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EPSRC Fellowship
Peer Review

EPSRC Reference: EP/S00503X/1

Document Status: With Council

EPSRC Fellowship - Early Career

Applicant Details

Applicant	Dr Ohad Kammar	Organisation	University of Oxford

Title of Research Project

Type refinement through algebraic effects

Review Information

Response Due Date	07/05/2018	Reviewer Reference:	107757619

Quality

Primary criterion. Please comment on the degree of research excellence of the proposal, making reference to:
(1) The novelty, relationship to the context, and timeliness;
(2) The ambition, adventure, and transformative aspects identified;
(3) The appropriateness of the proposed methodology.
(For multi-disciplinary proposals please state which aspects of the proposal you feel qualified to assess)

The current international cycle of interest in AI is substantially driven by what is termed Big Data, that is statistical techniques deployed as machine learning for identifying relationships in huge data sets. Here, a profound open challenge lies in establishing formally that machine learning algorithms reliably do what they're supposed to do.

This proposal directly address this challenge through a programme to systematically explore synergies amongst the mature formal approaches of denotational and axiomatic semantics, and refinement types, in characterising, and indeed constructing, Baysian inference algorithms.

The proposal is extremely timely and strongly contextualised. While approaches based on combining these formalisms are well established for programming language design and analysis, deploying them in this context is novel and highly appropriate. Along the way, it is highly likely that there will be novel results in extending, applying and synergising the underlying theories.

There is considerable ambition in the reach of the project, and adventure in scaling from small experiments to industrial strength application. In the longer term, the project has transformative potential. In the short to medium term, advances are likely to be most relevant to academic and industrially facing research, as is entirely reasonable.

Importance

Secondary major criterion. Comment on the national importance of the research. How it:
(1) Contributes to/helps maintain the health of other disciplines, contributes to addressing key UK societal challenges and/or contributes to future UK economic success and development of emerging industry(s);
(2) Meets national needs by establishing/maintaining a unique world leading activity;
(3) Complements other UK research funded in the area, including any relationship to the EPSRC portfolio.

What is broadly termed AI is seen as a key technology for all societies and economies. The UK is world leading in this area, in particular in Big Data and machine learning which this proposal addresses. The UK is also world leading in theoretical Computer Science and its applications, especially to programming languages and software engineering: these are key to establishing robust, sustainable software that all information technologies depend on. Accordingly, the EPSRC portfolio is strongly invested in all of these areas, with significant and sustained world class activity across UK universities.

This proposal has the potential to lead and underpin emerging activity in formally characterised Big Data, which is likely to be of increasing social and economic significance. It is also highly likely that this proposal will reinforce and grow knowledge and expertise in the component areas. Overall, it will contribute to maintaining and growing UK leads.

Impact

Secondary criterion. Please comment on the pathway to impact identified for this work, particularly:
(1) How complete and realistic are the impacts identified for this work;
(2) The effectiveness of the activities identified to help realise these impacts, including the resources requested for this purpose;
(3) The relevance and appropriateness of any beneficiaries or collaborators.

This is primarily theoretical and experimental research. It is most unlikely that it will have direct impact beyond advancing the field, contributing to industry facing R&D, and the production of skilled personnel, all of which it promises to do in a highly effective manner. It would be better for the proposal to simply acknowledge this.

However, the impact summary in the proposal form is mostly vague waffle, and reads like a half-hearted attempt to tick RCUK/EPSRC Pathway to Impact boxes.

In contrast, the academic impact section in the case for support is lucid, detailed and well structured. The programme of academic dissemination through substantive workshops and schools is very well conceived. The internship programme with Infinite Monkeys is highly commendable: it would be welcome if some priority were given to supporting women interns to meet RCUK/EPSRC diversity aspirations. Resource requests here are entirely appropriate.

Again, however, the separate Pathways to Impact document amplifies academic impact but does not consider EPSRC/UKRC criteria beyond the people pipeline.

Collaborations are with well chosen, world leading experts, in both academia and industry, in well defined areas against project objectives.

Ability to Deliver

Secondary criterion. Please comment on the applicant's ability to deliver the proposed project, making reference to:
(1) Appropriateness of the track record of the applicant(s);
(2) Balance of skills of the project team, including academic partners.

The applicant is a highly promising researcher with a strong track record and who is on an upwards trajectory. He certainly

has the capability to deliver this programme. The named researchers, Dr Ahman and Dr Moss, are highly promising early career researchers whose skills strongly complement the applicant's and each other's. Together, they constitute a very strong team.

There are no other directly funded academic partners.

Research Vision

Secondary criterion. Comment on the overall research vision and how the fellowship would enable the applicant to achieve their career aspirations.

The applicant's research vision of elaborating and evaluating a unified formal basis for programming based machine learning is compelling. However, they say nothing about their wider aspirations. I assume that, were this proposal funded, they would be in a strong position to seek academic promotion in the medium term.

Leadership Potential

Secondary criterion. Given the applicant's declared current career stage, please comment on their potential (and the expected timescale) for them becoming an international research leader.

The applicant currently holds a Fellowship at an Oxford college, giving them considerable freedom to pursue research, of which they have taken fruitful advantage. Thus, I would expect that a sustained sequence of successful outcomes from this proposed Fellowship would earn them a high international profile in three to five years time.

Resources and Management

Secondary criterion. Please comment on the effectiveness of the proposed planning and management and on whether the requested resources are appropriate and have been fully justified. Please comment explicitly on any equipment requested, or the viability of the arrangements described to access equipment needed for this project, and particularly on any university or third party contribution.

Planning is strong. Inter-dependencies are clear. Risks and their mitigations are explicit.

However, the nature, timing and degree of external collaborator involvement beyond Infinite Monkeys is not specified.

Staffing, travel and dissemination resources are well justified.

The 3 laptops and 3 desktops should be provided by the host organisation.

The host organisation should meet recruitment costs. Second guessing Brexit and the possible need for visas is not appropriate: the host organisation should meet such costs should they arise.

The host college has generously offered to vire the applicant's current Fellowship to support a DPhil student. Infinite Monkeys are offering strong support for internships.

Proposal Assessment

Please comment on the extent to which this proposal meets each of the criteria laid out in the call document not already covered by your previous answers.

Nothing further to add.

Overall Assessment

Please summarise your view of this proposal

This is an excellent proposal that should be funded.

My judgement is that:

1) This proposal is scientifically or technically flawed

2) This proposal does not meet one or more of the assessment criteria

3) This proposal meets all assessment criteria but with clear weaknesses

4) This is a good proposal that meets all assessment criteria but with minor weaknesses

5) This is a strong proposal that broadly meets all assessment criteria

6) This is a very strong proposal that fully meets all assessment criteria

1	2	3	4	5	✔ 6

My confidence level in assessing this is:

Low	Medium	✔ High

Reviewer Expertise

Please indicate your areas of expertise that are relevant to your assessment. Take care not to reveal your identity to the applicant.

formal design, implementation and analysis of programming languages and software