

Information Theoretic Characterisation of Evolutionary Transitions

Evolutionary transitions, including the emergence of cells, eukaryotic cells, multicellularity and the Cambrian explosion, have attracted interest of bioscience and interdisciplinary communities (such as Artificial Life) since many decades. Numerous models of evolutionary transitions exist. Many of these are designed to capture specific transitions, or specific aspects of transitions. However, a widely accepted theoretical framework of evolutionary transitions in general is not available to date.

Information theory has provided avenues to study complex systems with a focus on fundamental principles. In the biosciences, information theoretic concepts are applied to measure diversity, to understand principles of transcription factor evolution, and in several areas of neuroinformatics. The Adaptive Systems Research Group (ASRG) has a track record of establishing and applying information theoretic methods, including empowerment and relevant information, in the study of biological systems and control dynamics.

This project will approach evolutionary transitions using information theory. Points of departure for this project include

- Characterising evolutionary dynamics before and after transitions.
- Identifying processes and features that are shared by several transitions, and that allow application of information theoretic measures.
- Review the literature of models of evolutionary transitions, and on that basis build a library of models.
- Exploring measures to characterise evolutionary dynamics on a spectrum, e.g. from smooth gradual progress to fundamental transitions.
- Investigating the effects of evolutionary transitions on key levels of biological organisation, such as the genomic, phenotypic and ecosystems levels.

Candidates with experience in computational modelling of evolution or other biological processes are especially encouraged to apply.

References

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