

1 Assignment No. 6: Multi-way Trees

Transforms between different representations Allocated time: 2 hours

1.1 Implementation

1. You are required to implement **correctly** and **efficiently** *iterative* and *recursive* binary tree traversal. You may find any necessary information and pseudo-code in your course and seminar notes.
2. Moreover, the **correct** and **efficient** implementation of *linear* complexity algorithms is required for transforming multi-way trees between the following representations:
 1. **R1:** *Parent representation*: for each index, the value in the vector represents the parent's index, e.g.: $\Pi = \{2, 7, 5, 2, 7, 7, -1, 5, 2\}$
 2. **R2:** *Multi-way tree representation*: each node contains the key and a vector of child nodes.
 3. **R3:** *Binary representation*: each node contains the key and two pointers, one to the first child and the second to the right sibling (e.g., the next sibling).

Therefore, you need to define transformation **T1** from the *parent representation* (**R1**) to the *multi-way tree representation* (**R2**), and then the transformation **T2** from the *multi-way tree representation* (**R2**) to the *binary representation* (**R3**). For all representations (**R1**, **R2**, **R3**), you need to implement the Pretty Print (**PP**) display (see page 2).

Define the data structures. You can use intermediate structures (e.g., additional memory).

1.2 Requirements

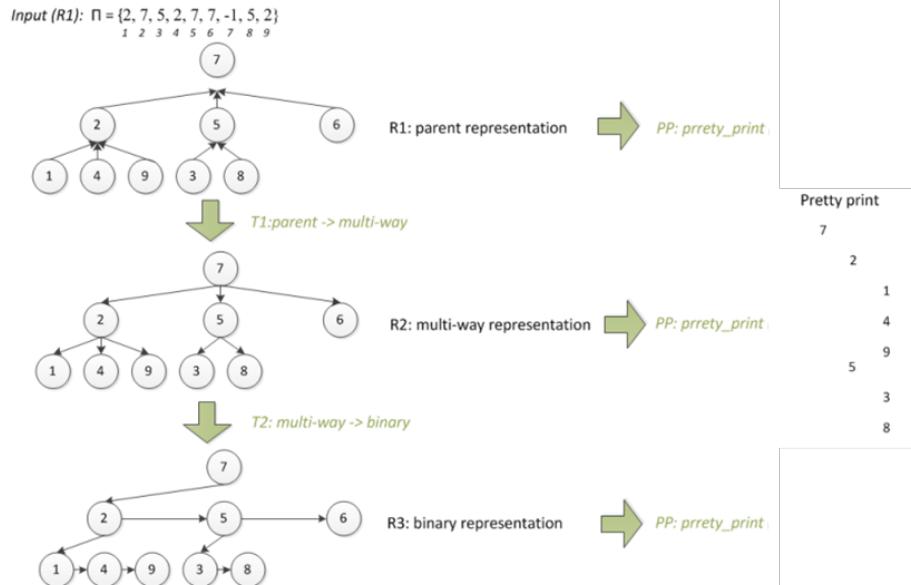
1.2.1 Implementation of *iterative* and *recursive* binary tree traversal in $O(n)$ and with constant additional memory (3p)

You will have to prove your algorithm(s) work on a small-sized input.

- 1.2.2 Implementation of transforms between different representations
- 1.2.3 Correct implementation for Pretty-print for R1 (2p)
- 1.2.4 Correct implementation for T_1 (from R1 to R2) and pretty-print for R2 (1p) + T_1 in linear time (1p)
- 1.2.5 Correct implementation for T_2 (from R2 to R3) and pretty-print for R3 (2p) + T_2 in linear time (1p)

The correctness of the algorithms should be demonstrated using the example $\Pi = \{2, 7, 5, 2, 7, 7, -1, 5, 2\}$.

Use Pretty Print for all three representations. *Each representation (R1,R2,R3) should have a pretty print of its own with a different implementation but with the same print.*



Analyse the time and space efficiency of the two transformations. Did you achieve $O(n)$? Did you use additional memory?