# Heuristics for optimal data arrangement problem on a tree

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The goal of the *data arrangement problem on complete d-ary trees* (*DAPTree*) is the embedding of the nodes of a given undirected (unweighted) graph $G$ onto the leaves of a given complete $d$-ary tree $T$, so as to minimize the overall sum of the distances between any two leaves of $T$ which correspond to an edge of $G$. Similarly as the *linear arrangement problem* (*LAP*) the *DAPBaum* is an *NP-hard* special case of the well investigated *graph embedding problem* (*GEP*). The complexity was proved by Luczak and Noble [1].

In the first chapter we *state the problem* and describe some *problem specific properties*. Then we introduce a *lower bound* which is a generalization of an already known lower bound for the *LAP* stated by Petit i Silvestre [2].

In the next chapter we introduce some *heuristics* for the *DAPTree* and test their *performance on a class of random graphs*. As an important result of this thesis we give a closed formula for the *expected value* and the *variance* of the objective function value of a random arrangement over a special class of graphs. Further we present some *Greedy-like heuristics* and some *local search* heuristics.

At the end we focus on some *polynomially solvable special cases* of the problem.

All heuristic approaches are illustrated by *examples*. We have also generated a *set of test instances* which allows us to compare the performance of the proposed heuristics on different types of test instances.

*Keywords.* Embedding; embedding problem; arrangement; heuristic; greedy; local search; combinatorial optimization; random graph

## References

[1] M.J. Luczak and S.D. Noble, Optimal arrangement of data in a tree directory, *Discrete Applied Mathematics* **121 (1–3)**, 307–315, 2002.

[2] J. Petit i Silvestre, Approximation heuristics and benchmarkings for the MinLA problem, *Alex '98 – Building bridges between theory and applications*, 112–128, 1998.

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