Information, Complex Systems and the Organization of Cognition:
Principled Routes towards Artificial Life, Artificial Intelligence and Robotics

Increasingly, information (in the sense of Shannon) is identified as a fundamental resource underlying all processes involved in decision-making, all the way from the level of molecular (e.g. protein) dynamics to the brain of higher animals, but also in computational systems implementing Artificial Intelligence. All these increasingly complex systems are driven by the need to organize information in the appropriate way.

We investigate the questions that emerge from this observation and ask what constitutes the fundamental principles according to which these organizational processes take place, how more complex systems and capabilities can emerge and self-organize seemingly spontaneously from simpler ones through informational principles, and how this can be utilized to ultimately create more intelligent and capable AI and robotic systems.

We invite applications for our PhD studentships to investigate these topics. You are interested in finding out the fundamentals behind the of emergence and self-organization of cognition and their applications to questions of Artificial Intelligence and Robotics in a principled way, typically based on information theory. This includes, but is not limited to, modeling how to arrange the cognitive structure how to enable robust decision making and flexible control how to discover and reflect the inherent structure of the world in your agent's "brain" understanding the role of embodiment how to create intrinsic and "altruistic" motivations and much more.

There is the opportunity for you to expand these questions into concrete robotics applications, including how to develop a more natural, robust and powerful robotic control algorithm, or alternatively towards biological and/or Artificial Life models, for instance contributing to better understanding the basis for the extraordinary success of organisms in a highly complex and seemingly unstructured environment. Here, there is also the opportunity to correspondingly explore fundamental questions of origin of life and cognition from first principles.

You should have a very strong first degree; a very keen interest and motivation in delving into and contributing to a fresh, stimulating and fast-moving research area. An outstanding background in one of the following or a related field is essential: Computer Science, Computational/Cognitive Robotics, Physics, Mathematics, Statistics or any other relevant discipline with a considerable quantitative/computational component. In particular, they should 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, information theory, differential geometry, control, dynamical systems, data modelling/neural network techniques.

The envisaged research will take place in the vibrant and enterprising environment of the SEPIA (Sensor Evolution, Processing, Information and Actuation) subunit of the Adaptive Systems Research Group in the School of 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 and with additional actively funded projects.

For interested candidates, more information about the topics is available from:

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