true sentences is the notion of illocutionary efficient utterance We will say that an utterance $F(P)$ is *performed* by speaker in a given context i iff:
1. Speaker achieve an **illocutionary point** of an illocutionary force F with content P in mode which agree with **mode of achievement** of F, and P fulfills **content conditions**, of F in a given situation;
2. Speaker presupposes all propositions determined by **preparatory conditions** for P.
3. Speaker express with **degree of strengthening** of F all mental states determined by **sincerity conditions** of F.

3. Pragmatics.

The logic presented below is based of formalism presented in Montague [68].

Lets start from a definition of a language.

(1) Logical constants: $\neg, \wedge, \vee, \rightarrow, \leftrightarrow, \exists, \forall, =$;

(2) brackets;

(3) individual variables $v_0 ... v_k ...$;

(4) n-ary predicates, for any natural number n, and designated unary predicate E (exists);

(5) n-ary function symbols for any n;

(6) n-ary operators for any n.

We assume that a language contains all the symbols of categories (1), (2) i (3). We can therefore identify ientity any language with a set of their predicates and function symbols.

n-ary operator is a symbol, which applied to n element sequence of sentences (formulas) gives us some sentence (formula). Usually we will work with unary modal operators like „It is necessary that..." „it is possible that...", however it is possible to consider more complex operators like modal conditionals.

Terms and formulas of a language will be defined in the natural manner. The set of the terms is the least set T such that:

(1) Any individual variable is a term (belong to T).

(2) $R(t_1, ... t_n)$ is a term if $t_1, ..., t_n$ are the terms.

The set of formulas is the least set Z such that:

(1) If P is an n-ary predicate and $t_1, ... t_n$ are terms then $P(t_1, ..., t_n)$ is a formula;

(2) if t_1 t_2 are terms then $t_1 = t_2$ is a formula;

(3) if ϕ and ψ are formulas then $\neg\phi$, $\phi \vee \psi$, $\phi \wedge \psi$, $\phi \rightarrow \psi$, $\phi \leftrightarrow \psi$ are formulas;

(4) if ϕ is a formula and v individual variable then $\forall_v \phi$ then $\exists_v \phi$ is a formula;

(5) if ϕ is a formula and N an operator then $N\phi$ is a formula.

For many utterances, information about some set of objects of its interpretation does not suffice to describe the conditions of its performance. Very often it is necessary to get higher order information i.e. about some properties or states of the world or abour mental states of speaker. We simply need information about the situation in which an utterance is to be performed.

DEFINITION 1. *Interpretation of* L we call an ordered triple (I, M, f) such that:

(1) I and M are the sets;

(2) f is a function on L;

(3) for any symbol A of L f_A is a function on I;

(4) if P is n-ary predicate of L and $s \in I$, then $f_P(s)$ is an n-ary relation on M, i.e. a set of n-tuples of elements of M;

(5) if A is an n ary function symbol L and $s \in I$, then $f_A(s)$ is $n+1$ ary relation on M such that for any $x_0, ...x_{n-1}$ from M, there is exactly one object y in M such that $(x_0, ...x_{n-1}, y)$ belong to $f_A(s)$;

(6) if N is unary operator in L and $s \in I$, then $f_N(s)$ is unary relation on set of all subsets of I.

Instead of $f(P)$ we will often use a symbol f_P. n-tuple of elements $x_1, ..., x_n$ will be denote by $(x_1, ..., x_n)$.

The set I in definition above will be called *the set of situations* for interpretation (I, M, f). Let s be a situation, E designated unary predicate (exists) L, then the objects x such that $(x) \in f_E(s)$ we be considered as an objects which exists in situation s with respect to interpretation (I, M, f). M is considered to be a set of all possible objects of interpretation (I, M, f), we don't assume then that all object from M actually exists.

We have now to introduce the notion of satisfiabitity of formulas by sequence of objects, and consequently the notion of truth.

DEFINITION 2. Given an interpretation $\mathbf{A} = (I, M, f)$ for L. The notion of *satisfaction* in given situation s will be defined recursively as follows:

(1) If t_1 and t_2 are terms of L, then $t_1 = t_2$ is *satisfied* in s according to $\mathbf{A}$ (in symbols $\mathbf{A} \models_s t_1 = t_2$) iff in M $f_{t_1}(s) = f_{t_2}(s)$.

(2) If P is n-ary predicate of L and $t_0,...,t_{n-1}$, are terms, then $P(t_0,...,t_{n-1})$ is *satisfied* in s according to $\mathbf{A}$ (in symbols $\mathbf{A} \models_s P(t_0,...,t_{n-1})$) iff in M the following holds: $f_P(s)(f_{t_0},...,f_{t_{n-1}})(s)$.

(3) If ϕ and ψ are formulas of L, then the formula $\neg\phi$, ($\phi \wedge \psi$ respectively) is *satisfied* in s according to $\mathbf{A}$ iff a formula ϕ is not satisfied in s (a formula ϕ is satisfied in s or a formula ψ is satisfied in s, respectively). (Similarly we define a satisfaction for other connectives.)

(4) If ϕ is a formula of L, then a formula $\exists_{v_n}\phi$ is *satisfied* in s according to $\mathbf{A}$ iff there exists $a \in M$ such that $f_\phi(f_{v_0},...,f_{v_{n-1}}, \mathrm{a}, f_{v_{n+1}},...,f_{v_k})$ holds in M. Similarly we define a satisfaction for „forall" quantifier.

(5) If N be unary operator, ϕ a formula. $N(\phi)$ is *satisfied* in s according to $\mathbf{A}$ (In symbols $\mathbf{A} \models_s N(\phi)$) iff for any s' such that $(s, s') \in f_N$ a formula ϕ holds in s' according to $\mathbf{A}$.

DEFINITION 3. Let $\mathbf{A}$ be an interpretation of L $\mathbf{A} = (I, M, f)$, $s \in I$, ϕ is a sentences (a formula without free variables). We say that a sentence ϕ is *true* in s according to $\mathbf{A}$ iff ϕ is satisfied in s according to interpretation $\mathbf{A}$. A set X of sentences will be called *consistent* iff there exists an interpretation such that any sentences of X is true in some situation.

It is worth to recall that existential quantifier is not identical with designated predicate E. A sentence with existential quantifier speak about existence of possible object, which can not exist in a sense of E. Of course it ia possible to quantify existing objects, for example by means of: $\exists_u(Eu \wedge Pu)$

DEFINITION 4. We will say that a sentence ϕ is a *logical consequence* of a set of sentences X, iff for any situation s of any interpretation $\mathbf{A}$ for L i $\mathbf{A} = (I, M, f)$, if any sentence of X is true in s then ϕ is true in s.

Lets define now a key notion of this paper, the notion of a language of utterances. We will define it building it over a language defined above.

By an utterance we mean a partial unary operator to some sentence of a language defined above. For example, „I promise that ..." or „I testify that ...." are identified with a function which to any content sentence correspond a set of sentences which, roughly speaking, describres the features a situation should possesses to perform a given utterance.

By a *language of utterance* we mean an ordered pair $(\mathcal{F}, L)$ such that: (1) L is a language defined above; (2) $\mathcal{F}$ is a set of unary partial operators on L.

We will enlarge now a definition of interpretation to cover utterances.

DEFINITION 5. *Interpretation of L* we call an ordered triple (I, M, f) such that:

(1) I and M are the sets;

(2) f is a function on L;

(3) for any symbol A of L f_A is a function on I;

(4) if P is n-ary predicate of L and $s \in I$, then $f_P(s)$ is an n-ary relation on M, i.e. a set of n-tuples of elements of M;

(5) if A is an n ary function symbol L and $s \in I$, then $f_A(s)$ is $n+1$-ary relation on M such that for any $x_0, ...x_{n-1}$ from M, there is exactly one object y in M such that $(x_0, ...x_{n-1}, y)$ belong to $f_A(s)$;

(6) if N is unary operator in L and $s \in I$, then $f_N(s)$ is unary relation on set of all subsets of I.

(7) if $F \in \mathcal{F}$ is an utterance operator, then $f_F(s)$ is a function which to any sentence α of L correspond a set $\tilde{F}(\alpha)$ of sentences of L. A set $\tilde{F}(\alpha)$ will be called an *essential condition* of F for α.

An interpretation of an utterance operator in a situation s depend on the structure of an operator, which is determined by conditions which have to hold.

DEFINITION 6. Let **A** be an interpretation of an language of utterance. $\mathbf{A} = (I, M, f)$. We will say that an utterance $F(\phi)$ is *(illocutionary) efficient* in s under **A** iff any sentence of the set $f_{F(\phi)}$ is true in s. An utterance $F(\phi)$ is *tautologically efficient* under **A** iff $F(\phi)$ is efficient in any situation of any interpretation.

An utterance is satisfiable iff it is efficient in some situation of some interpretation. An utterance $F(\alpha)$ is *inconsistent* iff the set $\tilde{F}(\alpha)$ is inconsistent under some interpretation.

COMPLETENESS THEOREM. *An utterance $F(\alpha)$ is inconsistent iff it is satisfiable.*

Definition 7. We will call an utterance $F(\phi)$ being a logical *consequence* of a set of utterances X, in s under **A** iff ϕ is efficient in s under **A**, if only utterances of X are efficient in s under **A**.

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