President's Message

Yaochu Jin
Westlake University, CHINA

Don't Play Games, Optimize

Hello Fellow CIS-ers,

When I give a talk about evolutionary machine learning, one question I often expect is why I use an evolutionary algorithm to optimize the hyper-parameters and structure of a neural network, rather than using a reinforcement learning algorithm. A quick answer might be, well, I am an evolutionary computation guy. I know this is a sloppy answer. Often, I attempt to explain the potential benefits of using an evolutionary algorithm in comparison with a reinforcement learning algorithm, e.g., in handling multiple objectives, in parallelizing the calculations, and also in dealing with sparse environmental feedback, among others. Clearly, it is always problem-dependent whether an evolutionary algorithm or a reinforcement learning algorithm should be chosen to solve a machine learning problem.

This is just one but very typical example of misunderstandings or polarized opinions between researchers from different communities, or from different disciplines. I can still recall the debates about whether probability theory or fuzzy sets should be used to model uncertainty in the 1990s. Similarly, I do not think there is a simple correct answer to the above question. My own naïve view is that probability theory is something for characterizing objective uncertainty, whilst fuzzy sets are well suited for representing subjective uncertainty, because fuzzy sets are usually linguistic variables human being use when they are uncertain in describing something they observe.

How to resolve these misunderstandings or gaps in opinions? There are different ways. The first option is to provide more evidence that further verifies one's own opinions. This helps in convincing others, and may also lead to deeper insights into the different approaches. A negative consequence of this option is that it may even more widely separate different groups of people. Alternatively, one can develop new theories that bridge the gap between two different approaches. For example, it has

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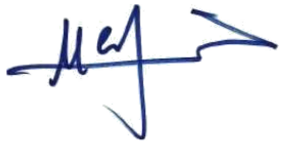
been suggested that possibility theory could be a connection between probability theory and fuzzy sets. Likewise, for evolutionary algorithms and reinforcement learning, increased research efforts have been dedicated to improving the performance of reinforcement learning using evolutionary computation, or vice versa.

Collaborating between researchers from different disciplines, rather than competing with or even fighting against each other, becomes increasingly important. Multidisciplinary research is not only a rich source for innovative research, but will be indispensable for many disciplines, such as the use of artificial intelligence for science.

I would conclude my message with a discussion of the differences between two approaches to decision-making, one is Nash Equilibrium in game theory, and the other is Pareto optimality in multi-criterion optimization. Nash equilibrium is reached when each decision-maker tries to find an optimal strategy given that the strategies of other participating decision-makers' strategies have been fixed, and no one is willing to unilaterally change their strategy. By contrast, Pareto optimality aims to achieve a situation where no individual decision-maker can be better off without making other participants worse off. Clearly, Nash equilibriums are not necessarily Pareto optimal, they are usually a set of non-dominated solutions. If the decision-makers are ready to collaborate and optimize their strategies, they can then find a set of Pareto optimal solutions. Therefore, do not play zero-sum games, collaborate and optimize our strategies to achieve win-win solutions that are beneficial to all parties, in research, in daily life, and in all other areas as well.



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