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Keynote Speech 2

Evolving Deep Neural Networks with Cultural Algorithms for Real-Time Industrial Applications

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Abstract: The goal of this talk is to investigate the applicability of evolutionary algorithms to the design of real-time industrial controllers. Present-day 'deep learning' (DL) is firmly established as a useful tool for addressing many practical problems. This has spurred the development of neural architecture search (NAS) methods in order automate the model search activity. CATNeuro is a NAS algorithm based on the graph evolution concept devised by Neuroevolution of Augmenting Topologies (NEAT) but propelled by Cultural Algorithms (CA) as the evolutionary driver. The CA is a network-based, stochastic optimization framework inspired by problem solving in human cultures. Knowledge distribution across the network of graph models is a key to problem solving success in CAT systems. Two alternative mechanisms for knowledge distribution across the network are employed. One supports cooperation (CAT-NEURO) in the network and the other competition (WM).

Bio: Dr. Robert G. Reynolds received his Ph.D. in Computer Science, specializing in Artificial Intelligence from the University of Michigan, Ann Arbor. He is currently a Professor of Computer Science and director of the Artificial Intelligence Laboratory at Wayne State University. He is a Senior Member of the IEEE. At the University of Michigan-Ann Arbor, Professor Reynolds is a Visiting Research Scientist with the Museum of Anthropology, and a member of the Complex Systems Group. His interests are in the development of computational models of cultural evolution for use in the simulation of complex organizations, computer gaming, and virtual world applications.

Dr. Reynolds produced a framework called Cultural Algorithms, to express and computationally test various theories of social evolution using multi-agent simulation models. He has authored or co-authored seven books in the area. His most recent books are "Cultural Algorithms: Tools for the Engineering of Social Intelligence into Complex Cultural Systems, 2020, Wiley-IEEE Press", and "Culture on the Edge of Chaos" publisheef by Springer-Verlag in 2018. In additional he has written over 250 papers. Currently, Dr. Reynolds along with his students, are developing a toolkit for testing Cultural Algorithms in dynamic environments; the Cultural Algorithm Toolkit (CAT). His research group has produced award winning game controller software for several international competitions using the Cultural Algorithms toolkit. In 2017, a software system based upon Cultural Algorithms came in second in the IEEE Single Real Valued Function Optimization competition held in conjunction with the IEEE Congress on Evolutionary Computation.