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ALTERNATIVE MATHEMATICAL MODEL OF THE NATURAL LANGUAGE SEMANTICS USING FIRST-ORDER FUZZY LOGIC

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In the first part of the dissertation, a project of the alternative mathematical model of the natural language semantics is carried out. Its mathematical frame is fuzzy set theory and it stems from the functional generative description of the natural language which is elaborated by Prague linguistic group.

Lexical meaning of a word is modelled by a fuzzy set together with the property φ determining it. The model of semantics of nouns with their grammatemes and complementations and of adjectives with the grammatemes of degree and their connection with nouns is proposed. The meaning of a verb is a fuzzy set of fuzzy relations. It is also proposed how the grammatemes of the verb could be modelled. The model of word quantifiers and some adverbials is proposed and the model of the semantics of simple sentences is demonstrated.

In the second part, a syntax and semantics of the first-order fuzzy logic is elaborated. The syntax contains basic connectives of disjunction $\vee$, conjuction $\wedge$, bold conjuction $\&$, and implication $\Rightarrow$, additional connectives $o_j, j \in \mathrm{Jop}$, basic quantifiers $\forall, \exists$, and generalized quantifiers $Q_j, j \in J_q$. Some sound rules of inference in the form

$$r : \frac{\varphi_1, \ldots, \varphi_n}{r^{\mathrm{syn}}(\varphi_1, \ldots, \varphi_n)} \left(\frac{\alpha_1, \ldots, \alpha_n}{r^{\mathrm{sem}}(\alpha_1, \ldots, \alpha_n)} \right)$$

are introduced together with the concept of a proof of a formula φ_n

$$\omega = \varphi_0[\alpha_0; P_0], \ldots \varphi_n[\alpha_n; P_n]$$

and its value $\mathrm{Val}(\omega)$ is defined. Some theorems on properties of the syntax and semantics are proved and the concept of a fuzzy theory $\mathcal{T}$ and its model $\mathcal{D}$ are introduced. The deduction theorem, closure theorem, theorem on constants and other ones are proved. The construction of the canonical model and a special

ultrafilter are the basis of a proof of the generalization of the classical Gödel's completeness theorem:

A formula φ is α–theorem, $\mathcal{T} \vdash_\alpha \varphi$, iff it is α–valid in the theory $\mathcal{T}$, $\mathcal{T} \models_\alpha \varphi$.

REPRESENTATIONS OF FLOWS AND GENERALIZED RUDOLPH'S THEOREM

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Problems connected with representations of flows are investigated in the thesis. The first part refers to the decomposition of a flow (formed by a very general contin uous group of homeomorphisms of a Polish space) into ergodic components without any substantial assistance of a measure. It is proved at the same time that the sets of quasiregular and regular points are Borel of the type $G_{\delta\sigma\delta}$, too. In the second part, there is solved the problem of the representability of a measurable flow $\{T_t\}_{t\in R}$ on a probability space by a canonical one, i.e. by a flow under the function taking only two (irrationally related) values, whose pro–images form a (two–element) generator of the basic automorphism. To this end an auxiliary invariant, the asymptotic rate of the flow, is introduced (in the case of countably generated σ–algebra in the state space). It is shown that the asymptotic rate of the flow under the function is closely related to the asymptotic rate of the basic automorphism. Thus, the use of the theorem on the minimal cardinality of the generator allows us to find the necessary and sufficient condition of the representability of an aperiodic measurable flow by means of a canonical one. This condition is just the finality of the asymptotic rate. As the asymptotic and entropy rates are equal in the case of the ergodic flow, the Rudolph's theorem was generalized to the non–ergodic case.

APPLICATION OF THE FACTORIZATION THEOREM FOR STONE ALGEBRAS IN LOCALES

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The theory of locales (Stone spaces, Stone algebras) has been invented to study topology by means of lattice theory. One of the most important notions to be investigated is the concept of a subspace of a Stone space. As shown elsewhere, it corresponds to the concept of a quotient Stone algebra.

In the present work we prove a theorem characterizing quotient Stone algebras obtained by an arbitrary system of relations. This allows to construct spaces from generators and defining relations. Our main aim is to study the applications of this method.

The basic theorem is proved in Chapter 1. In Chapter 2 we prove Tychonoff's theorem for locales without the axioms of choice and replacement. This strengthens a result of P.T.Johnstone and solves his problem.