Inria Chair of Junior Professor

Supporting institution / organization
Head of the institution / organization: Bruno Sportisse
Site concerned: Centre Inria de Sorbonne Université
Academic Region: Paris

Partner institution organization
Sorbonne Université

Project name
Machine learning et evolution equations

Acronym
MEGAVOLT (MachinE learning et équAtions d'éVOLuTion)

Thématique scientifique
Statistical learning, Machine learning, Evolution equations

Mots-clés
Statistical learning, machine learning, differential equations, mathematical modeling

Target duration
3 to 6 years

Profile required
A PhD or equivalent is mandatory to apply. A successful postdoc experience of 3+ years is expected to benefit from the possibility to become a senior permanent researcher within a 3-to-6-year time after hiring.

Financial overview
200,000€ for the duration of the project financed by ANR and which may be supplemented by Inria via incentive resources.

Section(s) CNU/CoNRS
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Context
As stated in Inria's 2019-2023 COP, in order to retrospectively demonstrate major contributions in a few scientific priorities, Inria has made choices and considers the theme of "Responsible AI", which covers a set of scientific themes on the mastery of algorithms and data processing chains, as a priority. Inria must promote the renewal of scientific themes and the emergence of new disciplines with a key role of digital technology as a lever for inter-disciplinarity. Inria wishes to establish a new joint project team in Paris, with the core focus on the major challenge of developing interactions between statistical learning based on the exploitation of large amounts of data and the modeling of complex phenomena from mathematical models. Having large amounts of data available should allow for the enrichment and improvement of models, thereby reducing the cost of simulations. Reflexively, and this is also a crucial issue, modeling from fine evolution equations enables a better understanding of the behavior of deep neural networks (often "black boxes") on temporal dynamics.

In this context, the Inria center at Sorbonne University wishes to co-build a joint project team. Both SCAI (Sorbonne Center for Artificial Intelligence), the LJLL (Jacques-Louis Lions Laboratory) and the LPSM (Laboratory of Probability, Statistics and Modeling) are enthusiastic about this possibility of launching teams at the frontier of disciplines. This creation reinforces the actions taken by SU. Indeed, SCAI is promoting a trans-disciplinary teaching program of "Minor in AI and Data Science" from the start of the academic year 2023. This option fully relies on the pedagogical structure of "Minor" at SU, which allows students to obtain a degree in a major discipline while developing solid foundations in a minor discipline on complementary or related themes. The IA and Data Science minor is accessible to all students enrolled in the Faculty of Science and Engineering.

The recruitment of an INRIA junior professor chair complements the planned recruitments within this new research project team and strengthens the creation of an "IA and Data Science minor". This recruitment will also allow the creation of a hub with a critical mass, capable of conducting cutting-edge research, with a strong synergy between statistical learning and mathematical modeling.

Summary of the scientific project
The scientific project is organized around the following axes:

- Developing a substantial research effort to understand and exploit the interface between two systems: statistical learning and machine learning on one hand, and mathematical modeling of complex phenomena typically realized from ordinary differential equations and partial differential equations on the other.
- Defining the framework for numerical solution of PDEs. The theme of machine learning in the context of partial differential equation solving methods for modeling physical systems for applied sciences and high technology is gradually emerging as a new field of research, enabling new techniques to advance difficult problems of nonlinear approximations. The objective is to complement existing methods by targeting specific goals.

The application domains are very diverse. However, in accordance with SCAI's scientific strategy and Inria's strategic objectives – which promote scientific risk-taking, particularly through responding to major interdisciplinary societal challenges – the field of climate and geophysics will be prioritized. The field of climate modeling presents numerous challenges in the areas of modeling and data processing, constituting a high-priority field of study with strong societal implications. Examples include discovering dynamics from data with the challenge of determining to what extent we could learn at least partially the shape of phenomena corresponding to observations, constructing hybrid systems combining physical knowledge and statistical modalities, or learning physically interpretable statistical models taking into account physically interpretable constraints.

Summary of the teaching project
The junior professor will significantly contribute to the pedagogical initiatives launched and supported by SCAI within the framework of the national strategy in Artificial Intelligence and the France 2030 program, both through the trans-disciplinary program of "minor in AI and Data Science" and through continuing education programs.

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The junior professor will carry out a mission as a teacher-researcher in the field of data science, optimization, statistics, and artificial intelligence (AI). He or she will be assigned to the Mathematics Department or the Engineering Department of the Faculty of Science and Engineering at Sorbonne University.

The holder of the position will be responsible for teaching undergraduate and graduate students. He or she may teach in one or more of the following programs:
- Research workshops on data science in L1
- Data Science and AI tracks in Mathematics and Computer Science Bachelor's programs
- "AI and Data Science" minor offered in L2 and L3 to students in Chemistry, Mechanics, Physics, Earth Sciences, and Life Sciences programs
- Optimization, statistics, and AI courses offered in Sorbonne University's Master's programs.

In addition to teaching, the holder of the position will participate with other teacher-researchers in the relevant disciplines in the pedagogical design of courses in the field of data science, optimization, statistics, and AI at Sorbonne University, and in the reflection on their evolution. He or she will have the opportunity to get involved and participate in continuing education programs offered by the Faculty of Science and Engineering at Sorbonne University in these different fields.

Skills
- Scientific excellence
- Supervision/management skills
- Teaching skills
- Participation in the scientific direction of the project
- Project management and fundraising abilities