Near-Optimal Depth-Constrained Codes

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This note considers an n-letter alphabet in which the ith letter is accessed with probability p_i. The problem is to design efficient algorithm for constructing near-optimal, depth-constrained Huffman and alphabetic codes. We recast the problem as one of determining a probability vector $q_1, q_2, \ldots, q_n$ in an appropriate convex set $\mathcal{Q}$, so as to minimize the relative entropy $D(p \| q)$ over all $q \in \mathcal{Q}$. Methods from convex optimization give an explicit solution for q in terms of p. We show that the Huffman and alphabetic codes so constructed are within 1 and 2 bits of the corresponding optimal depth-constrained codes.