China Scholarship Council / Université de Lyon
Scholarships for doctoral mobility
Call for Thesis subjects for 2020/2021

**RESEARCH SUBJECT TITLE:**
Educational deep learning from few examples: application to plant recognition on smartphone.

**Name of the laboratory:**
Website: [http://liris.cnrs.fr](http://liris.cnrs.fr)

**Name of the research team:**
Website: [https://liris.cnrs.fr/equipe/imagine](https://liris.cnrs.fr/equipe/imagine)

**Name of the supervisor:**
University / Institution: Université Lyon 2
E-mail address: laure.tougne@liris.cnrs.fr
(co-supervisor: carlos.crispim-junior@liris.cnrs.fr)

**Doctoral School:**
École Doctorale InfoMaths (ED 512)

**Lab Language:**
English / French

**Minimum language level required:**
- English: C1
- French: B1
- Other:

**Abstract:**
For several years, the LIRIS laboratory and in particular researchers from the Imagine team have been interested in the recognition of plants on Smartphone. This is an interesting theme for several reasons; in particular, it is an example of machine learning with low computer resources (low computing resources, low memory resources, network not always available, etc.). Moreover, it is a use case in which user interactions are "natural" and can be taken into account in the recognition mechanism. Finally, teaching...
everyone to recognize the plants around them is a way to get a little closer to nature, whereas the increasing urbanization tends to take us away from it.

This research began in 2010, in the framework of ANR ReVes¹, where work in segmentation [13, 9] and extraction of tree leaf characteristics [7, 10, 12, 11, 8, 14], in the context of Guillaume Cerutti's PhD thesis [6], has led to the development of an application called Folia for the recognition of trees and shrubs from photos of their leaves on smartphones. This application, which is interactive and whose treatments are fully embedded, has been freely available on the AppStore for 6 years. A study in human and social sciences of its use was the subject of a project funded by the Institut des Mondes Urbains².

Subsequently, research was oriented towards other organs such as bark [3, 2] and fruits/flowers [4], within the context of Sarah Bertrand's PhD thesis [1], which led to a multi-organ recognition of plants. This work was carried out within the framework of ANR ReVeRIES³. In this context also, we have worked on a deep learning version [5, 15] of the Folia application.

This latest research has raised a number of scientific questions among which the following two that we would like to try to answer in the framework of this thesis:

- **Learning from few examples**
  How can you learn most effectively with few images? In the context of plant recognition, we very often have many unbalanced classes. Indeed, it often happens that some classes have only a few examples. However, it is necessary to learn efficiently with few examples. This question refers to work on the notions of "few-shot learning" or "one-shot learning".

- **Educational deep learning**
  How to reintegrate pedagogy into the application? More specifically, how to make the link between botanical characteristics and the characteristics extracted by the networks? The idea here is both to make the link between the predictions and the areas of the image that led to the prediction ("explainable deep learning") and to link the space of representation of images of leaves, flowers, fruits with botanical terms. The aim is to propose a multimodal approach based on neural networks to project visual content and botanical vocabulary in the same space and to transpose the content from one space to another. These are related to "disentangled semantic learning" and "cross-domain translation".

Questions that resonate with the current state of the art and to which this study can contribute.

**Expected duration of the thesis:** (36 or 48 months)

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¹ [https://anr.fr/Projet-ANR-10-CORD-0005](https://anr.fr/Projet-ANR-10-CORD-0005)


³ [https://anr.fr/Projet-ANR-15-CE38-0004](https://anr.fr/Projet-ANR-15-CE38-0004)
36 or 48 months depending on the candidate

References:


[12] Guillaume Cerutti, Laure Tougne, Céline Sacca, Thierry Joliveau, Pierre-Olivier Mazagol, Didier Coquin, and Antoine Vacavant. Late Information Fusion for Multi-modality

