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SELF-MOTIVATED AND TASK-ORIENTED, MULTI-DIMENSIONAL LEARNING IN A DYNAMIC AND UNCERTAIN ENVIRONMENT WITHOUT HUMAN INTERVENTION

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Abstract. *The abilities to accept new information from the environment and use it to update our existing knowledge thus adapting to the changes of our environment have played a crucial role in the success of human beings as a species. Incorporating these abilities in machines has been an age long desire of artificial intelligence. In this paper, we present a learning technique based on evolutionary approaches that enables artificial agents to detect changes in their environment and adapt accordingly. Our focus is on enabling the agents to learn new tasks without any human intervention, relying only on stimulus from their environment. We argue that learning in such a dynamic environment should be a continuous process and past experiences must be retained for future scenarios. The learning method itself provides a mechanism where the decrease in performance, forced by the change in goals, triggers new learning. We conduct experimentation to show how this approach works and results from these experiments are very encouraging.*
Keywords: Artificial intelligence, Evolutionary computation, Individual and social learning, Continuous learning, Learning in a dynamic environment, Particle swarm optimization, Artificial neural network, Learning in imperfect information, Evolutionary games

1. **Introduction.** An intelligent system is a system that acts intelligently, i.e., it reacts according to its surroundings and needs. It must cater for changes in its environment and objectives. Ideally the abilities of such a system depend upon the information available to it and its perceptual and computational limitations. Such an intelligent system must be able to update its existing knowledge space when new information is available to it. In other words, intelligence can be defined as *the ability to learn new abilities*. This ability has been pivotal to the success of humans as a species. We (humans) adapt according to the changes occurring in our environment, allowing us to not only survive but thrive in (almost) any environment. It must be noted that these (real-world) environments are not static. On the contrary, they are uncertain and constantly changing. These changes maybe subtle and slow or discreet and obvious. In this paper, we present an algorithm based on evolutionary approaches (Particle Swarm optimization and Artificial Neural Networks) to enable the agents residing in it to learn from and behave according to changes occurring in their surroundings. These intelligent agents build a dynamic relationship with their environment enabling them to monitor changes and explore new possibilities. This is crucial for a successful evolution of the species. To the best of our knowledge, such a dynamic bond has been missing in most of the research work conducted in artificial intelligence (AI) research. To test our hypothesis and our learning algorithm, we have developed a game like environment to conduct experimentation.