

## CNN HYPERPARAMETERS OPTIMIZATION APPLIED TO EUROSAT DATASET

*PhD, Associate Prof., A.A. Podorozhniak, PhD Student, V.A. Yaloveha, Master Student D.M. Hlavcheva, National Technical University "Kharkiv Polytechnic Institute", Kharkiv*

Machine learning algorithms are used in many fields in the modern world. However, building well-performing machine learning applications requires highly specialized data scientists and domain experts [1]. Every machine learning system has hyperparameters. Recent deep neural networks crucially depend on a wide range of hyperparameter choices about the neural network's architecture, regularization, and optimization [2]. It is necessary to set values of numerous hyperparameters prior to the learning process. But with modern algorithms, the evaluation of a given hyperparameter setting can take a considerable amount of time and the search space is often very high-dimensional [3].

There are three classical and commonly used approaches for finding optimal hyperparameters: Grid Search, Random Search, Bayesian Optimization. Grid Search is resource-intensive and execution time even for a shallow neural network. Random Search uses a random selection from hyperparameters space and shows good results. The latest research introduces a new BOHB method, which combines Bayesian optimization and Hyperband algorithms [4].

Modern neural networks are successfully applied to satellite image classification problems [5]. EuroSAT dataset consists of 27,000 images across 34 European countries. Several experiments were carried out on the EuroSAT dataset. The explanation of Random Search and BOHB algorithms is provided. It is established that the BOHB algorithm is more effective and could find better neural network hyperparameters configuration which could increase classification accuracy on the EuroSAT dataset.

**References:** 1. *Zöllner M. A., Huber M. F.* Benchmark and survey of automated machine learning frameworks // *Journal of Artificial Intelligence Research.* – 2021. – V. 70. – P. 409-472. 2. *Feurer M., Hutter F.* Hyperparameter optimization // *Automated machine learning.* – Springer, 2019. – P. 3-33. 3. *Hinz T.* et al. Speeding up the hyperparameter optimization of deep convolutional neural networks // *International Journal of Computational Intelligence and Applications.* – 2018. – Vol. 17. – No. 2. – 1850008. 4. *Falkner S., Klein A., Hutter F.* BOHB: Robust and efficient hyperparameter optimization at scale // *International Conference on Machine Learning.* – PMLR, 2018. – P. 1437-1446. 5. *Yaloveha V.* et al. Fire hazard research of forest areas based on the use of convolutional and capsule neural networks // *2019 IEEE 2nd Ukraine Conference on Electrical and Computer Engineering (UKRCON).* – IEEE, 2019. – P. 828-832.