

Diverse and Representative Spanning Graphs

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Abstract

Spanning trees are fundamental structures in graph analysis and network design, yet conventional algorithms prioritise only edge weights or connectivity, often neglecting other structural attributes. In many real-world networks, edges carry additional labels – such as transport modes, communication channels, or data sources – that affect the interpretation and fairness of the network. We introduce DMST, a diversity-aware variant of Kruskal’s algorithm that jointly optimizes cost and diversity through a tunable parameter. To the best of our knowledge, this is the first MST algorithm to consider edge-diversity optimisation.

We evaluate the approach across synthetic graphs, as well as the London Transport Network dataset. Results demonstrate a clear and controllable trade-off: improving the edge-class balance within the spanning trees incurs an increase in total edge weight.

Our findings establish a principled framework for diversity-aware spanning tree construction, bridging classical graph optimization with fairness and representation objectives. This formulation opens new avenues for equitable network design, multi-modal transport planning, and diversity-regularised graph learning.

In this talk, we will also present extensions to DMST to work on t -spanners, to consider alternative definitions of representativeness, and include a robustness constraint to build a graph preserving the desired spanner condition (MST or t -spanner) even after removing any edge-class category (colour) from the spanning graph.