Distributed parallel computing and memory within a cellular computer architecture

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1 Introduction

At some point or another everyone surely experienced staring at a mottled surface without any thought in mind and found how their visual system started forming patterns like faces, animals or objects out of that mottled background. It probably perked one's attention for a while, and if one attempted to look at that mottled pattern again without forming those "images", it became difficult to do so without active repression.

This spontaneous organization of input into recognizable molds starts with just a few patches of visual field that seem to activate some already present archetype in the memory structure. The visual system queries the surrounding dots and patches to see if they can fit into that activated archetype, thus constructing a richer and more compelling pattern (a tiger, an unusual hairdo, a smiling child, etc.). Psychology would interpret that as a Rorschach test that shows what our unconscious mind was primed to see at that moment.

These types of experiences have led me to believe that parallel processing occurs in interconnected units, where each unit has to decide independently if it fits or not in the developing pattern according to its locally stored memory, and that it is a mechanical process that does not require thought or consciousness. It would only require local processing units with attached memory and simple software that interprets their immediate environment - that is, the activity of surrounding processing units. In order to be functional, such a system cannot limit itself to the simplest possible case (like letters only, or specific shapes only), but must be able to take in any possible input and memorize it as active networks. It also needs to be a closed system with self-referencing, have a closed phase space at each calculating node, and local and long distance connections. In other words a complex nonlinear system made out of simple agents following simple rules, that is, a small-world system.

Intelligent distributed computing needs to use nodes (agents) capable of independent computation, yet capable of receiving and sending information to other nodes. Such nodes need to use a common language and be housed in an architecture that permits each node to remember all of its potential states, and the states of its environment. The "architecture" can be distributed between physically separated nodes interacting with Wi-Fi or similar means, and variety of inputs can be translated into common language.

This article explains how memory associations at each level, and at each node, can function together to create an evolving meaning and classification system. Using this system with simple program variations at each node, can result in swarm intelligence, adaptive and tolerant with variations. At each level there is abstraction when going from input to complex nodes, and when going from complex nodes towards the input level it becomes more specific. At each level variation tolerance permits creation of analogies. Complex interactions in networks created by this system cannot be linearized, yet can be analyzed for meaning. This system can deal with very complex information integration, and can develop a

mechanical type of "world view", an indispensable ingredient needed in creation of meaning, and hopefully of a "common sense" computer.

The essential idea behind this system can be analogically compared to a puzzle where a given picture on the puzzle determines the shape of the puzzle piece. The puzzle is divided into many individual puzzle pieces, equivalent to nodes. Each node has an architectural position (place in the puzzle that does not change with a change of the picture) and a shape (shape determined by the surrounding activity and the node memory that makes it fit into the puzzle).

The position is a definite place with a unique address on a given level in the parallel computer architecture, and with fixed connections with surrounding nodes on the same level and connections to higher and lower levels.

The shape is represented by node's state, where each state depends on the activation, from higher and lower levels, and surrounding nodes (the context, equivalent to the picture in the analogy) as well as acquired memory and the activity of node's software (inner activation). Each node runs its software independently and asynchronously, and communicates with surrounding nodes and levels in a handshake manner.

Each node can be part of many different puzzles represented by different node states (ex: a blue, green or red dot), and the same state can also be part of multiple puzzles (ex: a blue dot can be found in many pictures). Each node can represent entire local phase space in local non-volatile memory, where each state is represented by a memory-space-address in a matrix. The memory can be stored, retrieved, searched and modified according to simple set of rules contained in local software, and executed by local CPU or GPU. All nodes at the same level execute the same software. The activity of local software depends on inputs from surrounding nodes and levels, is usually asynchronous with the activity of surrounding nodes and levels, but with feedback it can become synchronous.

A set of nodes triggered by the same input form a network that is memorized and represents "archetypal spaces" (information envelopes with specific expectations from the input). Two simultaneous networks are formed from the same input. One network represents the unified "shape", and the other represents the unified surround (place in which the shape exists). The same shape-network can co-exist with different surround-networks (ex: the same word found in different sentences) thus acquiring different meaning.

When a given input activates node-memory where there are several networks associated with that node state, analogies can be made between those networks, or competition for greatest fitness in the puzzle is resolved according to node's software. This leads to non-deterministic functioning, with an advantage of being able to use incomplete input, or variation of the input leading to recognition of the input pattern. If parts of various networks are triggered by the same input, a new unified network can be formed, thus creating a new perception, "insight", or "thought".

References

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