Department	School of Computing
Supervisors	Simon Powers
Project Title	The evolution of institutions for large-scale cooperation

PROJECT DESCRIPTION

Understanding how large-scale human societies arose from small-scale ones and continue to function is a central challenge in science. It raises the question of how far the behavior of individuals in this major transition can ultimately be explained by individual self-interested motivations. Understanding how far human behavior in large-scale societies can be explained by self-interested motivations is crucial to improving our ability to engineer solutions to societal challenges, from climate change to genocides.

Recent work has drawn on game theory and social science to highlight the important role of institutions in promoting cooperation in large groups of unrelated individuals. Simply put, institutions are the rules of social interactions, e.g. what counts as cooperative or selfish behaviour, what is the penalty for not cooperating, how will this be enforced, etc.? These have been found to be present throughout the social and computational worlds, from farmers managing irrigation systems and fishing waters, through to rules regulating social behaviour on Wikipedia and Mincecraft servers. However, we are currently lacking clear theory about when self-interested individuals will create institutions that promote cooperation, and about how these institutions will evolve over time.

This project will use evolutionary game theory and agent-based modelling to develop models of institution formation that can be applied to the kinds of examples above. This will allow us to better understand how we can engineer cooperativerative behaviour in large-scale social systems, and hence how we can tackle some of the most pressing social problems the world is facing today.

Academic qualifications

A first degree (at least a 2.1) ideally in computer science, economics, or biology with a good fundamental knowledge of programming.

English language requirement

IELTS score must be at least 6.5 (with not less than 6.0 in each of the four components). Other, equivalent qualifications will be accepted. Full details of the University's policy are available online.

Essential attributes:

- Experience of fundamental techniques in computer science or mathematical modelling
- Competent in programming
- Knowledge of agent-based modelling, or artificial intelligence, or evolutionary theory, or game theory
- Good written and oral communication skills
- Strong motivation, with evidence of independent research skills relevant to the project
- Good time management

Desirable attributes:

Interest in interdisciplinary work, with enthusiasm for working at the interface of computing, evolutionary biology and social science.

Indicative Bibliography	Lehmann, L., Powers, S. T., & van Schaik, C. P. (2022). Four levers of

	reciprocity across human societies: concepts, analysis and predictions. *Evolutionary Human Sciences*, *4*, https://doi.org/10.1017/ehs.2022.7 Powers, S. T., van Schaik, C. P., & Lehmann, L. (2021). Cooperation in large-scale human societies — What, if anything, makes it unique, and how did it evolve?. *Evolutionary Anthropology*, *30(4)*, 280-293. https://doi.org/10.1002/evan.21909
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Web page	https://www.napier.ac.uk/research-and-innovation/research-degrees/application-process