Post Specification

<table>
<thead>
<tr>
<th>Post Title:</th>
<th>PhD Researcher in numerical analysis and robustness for machine learning (2 Positions)</th>
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<tbody>
<tr>
<td>Post Status:</td>
<td>2 Specific Purpose Contracts. Full-time.</td>
</tr>
<tr>
<td>Research Group / Department / School:</td>
<td>School of Computer Science and Statistics, Trinity College Dublin, the University of Dublin</td>
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<tr>
<td>Location:</td>
<td>O’Reilly Institute</td>
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<td>Trinity College Dublin, the University of Dublin</td>
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<td>College Green, Dublin 2, Ireland</td>
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<td>Reports to:</td>
<td>Professor Andrea Patane</td>
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<tr>
<td>Salary:</td>
<td>Successful candidates will receive an attractive salary following the MSCA regulations for Doctoral Candidates. The salary includes a basic salary of €38,000/year, a mobility allowance (€600/month) and a family allowance (if the recruited doctoral candidate has or acquires family obligations during the duration of the fellowship). The exact salary will be confirmed upon appointment and is dependent on the candidate qualifications, experience and individual circumstances.</td>
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<tr>
<td>Closing Date:</td>
<td>17:00 (GMT), 6th November 2023</td>
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Post Summary

This post is for two PhD Researcher positions as part of the RELAX MSCA Doctoral Network project to work on two distinct projects led by Trinity College Dublin. RELAX includes includes 12 partnering institutions and a cohort of 12 PhD Researchers; the research network will
investigate cutting-edge topics in data analytics systems and data-intensive software systems to address the question of how relaxing the semantics of data analytics can enhance the capabilities of data analytics systems, both functionally and performance-wise. Successful candidate will be employed as a Researcher (for three years) and registered as a PhD student (typically a four-year duration) at Trinity College Dublin.

The first PhD project will focus on numeric accuracy and reproducibility in deep learning training and inference. Different versions of machine-learning hardware and software typically yield slightly different answers due to differences in floating point order of evaluation. The result is often poorer accuracy, or the same overall accuracy but different classifications between the two implementations, with unpredictable results. The goal of this project is to develop methods for trained models with sharper distinctions between classifications so that the model is more resilient to minor changes.

The second PhD project will focus on arithmetic and number systems for deep learning. Developing numeric types that match value distributions and operations of training better than existing default types. This project will identify number systems that make better use of limited encodings for both inference and training. It will also investigate domain-specific and application-specific number systems and encodings for improved compactness and customize the level of precision of data to the movement of the data within the parallel/distributed computing system.

Both PhD Researchers will be based in the School of Computer Science and Statistics at Trinity College Dublin, Ireland and supervised by Professor Andrea Patane. They will work closely with the other ten Doctoral Researchers hired on the RELAX project. Each PhD Researcher will also undertake a mobility secondment in industry to gain insight into the broader applications of their work on deep learning systems and to develop their industry networks. There will be opportunities for the PhD Researchers to present their work at national and international conferences.

**RELAX Project Description**

Many companies, across all industry sectors, are increasingly becoming data companies as they collect, curate, and analyse massive amounts of data to increase productivity and cost-effectiveness, or to develop new data-driven products and services. Within each application domain, the volume and rate of producing data increases over time, which has a knock-on impact on the power consumed by the data centres, devices and communication networks that drive data analytics. Consequently, the efficiency of data analytics is increasingly important: to scale analytics to increasingly larger and more complex data sets while maintaining low response times, but also to manage the computational requirements of analytics. Data analytics, however, operate in a complex software ecosystem combining a multitude of components to handle computation, storage, resource management, etc. Efficiency cannot be isolated in a single component, nor can it be delivered as a service. On the contrary, efficiency must permeate the system design. By consequence, data analytics systems need to be built as bespoke software systems that are optimised based on a thorough understanding of the full software stack. This requires developing an understanding of the domains where these systems would be used and embedding such understandings within the design of the software systems developed. The **RELAX Doctoral Network** will pursue a fundamentally new approach to this
problem by leveraging the semantics or correctness conditions of applications, with the goal of enhancing scalability, response times, and availability.

The RELAX Doctoral Network is funded by the European Union and is part of the Marie Skłodowska-Curie Actions – Doctoral Networks (MSCA-DN) programme. The network brings together 5 cross-disciplinary research groups working across data science, data management, distributed computing and computing systems and 7 industry partners, spanning 8 European countries (the Netherlands, France, Sweden, Germany, Denmark, Ireland, Greece, and the UK). RELAX offers a research platform and a training program for the Fellows to study the interplay and interdependencies between data, algorithmic semantics, application domain considerations and performance characteristics of computing systems. The Network will train a new generation of industry-conscious thinkers and leaders who will influence the design and operation of future data analytics systems and data-intensive software systems.

Funding Information

The RELAX Doctoral Network is funded by the European Union and is part of the Marie Skłodowska-Curie Actions – Doctoral Networks (MSCA-DN) programme.

Person Specification

Eligibility

Applicants need to fully respect three eligibility criteria:

● Supported researchers must be Doctoral Candidates (DC), i.e., not already in possession of a doctoral degree at the date of the recruitment. Researchers who have successfully defended their doctoral thesis but who have not yet formally been awarded the doctoral degree will not be considered eligible.

● Recruited researchers can be of any nationality and must undertake trans-national mobility (i.e., move from one country to another) when taking up the appointment. In particular, at the time of selection by the host organization, researchers must not have resided or carried out their main activity (work, studies, etc.) in the country of their host organization for more than 12 months in the 3 years immediately prior to their recruitment. Short stays, such as holidays, are not taken into account.

● Th candidates` ability to understand and express themselves in both written and spoken English should be sufficiently high for them to derive the full benefit from the network training.

Qualifications

● At least a 2.1 grade (or equivalent) in an undergraduate or postgraduate degree in Computer science, Applied Mathematics, Electrical Engineering or closely related discipline. An undergraduate degree is essential, and a Master’s degree is highly desirable.
Skills & Competencies

- Deep interest in big data analysis
- Basic programming skills in Python and C/C++ are expected, along with proficiency in at least one programming language
- Passionate about doing research and have or be willing to develop the skills to communicate this passion with other scientists and the general public.
- Have relevant skills and experiences, and a strong interest in both theoretical and applied science
- Welcome the opportunity to conduct research abroad and to work within an international and multidisciplinary team.
- Have excellent English speaking and writing skills.
- The Trinity College Dublin English language requirements for non-native speakers of English are available here: https://www.tcd.ie/study/apply/admission-requirements/postgraduate/

Additional Information

- Successful candidates will receive an attractive salary following the MSCA regulations for doctoral candidates. The salary includes a basic salary of €38,000/year, a mobility allowance (€600/month) and a family allowance (if the recruited doctoral candidate has or acquires family obligations during the duration of the fellowship). The exact salary will be confirmed upon appointment and is dependent on the candidate qualifications, experience and individual circumstances. The guaranteed PhD funding is for 36 months. Financial support will be available for year 4, however, such support would be at a lower level than years 1-3. Please note that the salary attached to this PhD Research position in years 1-3 is considerably higher than what PhD students are usually paid in Ireland.
- In addition to their individual scientific projects, all doctoral candidates will benefit from further training, which includes internships/secondments in relevant industry, a variety of training courses (including transferable skills), and active participation in workshops and conferences.

Application Procedure

Application process Please adhere to the following guidelines to apply for this position. Each application should consist of:

- A maximum 1-page cover letter outlining your suitability for the post, with reference to relevant qualifications or experience;
- Detailed curriculum vitae, including qualifications and experience, publications (if applicable) and the name and email contacts of two academic referees;
- Transcripts of degrees;
• A maximum 1-page statement outlining your research project experience to date (this can be related to undergraduate or postgraduate research projects and/or research work experience etc).

All four items above should be compiled into a **single pdf** document and be sent by email to Professor Andrea Patane at apatane@tcd.ie.

For the subject of your email, please use: RELAX-DN TCD application – [your surname] The deadline for applications is 6th November, 2023, 17:00 Irish time.

Do not include additional documents other than the one that has been requested. Do not include substantive information in the body of the email.

**Please note that applicants that do not follow these guidelines may not be considered for shortlisting.**

Informal queries can be emailed to Professor Andrea Patane apatane@tcd.ie

**Trinity College Dublin, the University of Dublin**

Trinity College Dublin, the University of Dublin is Ireland’s leading university, one of the top ranked universities in Europe and a member of the League of European Research Universities. It is currently ranked 98th in the QS World University Rankings 2023 and 91st Worldwide and QS Subject Rankings - Computer Science and Information Systems.

Located on an iconic campus in the heart of Dublin’s city centre, Trinity has 18,000 undergraduate and postgraduate students across our three faculties – Arts, Humanities, and Social Sciences; Engineering, Mathematics and Science; and Health Sciences. The pursuit of excellence through research and scholarship is at the heart of a Trinity education, and our researchers have an outstanding publication record and strong record of grant success. Trinity has developed **19 broad-based multidisciplinary research themes** that cut across disciplines and facilitate world-leading research and collaboration within the University and with colleagues around the world. Trinity is also home to 5 leading flagship research institutes:
- Trinity Biomedical Sciences Institute (TBSI)
- Trinity College Institute of Neuroscience (TCIN)
- Trinity Translational Medical Institute (TTMI)
- Trinity Long Room Hub Arts and Humanities Research Institute (TLRH)
- Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN)

**Equal Opportunities Policy**

The School of Computer Science and Statistics at Trinity College Dublin is a proud recipient of a Bronze Athena Swan award, attained in 2021. As part of the School's on-going actions in relation to equality, diversity and inclusion, it welcomes all applications that meet the eligibility and qualifications criteria and particularly those from under-represented groups.

Trinity is an equal opportunities employer and is committed to employment policies, procedures and practices which do not discriminate on grounds such as gender, civil status,
family status, age, disability, race, religious belief, sexual orientation or membership of the travelling community. On that basis we encourage and welcome talented people from all backgrounds to join our staff community. Trinity’s Diversity Statement can be viewed in full at https://www.tcd.ie/diversity-inclusion/diversity-statement.

Pension Entitlements

This is a pensionable position and the provisions of the Public Service Superannuation (Miscellaneous Provisions) Act 2004 will apply in relation to retirement age for pension purposes. Details of the relevant Pension Scheme will be provided to the successful applicant.

Applicants should note that they will be required to complete a Pre-Employment Declaration to confirm whether or not they have previously availed of an Irish Public Service Scheme of incentivised early retirement or enhanced redundancy payment. Applicants will also be required to declare any entitlements to a Public Service pension benefit (in payment or preserved) from any other Irish Public Service employment.

Applicants formerly employed by the Irish Public Service that may previously have availed of an Irish Public Service Scheme of Incentivised early retirement or enhanced redundancy payment should ensure that they are not precluded from re-engagement in the Irish Public Service under the terms of such Schemes. Such queries should be directed to an applicant’s former Irish Public Service Employer in the first instance.