Learning to recognize objects from few training samples

Context
The Safran Group is widely known for the advanced technologies it develops in both the civil and military aerospace domains. Nevertheless, Safran Group comprises various other teams and technological products in the field of digital technologies. In particular, Safran Electronics and Defense is a major actor on defense applications. Safran Group has developed significant expertise in information and image processing (low level processing, machine learning, acquisition systems, etc.). It is active in highly competitive sectors where permanent innovation is a matter of survival. Safran Tech (the research division of Safran) sustains the research and excellence efforts of its companies. In particular, Safran Tech conducts a certain number of studies and projects on video content analysis. The topic of this thesis is proposed within this context.

The PhD is funded by Safran Group under the CIFRE fellowship program. The candidate will work in Signal and Information Technologies department at Safran Tech and in the GALEN team at Ecole Centrale and Inria Saclay (with Prof. Dimitris Samaras as academic advisor). Both places are located in the proximity of the Saclay campus in south of Paris, France.

Topic of the thesis
Novel architectures for deep convolutional neural networks and their corresponding training algorithms enhanced major and fast progress in most computer vision fields. These architectures have become increasingly deep, featuring an impressive number of learnable parameters. This allows these models to efficiently fit and leverage massive amounts of data, such as ImageNet or MS-COCO.

Most recently, given the impressive performances of deep models in various large-scale tasks, the scientific community has started exploring the feasibility of these powerful techniques for other tasks with reduced amounts of available data. There are plenty of cases where access to high volumes of data is potentially difficult, expensive or where the number of available training samples is intrinsically low. For such cases, the learning strategy of these multi-million parameters architectures must be rethought in order to allow the networks to squeeze out and leverage maximum amount of information from the few available samples.

Various responses and solutions have been proposed for tackling this problem: semi-supervised or weakly supervised learning, multi-task learning, transfer learning and one-shot or k-shot learning. One-shot learning refers to the ensemble of learning techniques and classification methods adapted for cases where only a low number of examples is available. This thesis will be dealing with this type of approaches.

The objective of this thesis is to improve state of the art in object recognition in aerial imagery. The operational context of the recognition tasks demands the ability to recognize objects leveraging a small image corpus of examples with possibly large variations in illumination, orientation and context of the object of interest.

This thesis project aims to:
- Study architectures and learning techniques most suitable for object recognition from few samples
- Validate these approaches on multiple recognition tasks and use-cases:
  - Target objects are small in the image
  - Recognize objects from the same class
  - Recognize instances of the same object
Candidate profile

The candidate should have:
- Master's degree in Computer Science, Applied Mathematic or equivalent
- Solid background and interest in Machine Learning and Computer Vision
- Strong programming skills in at least one programming language (preferably Python)
- Good communication skills and will to learn new things

How to apply

Please send your application in pdf format to andreibursuc@safrangroup.com and sylvaine.picard@safrangroup.com, including the following:
- Full CV
- Motivation letter (max 1 page)
- Transcript of grades
- Name and contact info of two references