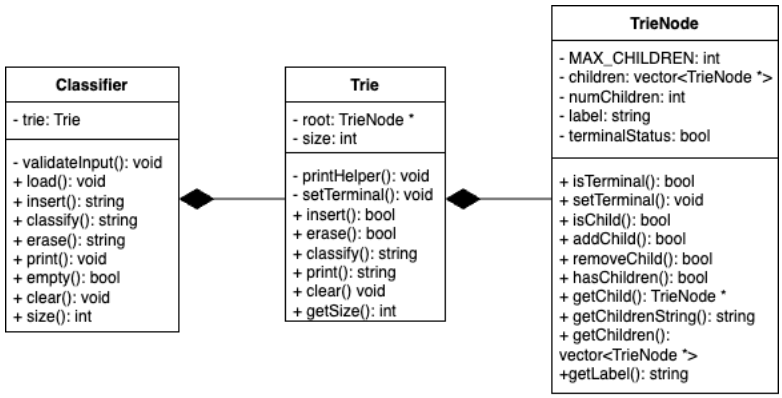
1.0 Class Design

1.1 TrieNode

Included a numChildren counter to make checking for and adding children O(1) .

2.0 UML Diagram



4.0 Runtime

4.1 INSERT

To insert an n class classification, Trie.insert(), will have to traverse n nodes. Traversing each node involves searching the children vector for a child with a label that matches the next class, which in the worst case is O(15). If any of the intermediate classes are missing, or once the terminal class is reached, they are added to the tree with TrieNode.addChild() which appends to the children vector which is an O(1) operation, in the worst case, this happens n times. The worst case time complexity for INSERT is then O(n* (1 + 15)) = O(n)

4.2 CLASSIFY

To classify an input, Trie.classify() will traverse through, in the worst case, N nodes and at each node it will call LabelText on the input with the current children as the possible classes. Getting the labels of the current children is O(15) in the worst case. The worst-case time complexity of CLASSIFY is then O(N*(15+15)) = O(N)

4.3 ERASE

To erase and n class classification, Trie.erase() will have to traverse n nodes. Once it has reached the terminal node of the classification, it will have to delete the node by calling TrieNode.removeChild(), which since the node is a terminal node, guarantees deletion will be O(1). To properly delete the node, the pointer in the children vector of the parent node also needs to be set to nullptr, which takes O(15) in the worst case. The worst case time complexity of ERASE is then O(n*15 + 1 +15) = O(n).

4.4 PRINT

To print a Trie, Trie.print() recursively calls Trie.printHelper() on the children of each node starting from the root. printHelper collects the labels of the nodes that called it and when it reaches a terminal node, appends the string of traversed nodes to the vector of traversal strings and then returns, both operations are O(1). For each classification in the tree, in the worst case printHelper is called NxC times where C is the number of classes in the classification. Once all the calls to printHelper have returned, print() iterates over the vector of traversal strings and prints them out. In the worst case, there are N traversal strings to be printed out. The worst case time complexity for PRINT is then O(N*C*(1+1) + N) = O(N).

4.5 EMPTY and SIZE

The size of the Trie, or the number of classifications, is tracked by incrementing and decrementing the size attribute whenever a Trie node becomes a new terminal node or ceases to be one respectively. Thus returning the size of the Trie is O(1) since Trie.getSize() just return the attribute value. Trie.empty() is also O(1) since it just makes a call and returns the Boolean comparison to 0. The worst case runtime for EMPTY and SIZE then is O(1).

4.6 CLEAR

Trie.clear() calls delete on the root which calls the TrieNode destructor which calls delete on each of the children of the TrieNode. For a Trie with N nodes, N memory deallocations occur which each take O(1) time. Then worst-case time complexity for CLEAR then is O(N*1) = O(N)

Show:

- Trie.insert()
- TrieNode.addChild()
- TrieNode.removeChild(),
- Trie.print()
- Trie.printHelper()
- Trie.getSize()
- Classifier.empty()
- Trie.clear()