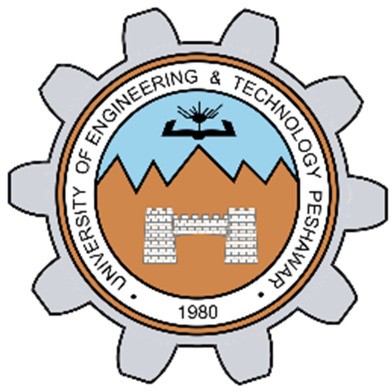
## LAB # 03



**Fall 2020**

**CSE208L Object Oriented Programming Lab**

Submitted by: **Fawad Ali** Registration No. : **19PWCSE1845** Class Section: **C**

“On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work.”

Student Signature:

Submitted to:

## Engr. Sumayyea Salahuddin

December 24, 2020

Department of Computer Systems Engineering University of Engineering and Technology, Peshawar

**Given Research Paper**

**AutoML-Zero: Evolving Machine Learning Algorithms From Scratch**

Authors: Esteban Real, Chen Liang, David R. So 1 Quoc V. Le

DATE: 30 Jun 2020

**SUMMARY**

**AIM:**

The aim of this paper is to show that AutoML can go further: it is possible today to automatically discover complete machine learning algorithms just using basic mathematical operations as building blocks. We demonstrate this by introducing a novel framework that significantly reduces human bias through a generic search space. Despite the vastness of this space, evolutionary search can still discover two-layer neural networks trained by backpropagation. These simple neural networks can then be surpassed by evolving directly on tasks of interest, e.g. CIFAR10 variants, where modern techniques emerge in the top algorithms, such as bilinear interactions, normalized gradients, and weight averaging

In this paper, author proposed an ambitious goal for AutoML: the automatic discovery of whole ML algorithms from basic operations with minimal restrictions on form.

**CONCLUSION:**

* The objective was to reduce human bias in the search space, in the hope that this will eventually lead to new ML concepts.
* As a start, Author demonstrated the potential of this research direction by constructing a novel framework that represents an ML algorithm as a computer program comprised of three component functions (Setup, Predict, Learn).
* Starting from empty component functions and using only basic mathematical operations, we evolved neural networks, gradient descent, multiplicative interactions, weight averaging, normalized gradients, and the like.
* These results are promising, but there is still much work to be done. In the remainder of this section, we motivate future work with concrete observations.

**Related Research Paper**

**General-purpose hierarchical optimization of machine learning pipelines with grammatical evolution**

Authors: SuilanEstevez-VelardeYoanGutiérrez, YudiviánAlmeida-Cruz, Andrés Montoyo.

DATED: JULY,2020 .

**SOURCE:** https://www.sciencedirect.com/science/article/abs/pii/S0020025520306988?via%3Dihub

**SUMMARY**

**AIM:**

* This paper introduces Hierarchical Machine Learning Optimization (HML-Opt), an AutoML framework that is based on probabilistic grammatical evolution. HML-Opt has been designed to provide a flexible framework where a researcher can define the space of possible pipelines to solve a specific machine learning problem, which can range from high-level decisions about representation and features to low-level hyper-parameter values.
* The evaluation of HML-Opt is presented via two different case studies, both of which demonstrate that it is competitive with existing AutoML tools on a variety of benchmarks.

Designing an effective solution to any one of these problems often involves a large experimentation phase where researchers use different datasets, algorithms, and specific parameters. As an example, Fig. 1 shows a hypothetical pipeline composed of several steps. In each step, different options are available. Suitable combinations of these options yield different values for the performance metric that is being evaluated. These hypothetical steps can range from applying some data preprocessing techniques to selecting specific algorithms and further determining the values of their hyperparameters.

## CONCLUSIONS:

* In this section, we present a high-level analysis of the experimental results and discuss key characteristics of HML-Opt. Unlike other proposals, our technique is not restricted to particular types of pipelines, such as neural networks, or shallow classifiers. Since the grammar defines the space of possible experimentation, anything can be included, such as natural language preprocessing techniques or knowledge bases.
* This paper presents Hierarchical Machine Learning Optimization (HML-Opt), an AutoML framework for automatically finding a close to optimal pipeline in a specific machine learning problem.
* This novel technique allows researchers to evaluate a much higher number of experimental setups than what is manually possible, given specific time frames and computational resources. Moreover, a key and innovative design feature of HML-Opt is to provide a declarative and expressive framework.

**COMPARISON:**

I found the first, given research paper (AutoML-Zero: Evolving Machine Learning Algorithms From Scratch) more valuable than the related Research paper (General-purpose hierarchical optimization of machine learning pipelines with grammatical evolution) due to some specific reasons which are mentioned below.

* The objective of the 1st paper is to reduce human bias in the search space, in the hope that this will eventually lead to new ML concepts.
* Author demonstrated the potential of this research direction by constructing a novel framework that represents an ML algorithm as a computer program comprised of three component functions (Setup, Predict, Learn).
* The idea of 1st paper is that, starting from empty component functions and using only basic mathematical operations, we evolved neural networks, gradient descent, multiplicative interactions, weight averaging, normalized gradients, and the like.
* In this paper, author proposed an ambitious goal for AutoML: the automatic discovery of whole ML algorithms from basic operations with minimal restrictions on form.