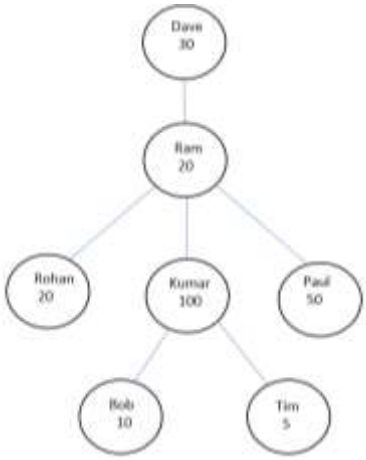
Birla Institute of Technology and Science, Pilani Hyd Campus
BITS F232: Foundations of Data Structures and Algorithms
1st Semester 2023-24: Assignment 1 (Set B)
Maximum marks: 20 Date of Submission: 8th Nov 2023

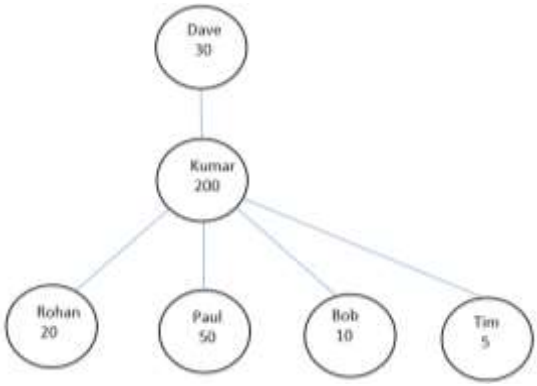
Q.1 In the magical town of Queensland, there are many families. Each family consist of an ancestor and all other family members are residents of the ancestor. Each family maintains a structure called the "Family Tree" which is basically a tree-like representation of the family where the nodes of the tree represent the family members and edges represent parent-child relationship. A parent can have multiple children in the town. Each family member has certain information which is to be stored in the tree like name, age, income and occupation.

The residents(non-ancestors) of the town frequently move out of Queensland. Hence, the Family Tree should remove the node corresponding to the resident who moved out of Queensland. Whenever a node is removed, the child node having the highest income takes its place and hence becomes the parent for the other children nodes. If the new parent earlier had any children nodes, they remain as children nodes along with other children nodes.



Initial Family Tree

(Name and income of each member is displayed)



Resultant Family Tree After Removal of Member named "Ram"

(Highest Earning child Kumar takes Ram's place)

If multiple child nodes have highest income, the first child node is chosen to become the parent. Hence, the family tree gets modified.

You are given an incomplete code for the Family Tree in 2.1 file. The first part of the assignment includes certain operations related to the Family Tree.

The first task is to complete the code to build the Family Tree as well as to remove any nodes so that the residents can fulfill their ritual.

Next, find the family having the highest income to age ratio. Income to age ratio of family is ratio of total income of all members to ratio of total age of all members of the family.

Lastly, you need to print the families (ancestor names) in the decreasing order of the total family income. Complete the code to achieve these tasks.

Q.2 Write a program to create a mini–Task Scheduler based on round-robin algorithm. Create a menu which provides users to:

1. Add Task
2. Execute
3. Exit

Each task has a priority associated with it (higher number represents higher priority), and during execution automatically the highest priority task must be executed.

Each task has certain burst-time given as an integer, which means for how long that task must be run for the task to be completed.

Round – Robin Algorithm:

Each task is run for a constant time declared by the user (time quantum). If the task's burst time <= 0 then the task is said to be completed, else the particular task is run for a single time quantum and pushed back into the queue with remaining burst time.

Same task may not run twice continuously unless it is the only task in the queue.

Note: 2 tasks can have the same priority, the task that was added earlier should have the priority.

Data Structures used: Priority queues and Vectors.

(Note: part code is given in file 2.2)
