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Algorithms and Datastructures
Summer Term 2024
Exercise Sheet 6

Due: Wednesday, June 5th, 2pm

Exercise 1: Minimum Distance between Values *(10 Points)*

(a) Given an array A that contains n integers. Describe an algorithm that finds indices $i \neq j$ such that $|A[i] - A[j]|$ is minimal among all indices. In other words, the algorithm should compute the entries of A that have the smallest distance. Argue the correctness of your algorithm and show that it runs in time $o(n^2)$. *(5 Points)*

(b) Now, assume that the n numbers from a) are given in a binary search tree B (instead of in an array). Again, give an algorithm that finds the two tree nodes $u \neq v$ such that $|\text{val}(v) - \text{val}(u)|$ is minimal. Show the correctness and explain why the runtime is on $O(n)$. *(5 Points)*

Exercise 2: *(10 Points)*

Again, given a binary tree B containing n integers. For a path $P = \{r, v_1, v_2, \ldots, b\}$, from the root node r to some leaf b, we define its weight by $w(P) = \sum_{v \in P} \text{val}(v)$. Describe an algorithm that finds the *heaviest* path from the root node to some leaf in B, i.e., the path P that maximizes $w(P)$ for all root-to-leaf path. State that the runtime is in $O(n)$. *(10 Points).*