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THE BASIC DEFINITIONS OF ARTIFICIAL INTELLIGENCE OPERATING SYSTEM: “AI- CONSCIOUSNESS”, “AI-TIME”, “AI-KNOW/NOT_KNOW” AND “AI-MEMORY” CONCEPTS

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БАЗОВІ ВИЗНАЧЕННЯ ОПЕРАЦІЙНОЇ СИСТЕМИ ШТУЧНОГО ІНТЕЛЕКТУ, ПОНЯТТЯ: “ШІ-СВІДОМІСТЬ”, «ШІ-ЧАС», «ШІ-«РОЗУМІННЯ» і “ШІ-ПАМ’ЯТЬ”

The article concerns the concept of “Artificial General Intelligence” (AGI) and in particular the issue of its basic definitions. In this article the following definitions had been proposed: “AI-consciousness”, “AI-Time”, “AI-Understanding” and “AI-memory”. The goal of the definitions is to be used in the modelling of AI-OS (Artificial Intelligence Operating System). As seen together the set of formulated definitions allow to model AI-OS for productive use. A distinctive feature of presented definitions is that they, if compared with known ones, allow the simulation and design of AI-OS using known methods and approaches.

Keywords: Artificial intelligence; definitions; consciousness; time; understanding; memory; operating system

Стаття стосується концепції "штучного загального інтелекту" (AGI – Artificial General Intelligence) і, зокрема, питання про основні її визначення. В цій статті представлені наступні визначення: “ШІ-Свідомість”, “ШІ-Час”, “ШІ-Розуміння” і “ШІ-Пам’ять”. Метою визначень є їх використання при моделюванні AI-OS («Операційної системи штучного інтелекту»). При спільному розгляді набір сформульованих визначень дозволяє моделювати AI-OS для продуктивного використання. Відмінною рисою представлених визначень є те, що вони, в порівнянні з відомими формулюваннями, дозволяють моделювати та проектувати операційну систему штучного інтелекту, використовуючи відомі методи та підходи.

Ключові слова: штучний інтелект; визначення; свідомість; час; пам’ять; операційна система

Introduction

Despite more a half a century of research in the field of Artificial Intelligence there is no universally recognized *AI-thesaurus*. The matter is complicated by the fact that scientists, engineers and programmers for the real systems development can only accept those definitions of AI concepts that contain mechanisms and algorithms that can be modeled within reasonable economic and time constraints.

The author proposed before the definitions of: “AI-Individual Type”, “AI-Collective Type”, “AI-Thought”, “AI-Emotion”, “AI-Abstraction/Concepts”, “AI-Knowledge”, “AI-Learning” [1,2]. This article with the definitions of: “AI-consciousness”, “AI-Time”, “AI-Understanding” and “AI-memory” (some initial thoughts) - continues

to build a system of basic definitions for the development of an Artificial Intelligence Operating System (AI-OS) within the framework of the concept “Artificial General Intelligence” (AGI) and it closes the «AGI-thesaurus» of basic definitions with the mentioned above ones. The future author research will be focused on the modelling of the concepts proposed.

Problem

The current task of developing an Artificial Intelligence Operating System requires new definitions of main concepts that could be used as a basis for technical specifications. At the same time, the modeling of these specifications should be implemented mostly on the basis of the existing scientific and technical achievements. The definitions of “AI-Individual Type”, “AI-Collective Type”, “AI-Thought”,

“AI-Emotion”, “AI-Abstraction/Concepts”, “AI-Knowledge”, “AI-Learning” author published before should be supplemented by with the concepts of “AI-consciousness”, “AI-Time”, “AI-Understanding” and “AI-memory” to make the thesaurus for AI-OS development.

Current state analysis

In Oxford Dictionary [3] we can see the definition of “Consciousness”:

“*Consciousness* (noun):

1. The state of being aware of and responsive to one's surroundings;
2. A person's awareness or perception of something;
3. The fact of awareness by the mind of itself and the world.

Consciousness emerges from the operations of the brain.”

For the purpose of AGI-development more close the “3)” one.

In many articles it was drawn the importance to define the relationship between consciousness and intelligence. For example, is consciousness a necessary condition for intelligent systems or would intelligent systems necessarily display consciousness?

Igor Aleksander in [4] proposed Axiomatic Consciousness Theory (ACT) with 5 axioms of Consciousness:

1. “I feel that I am a part of, but separate from an “out there” world”.
2. “I feel that my perception of the world mingles with feelings of past experience.”
3. “My experience of the world is selective and purposeful”.
4. “I am thinking ahead all the time in trying to decide what to do next.”
5. “I have feelings, emotions and moods that determine that determine what I do”.

That is in general right and in general is the same meaning as the “AI-Consciousness” definition author proposed below. But author’s variant: 1) it is the part of AI-thesaurus with the system of definitions by author mentioned before; 2) Consciousness by author’s definition can be modelled and programmed with known methods and approaches. The Aleksander’s definition – in general right – but very psychology one and need to be defined deeply and technically in

the meanings: “feel”, “experience”, “thinking”, “time”, “emotions”, “moods”. The author defined these concepts in his also “axiomatic approach” published before and proposed in this article.

The author does not concern researches of human brain features but is interested to have the definitions of “AI-consciousness” that can be used in real constructive software development. Just now the author has no information about the definitions of the concepts “Consciousness” to be modeled with current state of software technology.

The book of Alexander [4] have very wide and good literature overview for consciousness definitions and approaches.

AI-Time.

Time in sure have to be defined in AGI-development primarily. Just now there is very serious discussions about the place of Time in physics. There are very interesting attempts to formulate physics laws without Time as “independent variable” at all! For example, [5]. Author could not find the proper definition of Time to be the base for modelling of AGI. The authors view to the subject proposed below. In the minimum “Timer” should be eliminated from privileged functions of the kernel of AI-OS.

AI-Understanding.

In Oxford Dictionary [3] we can see the definition of “Understanding” (noun):

1. “The ability to understand something; comprehension.”
 - 1.1 “The power of abstract thought; intellect.”
 - 1.2 “An individual's perception or judgment of a situation.”
 - 1.3 “Sympathetic awareness or tolerance.”
 - 1.4 “An informal or unspoken agreement or arrangement.”

There are many works mostly in psychology concerning the meaning. The disadvantage of known definitions is lack of technical basics to be used as project specifications. The author’s definition proposed below.

There is very interesting article [6] concerning the issue “What is it like to be “the same?”. The meaning “the same” had

been deeply discussed and this issue is very close to the matter of this article.

“AI-Memory” – the most difficult to understand and imagine concept. For the author it does not matter what is really like in human being and in animals – in sure, *AI-memory* of “real AGI-entity” will be different in compare with living beings. Despite of many articles and books on the issue we are very far from real constructive results. Author’s thoughts about the matter also still lack of verisimilitude but some initial thoughts had been expressed.

Goal

In the article the definitions of the concepts: “AI-consciousness”, “AI-Time”, “AI- “understanding” and “AI-memory” had been proposed. They will be used in AI-OS development with the definitions of “AI-Individual Type”, “AI-Collective Type” and others had been formulated by the author before [1,2] and are based on these definitions.

Main material

“AI-Consciousness” – the definition.

AI-Consciousness is the combination of the following procedures during the existence of AI-Entity:

1. Procedure for determining and establishing of control over the *border* of *AI-Entity* (see the definition of “AI-Individual Type” [1]); it can be done, for example, as to determine some character points on “artificial sensitive skin” of AI-Entity and 2D coordinate system of the “skin” (as a hypersurface in 3D environment); or it can be the linking of the 3D-coordinate system of the visual sensor to the CAD model of AI-Entity preliminary downloaded; or some other approaches can be used.
2. Permanent Process of sensing of the «border» of AI-Entity or control it for: touching, penetration or tearing.
3. Permanent Process of control of the functions of AI-Individual Type for consistency (namely: function of homeostasis; information function: in particular forecasting of the environment and AI-Entity own state; function of imagination and planning; function to change AI-Entity own state;

function of the environmental impact; objective function – see [1]).

“AI-Time” – the definition of the concept.

“AI-Time” concept is related to:

- “AI-Entity” – “own time”;
- “Object/Subject/Process” in the view of AI-Entity (the “view” – maximum working distance for all sensors), or related to AI-Entity, or for “imagined Object/Subject/Process”.

AI-Entity can assign AI-Time any viewed or imagined Object/Subject/Process.

Object and Process can be whether external or internal for AI-Entity.

AI-Time can be in – “AI-Time states”:
past; present; future.

AI-Time as assigned to Object/Subject/Process can be – as “AI-Time types”:
indefinite, perfect, continuous, discrete.

AI-Time can be: current, imagined, forecasted, calculated by “AI-Entity time discrete” (“TD”).

At any moment AI-Time can be in several of AI-Time states and in several AI-Time types.

For example, <AI-time: future, continuous> can be: <forecasted> and <imagined> at the same time. AI-Entity can operate with any AI-Time states and types for its own decision.

Also, at any moment there can be several <AI-Time: past> or <AI-Time: present>.

AI-Time is the complex of the following processes and data – named “dimensions of time”:

- “**Chronological Time**” – corresponds to the “watch/timer time” – infinite number of time in some “AI-Entity time discrete” (TD): second or decimals of seconds; it is increasing permanently; it can be measured by “internal timer” or it can be requested/viewed from external watch; it will represent “Time Index” (for File Systems and Data Bases).
- **The set of “Cycles”** - some of them: year, day, - but there can be other ones; the “Cycle” is represented by: “Period” in TD; and “Phase” – the Time Index for the “start

of cycle”; it is increasing permanently by TDs from ”0” - the start of period, till “Period” - the end of the Cycle; “Period” and “Phase” can be corrected by AI-Entity; the Cycle (any existing one) can represent “Cycle Index” (in TD sums).

- **The set of “characteristic moments”** – can be assigned to Object/Subject/Process; can be or “Time Index” or/and “Cycle Index” (Cycle Indexes); for any Object/Subject/Process can be assigned any sets of characteristic moments.
- **The set of “characteristic events/states”**– can be assigned to Object/Subject/Process; the valid set of characteristic events/states must correspond to causality.

Any dimensions of AI-time can be associated with the parameters or descriptions.

AI-Understanding.

This definition concerns:

- States of AI-Entity «KNOW/DO NOT KNOW»;
- transitions «from “KNOW” to “DO NOT KNOW”», and «from “DO NOT KNOW” to “KNOW”»;
- the decisions «Understood» and «Did not understand» making.

To simplify the issue, the definition will concern ONLY “real world environment” interactions & operations, - we will postpone the issues of “imagined world” – the correspondent thoughts processing and modelling activities of AI-Entity.

The state of AI-Entity <KNOW> is:

- the starting state of AI-Entity – from the moment of the first “turning on” of the system («the birth»);
- preferential state of automate, – it is provided by design.

State <KNOW> is the function:

- sensors’ signals environment;
- context (current one recognized/classified).

The current <Context_xx> – some context from the “List of contexts” in the memory of AI-Entity – can be initially downloaded or trained/self-trained by AI-Entity before.

The state <KNOW> will be kept till the decision <Did not understand> will be made.

The decision <Did not understand> makes the state <DO NOT KNOW> valid (transition <KNOW> – <DO NOT KNOW>).

The decision <Did not understand> can be made on the base of <Context_xx> – the currently identified context, - by (any combination of):

- the forecast did not match the current situation;
- the results of activities could not be reached;
- knowledge base has no correspondence;
- pattern recognition/classifying – failed;
- sensors’ data analysis – there is no waited result;
- logic reasoning – there is no waited result.

In the state <DO NOT KNOW> AI-Entity stops all active actions in the environment in the case, if the actions can be stopped (if not - AI-Entity assures only support for stability of actions without changings).

AI-Entity can be in state

<DO NOT KNOW> only limited time T(i), i – number of the <Context xx> (xx = i).

During time T(i) AI-Entity can: (1) make the decision <Understood> and return to the state <KNOW> (transition from <DO NOT KNOW> to <KNOW>). If AI-Entity can test the decision <Understood> as hypothesis for the time T(i), AI-Entity should do it. If during time T(i) the decision <Understood> was not made, (2) the situation (the cause of the decision <Did not understand>) will be saved in the memory with the character: <Did not understand> and AI-Entity will be returned to the state <KNOW>.

Terminology:

External Actions – actions of AI-Entity in the environment, can be associated with movement in space or manipulators movements, etc. External Actions can be active or passive.

Active External Actions always need internal energy to be spent.

Passive External Actions are the consequence of:

- inertia;
- dynamic of environment.

Context xx- the circumstances that form the setting for an event, statement, or idea, and in terms of which it can be fully understood, xx – serial number of “context” in the list of.

AI-Memory (some initial thoughts).

Comments: the definition of AI-Memory was not completed yet, but the author try to see “the edge” earlier and then to go deeply... “The edge” – means: to define at first the complete list of concepts should be defined initially before AI-Memory can be defined in structure and data processing procedures. Later the definitions can be developed and detailed.

The definition:

AI-Memory belongs to AI-Agent; it means that the definition concerns logical structure of the memory where all data of AI-Agent are storing. The hardware of the memory can be any of existing types.

AI-Memory is divided on 2 parts: “AI-Memory: Part 1” and “AI-Memory: Part 2”.

These Part 1 and Part 2 are the same in structure and procedures.

The difference is that at every moment:

- one part of AI-Memory is in <Working Mode> (“Part-WM”) – that means: this part of AI-memory is connected to the sensors (named: AI-Sensation: all kind of the sensors and correspondent data sets) and the storing data is being processed by AI-Agent in “on-line” procedure (“real time”): the indexes of AI-Time are generated and assigned to the objects/subjects classified and forming new data structures;

- other part of AI-Memory is in <Sleep Mode> (“Part-SM”) - means: this part of AI-memory is disconnected from the sensors and the storing data is being processed by AI-Agent ONLY for classification and association purposes to generate AI-Knowledges (see “AI-Knowledge” definition); any AI-Time indexes are not generated and assigned; and the processes of <Function of Imagination and Planning> of AI-Individual Type (see the correspondent definition [1]) are based on the data stored in AI-Memory Part-SM.

<AI-Memory Monitor> – special procedure of AI-Memory – should:

- assign initially to one part of AI-Memory
- Part-x - be in “Working Mode”, and the other part – Part-y - correspondingly be in “Sleep Mode”;
- change the mode of the parts.

The internal structure of these parts of AI-Memory and the procedure to make the decision to change the mode of AI-Memory Parts is out of this version of the definition.

Conclusion

This article presents the author's new results on the development of basic definitions of the Operating System of Artificial Intelligence (AI-OS). The project “Operating System of Artificial Intelligence: axiomatic approach” is developing by the author. The project is open and the results are regularly being published in the author’s account in ResearchGate: <https://www.researchgate.net/project/Operational-System-of-Artificial-Intelligence-axiomatic-approach>

The author is sure that all functions mentioned above can be modelled with known approaches with the computers we have just now.

This article has completed AI-Thesaurus with the set of definitions: Artificial Intelligence – Individual Type, Artificial Intelligence – Collective Type (“swarm intelligence”), AI-Thought, AI-Emotion, AI-Abstraction/Concepts, AI-Knowledge, AI-Learning, AI-consciousness, AI-Time, AI-Understanding and AI-memory. Further it will be real development of AGI for some application that of course will enlarge the understanding of the concepts and detail them.

References

1. Kornieiev, S. (2016) Operatsionnaya sistema iskusstvennogo intellekta: bazovyye opredeleniya. *Shtuchnyi intelekt*, 74 (4), 7-14.
2. Kornieiev, S. (2017) The basic definitions of Artificial Intelligence Operating System: “AI-Thought” and AI-Emotions concepts. *Shtuchnyi intelekt*, 77-78 (3-4), 9-14.
3. Aleksander, I. (2005) World in My Mind, My Mind in the World: Key Mechanisms of Consciousness in People, Animals and Machines. Imprint Academic PO Box 200, Exeter EX55YX, UK. *Oxford Dictionary*. Available: <https://en.oxforddictionaries.com/definition/consciousness>;

<https://en.oxforddictionaries.com/definition/us/understanding>

4. Barbour, J. (2011) Shape Dynamics. An Introduction. *University of Oxford*. doi: 10.1007/978-3-0348-0043-3_13
5. Tozzi, A., Peters, J. (2016) What is it like to be «the same»? *Progress in Biophysics & Molecular Biology: An International Review Journal*. doi: 10.1016/j.pbiomolbio.2017.10.005

РЕЗЮМЕ

С. Корнєєв

Базові визначення операційної системи штучного інтелекту, поняття: «ШІ-Свідомість», «ШІ-Час», «ШІ-Розуміння» і «ШІ-Пам'ять»

В статті сформульовані визначення для понять: «ШІ-Свідомість», «ШІ-Час», «ШІ-Розуміння» і «ШІ-Пам'ять». Вони базуються на попередньо запропонованих автором визначеннях: «Штучний інтелект – індивідуальний тип», «Штучний інтелект – колективний тип» (“swarm intelligence”), «ШІ-Думка», «ШІ-Емоція», «ШІ-Абстракція/Поняття», «ШІ-Знання», «ШІ-Навчання».

«ШІ-Свідомість» базується на попередньо визначеним поняттям «межа», яке використовується в визначенні «Штучний інтелект – індивідуальний тип», та виконує контрольні функції відносно нього.

Визначення поняття “ШІ-Час” вводить поняття «власний час» та «час об'єкту/суб'єкту/процесу». Пропонується «стан часу», який пов'язаний з обрахуванням часу в минулому, поточному та майбутньому періодах; а також «тип часу»: невизначений, завершений, неперервний, дискретний. “ШІ-Час” може бути: «поточний», «уявний», «прогнозований».

Пропонується використовувати наступні «виміри часу»: хронологічний, циклічний, послідовність «характеристичних моментів, послідовність характеристичних подій/станів («причинність»).

Визначення «ШІ-Розуміння» пов'язане з станами ШІ-Сутності «знаю», «не знаю», та з переходами між ними, які обговорюються.

У визначенні «ШІ-Пам'ять» зроблені тільки перші кроки, однак обумовлюється необхідність «сну» для нормального функціонування ШІ-Сутності.

Стаття завершує наміри автора по формуванню базового тезауруса для розробки операційної системи штучного інтелекту «загального типу» (концепція AGI – “Artificial General Intelligence”).

Автор висловлює впевненість, що всі запропоновані поняття можуть бути змодельовані і запрограмовані з використанням існуючих підходів и методів, сучасних мов програмування і отриманий в результаті продукт у вигляді «Машини з інтелектом загального типу» може бути впроваджений на базі загально розповсюджених комп'ютерів. Автор вважає що це є основною відмінною рисою запропонованого підходу до моделювання в порівнянні з існуючими.

В статті надаються посилання на роботи інших авторів які дуже близькі по баченню та підходу до задачі, що розглядається.

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