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Towards an intelligent network for matching offer and demand: From the sharing economy to the global brain

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ABSTRACT

We analyze the role of the Global Brain in the sharing economy, by synthesizing the notion of distributed intelligence with Goertzel's concept of an offer network. An offer network is an architecture for a future economic system based on the matching of offers and demands without the intermediate of money. Intelligence requires a network of condition-action rules, where conditions represent challenges that elicit action in order to solve a problem or exploit an opportunity. In society, opportunities correspond to offers of goods or services, problems to demands. Tackling challenges means finding the best sequences of condition-action rules to connect all demands to the offers that can satisfy them. This can be achieved with the help of AI algorithms working on a public database of rules, demands and offers. Such a system would provide a universal medium for voluntary collaboration and economic exchange, efficiently coordinating the activities of all people on Earth. It would replace and subsume the patchwork of commercial and community-run sharing platforms presently running on the Internet. It can in principle resolve the traditional problems of the capitalist economy: poverty, inequality, externalities, poor sustainability and resilience, booms and busts, and the neglect of non-monetizable values.

1. Introduction

The relentless innovations accompanying the development of the Internet and related ICT may seem overwhelming. Hardly a week passes by without a revolutionary new technology, social network, or lucrative new business application being announced. Initially, in the 1990's, the applications of the Internet were primarily focused on publishing and retrieving information. The first decade of the new millennium saw a proliferation of so-called Web 2.0 collaborative communities and social networks. The present decade seems most in thrall with the sharing economy and the applications of Artificial Intelligence (AI).

With this explosion in the number of new applications and trends, forecasting the long-term future of our information society appears like a daunting prospect. Yet, there is a paradigm that offers hope for a more integrated vision: the *Global Brain* (Goertzel, 2002; Heylighen, 2002, 2008; Last, 2014). The analogy underlying this perspective is that the Internet increasingly starts to play the role of a brain for the planet, i.e. a distributed, intelligent network that supports humanity in solving its problems and coordinating its actions. The initial inspiration for the Global Brain model of Internet development (Heylighen and Bollen, 1996; Mayer-Kress and Barczys, 1995) came from its role as a medium for information transmission, storage and processing. However, this perspective seems less applicable to its more recent social and economic functions, where the emphasis is on exchanging goods, services and experiences rather than mere information.

The present paper wishes to propose a broader interpretation of the Global Brain (GB) metaphor – one that is directly applicable to the sharing economy and to the more distributed forms of social organization that accompany it. It will do so by synthesizing the notion of the GB as a distributed, intelligent network with Ben Goertzel's newly proposed concept of an *offer network*, i.e. an architecture for a future economic system that is not centered on the accumulation of money, but on the direct matching of offers and demands (Goertzel, 2015).

The intention is to show that the main applications of the Internet are likely to become integrated into a single, universal system for coordinating all the activities of the people and machines on this planet. Such a system would immensely reduce the confusion, friction and waste caused by poorly aligned activities, while boosting the synergy produced by effective collaboration. Complemented by on-going technological innovation, the resulting increase in productivity would create an *economy of abundance* (Diamandis and Kotler, 2012; Dugger and Peach, 2015), where all needs can be satisfied at negligible costs. The combination of abundance with an intelligent, bottom-up system of coordination should eventually produce a solution for all the major problems that plague humanity, such as global warming, poverty, inequality and conflict – a utopian but realizable scenario for the mid-term future that has been called “return to Eden” (Heylighen, 2014a).

To get there, we will first review the abstract conception of the Global Brain as a distributed mind, and some of the present applications of the sharing economy. We will then elaborate a generalized concept of an offer network that applies the cognitive capabilities of a distributed mind to the practical opportunities and demands of our society. Finally,

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we will argue that the various experiments with a sharing economy that we are witnessing are converging towards such a universal network, and that such a network would be able to solve our present problems of poverty, inequality, sustainability and resilience.

1.1. The Global Brain as a distributed mind

A mind in the most general sense can be defined as an intelligent, autonomous system that collects and processes information to assess its situation and decides how to act in order to attain its goals or preferences. In other words, a mind is a *sense-making agent*: it interprets and evaluates the phenomena it perceives in order to extract their meaning with respect to its value system, and then it acts based on that interpretation in order to further its values.

For an agent that is the product of evolution, such as an organism, these values include at the most basic level survival and growth, because agents that do not hold these values are eventually eliminated by natural selection. Artificial agents can in principle be programmed with different values, such as serving their designer, but it seems unlikely that they would last long in a complex environment without at least some inbuilt "survival instinct". Moreover, their lack of autonomy may disqualify them as true "minds".

The activity of a mind can be summarized by the basic cybernetic feedback loop:

perception of the situation → interpretation with respect to the goal (desired or most valued situation) → action to bring the situation closer to the goal → new perception to ascertain in how far the action was sufficient → new interpretation → new action →...

A perceived situation will elicit action if it entails a *problem* – i.e. a (threat of) deviation from the desired situation – , an *opportunity* – i.e. a possibility to advance even further towards the desired situation – , or some combination of the two. Situations that elicit actions may be called *challenges*: they challenge the agent to remedy the problem or to exploit the opportunity (Heylighen, 2012, 2014b).

The intelligence of the agent resides in its ability to recognize and effectively address the most relevant challenges. This requires knowledge, in the sense that the agent must be able to recognize different categories of situations (which we will call *conditions*), and to associate each condition with the action most appropriate to deal with it. The elements of such knowledge can be expressed most simply as "condition-action rules" or "production rules", with the following form:

$a \rightarrow b$

This is to be read as: IF condition a is perceived, THEN perform action b. For example: *banana* → *eat*, *tiger* → *flee*, *tired* → *rest*.

Such conditions that immediately lead to concrete actions are merely the simplest form of knowledge. More complex situations require a process of deduction or inference, in which perceived aspects of the situation (perceptions) imply more abstract conditions (conceptions), which in turn imply even further conditions, until the process settles on a particular action. Here is a simple example:

tiger → *predator*

predator → *danger*

danger → *flee*

More complex processes of inference will take into account conjunctions of conditions and actions (which we will denote by the "+" symbol), e.g.:

striped + large + catlike + animal→tiger

tiger + jungle → *flee*

flee + jungle → *locate tree* + climb tree

A given situation will normally be characterized by different recognized conditions. This set of perceived conditions will trigger several rules that infer additional conditions, which in turn trigger further rules, and so on. Thus, the initial perception will be processed through the application, in parallel and in sequence, of the different rules that constitute the agent's knowledge.

Such rule-based processing of information becomes even more flexible when the different rules have different "strengths", denoting their relative importance or probability of being correct. Strength can be represented by a number between 0 and 1, where 1 denotes a rule whose conclusion is absolutely certain. The principle is that if several rules compete for execution, the one with the highest strength will be chosen. Alternatively, if several rules act in parallel, then their contribution to the final conclusion will be proportional to their strength. These strengths should be able to adapt to experience: the more successful a rule has proven to be, the larger its strength should become. This is the basic mechanism of *reinforcement learning* that rewards good rules and weakens less good ones (Woergoetter and Porr, 2008).

These elements (conditions, actions, and their conjunctions, rules expressing elementary inferences, and adjustable strengths) correspond to those of the "production rule systems" (Anderson, 2014) that are used as general-purpose representations of knowledge and inference in Artificial Intelligence (AI) and cognitive science. They basically allow us to recover the flexibility of the neural networks that process information in the brain (Heylighen, 2014c; McLeod et al., 1998).

The present analysis of the functional components needed to build a mind is on purpose so general that it can apply to very different kinds of minds – including those exhibited by human brains, by AI computer programs, but also by the collectives of human and technological agents that together would form a "global brain". Let us see how these different components are realized in society.

First, society is an autonomous system: it is able to survive and grow by solving the problems or exploiting the opportunities that it encounters – and this without need for outside direction. It recognizes such challenges through its (largely implicit) value system, which recognizes certain conditions as beneficial (e.g. education, housing, drinkable water, peace, …) and others as harmful (e.g. hurricanes, pollution, crime, disease, …) to its development. It tackles these challenges by analyzing, interpreting and evaluating the situation, and by initiating actions to deal with it (e.g. purifying water, building houses, curing people from disease, preventing crime, …). This means that society has an implicit store of knowledge and an intelligence that applies that knowledge by making the necessary inferences and eventually reaching decisions about the right actions to take.

This intelligence is not localized in a central executive, such as a president or government, that would command and control the whole of the social system. It is rather distributed over billions of people, organizations, documents containing specialized knowledge and regulations, computer programs, and machines that perform actions. Thus, the intelligence of society is similar to the one inherent in the brain, where knowledge and inference processes are distributed over billions of neurons and their connecting synapses. But that insight is not yet sufficient to understand how this societal intelligence functions, how it can be improved, or how it is likely to further evolve. Let us therefore continue our analysis at the functional level rather than at the level of the physical components performing these functions.

1.2. Matching offer and demand

The goals and values of society present themselves as a collective *demand* for better conditions (Heylighen, 1997). Whenever some

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