Data Structure -- Introduction to *Trees*[1]

Lesson Plan

Objective

- Students understand the concept of the tree and how to represent the tree as an abstract data type;
- Students understand 4 basic operations of trees, namely traversal, insert, delete, and search;
- Students can implement a tree structure by using any programming languages they prefer.

Materials

- Textbooks
- Instruction slides
- Laptop with specific IDEs/compilers

Plan

I. Introduction (10 min)
   - Give a bridge from the *list* (introduced in the last lesson) to today's topic: *tree*;
   - Introduce the definitions of trees, ancestors and descendants, and their different types.

II. The main part (40 min)
   - Introduce four operations of a general tree structure: traversal, insert, delete, and search;
   - For each operation, give step-by-step examples, pseudo-codes and visualizations (should be prepared in the slides) to make students understand what happens behind the abstract operation.
   - If there are any questions, try to clarify by more examples.

III. Group work Part 1: discussion (15 min)
   - Divide students into 4 groups, and assign an operation to each group;
   - Let students discuss and explain the time and space complexities of their assigned operation, based on the pseudo-codes provided in the previous section;
   - Move around the groups and listen to the discussions, give some hints if they meet difficulties;
   - Let each group show their discussing results to other groups orderly. Correct any errors and potential misunderstandings politely if needed, to make sure that all students are on the right track.

IV. Group work Part 2: implementation (20 min)
   - Further divide the students in previous groups into pairs, and let each pair collaboratively implement the operation they just discussed using programming languages. This part can assess their understanding of the problems they discussed before;
   - Let students execute their programs, and compare the results with the theoretical results they derived in the last discussing part;
   - If they do not finish, leave the implementation task as a homework.

V. Summary (5 min)
   - Give a brief review of the topics covered in the previous part: including the concepts of the tree structure, its operations, and the corresponding time complexities.

VI. Close/homework (5 min)
   - Assign the homework for students, and emphasize the due date of the homework.

[1] The term *tree* here is a metaphorical name of an abstract data type. See https://en.wikipedia.org/wiki/Tree_(data_structure).