# Exercises: Dictionaries, Hash Tables and Sets

This document defines the **homework assignments** for the ["Data Structures" course @ Software University](https://softuni.bg/trainings/1147/Data-Structures-June-2015). Please submit a single zip / rar / 7z archive holding the solutions (source code) of all below described problems.

## Dictionary

Implement a **dictionary** using a **hash table**. Refer to the [**lab document**](6.%20Dictionaries-and-Hash-Tables-Exercises.docx) for detailed steps on how to implement the data structure.

Solve the next problems by using the **implemented dictionary**. You are **NOT** allowed to use the built-in **Dictionary** or **SortedDictionary** classes!

## Count Symbols

Write a program that reads some text from the console and counts the occurrences of each character in it. Print the results in **alphabetical** (lexicographical) order. Examples:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Input** | **Output** |  | **Input** | **Output** |
| SoftUni rocks | : 1 time/s  S: 1 time/s  U: 1 time/s  c: 1 time/s  f: 1 time/s  i: 1 time/s  k: 1 time/s  n: 1 time/s  o: 2 time/s  r: 1 time/s  s: 1 time/s  t: 1 time/s |  | Did you know Math.Round rounds to the nearest even integer? | : 9 time/s  .: 1 time/s  ?: 1 time/s  D: 1 time/s  M: 1 time/s  R: 1 time/s  a: 2 time/s  d: 3 time/s  e: 7 time/s  g: 1 time/s  h: 2 time/s  i: 2 time/s  k: 1 time/s  n: 6 time/s  o: 5 time/s  r: 3 time/s  s: 2 time/s  t: 5 time/s  u: 3 time/s  v: 1 time/s  w: 1 time/s  y: 1 time/s |

## Phonebook

Write a program that receives some info from the console about **people** and their **phone numbers**.

As input you will get the contacts in this form **{name}-{number}**. There will be no **invalid** input. The name can contain every asci character with **exception** of the **separator** {-}.

After filling this simple phonebook, upon receiving the **command** "**search**", your program should be able to perform a search of a contact by name and print her details in format "**{name} -> {number}**" until the “**end**” command is given. In case the contact isn't found, print "**Contact {name} does not exist.**" Examples:

|  |  |
| --- | --- |
| **Input** | **Output** |
| Nakov-0888080808  **search**  Mariika  Nakov  end | Contact Mariika does not exist.  Nakov -> 0888080808 |
| Nakov-+359888001122  RoYaL(Ivan)-666  Gero-5559393  Simo-02/987665544  **search**  Simo  simo  RoYaL  RoYaL(Ivan)  end | Simo -> 02/987665544  Contact simo does not exist.  Contact RoYaL does not exist.  RoYaL(Ivan) -> 666 |

## Ordered Set

Implement the **ordered set** data structure. It should store **unique elements** in a **binary search tree**. The elements should be kept **sorted at all times**. The **ordered set** should be **generic** and support the following operations:

* **Add(T element)** - adds the element to the set
* **Contains(T element)** - determines whether the element is present in the set
* **Remove(T element)** - removes the element from the set. Its place should be taken by the **bigger child node**.
* **Count** - property that returns the number of unique elements in the set
* The set should be **foreach**-able (just like arrays, lists and other data structures). Implement the **IEnumerable<T>** interface to achieve this. The set should yield all elements, **sorted**, in ascending order.  
  **Tip**: Use [in-order traversal](https://en.wikipedia.org/wiki/Tree_traversal#In-order).

|  |  |
| --- | --- |
| **Sample Code** | **Internal Binary-Tree** |
| var set = new OrderedSet<int>();  set.Add(17);  set.Add(9);  set.Add(12);  set.Add(19);  set.Add(6);  set.Add(25);  foreach (var item in set)  {  Console.WriteLine(item);  } |  |

## \*\* Balanced Ordered Set

Extend the ordered set from the previous problem by making the internal binary tree **self-balancing**. Balance the tree each time an item is inserted or deleted. Implement it using a binary search tree such as an [AVL tree](https://en.wikipedia.org/wiki/AVL_tree), [AA tree](https://en.wikipedia.org/wiki/AA_tree) or [Red-Black Tree](https://en.wikipedia.org/wiki/Red%E2%80%93black_tree).