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A uniform paradigm to succinctly encode various families of trees. (English) Zbl 1286.68117

Summary: We propose a uniform method to encode various types of trees succinctly. These families include ordered (ordinal), $k$-ary (cardinal), and unordered (free) trees. We will show the approach is intrinsically suitable for obtaining entropy-based encodings of trees (such as the degree-distribution entropy). Previously-existing succinct encodings of trees use ad hoc techniques to encode each particular family of trees.

Additionally, the succinct encodings obtained using the uniform approach improve upon the existing succinct encodings of each family of trees; in the case of ordered trees, it simplifies the encoding while supporting the full set of navigational operations. It also simplifies the implementation of many supported operations. The approach applied to $k$-ary trees yields a succinct encoding that supports both cardinal-type operations (e.g. determining the child label $i$) as well as the full set of ordinal-type operations (e.g. reporting the number of siblings to the left of a node). Previous work on succinct encodings of $k$-ary trees does not support both types of operations simultaneously.

For unordered trees, the approach achieves the first succinct encoding.

The approach is based on two recursive decompositions of trees into subtrees. Recursive decomposition of a structure into substructures is a common technique in succinct encodings and has even been used to encode (ordered) trees and dynamic binary trees. The main distinction of the approach in this paper is that a tree is decomposed into subtrees in a manner that the subtrees are maximally isolated from each other. This intermediate decomposition result is interesting in its own right and has proved useful in other applications.

MSC:
68P30 Coding and information theory (compaction, compression, models of communication, encoding schemes, etc.) (aspects in computer science)
68P05 Data structures
05C05 Trees

Keywords:
succinct data structures; trees; ordered trees; cardinal trees; unordered trees; compact encodings; entropy encoding

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