IEEE Transactions on Evolutionary Computation Special Issue on Evolutionary Neural Architecture Search

I. Motivation

Deep neural networks (DNNs) have shown remarkable performance in solving various real-world problems. In principle, the achievements of DNNs are mainly contributed by their deep architectures, which can learn meaningful representations at different levels. The learned representations can greatly enhance the performance of the subsequent machine learning algorithms. However, designing an optimal deep architecture for a particular problem requires rich domain knowledge of both the investigated problem domain and for DNNs, which is not necessarily held by every end-user.

Neural Architecture Search (NAS), as an emerging technique to automate the design of DNN architectures without or with little domain expertise, is a potentially promising technique to solve the aforementioned critical issue. However, NAS is a complex optimization problem challenged with discrete, bi-level, and computation expensive characteristics. Currently, reinforcement learning, gradient-based algorithms, and evolutionary computation (EC) are the three main techniques for NAS. However, the reinforcement learning-based NAS algorithms have typically a high computational complexity. Although gradient-based NAS can perform efficiently, it often relaxes the original NAS problem into a continuous optimization problem without any convincing justification. Furthermore, neither of them can fully automate the NAS process in practice.

EC-based NAS (ENAS) algorithms can solve the NAS problems in their natural form. ENAS algorithms can also automate the design of DNN architectures. In the literature, EC has been successfully applied to both architecture search and weight optimization of shallow and medium-scale neural networks for over 30 years. Unfortunately, these works cannot be properly scaled to DNNs, which typically have a large number of architectural parameters and weights. Although a number of ENAS algorithms have been published in top-tier journals and conferences in recent years, there is still much room to make improvements in addressing NAS problems.

II. Topics

This special issue is particularly focused on novel theories, algorithms and applications on ENAS. The topics of interest include but are not limited to:

- Theory of EC methods for NAS
- Novel encoding/representation strategies of ENAS
- Novel search space of ENAS
- Novel genetic operators of ENAS
- Performance estimation strategies for ENAS
- Multi- and many-objective ENAS
- Knowledge-based ENAS
- Critical analysis on the ENAS landscape
- Evolutionary constrained/bi-level/differential NAS
- Evolutionary transfer/multi-task learning for NAS
- Evolutionary surrogate-assisted NAS
- Evolutionary interpretable NAS
- Evolutionary search for activation functions
- Evolutionary weight optimization of neural networks
- Swarm-based algorithms for ENAS
- Hybrid evolutionary-reinforcement/evolutionary-gradient learning approaches to NAS
- Benchmark datasets/platforms of ENAS
- ENAS for edge devices
- ENAS for graph neural networks/generative adversarial networks/recurrent neural networks/spiking neural networks
- ENAS for complex/large-scale real-world applications
- Emerging approaches of ENAS to address expensive hardware and/or computationally efficient ENAS

III. Submission

Manuscripts should be prepared according to the "Information for Authors" section at https://cis.ieee.org/publications/t-evolutionary-computation/tevc-information-for-authors and submissions should be made through the journal submission website at https://mc.manuscriptcentral.com/tevc-ieee by selecting the Manuscript Type "ENAS" and clearly adding "ENAS Special Issue Paper" to the comments to the Editor-in-Chief. Submission of a manuscript implies that it is the authors' original unpublished work and is not being submitted for possible publication elsewhere.

IV. Important Dates

- Submission opens: January 1, 2023
- Submission deadline: March 28, 2023
- Tentative publication date: Summer 2024

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