Homework: Collection Data Structures and Libraries

This document defines the **homework assignments** for the "Data Structures" course @ Software University. Please submit a single **zip** / **rar** / **7z** archive holding the solutions (source code) of all below described problems.

Problem 1. Products in Price Range

Write a program to read a **large collection of products** (name + price) and efficiently **find the first 20 products** in the **price range [a…b]** ordered by price. Test for **500 000 products** and **10 000 price searches**.

Input	Output
7 apples 2.50 bananas 1.20 milk 1.33 water 1.30 beer 0.95 cheese 8.5 muffin 0.5 0.95 2	0.95 beer 1.20 bananas 1.30 water 1.33 milk

Hints (Click on the arrow to show)

Problem 2. String Editor

You have to implement a string editor that starts from empty string and executes sequence of commands:

- **APPEND some_string** – appends given string at the end of the text. Print "**OK**" on success.
- **INSERT some_string position** – inserts given string at given position. Print "**OK**" on success. Print "**ERROR**" in case of invalid position.
- **DELETE start_index count** – deletes the specified substring. Print "**OK**" on success**.** Print "**ERROR**" in case of invalid substring.
- **REPLACE start_index count some_string** – replaces the specified substring with the specified string. Print "**OK**" on success. Print "**ERROR**" in case of invalid substring.
- **PRINT** – prints the string in the editor.
- **END** – stops the program execution. Passed as last command in the input. Does not print anything.

Ensure your programs runs **efficiently** for tens of thousands of commands.

Input	Editor State	Output
APPEND pesho	pesho	OK
APPEND 123	pesho123	OK
INSERT 0 456	456pesho123	OK
DELETE 1 2	4pesho123	OK
DELETE 100 200	4pesho123	ERROR
PRINT	4pesho123	4pesho123
REPLACE 1 5 kiro	4kiro123	OK
REPLACE 700 800 hi	4kiro123	ERROR
APPEND Hello C#	4kiro123Hello C#	OK

PRINT END	4kiro123Hello C#	4kiro123Hello C#

Hints (Click on the arrow to show)

Problem 3. * Fast Search for Strings in a Text File

Write a program that finds a **set of strings** (e.g. 1000 strings) in a **large text** (e.g. 100 MB text file). Print how many times **each string** occurs in the text **as substring**. Ensure your program works fast enough!

The input comes from the console in the following format:

- The first line holds the **number of strings** for searching **s**.
- The next **s** lines hold the **strings** to be found in the text – one string per line.
- The next line holds an integer **l** – the **number of input lines**.
- The next **l** lines hold the **input text**.

Input	Output
4 C# at UNI a 6 Hello, I am studying C# at SoftUni. C# is my favorite language. It is unique! I like C# and Java. Atmosphere at SoftUni is great. SoftUni has very mature and practical learning system. "Ratamahatta" is Sepultura's ninth official single.	C# -> 3 at -> 7 UNI -> 4 a -> 24

Hints (Click on the arrow to show)

- Note that the string matching is **case-insensitive**.
- Match the strings as **substrings** (part of word), not as words.
- A correct, but **slow** solution is to use **`String.IndexOf()`** to find the occurences of each input string in each input line of the text.
- A **faster** solution is to **scan the input text char by char**, append the chars in a buffer and check after each char added if the buffer ends by some of the strings.
- A really **fast solution** is to use **Aho-Corasick's algorithm** and the **trie** data structure.
- A detailed **analysis** and **solution** with explaination of this problem can be found in the "C# Fundamentals" book: http://www.introprogramming.info/english-intro-csharp-book/read-online/chapter-26-sample-programming-exam-topic-3/.