Internship:

Explaining Deep Learning by use of Sensitivity Analysis in Supercomputers

Requirement: Last year Master's student or engineering degree (for France)
Location: Grenoble, but most probably part or all the intership will be performed remotely due to coronavirus restrictions.
Hosting Team: DataMove (INRIA Grenoble): https://team.inria.fr/datamove
Contact: Bruno RAFFIN (bruno.raffin@inria.fr) and Alejandro RIBES (alejandro.ribes@edf.fr)
Period: Flexible starting date (2021)
Prefered duration: 6 months (flexible – 4 months minimum)
Income: Gratification de stage (about 500 euros/month)

Context

INRIA and EDF R&D have an on-going collaboration on high-performance computing and data analytics. In this context, the Melissa open-source software (https://melissa-sa.github.io/) is being developed. Melissa manages large ensembles of parallel simulations and aggregates their data on-line in a parallel server. Melissa stands out by its flexibility, efficiency and resilience. Melissa enabled to run tens of thousands of simulations on up to 30 000 cores. Melissa has been used for computing statistics and train deep surrogate models.

On the other side, Deep neural network (DNN) is currently an indispensable machine learning tool that is increasingly used in industrial environments, such as the ones existing at EDF group. Yet, due to its black-box nature, it is inherently difficult to understand which aspects of the input data drive the decisions of the network. These problems become even more acute for industrial systems where non-controlled automated decisions can lead to disastrous consequences. Thus, validation, verification, and explainability methods are being researched for industrial applications of DNNs.

Objectives

Ensemble-based workflows are becoming common on supercomputers. They consist of executing the same application several times (up to millions) with different input parameters, the results being analyzed through statistical tools for different kinds of applications. In this intership, we will concentrate on sensibility analysis and hyperparameter tuning for Neural Networks. Because we expect Melissa to be a sound base for a DNN validation, verification and explainability; the intern will :

- Adapt Melissa to the analysis of already-trained DNNs.
- Execute several use cases on supercomputers.
- Analyse the obtained data for these use cases and propose a sound methodology for validation, verification, and explainability.

The intern will also perform bibliographical work about DNNs explainability and could be part of a future publication (depending on her/his contribution). The intern will have acces to one or several supercomputers in the top 500 (https://www.top500.org/) of the world for running experiments (corporate clusters of EDF, Chronos or Gaia, or converged CPU/GPU GENCI Jean-Zay supercomputer).

Through this intership the student will get experience at the cross-road between supercomputing, deep learning and statistics.

References:

- **Melissa: Large Scale In Transit Sensitivity Analysis Avoiding Intermediate Files. Terraz, Théophile and Ribes, Alejandro and Fournier, Yvan and Iooss, Bertrand and Raffin, Bruno. Supercomputing 2017.** https://hal.inria.fr/hal-01607479/
- **A Review of Uncertainty Quantification in Deep Learning: Techniques, Applications and Challenges.** Moloud Abdar and Farhad Pourpanah and Sadiq Hussain and Dana Rezazadegan and Li Liu and Mohammad Ghavamzadeh and Paul Fieguth and Xiaochun Cao and Abbas Khosravi and U Rajendra Acharya and Vladimir Makarenkov and Saeid Nahavandi. Jan 2021. https://arxiv.org/abs/2011.06225