Indian Statistical Institute

DFS LAB – COURSE PROJECT 1

MTech(CS) I year   2021–2022

Deadline: 31 January, 2022

(For BONUS marks)

SUBMISSION INSTRUCTIONS

1. Naming convention for your programs: `cs21xx-project1-progy.c` (assuming `cs21xx` denotes your roll number and `progy` denotes the program number).
2. To submit the solution files (`.c` or `.h`), ensure that they not password protected and mail them together to `<assignisik@gmail.com>` with the subject line as follows: `MTech (CS) 2021-23 cs21xx Computing Lab - project`.
3. Submissions from different students having significant match will be **debarred from evaluation**.

NOTE: All programs should take the required inputs from stdin, and print the desired outputs to stdout.

Q1. **Longest Heapable Subsequence Problem:** A heapable sequence is a sequence of numbers that can be arranged in a min-heap data structure. Finding a longest heapable subsequence of a given sequence was proposed by Byers et al. [1] as a generalization of the well-studied longest increasing subsequence problem. An equivalent formulation of the longest heapable subsequence problem is that of finding a maximum-sized binary tree in a given permutation directed acyclic graph (permutation DAG).

Parameterized algorithms have recently been studied for both longest heapable subsequence and maximum-sized binary tree [2]. Chandrasekaran et al. introduced alphabet size as a new parameter in the study of computational problems in permutation DAGs and show that this parameter with respect to a fixed topological ordering admits a complete characterization and a polynomial time algorithm.

Write a program in C to implement the fixed-parameter tractable (FPT) algorithm proposed by Chandrasekaran et al. for addressing the longest heapable subsequence problem parameterized by alphabet size.

References

[1] John Byers, Brent Heeringa, Michael Mitzenmacher and Georgios Zervas. Heapable sequences and subseqeuences. *8th Workshop on Analytic Algorithmics and Combinatorics*, 33–44, 2011.

[2] Karthekeyan Chandrasekaran, Elena Grigorescu, Gabriel Istrate, Shubhang Kulkarni, Young-San Lin and Minshen Zhu. Fixed-Parameter Algorithms for Longest Heapable Subsequence and Maximum Binary Tree. *15th International Symposium on Parameterized and Exact Computation*, 7:1–7:16, 2020.