

From automatization to neurophenomenology of artificial intelligence in robotics

Abstract

The main problem in robotics is strengthening of robot artificial intelligence (I_A) system. Its solution will facilitate cooperation of man with robot. Authors suggest advanced technology for I_A development. It borrows method of universal (deep) tutoring (T_U) relying on semantic axiomatic method (AM). By method T_U knowledge understanding is achieved by rational consciousness formation. It uses the utmost mathematical abstractions expressed on language of categories (L_C). Being functional one L_C is destined for intellectual processes (P_{IR}) description due to its universal constructions. Following T_U robot educational space (S_{ER}) is class of categories. Its I_A sophistication occurs through new categories inclusion as required in robot I_A multilevel hierarchical orientated network (N_C) of concepts. Universal laws of robot functioning are embodied as operations of algebraic structures being objects of N_C . It creates integrated environment of applications (IE_A). Robot intercourse with man and its interaction with working space (S_{WR}) make active P_{IR} happening in N_C . Processes of assignments execution (P_{ER}) begin just when satisfaction to a set of relations in S_{WR} and in robot space of notions is a success. Possibility of P_{IR} to climb up the highest levels of N_C and down the lowest ones endows robot with capability to generate P_{ER} making decisions in unfamiliar S_{WR} .

Keywords: neurophenomenology, universal tutoring, artificial intelligence, language of categories, functor, free algebra, algebraic system, abstract type of data, intellectual process, execution process, context

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Gromyko V,¹ Vasilyev NS²

¹Department of Computing Mathematics and Cybernetics, Lomonosov Moscow State University, Russia

²Department of Fundamental Sciences, Bauman Moscow State Technical University, Russia

Correspondence: Vasilyev NS, Department of Fundamental Sciences, Bauman Moscow State Technical University, Russia, Email nik8519@yandex.ru

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Abbreviations: I_A , artificial intelligence; T_U , universal tutoring; AM, axiomatic method; A_P , free algebras; S_A , algebraic system; S_{ER} , robot educational space; P_{IR} , robot intellectual processes; In Lib, inter subject library; P_{EdSpS} , personal educational semantic space.

Introduction

Authors' purpose is to clarify how one can train robot I_A to higher levels of complexity. Intellectual technical units imitate anthropogenesis (Figure 1). So principles of human rational consciousness development can be applied to robot I_A creation¹ Table 1. Research carried out before discovered universal laws of human mind functioning. It was proved that in human rational consciousness

creation the most important role plays universal ideas of mathematics expressed on language of categories,² Figure 1b. Meanings of the whole theories can be described on L_C in the form of categories. Method of T_U is proposed as basis of advanced technology of intellect perfection. It realizes projective method of teaching. The approach allows constructing multilevel net of robot notions N_C as base of I_A , see Figure 1b. It differs from inductive approach used in robotics to designing of clever specialized machines.³ Usually separate robot functions in it are gradually extended up to the partial intellectual capabilities. By our opinion with the help of general P_{IR} complex behavior in the form of P_{ER} can be obtained from simple robot actions. It becomes significant to create media for universal P_{IR} phenomenology.

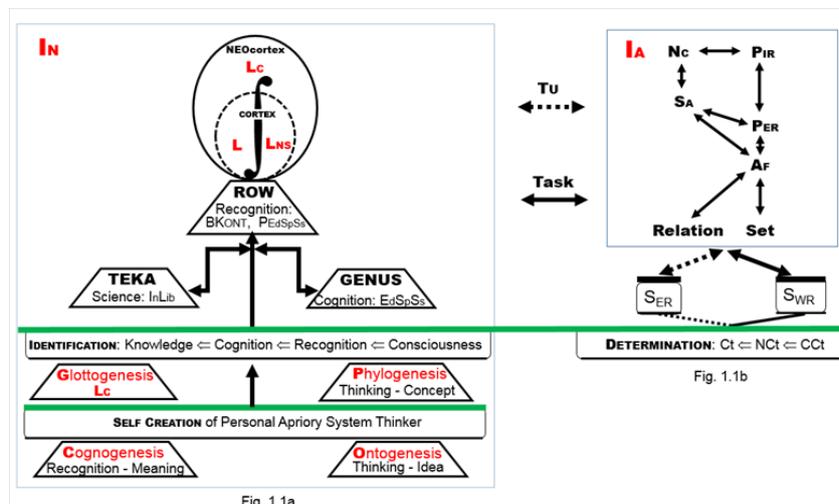


Figure 1 Functional Model – a) Natural Intellect I_N ; b) Multilevel Robot I_A System.

Table 1 Abbreviations

I_A (I_N), Artificial Intelligence (Natural Intellect)	N_C , Network of Categories
T_U , Universal Tutoring	S_A , Algebraic System
S_{ER} (S_{WR}), Robot Educational (Working) Space	A_P , Free Algebra
P_{IR} (P_{ER}), Robot Intellectual (Executive) Processes	InLib, Inter Subject Library
L (L_{NS} , L_C), Language (of Natural Science, of Categories)	BK_{ONT} , Ontological Knowledge Base
P_{EdSpS} , Personal Educational Semantic Space	$NCt \& CCt$, Net & Category of Contexts (Ct)

Universal tutoring of I_A

Scientific means of system-informational culture are clarified due to mathematics.^{1,2} Generalization serves for comprehension. So technology of T_U is grounded on semantic knowledge presentation. Cognitive and functional degrees of I_A complexity can be given in the form of its multilevel system organization, see Figure 1b. The most general I_A concepts are uplifted and disposed on the highest levels of N_C . Algebraic structures are objects of corresponding categories. Use of morphism allows comparing the objects in order to understand their semantics.

Definition: Context is a set of relations among objects of some categories

Robot is able to execute assignments described by quasi-functor $f_i:K'_i \rightarrow L'_i, i=1,2,\dots,n$, which make transformations of contexts. Then robot is capable to fulfill task $f':K' \rightarrow L'$ where $K'=K'_1 \cup \dots \cup K'_n$ and $L'=L'_1 \cup \dots \cup L'_n$ are co-products in the category SET.⁴ If new problem is put to obtain context L then robot tutoring consists in acquiring of knowledge about quasi-functor $\varphi:L \rightarrow L'$. Cartesian square⁴

$$\begin{array}{ccc} K & \xrightarrow{f} & L \\ \downarrow & & \downarrow \varphi \\ K' & \xrightarrow{f'} & L' \end{array}$$

Defines inverse image $f':K \rightarrow L$ of morphism f', φ . Task L execution corresponds to arrow f application. It worth mentioning that context K of S_{WR} is unfamiliar to robot.

Example: Let I_A be taught to recognize hand written letters using map f' . The problem of robot training for texts recognition is to be

solved. For the purpose robot must attain experience of quasi-functor $\varphi=(0, BTW)$ with operation 0 marking up start of text L . Relation BTW allows picking out text fragment lying between $0L$ and any other letter l of the text. Uplifting f' along φ equips I_A with the idea of linear order - arrow f .

Universal functionality of P_{ER}

Free algebras (A_P) of N_C become foundation of abstract types of data (ATD) interconnected by N_C . Robot specialization is achieved by interpretation scheme of assignments fulfillment which takes in consideration working context. It is a matter of relations between I_A notions in N_C and states of S_{WR} . Knowledge description on L_C corresponds to object oriented approach in programming. It also contributes to I_A creation. Carriers of free algebras become definite by means of S_{WR} and given task. It specializes ATD in IE_A (Figure 1b). The utmost laws of I_A functioning supplemented by S_{WR} allow using context for P_{ER} starting. In this manner I_A creative functions act.¹ Besides that availability of P_{IR} simplifies robot control system.

Conclusion

Proper to human mind neurophenomenology of I_A is result of P_{IR} interaction. Suggested advanced technology ensures growth of N_C levels in accordance with I_A sophistication. It will amplify intellectual fields of robot adaptation.

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None.

Conflicts of interest

No conflict of interest.

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