Project No.	Project Title	
2021-01-046	Development of Hierarchical Tables Ensemble algorithm for tabular data	
Academic Advisor	**Co-Advisor**	
Dr. Aharon Bar Hilel	Ph.D student Guy Farjon	
Team Members		
Omri Dahan	Shira Shushan	
omrd@post.bgu.ac.il	shirashu@post.bgu.ac.il	

Abstract

In recent years, deep learning has emerged as an important approach to solve both academic and real-world problems. In this approach, multiple layers (neural layers or others) are used, hierarchically, to progressively extract high-level features from the input data. One common deep learning model is the deep Artificial Neural Network (ANN). Contains millions of 'neurons' which usually requires the need of GPUs or other specialized hardware. ANNs had empirical success in the last decade and currently it is one of a few alternative existing in practice. We claim that there are other alternatives for deep learning, resulting with similar results but with faster performance.

Our proposed alternative is the **Hierarchical Table Ensemble** (HTE) algorithm. This algorithm uses ferns as the main computational component. Ferns are like decision trees, with a small but significant difference - the queries at each level ‘i’ are known in advanced and are not dependent on the results of level ‘j’. Each query is a simple binary question which is used for quicker calculations and optimization. These ferns are word-calculators ant their output is a K-bit binary codeword which is used an index into a 'voting table' which retrieves the corresponding output representation. By applying M such ferns, and summing their results, we get an ensemble of simple voting tables. HTE will be a stacked model of L such layers, connected one over the other to extract high level features for the input.

Other deep classifiers exist, such as “gcForest”, which is a deep random forest. HTE algorithm aims to compete with such architectures, enabling deep learning framework but as a computationally cheaper approach. As a first, we conducted experiments on synthetic data to tune the classifier's hyper-parameters. Seconds, after we were able to solve synthetic problems, we moved to real-world data. We compared results on publicly available datasets such as ADULT, LETTER, IMDB, WINE etc. with the “gcForest” algorithm. Currently, “gcForest” shows slightly better results at this point. For example, on the ADULT dataset which aims to figure out if a person is likely to earn 50K$ or more a year, only by knowing that person’s demographic information, the “gcForest” accuracy was 86% while HTE showed 83%.

Finally, HTE is a new deep algorithm which is still being researched. HTE suggests a framework that enables accelerated CPU inference for low-compute domains, with mild costs of accuracy descending and memory consumption. In our work we present how HTE works on synthetic examples and compare the algorithm results on various datasets with other known deep learning algorithms.

Key Words: Bit Functions, Ferns, Machine Learning, Deep Learning, Hierarchical Table Ensemble