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Perspective

Sharing Information and Knowledge on a Self-Organizing Medical Artificial Intelligence Network

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Abstract

Independent artificial intelligence units across medical facilities can be linked together on a network, where information and knowledge transmit along links. Among these AI units, some may be designed to have a higher level of learning ability and can process information into knowledge. Links can be maintained or severed between two autonomous nodes on the network. The self-organizing actions by AI units in equilibrium bring particular network configurations, and this framework is efficient.

Introduction

The development of artificial intelligence design will reach a state where linked AI units interact on a network. The literature, for example [1,2], has incorporated economic preferences based on rational human decision-making. This facilitates designing independently decision-making AI units, because a preference structure is necessary to obtain rationality in collective decision-making. For designing linked AI units across medical facilities, a non-preference decision-making environment, we can also introduce some results from the study on information networks. These results apply to a self-organizing AI network with independent decision on making link connections on which to sharing information and knowledge.

The Model

Consider a model of a number of medical facilities over a geographic area; each contains an AI unit which is capable of monitoring and collecting information from the local medical facility. There are potential links among these units. Due to the constraint of location, not all links between two nodes are available. This is a potential network with AI units as nodes. Among available links, two nodes can choose to maintain or sever the link between them. Maintaining the link requires a cost and the cost is shared by both nodes. The focus of this model is to analyze the transmission of information and knowledge on a network of connected artificial intelligence units. This information can also be transmitted along the network to other nodes. Due to communication imperfections n accuracy, delay, or a cost on the network, transmitted information is subject to a decay factor per link passed. Among these AI units, some have a higher level of learning power and play a leading role in processing information into knowledge. For simplicity, suppose knowledge is information being augmented into a larger amount (for output purposes). The processors then distribute knowledge back to the network, with decay, to other nodes. Each unit of information and knowledge gathered by nodes has the output value of one.

Result

In this framework, AI nodes decide whether to maintain or sever a link, after evaluating the benefit from information and knowledge transmitted through the link and the cost of maintaining it. If these independent actions reach a final network configuration, it would be an equilibrium resulting from free link choices by the nodes. Equilibrium concepts on networks are discussed in [3,4]. The key issue is whether actions taken by nodes over links are unilateral or bilateral. In our network, severing a link can be done unilaterally since simply turning the switch will stop the flow of information. On the other hand, when two nodes want to link together, both sides need to switch it on. Within this frame work, the following configuration is always in equilibrium when link costs are not too large [5]. It has all nodes linked to a processor with their shortest distances respectively. Among these configurations, the one utilizes minimum number of links is also the most efficient. If we narrow down to a network design with only one processor, a tree graph is the only equilibrium configuration, and also the only efficient configuration. An interesting discovery is that when there are more than one processor, circles may appear on the network in equilibrium. This is due to an extra shortcut can access knowledge with less decay.AI units can be designed to have an even higher level of autonomy. They may have the freedom to choose whether to become a processor (this higher computing power may require extra cost though).In this framework, a network equilibrium also exists when link costs are not large.

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