Contexte et atouts du poste

Reservoir computing is an established method that was shown to outperform other methods on difficult tasks (such as chaotic time series prediction) and has been used in a variety of domains since [4]. However, despite its low computational cost and the need for less training data compared to LSTM: [2] it is currently underutilized due to current deep learning trend. However, a new python library called ReservoirPy [1] was recently developed, which enables to easily develop complex models [6] and already implement several advanced features from the literature.

This position takes place into a collaborative PHDS Bordeaux Network of teams working in statistical, machine learning and health data. The engineer is expected to work on a subset of the five research topics of the network:
- Translate complex, noisy, incomplete and high dimensional observations into mechanistic models
- Develop causal inference techniques for the complex dynamic settings encountered in epidemiological cohorts
- Improve individual predictions of health outcomes using statistical modelling and learning
- Unravel complex data structures using clustering methods
- Develop machine learning techniques for complex health data

ReservoirPy is a simple user-friendly library based on Python scientific modules. It provides a flexible interface to implement efficient Reservoir Computing (RC) [4] architectures with a particular focus on Echo State Networks (ESN) [5]. Advanced features of ReservoirPy allow to improve computation time efficiency on a simple laptop compared to basic Python implementation. Some of its features are: offline and online training, parallel implementation, sparse matrix computation, fast spectral initialization, advanced learning rules (e.g. Intrinsic Plasticity) etc. It also makes possible to easily create complex architectures with multiple reservoirs (e.g. deep reservoirs), readouts, and complex feedback loops. Moreover, graphical tools are included to easily explore hyperparameters with the help of the hyperopt library. It includes several tutorials exploring exotic architectures and examples of scientific papers reproduction.

Mission confiée

The engineer will be working on various health data projects of the PHDS network using the Reservoir Computing framework through the ReservoirPy library developed in the team. The first weeks will be dedicated to take charge of the ReservoirPy library and the tutorials of ReservoirPy. Then the recruited engineer will work on the various projects in parallel. She/he will also extend ReservoirPy library depending on the needs of the projects and maintain the library.

We have been extensively developing ReservoirPy during the past 2 years. The library is now mature and to be used in complex scenarios with the high flexibility provided by the library. The recruited engineer will be required to maintain the library by answering issues on the Github repository, continue to enhance the current documentation, tests, etc. She/he will also be developing new features of the library, such as the ones needed for the projects on health data.

This job is highly collaborative: it will happen within the PHDS Bordeaux Network, involving engineers and researchers of Bordeaux area. The hired engineer is expected to travel to French or foreign events to presents the results and present the ReservoirPy library.

Principales activités

Prepare, clean, analyse, report on data of the various health data projects of the PHDS network. Reporting of advances and problems. Weekly synthetic reporting.

Continue the implementation of the development infrastructure (Travis, Coverage, ReadTheDocs)
- Development + testing + documentation
- Improvement of the hyper-parameter search tool for specific health applications
- Optimization of some calculation
- Identification of "low-performance" parameter regions
- Implementation of examples from the literature
- Implementation of optimization methods from the literature
- Writing of scientific articles in English (conferences and journal papers)
- Management of external pull-requests + correction of possible bugs found by the community
Compétences
Have an engineering degree and/or a PhD in digital sciences (computer science, automation, signal processing).
Have a first professional experience or internship (6 months to 3 years) in software development.

SOFTWARE ENGINEERING
Have skills in software development:
- Proficient in several of the following programming languages: Python and associated scientific libraries (Numpy, Scipy, Matplotlib);
- Know how to implement the methods and tools underlying version management (Git,...), continuous integration and test-driven development in an agile context.

SCIENTIFIC
Knowledge in:
- artificial neural networks
- artificial learning and their mathematical foundations (and in general, a good foundation in mathematics)
- knowledge and experience in the field of “Reservoir computing” is a plus

GENERAL
- Ability to work in a multidisciplinary team;
- Ability to adapt to the project context;
- Know how to establish a relationship of trust with his interlocutors;
- Be autonomous in personal organization and reporting;
- Good written and oral communication skills in French;
- Mastery of technical and scientific English.

Avantages
- Subsidized meals
- Partial reimbursement of public transport costs
- Possibility of partial teleworking 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

Politique de recrutement:
Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

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