# Towards a new approach to reveal dynamical organization of the brain using topological data analysis

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- They observe that the revealed individual differences in the dynamical organization of the subject were predictors of the task performace

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- Previously, this data has typically been used in models after some kind of "averaging" procedure
- The previous approaches have been unable to reveal the optimal temporal and spatial scales which best probe clinically and behearviorly relevant brain dynamics
- Additionally, they are unable to determine if the brain dynamics are best thought of as continuous or discrete or able to tell whether a particular brain activity is healthy or not

# Pipeline

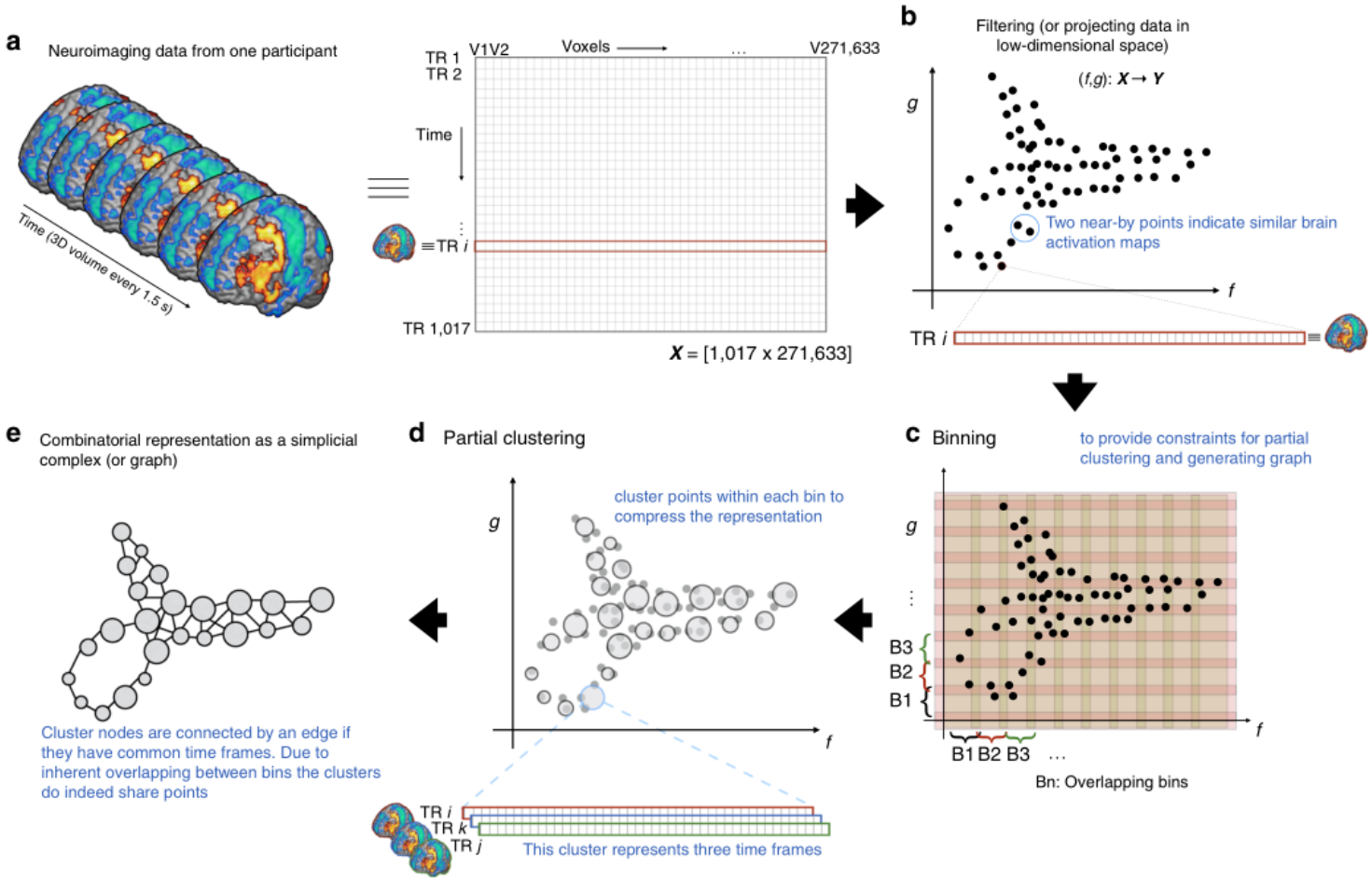


Figure: The method used to convert the 4-dimensional fMRI data into a simplicial complex. Steps b-e are a part of Mapper (the TDA-based algorithm/tool the authors used).

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- Step c is just binning the space using the provided parameters: number of bins and the percentage overlap between bins
- Step d goes through each bin, and performs single-linkage clustering in order to form clusters of nearby points
- Step e treats each cluster as a vertex of a graph and adds an edge between two vertices if they shared a point [3]

# Example

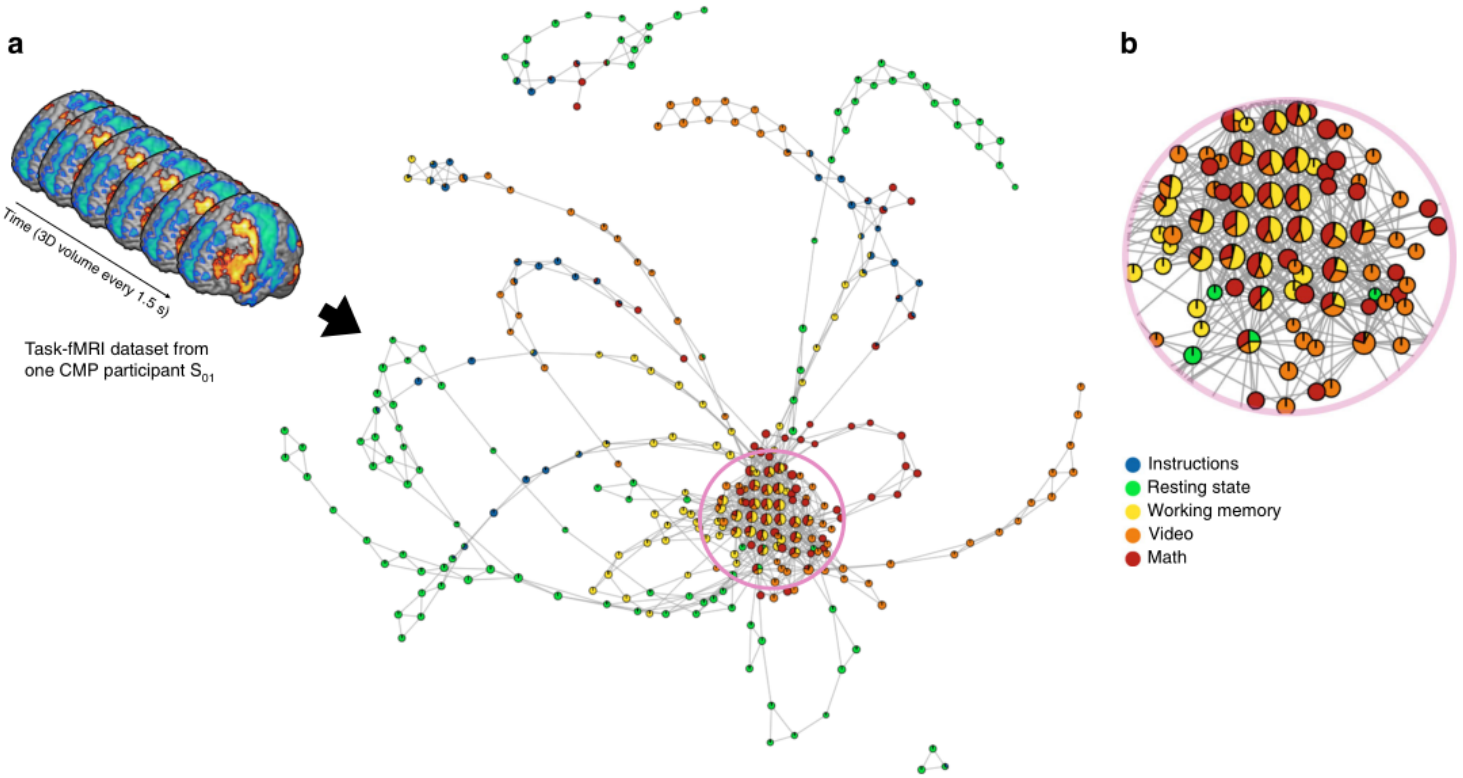


Figure: After running Mapper on an individual's fMRI data, we are left with a graph like the above.

# References I


[1] Saggar Manish et al. *Towards a new approach to reveal dynamical organization of the brain using topological data analysis*. 2018. URL: https://www.nature.com/articles/s41467-018-03664-4#citeas.

[2] Maria Giulia Preti, Thomas AW Bolton, and Dimitri Van De Ville. "The dynamic functional connectome: State-of-the-art and perspectives". In: *NeuroImage* 160 (2017). Functional Architecture of the Brain, pp. 41–54. ISSN: 1053-8119. DOI: https://doi.org/10.1016/j.neuroimage.2016.12.061. URL: https://www.sciencedirect.com/science/article/pii/S1053811916307881.

[3] Gurjeet Kaur Chatar Singh, Facundo Mémoli, and Gunnar E. Carlsson. "Topological Methods for the Analysis of High Dimensional Data Sets and 3D Object Recognition". In: (2007).

# The End