Generalized Node Splitting and Bilevel Image Compression

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Among the existent methods for lossless compression of bilevel images, algorithms that do node splitting on context pixels obtain the highest compression ratios. For the most part, these methods use binary variables to do the splitting. Variables that can adopt more than two values are sometimes used, but each possible value of the variable always determines a separate child of a node. In this paper, we put forward the use of splitting variables that can adopt a very large number of values, including intervals over the reals. At the same time, the number of children per node is kept as small as needed. We use a greedy algorithm to repeatedly divide the range of the splitting variable so as to maximize entropy reduction at each step. Both non-local information, e.g., position, and functions on neighborhood pixels can go into tree-building. The resulting compression ratios are higher than those of traditional node-splitting methods.

We also show that a context-based codebook, i.e. a function from the set of all possible contexts to the real interval \([0,1]\), can be composed with the inverse of a function from the set of all possible contexts to the reals, such as a function based on Grey coding of the context bitstring, to produce a function from the reals to \([0,1]\) that is very amenable to moderately lossy compression. Even though compression of the codebook is lossy, compression of the image itself is lossless. The compression ratios resulting from this alternative method are almost as high as those attained by node-splitting. Both this method and generalized node-splitting can be easily extended to lossless compression of gray-scale images.