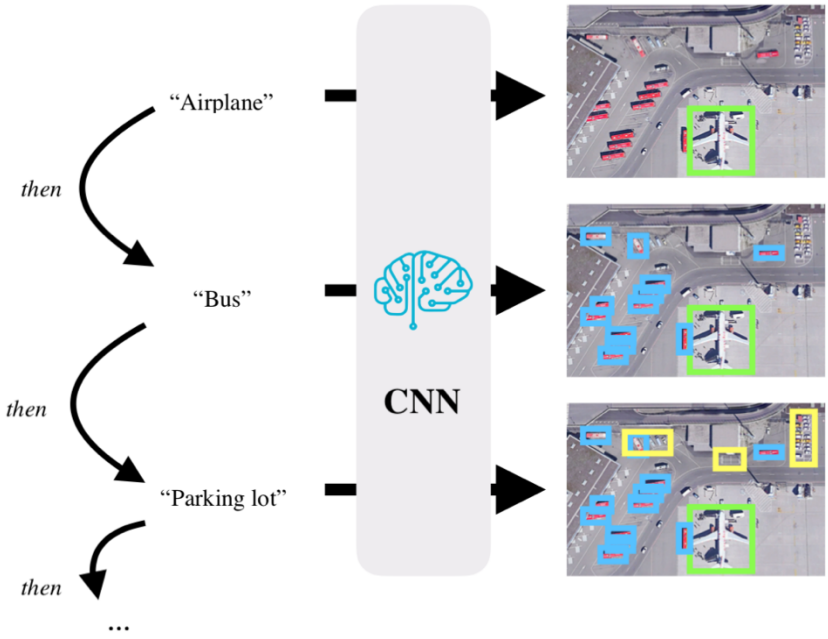
Master thesis subject

Deep lifelong learning to find objects in aerial scenes

Context

The automated detection of objects in aerial images is an important asset for many fields, ranging from operational safety in air traffic control to land use assessments. Agencies in these fields typically require the identification of multiple types of objects in a scene, but often do not have all data available from the start. In this project, you will develop machine learning solutions for object detection that can be trained to recognise different types of objects by means of incremental learning on multiple data sets.



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Recent years have seen a tremendous rise in using machine learning models for object detection, mainly through deep learning (Krizhevsky et al., 2012; Lin et al., 2017). In particular, deep convolutional neural networks (CNNs) are often trained on large training data sets that are expensive to acquire. Even more limiting, large-scale training data are often not readily available for remote sensing applications, and it is often impossible to train a CNN-based detector that can find all object types of interest (airplanes, buses, etc.; cf. Figure 1) at once in an image.

In this project, the student will investigate ways to overcome this problem. By training a deep learning detector on multiple data sets in a row, the model is able to learn about a new class each time without forgetting the previously learned object types. This is known as “lifelong learning” (Srivastava et al., 2019).

Objectives

- Search for and gather a dataset for multiples objects detection issued from several aerial imaging benchmarks
- Familiarise with deep learning and successfully set up a CNN-based object detection training and testing pipeline for remote sensing images.
- Investigate lifelong learning-based approaches to train detectors sequentially on multiple types of objects, and data sets.
- Provide detection results, accuracy assessments, and comparisons to non-sequential baselines.

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.
- Lin, Tsung-Yi, et al. "Focal loss for dense object detection." Proceedings of the IEEE international conference on computer vision. 2017.
- Srivastava, Shivangi, et al. "Adaptive Compression-based Lifelong Learning." arXiv preprint arXiv:1907.09695 (2019).

Contact

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