**PROJECT TITLE:** Computational biology for simulated evolving plants and animal growth patterns.

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

**Project Enquiries:** n.vaughan@exeter.ac.uk

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

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

**Project description:** The project will involve virtual tree models to simulate growth of branches and tree structure using mathematical rules. This could also include modelling organism behaviour and interactions between simulated groups or swarms of organisms or plants. (a) Community ecology: The structure, composition and dynamics of trees growing close together under competition for sunlight. Relationship between species and their environments, trophic structure; succession, stability, biodiversity, coexistence and competitive exclusion, spatial structure and relative abundance of component species. (b) Population ecology: Understanding of population dynamics, including evolution of rules for modelling tree growth. Extinction processes and spatial competition. (c) Topological adaptations: The project can model structural changes in trees in response to nutrients and environmental stresses, competition for sunlight in their natural environment to maximise fitness. (d) Evolutionary dynamics: Using computer-based modelling to simulate evolution of trees and plants to optimise the fitness within their natural environment (Figure 1.)

Fig. 1. Examples of simulating tree and plant growth and virtual plants using mathematical rule-based generation systems in computer simulator models.

**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.
- Week 8 will be final report writing week.

**Background reading**


1. 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
2. Vaughan N, (2018) Swarm Communication by Evolutionary Algorithms, In IEEE Evolving and Adaptive Intelligent Systems (EAIS), https://ieeexplore.ieee.org/abstract/document/8397189