Chapter 7
Building Representations in Motivated Learning

ABSTRACT

If an intelligent system is to benefit from prior experiences, then such a system must have the ability to learn. Learning must lead to the gathering of new knowledge of increased complexity and is based on the exploration of the world and social interactions. In this chapter authors describe building representations in motivated learning, a process that is close to learning by natural systems and yields better learning results in artificial systems than reinforcement learning. An embodied agent's mission is to survive in an unfavorable environment. The agent must have needs whose fulfillment is a measure of its success – survival. Meeting these needs require physical and mental efforts, and the development of useful skills is associated with the development of intelligence. The agent's environment must provide conditions in which individuals will be subjected to pressure from an environment in which better solutions, greater skills, and broader knowledge count. The agent treats unmet needs as signals to act. The strength of these signals depends on the degree of unmet needs so that the agent can differentiate between them and compared them. Various need signals provide motivation for action and control the learning process. In complex environments, there are rules that regulate the relationships between objects. By discovering these rules, the machine gains knowledge about the environment. Knowledge is represented by building connections between neurons in semantic memory. New concepts, objects, needs, or motor skills are represented by adding new memory cells and by associating them with other concepts, actions, and needs. Whether or not a new object or idea is created in semantic memory depends on the mechanism of novelty detection. The more time an agent spends on working or playing with an object, the better it learns the object's physical properties and how to use it. The intended use of objects determines characteristic features needed to classify them. Initially, semantic memory does not store any concepts, does not know places, does not recognize any objects, and does not support any activities or motivations. New concepts or representations of objects emerge from observation and manipulation of objects. A virtual agent's semantic memory obtains symbolic representations of objects and their location or movement in the observed scene. The focus of perceptual attention may result from detection of novelty, change, movement, signal intensity, or meaning in the context of needs. Attention should be focused long enough for the working memory to evaluate how much observed object or considered plan is useful. The focus of attention must also be accompanied by the possibility of switching attention. The

DOI: 10.4018/978-1-7998-5653-5.ch007

attention switching responds to various types of signals, from sensory stimuli through planning and monitoring of performed activities to associative activation of memory. It results from constant rivalry between these signals for attention.

MOTIVATED LEARNING

Writing about the imaginary mind and natural minds that inhabit living brains, we naturally must address the necessity of teaching them. Human minds require a long period of teaching a child almost everything—moving, grasping, walking, speaking—not to mention the many years of learning knowledge about the world, about society, and about oneself. Without this, children will not become full-blown adults, and perhaps they will not be able to survive on their own. Many animals come into the world with a resource of skills and innate knowledge, but for the hatchling to become an eagle or a gull, the kitten a tiger and the puppy a wolf, the animal must learn a lot from its parents, other members of the pack, or its community in general. We know that the higher the intelligence of the animal, the more complex the social behavior, the longer the period of education, and the greater the dependence on the parents and the learning period.

We have tried to show that if an intelligent system is capable of processing information in such a way that it can benefit from the acquired knowledge, then such a system must have the ability to record previous experiences, which means the ability to learn. What is more, we have demonstrated that to achieve deep knowledge about the world, a knowledge that allows for the development of logical relations between abstract concepts and underlying sensory feelings, it is necessary to link sensors and effectors to the mind with the help of a body. Such embodiment allows the self-learning process to be accomplished by manipulating the environment.

The question arises as to whether we also have to teach robots. Do their minds have to be built like minds we imagined? Can these rules be simplified? We have already asked this question, suspecting that it is enough to build appropriate algorithms to control the robots, and they will do what is programmed for them. This claim is true. We already have such robots. They behave according to predetermined rules. We have already given examples of autonomous cars, drones, and other vehicles. However, having such robots does not satisfy people who build them and want to use them to perform increasingly difficult tasks in an increasingly complex and unpredictable environment.

The implementation of tasks in city traffic or on the battlefield is already sufficiently complicated. And what will happen if the battlefield is crowded by other autonomous vehicles, which will also try to fool and mislead enemy combat systems? Robots designed for such sophisticated missions should be able to adapt to the changing environment and constantly develop their abilities to survive and achieve goals. That is why we will continue to deal with robots capable of learning and developing.

ROBOT LEARNING

If the adaptation to the operating conditions is not evolutionary involving the principles of the genetic transmission of traits but instead involves open-ended learning in embodied machines, then such systems are called epigenetic ones. Epigenetic systems, both natural and artificial, are characterized by a developmental process in which the change in the behavior of the subject is the result of interactions between this subject and its physical and social environment. Epigenetic robotics has two related goals:

Related Content