

國立陽明交通大學應用數學系

演講公告

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講題：Topological Alignment in Machine Learning: Structure
and Direction

時間：115 年 10 月 2 日(星期五) 下午 13:30–14:30

地點：(光復校區) 科學一館 307 室

Abstract

Machine learning often asks how two representations of the same data relate: an image encoder and a text encoder, a teacher and a student, or the observed signals of two coupled dynamical systems. Persistent homology offers a multiscale summary of such representations. The usual practice, however, is to match persistence diagrams with a symmetric distance, which leaves two questions open: what should align, and in which direction?

The first part of the talk asks what should align. The death edges of zero-dimensional persistent homology are exactly the edges of a minimum spanning tree, so topology records which samples are linked, not only when components merge. Using this identity, our recent work revisits the Platonic Representation Hypothesis across 204 vision–language model pairs. After calibration, the relational structure of representations converges at both local and global scales. Agreement on exact distances, by contrast, weakens quickly and loses its dependence on model capacity. The second part asks in which direction alignment runs. We introduce persistent cross entropy (PCE) that extends persistent entropy to pairs of diagrams. One diagram induces a probability on the points of the other, and an explicit event collects what it fails to explain. The excess over persistent entropy is a Kullback–Leibler divergence and is stable in the Wasserstein distance. We present several numerical examples that shows that PCE is directional and it recovers causal direction in dynamical systems without a joint attractor, and in a first distillation experiment it serves as a teacher-to-student topology loss.

敬請公告 歡迎參加

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