Reinforcement learning for graphs and beyond

Dragan Stevanović

Mathematical Institute SANU, Kneza Mihaila 36, 11000 Belgrade, Serbia
e-mail: dragan_stevanovic@mi.sanu.ac.rs

Abstract. Adam Zsolt Wagner [1] showed how a particular reinforcement learning technique, the so-called cross entropy method, can be used to construct (counter)examples in graph theory. We have recently provided an improved implementation of this method [2] and in this lecture we will showcase how it can be used to construct counterexamples for a set of older conjectures on the Laplacian spectral radius of graphs [2], edge-colorings of complete graphs that lead to new lower bounds on Ramsey numbers [3], and, with a minor adaptation, also the shape of optimal window overhangs for residential homes [4].

Keywords: Reinforcement learning; Cross-entropy method; Graph theory; Building energy optimization.

References

[1] **A.Z. Wagner.** Constructions in combinatorics via neural networks. *arXiv:* 2104.14516 (2021).
[2] **M. Ghebleh, S. Al-Yakoob, A. Kanso, D. Stevanović.** Reinforcement learning for graph theory, I. Reimplementation of Wagner's approach. *arXiv:* 2403.18429 (2024).
[3] **M. Ghebleh, S. Al-Yakoob, A. Kanso, D. Stevanović.** Reinforcement learning for graph theory, II. Small Ramsey numbers. *arXiv:* 2403.20055 (2024).
[4] **H. Dashti, S. Stevanović, S. Al-Yakoob, D. Stevanović.** Reinforcement learning for building energy optimization. *Preprint.*