Homework: Dictionaries, Hash Tables and Sets

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. Dictionary

Implement a **dictionary** using a **hash table**. Refer to the **lab document** 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!

Problem 2. 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

`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`

Input	Output

`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`

Problem 3. Phonebook

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

You are free to choose the manner in which the data is entered; each **entry** should have just **one name** and **one number** (both of them strings).

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}**". In case the contact isn't found, print "**Contact {name} does not exist.**" Examples:

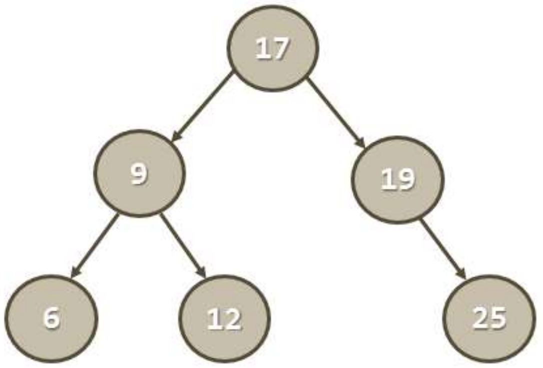
Input	Output
Nakov-0888080808 **search** Mariika Nakov	Contact Mariika does not exist. Nakov -> 0888080808
Nakov-+359888001122 RoYaL(Ivan)-666 Gero-5559393 Simo-02/987665544 **search** Simo simo RoYaL RoYaL(Ivan)	Simo -> 02/987665544 Contact simo does not exist. Contact RoYaL does not exist. RoYaL(Ivan)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

Problem 4. 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.

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);
}
	

Problem 5. ** 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, AA tree or Red-Black Tree.