

Informational Principles in Artificial Intelligence and Artificial Life

We investigate principles underlying cognition and life, specifically in context of Artificial Intelligence and Artificial Life. For this purpose, we specifically focus on information theory as universal language of discourse. Amongst the questions studied are origin of life and cognition from first principles, emergence of complexity in nature, and constraints guiding information processing in adaptive, complex and self-organizing systems. Complementing this, our goal is to adapt such principles for more flexible and biologically plausible AI and robotic applications.

Our chief tools are mathematical methods with particular emphasis on Shannon's information theory which has proven to be an extremely powerful toolbox. A particularly striking example of the power of information theory is Deep Learning where very recent work by N. Tishby has shown how the Information Bottleneck can shed light on what goes on inside Deep Networks.

In the following we list a small selection of potential PhD research directions (not exclusive) :

- information and the organization of cognition
- self-organization of complex systems
- origin of life
- principled AI methods for autonomous robotics
- models for intrinsic motivation
- informational principles of biological computation

The prospective candidates should have a very strong first degree; a keen interest in delving into and contributing to a fresh and fast-moving research area; and an outstanding background in Computer Science, Physics, Mathematics, Statistics or another relevant computational/quantitative discipline. 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 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 Adaptive Systems Research Group in the School of Computer Science at the University of Hertfordshire; there will also be the opportunity to collaborate with the socSMCs (Socializing Sensorimotor Contingencies, FET Open) and link to the WiMUST (Widely Scalable Mobile Underwater Sonar Technology) EU Horizon 2020 project, and especially the School's successful humanoid robot RoboCup team, the Bold Hearts.

For more information about the field or relevant questions, feel free to contact:

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