A special case of the data arrangement problem on binary trees

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The data arrangement problem on regular trees (DAPT) consists of assigning the vertices of a given graph $G$ to the leaves of a $d$-regular tree $T$ such that the sum of the pairwise distances of all pairs of leaves in $T$ which correspond to edges of $G$ is minimised. Luczak and Noble have shown that this problem is NP-hard for every fixed $d \geq 2$. The question about the computational complexity of the DAPT in the case where the guest graph is a tree is still open.

We deal with one special case of this problem where both the guest and the host graph are binary regular trees. First, we provide a solution algorithm which clearly yields an upper bound. Then we introduce and solve the $k$-balanced partitioning problem ($k$-BPP) of a binary regular tree for particular choices of $k$ and show that a lower bound for the original problem can be derived by solving $h$ instances of $k$-BPP, where $h$ is the height of the host graph $T$.

By combining both bounds we obtain an approximation algorithm for the special case of DAPT.

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