Depth-based Hypergraph Complexity Traces from Directed Line Graphs

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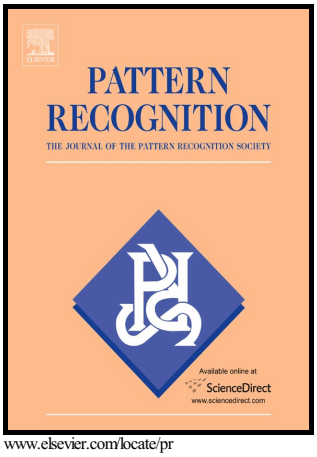

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Depth-based Hypergraph Complexity Traces from Directed Line Graphs

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Abstract

In this paper, we aim to characterize the structure of hypergraphs in terms of structural complexity measure. Measuring the complexity of a hypergraph in a straightforward way tends to be elusive since the hyperedges of a hypergraph may exhibit varying relational orders. We thus transform a hypergraph into a line graph which not only accurately reflects the multiple relationships exhibited by the hyperedges but is also easier to manipulate for complexity analysis. To locate the dominant substructure within a line graph, we identify a centroid vertex by computing the minimum variance of its shortest path lengths. A family of centroid expansion subgraphs of the line graph is then derived from the centroid vertex. We compute the depth-based complexity traces for the hypergraph by measuring either the directed or undirected entropies of its centroid expansion subgraphs. The resulting complexity traces provide a flexible framework that can be applied to both hypergraphs and graphs. We perform (hyper)graph classification in the principal component space of the complexity trace vectors. Experiments on (hyper)graph datasets abstracted from bioinformatics and computer vision data demonstrate the effectiveness and efficiency of the complexity traces.

Keywords: Hypergraphs, Directed Line Graphs, Entropies, Centroid Vertex, Depth-based Complexity Traces

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