

Doctoral School of Information and Biomedical Technologies Polish Academy of Sciences

Subject

Modelling aquatic food webs with graph neural networks

Supervisor

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Institute, in which the topic will be conducted

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Scientific discipline Information and Communication Technology

Recruitment form Interview

Available positions 1 (one person)

Project description

Trophic relations between species form a food web [1]. It is the basis for studying the structure and dynamics of an ecosystem as well as its vulnerability to perturbations induced by factors such as excessive extraction or climate change. These results support both conservation practice and fishery management.

Mathematically, food webs are directed, weighted graphs with a distinctive hierarchical structure (primary producers, herbivores, carnivores) and cycling through dead organic matter (detritus). This project will use deep learning algorithms [2] to generate networks that have the characteristics of food webs. Next, metaheuristic optimization will ensure the desired structural properties [3]. Such graphs, known as null models, are commonly used for ecological modelling and improving their similarity to actual ecosystems would be a significant step forward.

Training and validation of the graph neural networks will utilize 250 empirical weighted food webs. This database is the largest in the world and is not yet publicly available. Its analysis is conducted together with scholars from Austria, Sweden, Japan and South Africa.

Bibliography

1. Ulanowicz, Robert E. Quantitative methods for ecological network analysis, *Computational Biology and Chemistry*, 28 (5–6), 321-339 (2004).
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3. Kazanci, C. & Ma, Q. Chapter 3 – System-wide measures in ecological network analysis. In Park, Y.-S., Lek, S., Baehr, C. & Jørgensen, S. E. (eds.) *Advanced Modelling Techniques Studying Global Changes in Environmental Sciences*, vol. 27 of Developments in Environmental Modelling, 45–68 (Elsevier, 2015).

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