Offre n°2024-07458

Post-Doctoral Research Visit F/M [Campagne post-doctorants] - Multi-Agent Reinforcement Learning for Mean-Field Games and Systemic Risk

Le descriptif de l'offre ci-dessous est en Anglais

Type de contrat : CDD

Contrat renouvelable : Oui

Niveau de diplôme exigé : Thèse ou équivalent

Autre diplôme apprécié : PhD thesis

Fonction : Post-Doctorant

Contexte et atouts du poste

This Postdoctoral Research Fellowship position is proposed by the Mathrisk INRIA Research team, https://team.inria.fr/mathrisk/en/, which is common with INRIA, the Ecole Nationale des Ponts et Chaussées and the University Gustave Eiffel.

The Mathrisk team addresses broad research topics in the area of mathematical handling of risk, embracing risk measurement and risk management, modeling and optimization in quantitative finance and other related domains where risk control is paramount.

It also develops a numerical platform for quantitative finance (http://www.premia.fr), supported by a consortium of financial institutions.

Mathematical expertise of the team includes stochastic modeling, stochastic analysis, in particular stochastic (partial) differential equations and various aspects of stochastic control and optimal stopping of these equations, stochastic optimization, dynamic game theory, random graphs, martingale optimal transport and numerical probability. In recent years, systemic risk has emerged as a major focus of research. Unlike traditional risk management approaches that primarily consider risks faced by individual institutions, the emphasis now lies on modeling the intricate interrelationships among institutions and the mechanisms of distress propagation across them. Leveraging a multi-agent reinforcement learning (MARL) approach enables a more detailed examination of systemic risk within financial networks. As evidenced by past crises, effective tools for monitoring stability in large and complex financial systems must accurately account for the diverse interconnections within these systems. In this context, our research proposal builds upon our previous findings on systemic risk using a random graph approach, integrating mean-field games and reinforcement learning strategies. This integration enhances both the depth and precision of our analyses within a dynamic financial network framework.

Academic Partnership : Hamed Amini, Associate Professor, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, USA, email: aminil@ufl.edu

Travel expenses are covered within the limits of the scale in force.

Mission confiée

Assignments

The objective of this project is to develop data-driven stochastic network models for quantifying systemic risk in financial systems using Multi-Agent Reinforcement Learning (MARL) techniques and Mean-Field Games (MFGs). While systemic risk analysis has seen a surge in interest post-crisis, existing models often lack the ability to capture the heterogeneity, variety of contagion channels, and dynamics of financial networks. By integrating MARL and MFGs, we aim to address these limitations and derive forward-looking systemic risk measurement tools that can adapt and learn from continuous changes in financial networks. Through this approach, we seek to provide a more accurate and insightful understanding of potential future crises while identifying key factors contributing to systemic risk.

References:

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- Amini, Z. Cao, A. Minca, and A. Sulem. Ruin probabilities for risk processes in stochastic networks. arXiv:2302.06668, 2023.
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- Amini, Z. Cao, and A. Sulem. Stochastic Graphon Games with Jumps and Approximate Nash Equilibria. SSRN: 4412999, 2023.
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- Bayraktar, S. Chakraborty, and R. Wu. Graphon mean field systems. The Annals of Applied Probability, 33(5), pp.3587-3619, 2023.
- Borgs, J. T. Chayes, L. Lovasz, V. T. Sos, and K. Vesztergombi. Convergent sequences of dense graphs i: Subgraph frequencies, metric properties and testing. Advances in Mathematics, 219(6):1801–1851, 2008.
- Borgs, J. T. Chayes, L. Lovasz, V. T. Sos, and K. Vesztergombi. Convergent sequences of dense graphs ii. multiway cuts and statistical physics. Annals of Mathematics, pages 151–219, 2012.
- E. Caines and M. Huang. Graphon mean field games and their equations. SIAM Journal on Control and Optimization, 59(6):4373–4399, 2021.
- Carmona, D. B. Cooney, C. V. Graves, and M. Lauriere. Stochastic graphon games: I. the static case. Mathematics of Operations Research, 47(1):750–778, 2022.
- Carmona, J.-P. Fouque, and L.-H. Sun. Mean field games and systemic risk, http://arxiv.org/abs/1308.2172, 2013.
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- Garnier, G.Papanicolaou, and T.W.Yang. Large deviations for a mean field model of systemic risk, SIAM Journal on Financial Mathematics, 4(1):151--184, 2013.
- -M. Lasry and P.-L. Lions. Mean field games. Japanese Journal of Mathematics, 2:229--260, 2007.

Collaboration :
The recruited person will work in collaboration with Agnès Sulem, INRIA Paris, agnes.sulem@inria.fr and Hamed Amini, Associate Professor, Department of Industrial and Systems Engineering, University of Florida, Gainesville, FL, USA, email: aminil@ufl.edu

Principales activités

Main activities :

It is expected that the successful candidate will conduct novel research in the proposed topic and will be able to valorize it by writing articles and presenting the results in workshops and conferences. The postdoctoral fellow will also participate to the scientific life of the team, in particular by attendance to the seminars. He/she might visit Prof. Hamed Amini in University of Florida for collaboration.

Compétences

PhD in applied mathematics or Computer sciences.

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 and flexible organization of working hours (after 12 months of contract)
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training

Rémunération

According to civil service salary scales

Informations générales

- **Thème/Domaine :** Approches stochastiques
  Calcul Scientifique (BAP E)
- **Ville :** Paris
- **Centre Inria :** Centre Inria de Paris
- **Date de prise de fonction souhaitée :** 2024-10-01
- **Durée de contrat :** 1 an, 6 mois

- **Date limite pour postuler :** 2024-05-19

Contacts

- **Équipe Inria :** MATHRISK
- **Recruteur :**
  Bialobroda Sulem Agnes / Agnes.Bialobroda_Sulem@inria.fr

A propos d'Inria

Inria est l'institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 215 équipes-projets agiles, en général communes avec des partenaires académiques, impliquent plus de 3900 scientifiques pour relever les défis du numérique, souvent à l'interface d'autres disciplines. L'institut fait appel à de nombreux talents dans plus d'une quarantaine de métiers différents. 900 personnels d'appui à la recherche et à l'innovation contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde. Inria travaille avec de nombreuses entreprises et a accompagné la création de plus de 200 start-up. L'institut s'efforce ainsi de répondre aux enjeux de la transformation numérique de la science, de la société et de l'économie.

L'essentiel pour réussir

Skills required:

Specialists in stochastic analysis, reinforcement learning, random graph theory, numerical probability, financial mathematics, operations research, network analysis, game theory are welcome. In particular, skills in the domains of mean-field systems and games, Graphons, backward stochastic differential equations are welcome. Experience in financial modelling and machine learning for complex financial data is highly appreciated.

Consignes pour postuler

Application

The candidates must send a letter of motivation explaining how their scientific skills and profile match the research proposal. Their application should also include
* a CV
* the list of publications
* the thesis reports (if the thesis has been already defended)
* Candidates who have not yet defended their thesismust provide a letter from their PhD adviser certifying that the thesis is ready to be defended, giving a date of defense and the composition of the defense committee.
* Recommendation letters (at least a letter from the PhD adviser) they can be directed send to Agnes Sulem

Sécurité défense :
Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l'arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

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