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Visualization Complex Cognitive Networks

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Abstract. Cognitive flow is the important applications of information flow, workflow, social flow after, but need to break through the difficulties in cognitive mapping and materialized. Use visualization techniques to build a simulation platform to realize cognitive schema, cognitive map, flow and other visual cognitive projection, make the invisible visible understanding, building cognitive materialized, visualization mode. Base visualize digital network technology innovation Visualization Complex Cognitive Networks (VCCN) platform, achieve "symbol, mathematical, process" visual computing architecture, and the formation of cognitive visual paradigm. Base VCCN research in human-computer system needs to establish the cognitive interface to build field of cognitive, modulation of cognitive coupled states, through the acquisition of Cognitive Symbol Sequence(CSS), and cognitive activity is mapped to VCCN. It is framed for cognitive nodes, relation, chain, flow, maps, schema, and achieved cognitive object editing, storage, switching, routing, navigation, evaluation, and cognitive flow coupling, excitation, propagation, and be the cognitive visual, functional simulation, power system studies provide new ideas, new paradigm of brain information. VCCN similar negatives shot to the brain cognitive activity with CSS, for the reconstruction of cognitive activity to provide a method.

Keywords: complex networks, cognitive visualization, cognitive schema, cognitive map, cognitive symbol sequence, cognitive coupling.

1. Cognitive Flow

The brain is a material, energy and information dissipation structure, brain research is to use instruments to stimulation, probe, scan of the brain material, energy, information process, and shooting, collecting data, use the data to understand brain. In the biological area is the main target to study the brain's physical structure; EEG field (ElectroEncephaloGram), ERP field (Event-Related Potential) aspects of the brain from the energy perspective to understand the state of brain activity energy characteristics. energy level is currently the most popular areas of brain research, and in the information level, not forming paradigm[1].

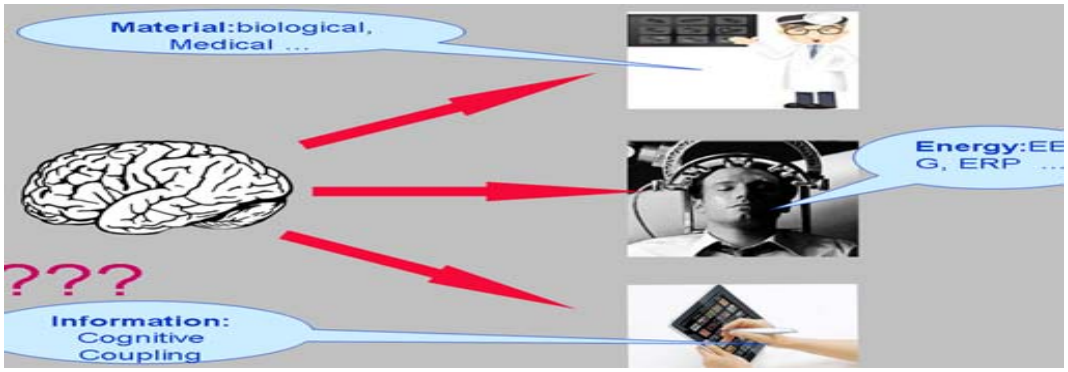

Fig. 1: Material, energy and information level of brain research.

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Study of the brain with information technology needs new tools and platform ,like the brain in the physical level, energy level. New tools to capture the brain's cognitive information signal, and at visual analysis, or simulation of cognitive function.

Cognitive map, cognitive schema are trying to visualize cognitive[2]. Typically, the visual description than the other way to transmit information faster and more efficiently. For example a “person” can face the following description: text, face photographs, one set of data tables, this set of data generated plot. It is very different effectiveness for describe the these different ways the message. Visualization technology using natural human perception can quickly understand the basic characteristics, such as color, size, shape, motion and proximity, etc. It can use these visual features to enhance the data density display information. Because it is easy to understand these characteristics, but each feature can be used to represent different data attributes, so good visualization techniques not only make us more likely to perceive information and knowledge, but also perceive more information and knowledge. Visualization technology to bring cognitive of fundamental change, it will be computer technology, digital technology, multimedia technology, combined use of visualization technology, and those often difficult to imagine the cognitive object to be related and cognitive activities in a dynamic and intuitive way to show it, to reveal its own rules for scientific research and decision making. Visual cognitive is cognitive science, computer visualization technology necessary stage of development, cognitive research provide a new platform.

We believe that cognitive visualization should follow the research framework,1）First create a digital cognitive situation,2) Deploy cognitive interface in the situation of cognitive interfaces,3) Collection of cognitive data from a cognitive interface,4) The collected data visualization.

Fig. 2: Study of the brain with information technology needs new tools and platform.

Currently, mind map is simple cognitive visualization tools. Mind mapping is to express the thinking of launching an effective tool for graphic thinking. The theme of the relationship at all levels change to attached to each other and associated with the layer of figure. The theme of words and images, colors, etc. create a memory link. The mind map is full use of function of left and right brain and the memory, reading, thinking the law, to help brain in the science and art, logic and imagination balanced development between.

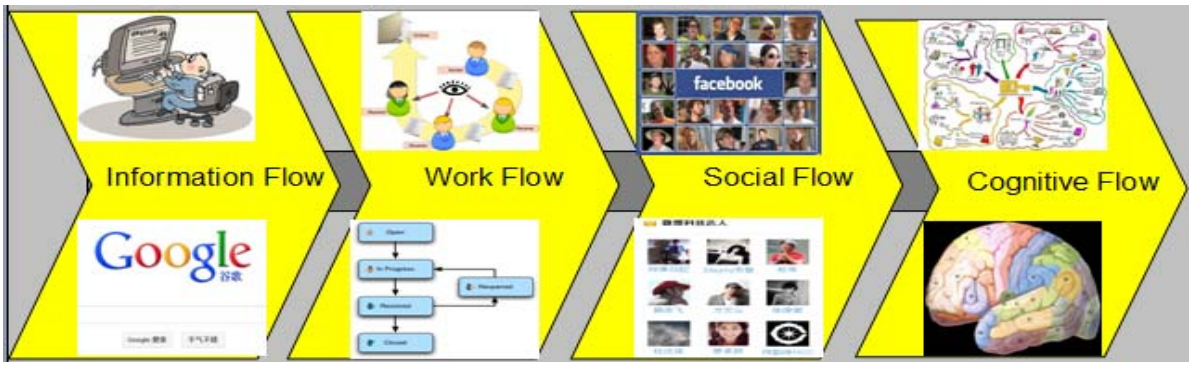

Fig. 3: Information flow, workflow, social flow, cognitive flow is the evolution of Internet application circuit diagram.

Based on cognitive map, cognitive flow visualization to establishment of Visualization Complex Cognitive Networks.

2. Visualization of Complex Cognitive Network(VCCN)

Over the past decade, complex networks are placing high hopes to become a tool to describe complex systems and methods, means, a tool for studying complex systems[3]. We believe that this cognitive occurs in the brain in the phenomenon of complex systems, and complex network can be carried out mapping and simulation of cognition. Cognitive content to see the complex network of nodes, the relationship between the content of the edges between network nodes. We call the complexity of the network load cognitive activity is a complex cognitive network. And the general study of complex networks in different ways, we have established human-machine interface, cognitive networks and complex "living body", "objective" understanding of the brain connected online. The brain is cognitive-behavioral and cognitive network is an interactive system, a two-way information flow, also that the brain and cognitive information network interaction coupling the two systems.

From a technical point of view, digital network to achieve the visualization of complex cognitive network simulation, be as follows function.

- Depicts the mesh node of cognitive activity, associated with the topology view.
- The cognitive network edge is a vector, into single, two-way form..
- Network view has level dimensions, nodes and edges can exist across the layers.
- Composed of nodes and edges cognitive flow of the pipeline, the behavior is logical control.
- The formation function and space-time structure, there are evolutionary behavior.
- Through the man-machine interface to complex cognitive and brain cognitive network connection for online coupling.

And the general complex network of different, complex cognitive networks increased level of dimensions, can be more effective in providing support for the simulation of cognitive activities. Cognitive network G = (V, E), in which V = {V1, V2, ..., Vn} is a set of vertices, E = {E1, E2, ..., En} $\in V \times V$ is a collection of edges, V and E are a hierarchy dimension.

Complex cognitive network is a software system, the data structure is an important foundation, We use tree structure to describe the complex cognitive network nodes and their relationships. Difficult to express in some of the tree structure of jumping association, the use of words to describe, for example, link to, link from, jump to, jump from and so on..

From the content perspective, the cognitive network can be used to express the concept of scientific knowledge networks, for example, the word network, academic networks, the problem space, geographical space.

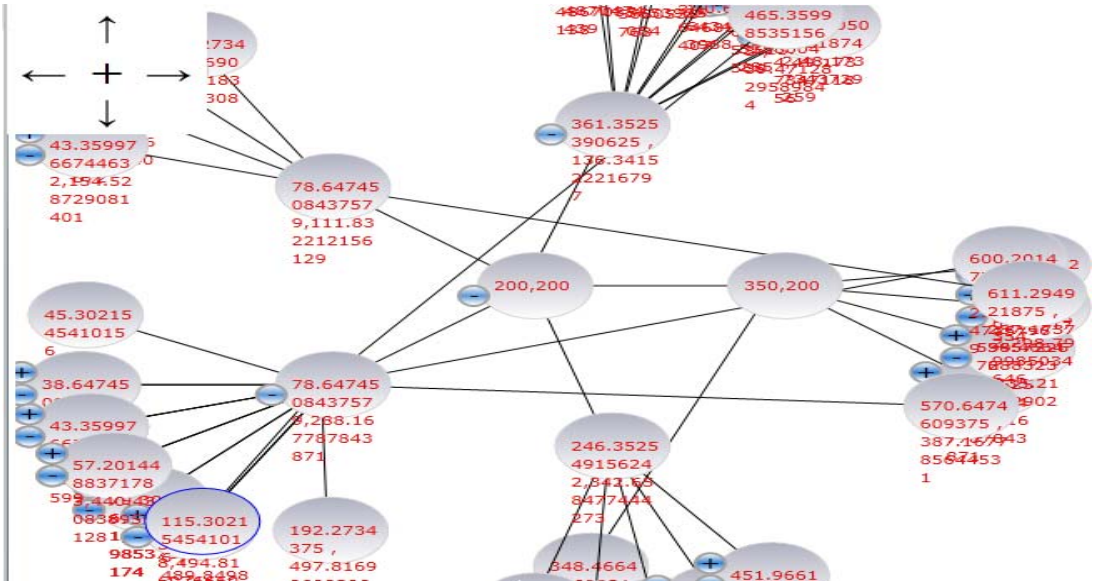

Fig. 4: Using visualization techniques, visualization of complex cognitive construct of cyberspace, the cognitive content, physical and chemical processes.

3. Power of Cognitive Schemata

Schemata, map[4] in cognitive psychology is a very important concept. The use of complex cognitive network visualization tools, we visualize the cognitive schemata. As the visual complex cognitive networks is the use of the expression tree data structure and content of cognitive data, and general GIS map different, We mainly use the hierarchy to represent the cognitive content of view, for example, “face” the word as a starting point for the network, and grow around the root node of its associated lower, and so on, forming a complex network of words.

Assume that cognitive activity is a sequence of complex cognitive network nodes objects; It is need for fine-grained control of complex cognitive object. Cognitive object from the content, behaviour, mathematical logic. Cognitive behaviour of an object can be used "if then" commands to control, each cognitive object is a programmable object, all complex cognitive control rules to form a large network of computer program.

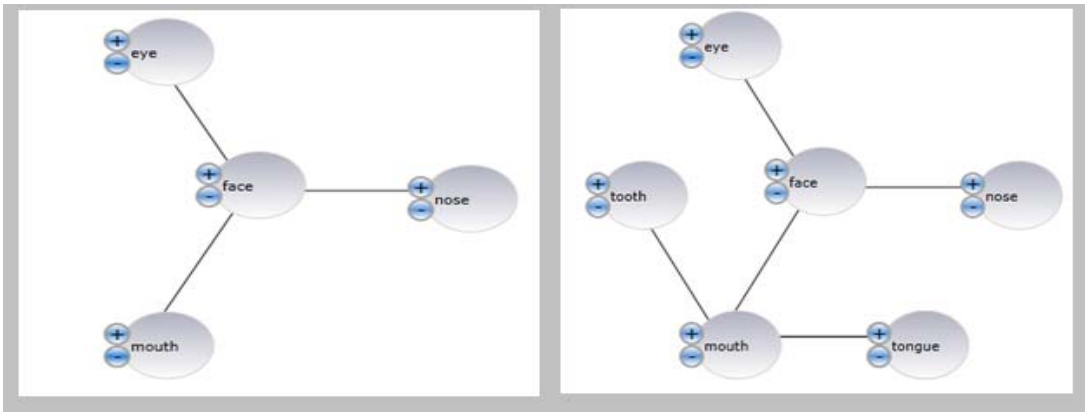

Fig. 5: Visualization of complex cognitive network can reflect the brain's cognitive schemata, for example, and the “face” layer to achieve the associated concepts associated.

4. Dynamic Mechanism of Complex Cognitive Network

Visualization of complex cognitive network needs to reflect the dynamic mechanism of cognitive brain, we use the following mechanism to simulate the cognitive dynamics of brain.

- Branch – Select: Cognitive node and multiple node association, node in a cognitive process that according to selected logic to determine the bifurcation into the next node in the flow of cognitive.

- Long-range correlation: Two different regions can be achieved across the cognitive nodes associated with nodes and reunion.
- Synchronization or coupling: Some nodes have synchronized, coupling behavior under certain conditions.
- To attract – exclusive: Nodes become part of a regional attractor or part of the association lost its appeal.

Brain cognitive dynamics equation has always been our goal, It is a key step to achieve the target that the cognitive is projected onto the VCCN. VCCN is cognitive visualization space, cognitive digital tools. Complex cognitive networks can simulation of cognitive processes, and description cognitive object complex relationship between cognitive object, also based on cognitive mathematical equation simulation of cognitive dynamics.

No doubt, we can also use a complex network theory to study the dynamic behaviour of complex cognitive network.

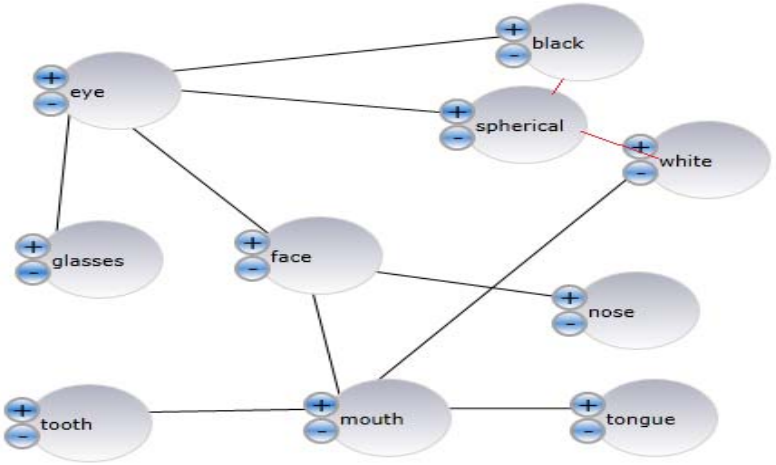

Fig. 6: Cognitive node reunion, long-range correlation: The "spherical" centre to achieve "black, white" convergence.

5. Conclusion

Assuming cognitive activity is a complex networks system, the use of information visualization techniques, build Visualization Complex Cognitive Networks, design online human-machine Cognitive interface, achieve to cognitive mapping, Cognitive schemata and Cognitive map visualization. Visualization Complex Cognitive Networks can reference complex network of research and infrastructure but Programmable Technology to achieve fine control of each cognitive object, to simulate the dynamic evolution of cognitive schemata process, formation of brain cognitive aspects of the new paradigm of information.

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