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Ассоциативные семантические компьютеры для интеллектуальных компьютерных систем нового поколения

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В работе рассмотрены недостатки доминирующей в настоящее время фон-Неймановской архитектуры компьютерных систем в качестве основы для построения интеллектуальных компьютерных систем нового поколения, проведен анализ современных подходов к разработке аппаратных архитектур, устраняющих некоторые из указанных недостатков, обоснована необходимость разработки принципиально новых аппаратных архитектур, представляющих собой аппаратный вариант реализации платформы интерпретации систем, построенных на базе Технологии OSTIS, — *ассоциативных семантических компьютеров*.

Предложены общие принципы, лежащие в основе *ассоциативных семантических компьютеров*, рассмотрены три возможных варианта архитектуры таких компьютеров, представлены их достоинства и недостатки.

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Open Semantic Technology as the Foundation for New Generation Intelligent Systems

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***Abstract*—Issues of new generation intelligent systems development are discussed. A hypothesis is proposed: for the effective implementation of the OSTIS Ecosystem project, it is necessary to create a fundamentally new computer architecture (specialized computers)..**

***Keywords*—OSTIS technology, Ecosystem, Intelligent Systems, Specialized computers, Hardware Platform**

I. Introduction

Artificial Intelligence, like any young scientific direction, develops in leaps and bounds, replacing one generation of technical systems with others. Let's try to present an condition ontology of this direction, which reflects the subjective vision of the authors.

We will make a reservation right away that in this article we will try to use generally accepted statements and trends to avoid unnecessary controversy. We will use the generally accepted understanding of Artificial Intelligence, which stages of evolution are distinguished, at what stage of progress we are now, etc.

We will consider an intelligent system as a product obtained as a result of mathematical apparatus applying, developing algorithms and software and hardware implementation without specifying the application. The mnemonic scheme of the intelligent systems ontology can be represented as three components, as shown in Fig.1. It's no coincidence that in the figure the Mathematical Model (as a paradigm, in a broader sense) intersects with the Algorithms that implement it, and the Hardware Platform intersects with the Software.

In most cases, when creating intelligent systems, they use the mathematical apparatus of Neural Networks and Machine Learning - in Data Processing, as well as Semantic Networks, Inference and Ontologies – in Knowledge Processing (Knowledge Discovery). In addition, Evolutionary Design and Fuzzy Sets are used as extended tools for these paradigms to increase the efficiency of solving intellectual problems.

Remark. In the context of this work, we will not refer to the role of Linguistics, Neurophysiology, and other fundamental disciplines. They, of course, influenced both the formation of Artificial Intelligence, and still influence its development, but are not the topic of the current discussion.

For each mathematical direction, there is a wide range of technological software support to creating intelligence applications (Tensor Flow, Coffee, ScikitLearn Python, Keras, R, etc.). The hardware platform is traditionally presented as "universal" and "specialized". The universal platform includes conventional computers with GPUs, as well as supercomputers and computing clusters. A specialized platform is mainly neurocomputers and graphic computers (semantic, associative). It's easy to see that specialized "intelligent" computers correspond to the main artificial intelligence mathematical paradigms. If we trace the development chronology of this area of hardware platforms, we will notice obvious surges and falls in the interest of the scientific community and developers. You can also note a wide variety of architectures and technical solutions proposed at different times [1] [2] [3]

As an example, we can highlight one of the latest developments announced by the Moscow State Technical University named after N. E. Bauman – "Leonhard" [4]. As the author's state: " ... for the first time in the history of computing, a universal computing system with many instruction streams and one data stream (MISD) has been developed that implements the DISC (Discrete Mathematics Instruction Set computer) instruction set." There have been quite a few such statements in the past, but none of the specialized «intelligent computers» has found mass industrial use. In our opinion, this is explained by the simple victory of "universal" computers in competition with specialized processors. As a rule, intelligent computing algorithms are highly complex, and therefore require the appropriate performance of the hardware platform. Therefore, throughout the development of the intelligent computing direction, there have been periodic attempts to create specialized (problem-oriented) architectures, the so-called. neurocomputers, graphic computers, semantic computers, associative computers, focused on supporting the corresponding computing paradigm. However, over and over again, special processors were inferior in their characteristics to modern "universal" (multi-core and graphics) computers. In particular, the narrow application focus of specialized computers with large (even huge) development costs in terms of time and

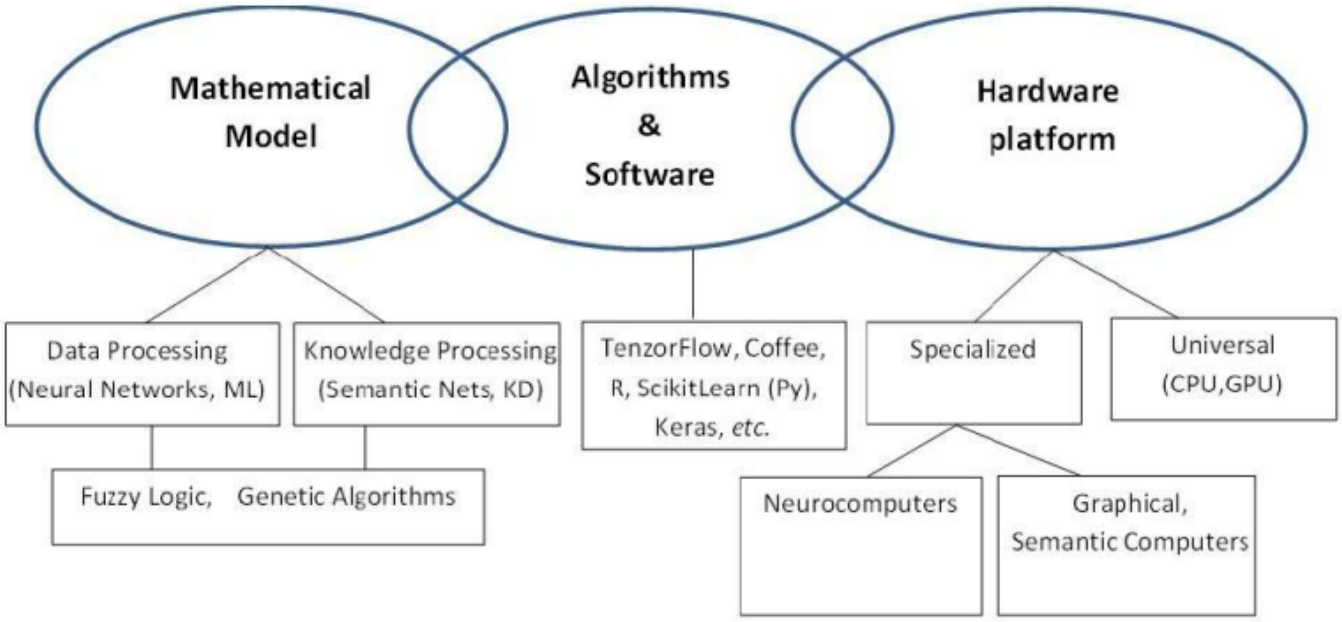

Figure 1: Ontology of intelligent systems

price offset the expected performance gain. In addition, general electronic technologies consistently improve the performance of «universal» computers. In general, a paradoxical situation has occurred in the Artificial Intelligence field. On the one hand, there is the possibility of a quick and relatively inexpensive (using existing libraries and universal software and hardware platforms) creation of highly specialized, commercially successful products with a formal manifestation of intellectual properties. On the other hand, this hinders the development of new (FUNDAMENTALLY NEW) intelligent systems with qualitatively new properties and higher technical characteristics.

The purpose of this presentation is to reflect on what it could be like a New Generation of Intelligent Systems, and what impact OSTIS will have in its emergence.

II. General trend in the development of Artificial Intelligence technologies

As a result of a series of industrial and information revolutions, society has moved into a qualitatively new stage of its evolution. Now the information sector occupies a decisive and important position in the context of the development of fundamentally new information technologies aimed at acquiring, processing, and storing knowledge. Currently, UNESCO is promoting the concept of the knowledge society as an antithesis of the concept of the Information Society, the success of which depends primarily on the development of the knowledge-based economy [5]. The indicated trends inevitably lead to digitalization, automation, and finally Digital Transformation of current business processes. It‘s important to highlight that the use of Artificial Intelligence technologies is one of the fundamental principles of the society digital transformation [6]. Today we can state certain successes and practical achievements in the implementation of commercially successful projects of intelligent computer systems. However, despite the apparent prospects, it can be assumed that with the development of the information society (with a further increase in the volume of information), the approaches underlying such systems will reach the limit of their capabilities, just as it happened before with many computer systems for data processing. Combining many intelligent services into Digital Platforms significantly increases the efficiency of solving a particular range of tasks. This is achieved by Distributing Computations and powers between resources that are available within the platform to all its participants (Fig. 2). The use of an architecture based on autonomous services (also known as Microservices) allows you to speed up the development process and organize the formation of various platform configurations. At the same time, the Knowledge Base of each such service is built autonomously and is often encapsulated within its implementation. This gives rise to multiple duplication of information and redundancy in the knowledge processing. In this connection, it should be noted that the problematic issues of metadata and ontologies of the modern information society are strongly connected with the problems of "conceptual plurality of information"and "data representation in subject areas of knowledge".

However, the most promising approach to building AI applications is the collaboration of intelligent systems, which forms a single complete ecosystem. This solution is projected to solve a wide class of problems in various

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