Autonomous Adaptive Agents with Lightweight Deep Reinforcement Learning
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Ph.D. student position @ Hessian.AI - TU Darmstadt

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The newly founded LiteRL group, led by Dr. Carlo D'Eramo, within the context of the 3AI project of Hessian.AI, and in cooperation with the Intelligent Autonomous Systems Lab (IAS) at the Technical University of Darmstadt (TU Darmstadt), is seeking 1 Ph.D. student with a strong interest in one or more of the following research topics:

- Reinforcement Learning for decision-making;
- Lightweight methods for efficient deep Reinforcement Learning;
- Multi-task and transfer Reinforcement Learning for adaptive agents;
- Multi-agent Reinforcement Learning in collaborative and competitive scenarios.

The Ph.D. student will work on the highly interdisciplinary topic of Reinforcement Learning (RL), which burst since the recent coupling with deep learning methods (deep RL) and it is becoming pervasive in a wide range of research fields. Despite the recent extraordinary success, (deep) RL has crucial open problems of sample-efficiency and generalization that are hindering its applicability to realistic problems.
Our research will revolve around the problem of *how agents can efficiently acquire expert skills that account for the complexity of the real world*. We will investigate novel methods spanning several RL subfields. We will study multi-task and transfer learning for endowing agents with the ability to adapt across multiple tasks, and effectively react to previously unseen situations. Moreover, we will consider hierarchical and curriculum learning to enhance the autonomy of learning agents and curb the need for human expert supervision. Additionally, we will extend our analysis to multi-agent problems to obtain autonomous and adaptive group dynamics in collaborative and competitive scenarios. Our research will shed a light on the unexplored fundamental connections among the mentioned subfields and show that a concerted use of our methodological advances is of pivotal importance to foster the applicability of RL in realistic problems.

ABOUT THE APPLICANT
Ph.D. applicant need to have an M.Sc. degree (high grade required) in a relevant field (e.g., Computer Science/Engineering, Machine Learning, Math, and Statistics). Significant experience in working with *Python* and/or *C/C++*, and Machine Learning libraries (e.g., *Pytorch*/*Tensorflow*) is required. A track record of peer-reviewed publications and experience in writing scientific papers is a big plus, together with a strong interest or past experience in working with an interdisciplinary team.

THE POSITION
The positions are for a **36**-month contract. Payment will be according to the German TVL payment scheme, at the **E13 (100%)** level.

HOW TO APPLY?
All complete applications submitted through our online application system found at https://www.ias.informatik.tu-darmstadt.de/Jobs/Application will be considered.

The position is planned to start **as soon as possible**. Ph.D. applicant should provide a research statement, a PDF with his/her CV, degrees, grade sheets, and two references who are willing to write a recommendation letter. Please state clearly how your past experience relates to the topics in your research statement. Note that we heavily favor candidates with hands-on experience in implementing RL experiments and writing scientific papers or reports. Please ensure to include your date of availability for starting the Ph.D. position and, after submitting the application, send a quick notification with the subject line “Ph.D. student applicant for LiteRL” to Dr. Carlo D’Eramo (carlo.deramo@tu-darmstadt.de) and include your application number in the e-mail.

ABOUT LiteRL and IAS

The **LiteRL** group is a newly founded group researching lightweight Reinforcement Learning (RL) methods for obtaining autonomous adaptive agents, led by Dr. Carlo D’Eramo. LiteRL has been created as a DEPTH research group within the HMWK-funded cluster project "The Third Wave of Artificial Intelligence - 3AI" of Hessian.AI. Hessian.AI is the Hessian Centre for Artificial Intelligence, which has the mission of “understanding the interplay of AI algorithms, AI systems, and synergies between artificial and natural intelligence to provide the foundation for AI transformation”. The DEPTH program of 3AI serves to support postdocs with the career goal of becoming professors. The LiteRL group will have access to the work environment of TU Darmstadt and to the computational resources of Hessian.AI and TU Darmstadt, including the powerful Lichtenberg cluster.

Before being promoted to independent junior research group leader in the DEPTH program within 3AI, Dr. Carlo D’Eramo has been a postdoctoral researcher at the Intelligent Autonomous Systems group (IAS) in the Department of Computer Science at TU Darmstadt. During the years, he gained extensive experience in RL and provided key methodological advances in several related topics; moreover, he made important and well-recognized contributions to AI uncertainty quantification and exploitation, multi-task and curriculum RL, skill decomposition, residual learning, and planning. He is the developer of MushroomRL, a widely accepted RL library for simplifying the implementation of RL experiments. The work of Carlo D’Eramo has been broadly published in top ML and Robotics conferences, e.g., ICML, NeurIPS, AAAI, ICLR, ICRA, RSS, and journals, e.g., JMLR, Frontiers in Robotics and AI (Google Scholar).

The **Intelligent Autonomous Systems (IAS)** group of TU Darmstadt is considered one of the strongest robot learning groups in Europe with expertise ranging from the development of novel machine learning methods (e.g., novel Reinforcement Learning approaches, policy search, imitation learning, regression approaches, etc.) over semi-autonomy of intelligent systems (e.g., shared control, interaction primitives, human-collaboration during manufacturing) to fully autonomous robotics (e.g., robot learning architectures, motor skill representation acquisition & refinement, grasping, manipulation, tactile sensing, nonlinear control, operational space control, robot table tennis). IAS members are well-known researchers both in the machine learning and the robotics community. The lab collaborates with numerous universities in Germany, Europe, the USA, and Japan as well as companies such as ABB, Honda Research, Franka Emika, and Porsche Motorsport. The LiteRL and the IAS groups are located in the city center campus of TU Darmstadt close to the beautiful Herrngarten park.

ABOUT TU DARMSTADT

TU Darmstadt is one of Germany's top technical universities and is well known for its research and teaching. It was one of the first universities in the world to introduce electrical engineering programs, and it is Germany's first fully autonomous university.

ABOUT DARMSTADT

Darmstadt is a well-known high-tech center with essential activities in spacecraft operations (e.g., through the European Space Operations Centre, the European Organization for the Exploitation of Meteorological Satellites), chemistry, pharmacy, information technology, biotechnology, telecommunications, and mechatronics, and consistently ranked among the Top high-tech regions in Germany. Darmstadt's important centers for arts, music and theater allow for versatile cultural activities, while the proximity of the Odenwald forest and the Rhine valley allows for many outdoor sports. The 33,547 students of Darmstadt's three universities constitute a significant part of Darmstadt's 140,000 inhabitants. Darmstadt is located close to the center of Europe. With just 17 minutes driving distance to the Frankfurt airport (closer than Frankfurt itself), it is one of Europe's best-connected cities. Most major European cities can be reached within less than 2.5 hours from Darmstadt.