CSE 847 Project Proposal

Submitted by: Ritam Guha (MSU ID: guharita)

Date: February 15, 2021

1 Project Title

Neural Architecture Search using Meta-heuristic Evolutionary Optimization Algorithms

2 Team Members:

Ritam Guha (Solo)

3 Description of the problem:

Deep Neural Networks have shown tremendous progress over the past decades in various fields like image classification, speech recognition, language translation etc. The success of the deep learning models are currently attributed to the architectures manually designed by the domain experts. But this process is very time consuming as it requires proper understandings of the domains and human intervention makes it error-prone. The most effective way to solve this kind of a problem is to automate the process of architecture design. This resulted in the introduction of Neural Architecture Search (NAS) [1] which is known as the process of automating architecture engineering. NAS is a resource-intensive and difficult process due the presence of a large number possibilities in the architecture space. Exhaustive search over the entire search space is almost next-to-impossible in NAS. As a part of this project, I want to modify evolutionary meta-heuristic optimization algorithms [2, 3] to solve this problem within an acceptable time stamp. As it is not a deterministic approach, the goal is to reach a near-optimal solution using limited resources instead of the best possible solution.

4   Preliminary Plan (Milestones):

The resource requirement of NAS got decreased to a large extent in the domain of image classification after researchers started proposing various benchmarks related to NAS [4, 5]. For the project, I have the following logistics in mind:

Dataset: NAS-Bench-101. It is a dataset consisting of 423K unique architectures for CIFAR-10 dataset and the probability of hitting one of the elite architectures is nearly 1 to 50000 which makes it a really challenging problem.

Evolutionary Algorithm: The evolutionary optimization algorithm to be used is currently undecided. I want to start with Genetic Algorithm (GA) to get an idea of how these algorithms need to be updated to search the architecture space.

Comparative Study: After checking the performance with respect to GA, I want to perform a comparative study between GA and non-GA algorithms for NAS. This will help me interpret the applicability of differnt algorithms in the domain of NAS.

References

[1] Thomas Elsken, Jan Hendrik Metzen, Frank Hutter, et al. Neural architecture search: A survey. *J. Mach. Learn. Res.*, 20(55):1–21, 2019.

[2] Zhichao Lu, Ian Whalen, Vishnu Boddeti, Yashesh Dhebar, Kalyanmoy Deb, Erik Goodman, and Wolfgang Banzhaf. Nsga-net: neural architecture search using multi-objective genetic algorithm. In *Proceedings of the Genetic and Evolutionary Computation Conference*, pages 419–427, 2019.

[3] Ritam Guha, Soulib Ghosh, Kushal Kanti Ghosh, and Ram Sarkar. Groundwater flow algorithm: A novel hydro-geology based optimization algorithm. 2020.

[4] Chris Ying, Aaron Klein, Eric Christiansen, Esteban Real, Kevin Murphy, and Frank Hutter. Nas-bench-101: Towards reproducible neural architecture search. In *International Conference on Machine Learning*, pages 7105–7114. PMLR, 2019.

[5] Xuanyi Dong and Yi Yang. Nas-bench-201: Extending the scope of reproducible neural architecture search. *arXiv preprint arXiv:2001.00326*, 2020.