

## Section Sciences et Ingénierie de l'environnement Design Project 2021 (semestre de printemps)

### Proposition n°39

### Machine learning strategy for low shot learning of semantic segmentation in Aerial & Satellite imagery

#### Partenaire externe

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Picterra SA

Taille de l'entreprise (nbre de collaborateurs) : 15

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#### Descriptif du projet

Picterra has developed a machine learning platform for extracting geospatial information from Earth imagery, being from drone, aerial and satellite platforms. The platform is a web application running on cloud infrastructure with a highly interactive frontend and machine learning in the backend.

During this internship/thesis, you will work on semantic segmentation in Earth Observation imagery and explore new strategies for transfer learning to train a model on a new segmentation task with only few annotations by leveraging the following:

- A variety of training datasets from Picterra platform available (resolution, classes, quality, etc.) in an experiment-ready format.
- Unlabeled dataset available in larger quantities

The dramatic forgetting when fine-tuning a pretrained model often leads to poorly generalizable models and somehow avoids ensuring robustness.

The goal will be to find the right way of selecting the datasets for pretraining (several model(s) from these different segmentation tasks, as well as finding the right way of transferring and fine-tuning the model on the new task using the right pretrained model(s). Prior research have been performed with the use of Reptile, a meta-learning approach, and serves as a baseline for comparison.

## Objectif et buts

More specifically the overall goal is to define a strategy for training a model on a segmentation task (e.g. animals) leveraging existing training datasets on multiple other segmentation tasks (e.g. roofs, solar panels, vehicles, crops, trees, etc.). This transfer learning in a low-shot learning context (few training annotations available for the new task) needs to be tackled along the following sub-goals:

- What to transfer (1/2): Define a high level grouping of datasets to be trained together (e.g. spatial resolution ranges, type of objects, geographical location, etc.)
- What to transfer (2/2): Define and assess different pre-training strategies: train one after the other, train all task at once, etc.
- How to transfer: Define and assess different transfer strategies: fine-tune the pretrained model on the new task, all the model, only the upsampling or downsampling part of the model, etc.

## Descriptif tâches

Task1: Manipulate and study the available training datasets (e.g. distribution, quality, resolutions, etc.)

Task2: Study the baseline approach: Reptile - Meta-Learning strategy

Task3: Research about alternative transfer approaches from state-of-the-art publications

Task4: Select and assess certain alternative strategies

Task5: Recommendations for further research on this subject