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Depth-Based Complexity Traces of Graphs

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Abstract

In this paper we aim to characterize graphs in terms of a structural measure of complexity. Our idea is to decompose a graph into layered substructures of increasing size, and then to measure the information content of these substructures. To locate dominant substructures within a graph, we commence by identifying a centroid vertex which has the minimum shortest path length variance to the remaining vertices. For each graph a family of centroid expansion subgraphs is derived from the centroid vertex in order to capture dominant structural characteristics of the graph. Since the centroid vertex is identified through a global analysis of the shortest path length distribution, the expansion subgraphs provide a fine representation of a graph structure. We then show how to characterize graphs using depth-based complexity traces. Here we explore two different strategies. The first strategy is to measure how the entropies on the centroid expansion subgraphs vary with the increasing size of the subgraphs. The second strategy is to measure how the entropy differences vary with the increasing size of the subgraphs. We perform graph classification in the principal component space of the complexity trace vectors. Experiments on graph datasets abstracted from some bioinformatics and computer vision databases demonstrate the effectiveness and efficiency of the proposed graph complexity traces. Our methods are competitive to state of the art methods.

Keywords: Depth-based complexity traces, Entropy, Entropy difference, Centroid vertex, Centroid expansion subgraphs, Graph classification

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