Application prospects for vector time maps of cognitive images links

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Abstract. Neural networks have a great advantage in the analysis of implicit dependencies, big data analysis, image recognition and other recognition systems. However, they do not perform the function of memorizing information in an explicit form, they cannot logically think like a person. Neural networks are not managed repositories of information about cognitive images. They are quite difficult to edit or create new structures based on existing trained models. They do not have the necessary flexibility and scalability in the process of learning and in use. We propose to create vector-time communication maps of cognitive images links, containing functions for memorizing individual cognitive images and their links, with the possibility of forming explicit centers and with the possibility of scaling.

1. Introduction

Modern convolutional neural networks (CNN) have shown to good advantage in implicit dependencies analysis, Big Data analysis (BD), image recognition and other multiple classification systems. However, they do not perform the function of memorization (i.e. having memories) and the function of argumentation which are intrinsic to humans. Neural networks are not manageable cognitive image information repositories. It is quite difficult to edit them or to create new structures based on existing trained models. They do not have necessary flexibility and scalability in the learning process and in use [1], [2], [3], [4], [5], [6], [7], [8], [9], [10].

It is necessary to create new neural network structures containing the functions of memorizing individual cognitive images with the possibility of forming explicit digital cognitive image centers, its expansion by means of new structures memorizing small nuances and all details of images (same as the final neural structures of information preparation for "grandmother cells"). These new neural network structures should have the ability to activate or suppress active centers, to create new connections between centers as well as to disactivate rudimentary connections. And the most important point is that these structures should be able to create software scalable chains of neurological discourses of any depth and any degree of hardware scalability [11], [12], [13], [14].

For this purpose, new patterns of should be used [15], [16], [17], [18].

2. Objective

To propose the idea of constructing vector-time communication maps of cognitive image links (VTCMCIL) for use in neural networks. Suggest a method for vector-time communication maps of cognitive image links.
3. VTCMCIL construction example

Let’s imagine a story: there is a furnished room; on the 4th second a toy ball rolls into the room from the right corner; it is rolling across the room during 2.7 seconds; the ball disappears; 6 seconds after that a man enters the room and stays for 3 seconds; he takes a vase in 2 seconds; he goes to the right in 3 seconds. The whole story goes on for 20.7 seconds.

A classification unit is a neural network that is trained to recognize all objects in the room, or it is built on Kohonen networks and is able to select objects from the plot, or has another function to highlight the features (attributes) of the plot. With that a plot decomposition can be done and a specific digital image (Digital Image - DI) can be assigned to each particular object. The activity of each digital image with the account of its time sequence (Time Sequence - TS) allows to create a vector-time communication maps of cognitive image links. Thus, images in the plot appear, exist and disappear on the time axis.

Certain objects are featured according to decomposition process of the plot. They form graph peaks. Each peak is a cognitive image of an object. Each peak is associated with the classification unit and therefore they are easily identified with real life objects.

![Figure 1](image-url) The principle of construction VTCMCIL.

Each peak has an additional parameter of the Time of the Activity Period (AP), that indicates a period of time in the plot during which a certain object is observed. The peaks are connected into a graph by arcs. Each arc has a parameter which is equal to an amount of time elapsed between two arc-connected peaks’ activation.

This graph will be a map of objects’ behavior sequence in our video plot. We call it the vector-time map of cognitive image links. With such a map it is easy to restore the plot and the temporal sequence of events taking one peak of the graph as a starting point of our memory. The graph is a digital map, which contains a sequence of cognitive images and a clear differentiation of each image from the accompanying ones in the plot.

Some advantages of this data presentation are as follows:
• a compact method of keeping information in the form of separate logically related cognitive images;
  • clear and easily analyzed structure for further neural analysis;
  • possibility to analyze events in the direct and reverse order;
  • possibility to enter the map by activating any peak, which allows restoring part of the plot or the whole plot completely, using a part of the graph or the entire graph;
  • possibility to expand the graph based on other video plots according to the principle of individual cognitive image identity;
  • possibility to form smaller graphs: based on contiguity to the top or conditions, limiting time intervals;
  • possibility to simplify the graphs by reducing the insignificant peaks and arcs;
  • possibility to use various object features besides objects themselves and their location which will be determined by the functions of feature selection (for example PS);
  • possibility to create a chain of logical discourse of any complexity. To do this, it is necessary to combine other graphs of identical or similar peaks, choose the initial and final peaks of the connected set, construct logical chain paths. Then choose the optimal logical chain according to the will and goals of the projected artificial intelligence (AI);
  • possibility to create abbreviated, compact and generalized graphs ones based on a combination of some connected sets based on the discourse graph of a long logical chain.

Let us go back to the plot and consider the ball’s movement zone. As one of the objects it moves along on the floor, shows during certain intervals at certain spaces (i.e. has got some speed) and is round in shape. This part of the plot can be a separate independent map that fits a certain class of similar events and can be predicted before the completion of the story part.

Using the map, it is possible to analyze individual objects by collecting additional information about them creating new mixed maps.

Using this method, it is also possible to explore individual cognitive images reinforcing structural connections of maps and increasing intellectual capabilities of artificial intelligence.

This method can be easily used in mapping for other tasks:
• positioning in space;
• conducting chemical researches;
• proving theorems;
• outer space exploration.

4. Results
We have proposed a method for constructing vector-time communication maps of cognitive image links. The method of mapping is applicable to any set of objects observed on visual and non-visual channels, taking into account changes over time.

5. Conclusions
VTCMCIL is a compact way to record and store a dynamically changing content. VTCMCIL together with CNN can be the basis for building multi-layer networks with understandable internal structures. VTCMCIL can be easily reduced by removing cognitive images and their connections. VTCMCIL can be easily increased by connecting multiple VTCMCIL to coincidence points of cognitive images. This allows you to build unlimited large graph-like VTCMCIL structures for building logical chains of thought that completely repeat the observed picture of the world.

References
[1] Pustovoy E and Pustovaya O 2017 Management of neural networks using the spatial matrix of coefficients, ICECDS 2017, easychair org/conferences/submission_download.cgi?a=15280779;submission=3358826;file=66747
[2] Nils J Nilsson, Logic and artificial intelligence, computer science department, Stanford University, Stanford, CA 94305, USA Received February 1989, ai.stanford.edu/~nilsson/OnlinePubs-Nils/PublishedPapers/logical.pdf

[3] F Brown 1987 The Frame Problem in Artificial Intelligence

[4] V Lifschitz 1987 Formal Theories of Action, in F Brown, ed, The Frame Problem in Artificial Intelligence (Morgan Kaufmann, San Mateo, CA, 1987) 35-57

[5] J McCarthy 1980 Circumscription--a Form of Non-Monotonic Reasoning Artif. Intell. 13 27-39;

[6] Ilyin I V 2017 Review of Deficiencies of Artificial Neural Networks Herald modern research 11-1(14) 210-2

[7] Korepina T A, Chekmareva E A 2017 Neural networks in agent-oriented models: advantages and disadvantages of hybrid research methods Territorial Development Issues 4(39) 6

[8] Galkina S Yu, Kurochkina I P 2016 Advantages and Disadvantages of the Application of Neural Network Modeling During Management Decisions Modern Trends in the Development of Science and Technology 2016 12-11 28-30

[9] Beloglazov D A 2008 Features of Neural Network Solutins, Advantages and Disadvantages, Prospect of Application Izvestia SFU, Technical science 7(84) 105-10

[10] Guo-Jun Qi and Jiebo Luo Small data challenges in big data era: a survey of recent progress on unsupervised and semi-supervised methods, arxiv.org/pdf/1903.11260

[11] Felix M Riese and Sina Keller, SUSI: Supervised self-organizing maps for regression and classification in Python, arxiv.org/pdf/1903.11114

[12] Yong Liu, Ruiping Wang, Shiguang Shan and Xilin Chen, Structure inference net: object detection using scene-level context and instance-level relationships, arxiv.org/pdf/1807.00119

[13] Jason Jo, Vikas Verma, and Yoshua Bengio, Modularity Matters: Learning invariant relational reasoning tasks, arxiv.org/pdf/1806.06765

[14] Yu Zhao, Xiang Li, Wei Zhang, Shijie Zhao, Milad Makkie, Mo Zhang, Quanzheng Li, and Tianming Liu, Modeling 4D fMRI data via vpatio-temporal convolutional neural networks (ST-CNN), arxiv.org/pdf/1805.12564

[15] O’Keefe J and Dostrovsky J 1971 The Hippocampus as a Spatial Map Preliminary Evidence From Unit Activity in the Freely Moving Rat Brain Research 34 171-5

[16] O’Keefe J 1976 Place Units in the Hippocampus of the Freely Moving Rat Experimental Neurology 51 78-109

[17] Fyhn M, Molden S, Witter M P, Moser E I, Moser M B 2004 Spatial Representation in the Entorhinal Cortex Science 305 1258-64

[18] Hafting T, Fyhn M, Molden S, Moser M B and Moser E I 2005 Microstructure of Spatial Map in the Entorhinal Cortex Nature 436 801-6