The topic proposed for this position is that of “Joint detection and tracking of people in videos”. The basic question this project seeks to answer is “Can detection and tracking be done simultaneously?”.

Previous research work has shown that people detection aids tracking and vice-versa. However, most contemporary approaches perform tracking after detection and therefore depend upon the quality of people detection systems. The proposed project aims to formulate an end-to-end pipeline in which detection and tracking take place simultaneously. Real-time performance is another aspect of this work which is of interest to the community and hence to us.
The validation of work done in this project would be through publicly available challenging datasets such as BDD100K and MOT. The candidate will also be encouraged to diversify the proposed approaches to other related applications such as person re-identification.

Principales activités
We outline the major research topics we aim to address:

1. **Evolution of feature space topology in deep neural networks**
   Training of deep neural networks takes place over a large number of iterations; each iteration modifying the network weights and thereby changing the feature space topology. It has been shown using visualization techniques like t-SNE, which as a network converges; the feature space is partitioned into C clusters where C is the number of classes in a given problem. Feature spaces in deep neural networks are Riemannian manifolds and the evolution of a feature space through training iterations is therefore a sequence of manifolds. Thus while the nature of its convergence (assuming convergence of the network) is known, little is known about the nature of this sequence prior to convergence. Uncovering this feature space topology lends us an understanding of how features of various object classes are learnt relative to each other—an important basis to formulate robust loss functions and training strategies for weakly supervised detection and tracking.

2. **Bayesian non-parametrics as a weakly supervised learning strategy**
   Non-parametric Bayesian systems adjust their complexity in accordance with new data. An assortment of rich tools such as Dirichlet processes and Indian buffet processes form a major cornerstone of non-parametric Bayesian models. However, there exists very sparse literature on the incorporation in deep learning based techniques. By their nature, non-parametric Bayesian methods can be used to impart greater generalization capacity to a learning system. This makes it of great interest to develop and work out methods to incorporate Bayesian non-parametric approaches into mainstream weakly supervised techniques.

   These learning methods are grouped together under the umbrella title of weakly supervised learning, a term indicating learning from incomplete or inexact annotations. Manual annotation in the field of pedestrian detection and tracking requires the identity and bounding box annotations localizing every pedestrian in a dataset. This is a time-consuming and costly process, which is prone to many challenges such as inter-annotator variance. Compared to bounding box annotations, collecting information about is much easier and faster. Research in weakly supervised learning based detection and tracking systems has the capacity to make better and faster utilization of the wealth of image and video data available today. By eliminating the need for exact manually annotated bounding boxes, it removes a basic bottleneck in the machine learning pipeline. Considering the expected widespread applicability of surveillance applications, a weakly supervised learning system makes adjustments to previously trained systems to new environments (a process called fine-tuning in deep learning literature) easier and faster.

Compétences

1. Strong programming skills in Python and in using one of the deep learning libraries like PyTorch or TensorFlow.
2. Experience in C/C++ and CUDA programming is highly preferred.
3. Experience with Linux scripting and large scale computations will be an added plus.

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération
Gross Salary: 2653 € per month