Data Structures

Assignment 3

Question no. 1

We have implemented a linked list of linked lists, stack of queues. Now it's time to implement tree of trees where each node of tree will have root node of another tree. Let's understand with an example.

Example:

Resource / Task Allocation

Consider implementing a task and resource allocation matching system. This system will facilitate the efficient allocation of tasks to available resources based on their skill-set:

1. Read a file that contains a list of applicants and their skill-set, where each skill is listed along with experience (in years) comma separated, as in the following example:

```
Ahmed | c:2, c++:3, java:1
Ayesha | c: 2, c++:2, assembly:2
Ali | c++:3, java:3
Salman | java:4, javascript:2, python:2
Sara | python:3, javascript:2
```

2. Read a file that contains a list of tasks and required skill-set along with skill level: beginner (b), intermediate (i), expert (e), for instance :

```
Web Development | javascript:e, java:i
Data Analytics | python:e, javascript:i
System Programming | c:i, c++:i, assembly:i
```

Here b = 1, i = 2, e = 3. We are having 3 types of data skill, resource and task mean we will have 3 types of trees skillTree, resourceTree and taskTree. Their structure **must be** like as follows:

```
class skillTree {
        class skillNode {
                int level; // it will be used as integer value in node to sort skill tree
                string name;
        }
        skillNode *left;
        skillNode *right;
}

class resourceTree {
        class resourceNode {
                int id; // it will be used as integer value in node to sort resource tree
                string name;
                skillTree *root;
        }
}

class taskTree {
        class taskNode {
                int id; // it will be used as integer value in node to sort task tree
                string name;
                skillTree *root;
        }
}
```

Let's look at an example in which have the following data set.

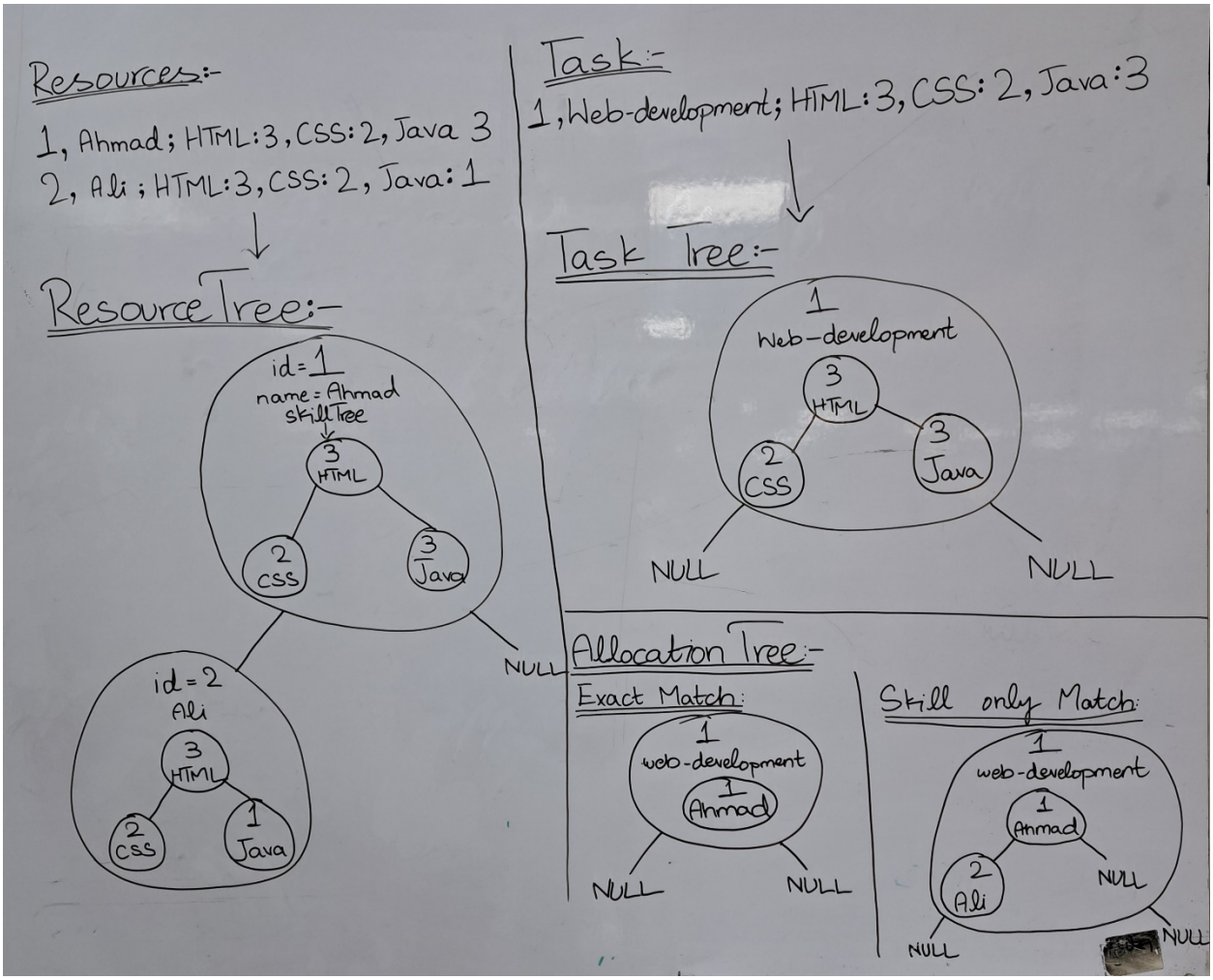
task tree is having 1 node {id = 1, name = web-development, skillTree = {{name = HTML, level = 3}, {name = CSS, level = 2}, {name = Java, level = 1}}}

resource tree is also having 1 node {id = 1, name = Ahmad, skillTree = {{name = HTML, level = 3}, {name = CSS, level = 2}, {name = Java, level = 3}}}

you will start by traversing task tree, at each node there is task name to which you must allocate tasks by matching skill tree. At each node there is a skill tree which has skill name and level, if the level here is 3 then you will sort skill tree at each node of resource tree with max heap so that you will have level 3 skills at top of skill tree in resource tree, if you found level 2 skill to match, do not sort but in case you find 1, you will sort skill tree at each node in task tree by using min heap so that skills with level 1 will be at top of tree.

After applying heap sort algorithm, you will match skill level with skill level at first node of skill tree in first node of resource tree, if it matches then you will match name other wise you will go to next node of skill tree in first node of resource tree. You will do the same for all nodes of resource tree with one node of task tree and make a tree of allocations which will have the allocated resources for each task.

Example visualization:



You will match and make the allocation tree as above.

```
class AllocationTree {
        class AllocationNode {
                int id;
                string name;
                class allocatedResources {
                        int id;
                        string name;
                }
        }
}
```

At the end you must encode the allocation tree with the help of Huffman encoding. You will get the file size the same even after the encoding if you do it with strings or characters. You need to convert the allocation tree in binary tree values then you must apply encoding and decoding algorithms on allocation tree with binary values. That’s it.