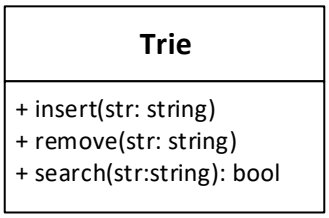
Lab Exercise: Tries

In this exercise you will get acquainted with the Trie data structure. Tries are extremely efficient in storing strings, i.e. sequences of digits of characters from a limited alphabet. In this sense, a Trie may store regular text strings, but also e.g. DNA sequences (consisting of the nucleotides C, T, A and G), long integers (consisting of digits 0-9), etc.

Without loss of generality, this exercise will limit its scope to working with regular text strings.

You are provided with an implementation of a `TrieNode` and test suites for each set of exercises.

The overall goal for this exercise is to implement a class `Trie` with the by-now common operations `insert()`, `search()` and `remove()`. The UML class diagram for this class is given below:



(you may of course add private methods, member variables, etc., as you wish)

Exercise 1:
Investigate the provided implementation of a Trie and the (inner) class `TrieNode`. Ensure that you understand…

- Why the class `Trie` has the constructor it does
- What a `TrieNode` consists of, specifically what the typedef's `TrieMap` and `TrieMapIter` represent and why they are there.

Exercise 2:
Investigate the provided implementation of the private member function

```
unsigned int findPrefixEnd(string str, TrieNode*& end).
```

This method sets `end` to the last node in the prefix of `str` in the Trie and returns the length of this prefix.

Ensure that you understand how this method works, what the purpose of the pointer-reference `end` is, and what it returns.

Exercise 3:
Design the method `search()` in accordance with your design. Hint: Can you use `findPrefixEnd()` to make this a whole lot easier?

Exercise 4:
Design the method `insert()`in accordance with your design. Hint: Can you use `findPrefixEnd()` to make this a whole lot easier?

Exercise 5:
Implement your designs for `insert()` and `search()`. Use the relevant test suite to verify that your implementation works.

The following exercises are advanced, and you do not need to do them – but hey, now that we're add it, right? Pour some coffee and get crackin' ☺.

Exercise 6:
Design the method `remove()`. Remember to handle all the cases that we have discussed in class.

Exercise 7:
Implement your design of `delete()` in accordance with your design. Use the relevant test suite to verify that your implementation works.

Exercise 8 (advanced, but fun!):
Design a new method for the Trie class `findAllWithPrefix()` that returns all strings with a given prefix. I.e., for the Trie given in the Pair & Share-questions for this lesson, `findAllWithPrefix("an")` should return the strings "`ant`", "`antibody`" and "`antilope`".

Implement `findAllWithPrefix()` and test it using the relevant test suite.