Environmental Computational Science and Earth Observation Laboratory

Master thesis subject

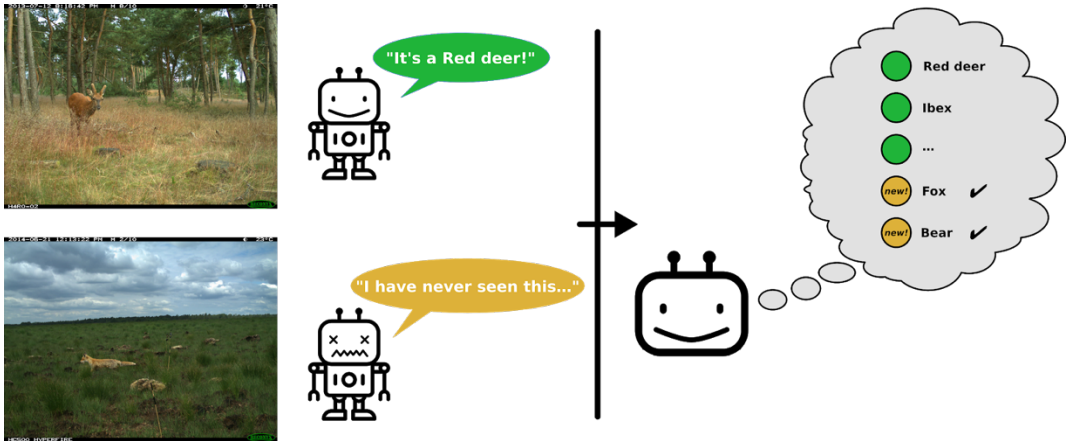
Dynamic adaptation: classifying wildlife in camera trap images, no matter the species

Context

Camera Traps (CTs) are highly versatile instruments to record presence and abundance of wildlife species in their habitat. Although they are conventionally motion-triggered and thus should only acquire images whenever an animal passes in front of the view, this mechanism still results in many empty images (where no animal is present).

Recent developments have seen increased usage of machine learning models, in particular Convolutional Neural Networks (CNNs), to automatically classify individuals in CT imagery. CNNs are able to provide high-accuracy predictions and can process large amounts of data in reasonable time, which makes them predestined for the deluge of CT imagery, oftentimes in the millions of images.

Conventionally, CNNs need to be initialized with a predefined list of label classes (in our case, species) it can predict. However, some applications may require the expansion of this list, for example in the case of species re-introductions to a habitat, or adaptation of the model to other habitats. For example, a CNN trained to detect ibexes in the Alps will likely miss e.g. bears that occasionally roam in the region, if it has not been provisioned with a dedicated "bear" class.



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In this work, we attempt to overcome this problem by training a CNN that can learn to adapt to new species. To do so, the student first trains a CNN on a subset of species in a curated data set of CT imagery, coming from the Swiss National Park (SNP). To make the CNN cope with the different species of this data set, the student will investigate methodologies like class additions based on neuron re-weighting. Focus will be laid on (a.) ensuring the addition of new classes does not bring the trained model out of balance, and (b.) investigations on the number of examples required to incorporate the new species. If successful, the end result will be a CNN-based classifier for CT imagery that can incorporate new species in a sequential way and only requires a small amount of images to obtain satisfactory accuracy, also for the new classes.

Objectives

- Familiarise and successfully set up a CNN for wildlife classification in CT imagery
- Investigate the possibilities of class additions for training deep learning models
- Provide a CNN that can classify species in CT imagery and can be expanded to new species with a limited amount of training data

Requirements and practical info

- Background in machine/deep learning is welcome.
- Programming skills in Python.
- The thesis will be supervised from the Sion campus.
- Access to parallel computing resources is provided.

Literature

- Krizhevsky, Alex, Ilya Sutskever, and Geoffrey E. Hinton. "Imagenet classification with deep convolutional neural networks." Advances in neural information processing systems. 2012.
- Qi, Hang, Matthew Brown, and David G. Lowe. "Low-shot learning with imprinted weights." Proceedings of the IEEE conference on computer vision and pattern recognition. 2018.

Contact

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