Information and the Origin of Cognition:
Principled Routes towards Artificial Intelligence and Robotics

Shannon information is identified as a fundamental resource in cognition and in decision-making, from of molecular dynamics to animal brains, up to Artificial Intelligence systems. All these complex systems are driven by the need to organize information.

We investigate the fundamental principles along which these intelligent organizational processes take place, and how more powerful systems and capabilities can emerge and self-organize spontaneously through informational principles. We then ask how, in turn, these principles can be used to create and understand more capable and transparent AI and robotic systems.

We offer PhD studentships researching these topics. As a candidate, you are interested in discovering the principles behind the emergence and organization of cognition and its application to Artificial Intelligence and Robotics, typically based on information theory. Possible research questions include, but are by far not limited to:

- modeling cognitive structure

- extracting structural generalizations

- enabling robust decision making, minimal and flexible robotic control

- agents that "want": intrinsic motivations, especially, but not limited to *empowerment*

- unlocking the role of embodiment and informational ecology

- using above for concrete robotics applications

- models of biological or Artificial Life, including questions of of origin of life and cognition from first principles.

- links to physics and complex systems in general

You will have a very strong first degree; a keen interest and motivation to delve into and contribute to a fresh, stimulating and fast-moving research area at the boundaries of AI, robotics, biology, physics and psychology. An outstanding background in one of the following or a related field is essential: Computer Science, AI, Computational/Cognitive Robotics, Physics, Mathematics or any other relevant discipline with a considerable quantitative/computational component. In particular, you will demonstrate excellent programming skills in at least one major computer language. A mathematical/numerical background would be highly desirable. Knowledge in at least one of the following fields would be a strong plus: probability theory, Bayesian modeling, information theory, differential geometry, control, dynamical systems, statistical learning data modelling/neural network techniques.

The research will take place in the vibrant, enthusiastic and creative environment of the Adaptive Systems Research Group of the School of Physics, Engineering and Computer Science at the University of Hertfordshire; for interested candidates, there will also be the special opportunity to collaborate with the School's successful humanoid robot RoboCup team, the Bold Hearts, with additional actively funded projects and with research groups world-wide.

More information about the topics is available from:

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n.catenacci-volpi@herts.ac.uk
c.salge@herts.ac.uk
d.polani@herts.ac.uk
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