The project of JINR-2023 Program of Egyptian students

Machine learning applications for plant disease detection

Meshcheryakov Laboratory of Information Technologies (MLIT)

Introduction

Plant disease detection is a very popular field of study intended to make a farmer's life easier. The research aiming to solve the problem of detection and preventing diseases of agricultural crops with the help of machine learning was accomplished (http://www.computeroptics.ru/KO/PDF/KO45-4/450416.pdf). As a starting source of data, a special database was gathered. As a result of our research, we identified the most appropriate deep learning architecture to deal with limited image datasets. Namely, the deep siamese convolutional network was developed to solve the problem of recognizing healthy leaves and affected by diseases and to distinguish with high precision between types of illnesses. The important aspect of applications of the developed deep learning programs in agricultural practice is to provide a convenient interaction of the farming community with this software. Therefore, a multifunctional web-based plant disease detection platform (PDDP) (http://pdd.iinr.ru) was developed. It uses the modern cloud-based organization and has a web interface designed to manage various databases of agricultural crops necessary for training and testing the corresponding deep neural network. PDDP also provides effective and convenient means for storing, transmitting and retrieving photos and textual and comments obtained from farmers to our system for further recognition. The PDDP is based on facilities of the JINR cloud service (http://cloud.iinr.ru) and of the LIT JINR *"HybriLIT"* heterogeneous cluster (http://hybrilit.jinr.ru).

Project aims

1. Theoretical knowledge on various deep learning methods, in particular, the deep siamese convolutional networks, problems of their training and testing.
2. Python programming on the level to use PyTorch to train one's own deep learning models.
3. Python programming on the level to use YOLO framework to train one's own object detection models.
4. Practical skills to expand image database by new crop samples, train and test the deep siamese convolutional network.
5. Practical trainings are held on Multifunctional Information and Computing Complex JINR.

Entry requirements

Expected:

Good knowledge in user-level skills of administration and programming (including text editors and shell scripting) are expected from applicants.

Recommended:

Basic knowledge of Machine Learning foundations.

Recommended literature

1. Uzhinskiy A., Ososkov G., Goncharov P., Nechaevskiy A., Smetanin A., Oneshot learning with triplet loss for vegetation classification tasks. Computer Optics 2021; 45(4): 608-614. DOI: 10.18287/2412-6179-CO-856.
2. Goncharov, P., Uzhinskiy, A., Ososkov, G., Nechaevskiy, A, Zudikhina, J. 2020 Deep Siamese Networks for Plant Disease Detection, Mathematical Modeling and Computational Physics 2019, EPJ Web of Conferences, p 2-4 DOI:https://doi.org/10.1051/epjconf/202022603010
3. Smetanin A., Uzhinskiy A., Ososkov G., Goncharov P., Nechaevskiy A., Deep Learning Methods for The Plant Disease Detection Platform// AIP Conference Proceedings 2377, 060006 (2021); https://doi.org/10.1063/5.0068797

4. MULTIFUNCTIONAL PLATFORM AND MOBILE APPLICATION FOR PLANT DISEASE DETECTION, Uzhinskiy A., Ososkov G., Goncharov P., Nechaevskiy A., CEUR Workshop Proceedings. NEC 2019 - Proceedings of the 27th Symposium on Nuclear Electronics and Computing. 2019. C. 110-114.
5. Goncharov P., Nestsiarenia I., Ososkov G., Nechaevskiy A., Uzhinskiy A., DISEASE DETECTION ON THE PLANT LEAVES BY DEEP LEARNING, Advances in Neural Computation, Machine Learning, and Cognitive Research II, Springer, 2018, p. 151-159 DOI: 10.1007/978-3-030-01328-8_16
6. G.Ososkov, P.Goncharov, Shallow and Deep Learning for Image Classification, Optical Memory and Neural Networks, 2017, Vol. 26, No. 4, pp. 221-248.
7. Ferentinos K.P.: Deep learning models for plant disease detection and diagnosis, Computers and Electronics in Agriculture 145, 311-318 (2018).
8. Ronnel R., Atole A.: Multiclass Deep Convolutional Neural Network Classifier for Detection of Common Rice Plant Anomalies, International Journal of Advanced Computer Science and Applications(ijacsa), Volume 9 Issue 1 (2018)
9. Koch G., Zemel R., Salakhutdinov R. Siamese neural networks for one-shot image recognition //ICML Deep Learning Workshop. - 2015. - T. 2.
10. Kingma D. P., Ba J. Adam: A method for stochastic optimization //arXiv preprint arXiv:1412.6980. - 2014.

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