The Alan Turing Institute

RESEARCH ASSOCIATE, AUTOMATED ANALYSIS OF STRATEGIC INTERACTIONS

A Research Associate, to work on the project "**Automated Analysis of Strategic Interactions**" within the **Game Theory and Collective Decision Making pillar** at the University of Liverpool, and the Alan Turing Institute.

BACKGROUND ON THE ALAN TURING INSTITUTE

There has never been a more significant time to work in data science and AI. There is recognition of the importance of these technologies to our economic and social future: the so-called fourth industrial revolution. The technical challenge of keeping our data secure and private has grown in its urgency and importance. At the same time, voices from academia, industry, and government are coming together to debate how these technologies should be governed and managed.

The Alan Turing Institute, as the UK's national institute for data science and artificial intelligence, plays an important part in driving forward advances in these technologies to change the world for the better.

The Institute is named in honour of Alan Turing, whose pioneering work in theoretical and applied mathematics, engineering and computing is considered to have laid the foundations for modern-day data science and artificial intelligence. The Institute's goals are to undertake world-class research, apply its research to real-world problems, driving economic impact and societal good, lead the training of a new generation of scientists, and shape the public conversation around data and algorithms.

After launching in 2015 with government funding from EPSRC and five founding universities, the Institute has grown an extensive network of university partners from across the UK and launched several major partnerships with industry, public and third sector. Today it is home to more than 500 researchers, a rapidly growing team of in-house research software engineers and data scientists and a business team.

GAME THEORY AND COLLECTIVE DECISION MAKING PILLAR

We are looking for a **Research Associate** to join the "Automated Analysis of Strategic Interactions" theme, which began in September 2023 within the Game Theory and Collective Decision Making Pillar. The current project team consists of directors Rahul Savani (University of Liverpool) and Theodore Turocy (University of East Anglia), and a research associate. For more information, see the project webpage at https://www.turing.ac.uk/research/research-projects/automated-analysis-strategic-interactions

AUTOMATED ANALYSIS OF STRATEGIC INTERACTIONS

Current AI increasingly considers that automated agents interact strategically with other agents, both automated and human. Game theory is a formal framework for reasoning about strategic interactions. To integrate game theory into AI reasoning and behaviour, a robust and standard framework for working with and analysing game models computationally is needed. The leading software package for working with models in game theory is Gambit.

Strand 1: Developing Gambit.

Heretofore Gambit has focused on games which are played only once and can be represented explicitly using a relatively small game tree or payoff table, and for computing Nash equilibria of these games. Building on this platform, we will develop a conceptual framework for expressing games, including games which are too large to represent explicitly, so that

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complex strategic interactions can be modelled with the assurance that the game model written down is the one intended by the user. We will extend Gambit to implement this model, which will make it suitable for supporting automated reasoning. We will incorporate recent developments in the algorithmic solution of games, including both exact and approximate equilibria, building upon and contributing to other cutting-edge libraries for scientific computing and mathematical programming. The computation of many solution concepts in games has been shown to be demanding, but experience also suggests the practical feasibility of computation depends on algorithm selection and details of the game. We will develop evidence for the selection of algorithms for various solution concepts. This strand will be mainly led by Ted Turocy at UEA.

Strand 2: Solving huge games.

When a game is too large to write down and reason about explicitly, one would only have access to the game via simulation of game play, which would consider only a small subset of the strategic plans possible. In this strand we will develop methods for analysing such games, e.g. via Multi-Agent Reinforcement Learning and query-based algorithms. In doing so we will make progress towards being able to do automated empirical analysis of games which incorporate the richness and complexity of strategic interactions in applications, while staying within the bounds of what is computationally feasible on the timescales required for automated agents. This strand will be mainly led by Rahul Savani at the University of Liverpool.

Strand 3: Case studies.

We will demonstrate the applicability of our developments in strands 1 and 2 through a selection of case studies. These case studies will be drawn from applications in computing science, economics, and/or related fields. These could include (but are not necessarily limited to): auctions and competitive bidding, automated pricing in online platforms, defence and security games such as patrolling and cyber defence, health applications, sports modelling, and transportation systems. This strand is a collaboration among the investigators and the two research associates.

ROLE DESCRIPTION

The research associate will work together to support the PIs, Rahul Savani and Ted Turocy, with the delivery of the project. The research associate will be based either at the University of Liverpool (with Rahul Savani and another research associate) or at University of East Anglia (with Ted Turocy). The whole team meets frequently online, and the project includes support for reciprocal travel between the Liverpool and University of East Anglia. In addition, as an employee of the Alan Turing Institute (Turing), the research associate will have access to the Turing I offices in London, where we will hold periodic project and pillar meetings, and where they can interact with the wider Turing community.

All members of the project team make contributions to each of the three strands. The specific allocation of time to the three strands will vary depending on the skills and interests of the research associate, and emphasis on the various strands will evolve over time as the project progresses.

DUTIES AND AREAS OF RESPONSIBILITY

The duties of the research associates will include:

- Undertake research with other members of the project team.
- Keep on top of the state of the art in the relevant literatures, in particular at the intersection of Game Theory and AI
- Develop and implement new methods for representing, transforming, and analysing games
- Run computational experiments to analyse games and understand the efficacy of new and existing analysis methods

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- Develop the infrastructure to maintain and disseminate the Gambit package and documentation as part of the broader open-source scientific computing ecosystem.
- Contribute to writing academic research papers
- Disseminate our research output to the research community, e.g., by giving talks at international conferences in computing science and other relevant disciplines, and co-authoring articles for journals.
- Present, disseminate and explain our work at internal and external events hosted by the Turing.
- Contribute to the life of the Turing and support its community.

Please note that job descriptions cannot be exhaustive, and the post-holder may be required to undertake other duties, which are broadly in line with the above key responsibilities. This job description is written at a specific time and is subject to changes as the demands of the ATI and the role develop.

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PERSON SPECIFICATION		
Skills and Requirements Post holders will be expected to demonstrate the following	**Essential (E) Desirable (D)**	**Tested at application(A) Tested at interview(I)**
Education		
Research Associate level: PhD in Mathematics, Computer Science, Economics, or a closely related discipline.	**E**	**A**
Research Assistant level: Near completion (thesis submitted) of a PhD or equivalent level of professional qualification in Mathematics, Computer Science, Economics, or closely related discipline.	**E**	**A**
Knowledge and Experience		
A solid background in one or more of the following: game theory, equilibrium computation, (multi-agent) reinforcement learning.	**E**	**A&I**
Experience in design, development and implementation of research software tools and libraries, especially within the Python scientific computing ecosystem.	**E**	**A&I**
Experience with modern C++ (C++17 or later).	**D**	**A&I**
Experience with using current software engineering tools for managing and coordinating distributed projects, such as git and github for distributed version control, static code checkers, and similar tools.	**D**	**A&I**
Track record of the ability to initiate, develop and deliver high quality research aligned with the research strategy indicated by the PI and any industrial stakeholders and to publish in peer reviewed journals and conferences.	**E**	**A&I**
Track record of outstanding research and in delivering impact appropriate to career stage	**E**	**A**
Experience in publishing research papers, code libraries or technical reports and giving presentations or classes on technical subjects.	**E**	**A/I**
Ability to rapidly assimilate new computational and mathematical ideas and techniques on the job and apply them successfully.	**E**	**A/I**
Ability to create and promote a collegial and collaborative approach to interdisciplinary research activities.	**D**	**A/I**

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Communication		
Excellent writing skills and proven ability to communicate complex, specialist or conceptual information/research findings clearly and persuasively to diverse audiences, including the ability to explain technical concepts to technical and nontechnical audiences.	**E**	**A/I**
Ability to write research reports and papers in styles accessible to both academic and lay audiences.	**D**	**A/I**
Analysis and Research		
Ability to organise working time, take the initiative, and carry out research independently, under the guidance of the PI	**E**	**I**
Ability to use own judgement to analyse and solve problems	**E**	**I**
Liaison and Networking		
Experience of participation within an organisation or discipline-related network to share knowledge and information in order develop practice or help others learn	**D**	**A/I**
Initiative and Problem Solving		
Ability to lead one's own work, including planning and execution, and to prioritise work to meet deadlines	**E**	**A/I**
Other Requirements		
Commitment to EDI principles and to the Organisation values	**E**	**I**

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OUR VALUES

The Alan Turing Institute is committed to equality diversity and inclusion and to eliminating discrimination. All employees are expected to embrace, follow and promote our EDI Principles and Our Values.

APPLICATION PROCEDURE

If you are interested in this opportunity, please click the apply button below. You will need to register on the applicant portal and complete the application form including your CV and covering letter. If you have questions about the role or would like to apply using a different format, please contact us at recruitment@turing.ac.uk.

CLOSING DATE FOR APPLICATIONS: Sunday, 7th April 2024 at 23:59

TERMS AND CONDITIONS

This full-time post is offered on a 2-year fixed-term basis. The annual salary is £42,893 - £48,510 (depending on experience) plus excellent benefits, including flexible working and family friendly policies, https://www.turing.ac.uk/work-turing/why-work-turing/employee-benefits

Candidates who have not yet been officially awarded their PhD will be appointed as Research Assistant at a salary of £40,148 per annum.

EQUALITY, DIVERSITY AND INCLUSION

The Alan Turing Institute is committed to creating an environment where diversity is valued and everyone is treated fairly. In accordance with the Equality Act, we welcome applications from anyone who meets the specific criteria of the post regardless of age, disability, ethnicity, gender reassignment, marital or civil partnership status, pregnancy and maternity, religion or belief, sex and sexual orientation.

We are committed to making sure our recruitment process is accessible and inclusive. This includes making reasonable adjustments for candidates who have a disability or long-term condition. Please contact us at adjustments@turing.ac.uk to find out how we can assist you.

Please note all offers of employment are subject to continuous eligibility to work in the UK and satisfactory pre-employment security screening which includes a DBS Check.

Full details on the pre-employment screening process can be requested from HR@turing.ac.uk***.***