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Persistence diagrams via limit-to-colimit maps and Möbius inversions

The persistence diagram (equivalently barcode) has been one of the most prevalent objects in topological data analysis (TDA) as an object which summarizes features of a persistence module. With the goal of adapting the idea behind persistent homology to the study of wider types of data (e.g. time-varying point clouds), variants of the indexing set of persistence modules inevitably occur, leading for example to multiparameter persistence and zigzag persistence. However, it is not always evident how to define a notion of persistence diagram for such variants.

This talk will introduce a generalized notion of persistence diagram for many of such variants which arises through exploiting both the principle of inclusion-exclusion from combinatorics, and the notion of (co)limit from category theory. We describe how this resulting generalized persistence diagram subsumes some other well-known invariants of 2-parameter persistence modules and how it mediates between 2-parameter persistence and zigzag persistence. This talk is based on joint work with Nate Clause, Tamal Dey, Facundo Mémoli, and Samantha Moore.