

**PROJECT TITLE:** Bio-inspired computer simulation for evolution and behaviour of living organisms.

**Project Supervisor:** Associate Professor Neil Vaughan, University of Exeter, Faculty of Health and Life Sciences (HLS), Department of Clinical and Biomedical Science.

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**Project keywords:** Bio-inspired computer based individual modelling.

**Proposed start date:** Monday 3rd June 2024.

**Project description:** The project will involve modelling organism behaviour and interactions between simulated groups or swarms of organisms or plants. (1) Behavioural ecology: The project can model behavioural strategies used by organisms in their natural environment to maximise fitness. Foraging, social and reproductive (including parental care, sexual selection and mate choice) behaviour. Behavioural responses to predators, communication, migration and homing. (2) Population ecology: Understanding of population dynamics, including trophic interactions. Demography of populations. Extinction processes. Spatial processes and metapopulation dynamics. (3) Community ecology: The structure, composition and dynamics of ecological assemblages. Relationship between species assemblages and their environments, trophic structure; succession, stability, biodiversity, coexistence and competitive exclusion, spatial structure and relative abundance of component species. (4) Evolutionary dynamics: Using computer based modelling to simulate evolution of organisms or plants to optimise the fitness within their natural environment. These models are known as multi-agent system (MAS), Individual-based models (IBM) (Figure 1.)

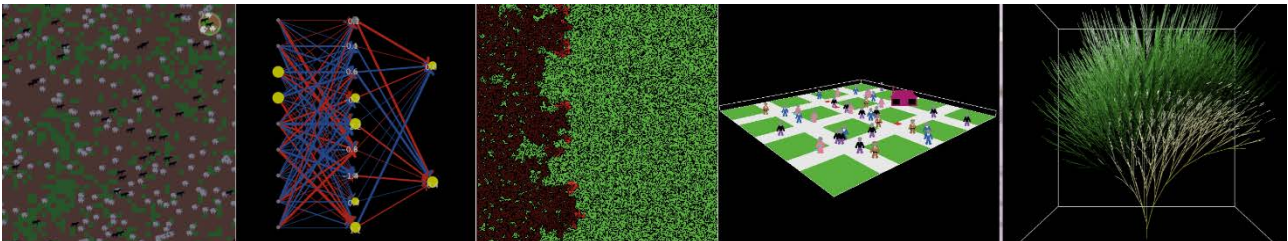


Fig. 1. Examples of simulating the interaction and evolution within groups of simulated organisms using multi agent systems individual-based behavioural modelling with computational simulations.

**Candidate requirements:** Student with some background experience with computer science, or data science, AI, machine learning, modelling or simulation.

**Approximate Work Schedule in weeks (desk based/lab/report writing):**

- Weeks 1-7 will be desk-based computer modelling research which will also involve working with data sets, research group meetings and networking.
- Week 8 will be final report writing week.

**Background reading:**

- [1] Vaughan N, (2018) Swarm Communication by Evolutionary Algorithms, In IEEE Evolving and Adaptive Intelligent Systems (EAIS), <https://ieeexplore.ieee.org/abstract/document/8397189>
- [2] Vaughan, N. (2018). "Evolution of Neural Networks for Physically Simulated Evolved Virtual Quadruped Creatures". Springer-Verlag, Lecture Notes in Artificial Intelligence, Living Machines, Conference on Biomimetic and Biohybrid Systems, [https://link.springer.com/chapter/10.1007/978-3-319-95972-6\\_54](https://link.springer.com/chapter/10.1007/978-3-319-95972-6_54)