Out-of-Distribution Monitoring for Object Detection

Keywords: Machine Learning, Object Detection, Out-of-Distribution

Institution

The French Alternative Energies and Atomic Energy Commission (CEA) is a key player in research, development, and innovation. Drawing on the widely acknowledged expertise gained by its 16,000 staff spanned over 9 research centers with a budget of 4.1 billion Euros, CEA actively participates in more than 400 European collaborative projects with numerous academic (notably as a member of Paris-Saclay University) and industrial partners. Within the CEA Technological Research Division, the CEA List institute addresses the challenges coming from smart digital systems.

Among other activities, CEA List's Software Safety and Security Laboratory (LSL) research teams design and implement automated analysis in order to make software systems more trustworthy, to exhaustively detect their vulnerabilities, to guarantee conformity to their specifications, and to accelerate their certification. Recently the field of activity of the laboratory has been extended to artificial intelligence safety and security verification.

Scientific context

Perceptive programs are to become more pervasive in a vast amount of fields, among those being healthcare, autonomous transportation or legal assistance. Trusting those programs as they will operate on multiple aspects of our lives is thus paramount, both for public acceptance and an easier development process. Trust is however a multi-faceted notion: one of those facet being the ability to monitor the performance of the neural network when facing unknown data.

There is a rich field on anomaly detection, using for instance the output of the neural network (Hendrycks and Gimpel 2017), emulating the Bayesian prediction framework (Gal and Ghahramani 2016), or retraining the neural network to increase its awareness of outliers (Lee et al. 2018).

We developed a method to detect Out-of-Distribution samples for classification (Xu-Darme et al. 2022). We would like to investigate its applicability on object detection use cases. This setting is notably more complex than image classification, as it require a much finer classification ability, and involves intricate pipelines.

The notion of confidence score is also to be questioned, as object detection systems tend to often include temporal reasoning.

Internship goal

The internship goal is to assess the applicability of Out-of-Distribution metrics on the field of object detection.

This internship can be described by the following goals:

- familiarization with the state-of-the-art on object detection and out-of-distribution metrics
- benchmarking a selection of existing metrics on object detection public use cases
- propose enhancements of those metrics for object detection
- demonstrate the validity of such enhancements

Qualifications

The candidate will work at the crossroads of formal verification and artificial intelligence. As it is not realistic to be expert in both fields, we encourage candidates that do not meet the full qualification requirements to apply nonetheless.

- **Minimal**
    - Master student or equivalent (2nd/3rd engineering school year) in computer science
    - ability to work in a team, some knowledge of version control

- **Preferred**
  - notions of AI and neural networks (PyTorch, Tensorflow, Keras)
  - familiarity of object detection and image classification

Characteristics

The candidate will be monitored by two research engineers of the team.

- **Duration:** 5 to 6 months from early 2023

- **Location:** CEA Nano-INNOV, Paris-Saclay Campus, France

- **Compensation:**
  - €700 to €1300 monthly stipend (determined by CEA compensation grids)
  - maximum €229 housing and travel expense monthly allowance (in case a relocation is needed)
  - CEA buses in Paris region and 75% refund of transit pass
  - subsidized lunches
  - 3 days of remote work with daily bonus

Application

If you are interested in this internship, please send to the contact persons an application containing:

- your resume;
- a cover letter indicating how your curriculum and experience match the qualifications expected and how you would plan to contribute to the project;
- your bachelor and master 1 transcripts;
- the contact details of two persons (at least one academic) who can be contacted to provide references.

Applications are welcomed until the position is filled. Please note that the administrative processing may take up to 3 months.

Contact persons

For further information or details about the internship before applying, please contact:

- Julien Girard-Satabin (julien.girard2@cea.fr) (also available on LinkedIn)
- Zakaria Chihani (zakaria.chihani@cea.fr)

Bibliography

Gal, Yarin, and Zoubin Ghahramani. 2016. "Dropout as a Bayesian Approximation: Representing Model Uncertainty in Deep Learning." In *International Conference on Machine Learning*, 1050–59. PMLR.

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Lee, Kimin, Honglak Lee, Kibok Lee, and Jinwoo Shin. 2018. "Training Confidence-Calibrated Classifiers for Detecting Out-of-Distribution Samples." In *International Conference on Learning Representations*.

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