Proceedings of the 8th World Congress on Electrical Engineering and Computer Systems and Sciences (EECSS'22)
Prague, Czech Republic - July 28- 30, 2022
Paper No. CIST 112
DOI: 10.11159/cist22.112

Cognitive Mapping of Carbon Agent for Better Understanding of Silicon Agent

Attila Márton Putnoki[1], Dóra Mattyasovszky-Philipp[1], Bálint Molnár[1]
[1] Faculty of Informatics/ Eötvös Loránd University
Pázmány Péter 1/C, 1117, Budapest, Hungary
faf2j3@inf.elte.hu ; mattyasovszky@inf.elte.hu; molnarba@inf.elte.hu

Extended Abstract

We consider human cognition as the most elevated tool for problem-solving. Regarding the human brain, we still do not have all the information needed to understand each function of human cognition, however, there is a view, that to build a Cognitive Information System (CIS) there is only one way, which is to mimic the human cognition. Understanding the human cognition will explain all those elements and processes, that is needed to be able to develop such an information system that can be called Cognitive Information System. However, there are on the market already systems called CIS, there are still well-known gaps that are questioning the complex functioning of these information systems. Therefore, our objectives to support the development of CIS in a way to model the human cognition, as a Carbon agent side via Human-Computer Interaction (HCI) and compare it with the computer side as a Silicon agent side.

To be able to understand the Carbon agent side there is a need to develop a mental model, which describes the cognitive hierarchical mapping function of a Subject-domain. The tool that ensures the flexible and logical description of the human mental model is the hypergraph [1][2]. Modelling with the hypergraphs ensures the consistency of the model [3]. The mental model in the Subject-domain contains the notions and their features, which can be described with various attributes. The notion hierarchy has a specific range. The hierarchy mapping between notion hierarchies of the Subject-domains is an association between a pair of notion hierarchies. Association ensures the correspondence and the similarity mapping, that lead to labelling [4]. Labelling will drive further to a multidimensional model of the human cognition, that can be a base model of the human cognition, which is essential to build a Silicon agent's cognition model. The future model needs to be developed, meanwhile the current multidimensional human model must be adjusted to ensure the appropriate description of the cognition, that drives to improve the Silicon model. The aim that the Silicon agent mental model has a high correspondence and similarity grade to the Carbon agent mental model, that will improve the cognitive function of the CIS [5][6]. With this improvement, we could expect higher success on various domains using CIS.

One opportunity is in Natural Language Processing (NLP) for development, where it is possible to use algorithms and models of Machine-Learning (ML) to analyse data and map the expected output. The output – e.g., summary –, can be personalized and created by the Silicon agent within the subject area considering the capability of the Carbon agent. To exploit the services of the NLP and to understand the Carbon agent more closely, we can use a Deep Learning (DL) Artificial Neural Network (ANN), which is built and operates imita of the human mind. Further knowledge about Carbon agents is needed to further develop human-based systems. By increasing our knowledge, our goal is to improve and better describe our Carbon-based mental model, helping the development of CISs.

References

[1] A. Bretto, *Hypergraph Theory: An Introduction.*, Springer Publishing Company, Incorporated, 2013
[2] B. Molnár, A. Béleczki, and A. Benczúr, "Information systems modelling based on graph-theoretic background," *Journal of Information and Telecommunication*, vol. 2, pp. 68–90, 2018.
[3] B. Molnár, "Applications of hypergraphs in informatics: a survey and opportunities for research," *Ann. Univ. Sci. Budapest. Sect. Comput*, pp. 261–282, 2014
[4] Mattyasovszky-Philipp, D.; Molnár, B. An Architectural Approach to Cognitive Information System., *Acta Polytechnica Hungarica*, 2020, 17, 237–253. doi:10.12700/aph.17.2.2020.2.13.

[5] Rasmussen, J., 1980., The human as a systems component. In: Human interaction with computers., London: *London Academic Press*, pp. 67-96.
[6] van Ments, L.; Treur, J. *Modeling Adaptive Cooperative and Competitive Metaphors as Mental Models for Joint Decision Making.*, Cognitive Systems Research 2021