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Identification of cells in tree rings with deep learning for climate reconstruction

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Abstract	The goal of this project is to develop a Machine Learning framework for cell identification in high-resolution images of tree rings. Cells in tree rings are a novel and promising natural archive to reconstruct past climate.
Keywords	Machine learning, few shot learning, online learning, active learning, tree rings, wood anatomy, wood cells, climate change, climate reconstruction, image analysis
Project description:	 Tree rings are one of the most important natural archives to investigate past climate and tree responses to ongoing climate change. A novel approach into tree-ring analysis is now emerging: instead of simply measuring the width of entire tree rings, the dimensions of individual wood cells in the tree rings are quantified in anatomical images. Targeting these basic units of trees could further improve the power of tree ring information for environmental research in terms of temporal resolution and process understanding. An increasing number of studies using this cell anatomical approach confirm these expectations. Yet, the currently leading image-analysis software in this field, ROXAS (www.wsl.ch/roxas), still requires substantial user-input after automatic cell detection to handle artifacts and heterogeneity in anatomical sample preparation. The time-consuming data production – often millions of cell measurements per dataset – currently is a limiting factor. Recent advances in Machine Learning (ML) might solve this and further boost the use of the cell-based tree-ring archive. There is thousands of edited images available to train and validate ML algorithms. If successful, the developed ML module will be incorporated into ROXAS. The master student will develop a Deep Learning framework for wood cell identification using images from the WSL supervisor.
Required skills:	Programming: Python (or C++, C, Java and motivation to learn Python) Education: computer science, machine learning, geomatics, computational geography, remote sensing, computer vision, ecology, environmental sciences