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**Evolutionary Algorithms**

**Neuroevolution of Artificial Neural Networks**

**Studying the Efficiency of the Evolution of Neural Networks for Predicting Human Interactions in Repeated Games**

Evolutionary Algorithms are one of the most interesting algorithms in the study of machine learning. The study of Evolutionary Algorithms is a field that contains a vast variety of different concepts. Of which, the most interesting is the study of Neural Networks. The same way that Evolutionary Algorithms contains many different algorithmic fields, Neural Networks can be implanted in a lot of different ways. Evolutionary Algorithms are algorithms that evolve by themselves over generations (over time). Due to Neural Networks being a sub-category of Evolutionary Algorithms, they are also a type of algorithm that learns and improves upon itself over time.

Neural Networks are the implementation of interconnected networks, under specific rules and conditions, to achieve a certain behavioral goal. Due to these types of algorithmic networks working really similarly to the same way the Biological Neural Networks in organisms, the possibilities are limitless. This means that A.I and Robots with the right implementation of Neural Networks can be taught literally any job.

Another way Neural Networks can be used is in self-driving cars. These self-driving cars use Neural Networks to learn detection algorithms and adapt to different situations. This is due to Neural Networks evolving with each test run that they are given. The same way a baby’s brain develops new neural pathways over time, these Evolutionary Algorithms learn new behavior over time too. Although the outcome of these new learned behaviors is not always optimal, sometimes really dangerous too, yet with further conduct of studies towards the topic, we may eventually reach a level where the implementation of neural networks is so efficient that it allows humanity to never work again.

Our aspect of interest in this paper is to study the Neural Network Evolution and Adaptation of implanted neurological pathways in A.I Robots and Bots, and how efficient and complicated these neural networks can get by themselves. For this study to be conducted, three key conditions have to be met:

**Condition 1**: The neural network under study has to be in an environment where it is ever evolving.

**Condition 2**: The neural network must follow simple but advanced rules and conditions.

**Condition 3**: The neural network must be in an environment where it has to adapt to unexpected inputs.

The best way to meet all these 3 conditions has a simple answer. Video Games. One of the most interesting examples to such a video game is Conway’s Game of Life. It is basically a simulation that depends on a few given inputs by the user in the beginning, and a few set rules by the programmer. Once the simulation is run, the game starts evolving depending on the first input variables. Interesting patterns can be observed throughout the simulation.

Although Conway’s Game of Life is no where near as complicated as a full-on neural network, yet the concept remains. Simple repeated games such as these meet all three criteria that are needed to be met in our study. Condition 1, repeated games with no end give more space for the neural network to develop. If the time limit or number of test generations is infinite, the we can expect to reach a perfect neural network eventually (on theory that is). Condition 2 is met when the neural network is given simple enough rules to follow that can evolve into complicated situations over time. This allows us to study the evolutionary capability of the implanted neural network, by observing how well it can adapt and how complicated it can get. Finally, condition 3 is met when the said game requires the users input in every cycle. This means that on top of the set rules for the game, the neural network has also to deal with unexpected user input throughout every generation. This will help us study how efficient a neural network is to adaptation.

Overall, this research paper will aim to research the capabilities and ceiling of evolution for neurological algorithms in implemented neural networks, through testing them in artificial intelligence using games vs humans. Key aspects we are looking for are: Evolutionary Capabilities, Efficiency in Adaptation, Affinity towards Complexity, and finally, the Perfect A.I with Neural Networks.