

Associative Arrays

Collections and Queries



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Associative Arrays

A Collection of Key and Value Pairs

Associative Arrays (Maps, Dictionaries)

- Associative arrays are arrays indexed by keys
 - Not by the numbers 0, 1, 2, ... (like arrays)
 - Hold a set of pairs {key → value}



Key	Value
John Smith	+1-555-8976
Lisa Smith	+1-555-1234
Sam Doe	+1-555-5030

- Dictionary<K, V> – a collection of key and value pairs
- The keys are **unique**
- Keeps the keys in their **order of addition**
- Uses a hash-table + list

```
var fruits = new Dictionary<string, double>();  
  
fruits["banana"] = 2.20;  
  
fruits["apple"] = 1.40;  
  
fruits["kiwi"] = 3.20;
```

Sorted Dictionary

- **SortedDictionary<K, V>**
- Keeps its keys always sorted
- Uses a balanced search tree

```
var fruits = new SortedDictionary<string, double>();  
  
fruits["kiwi"] = 4.50;  
  
fruits["orange"] = 2.50;  
  
fruits["banana"] = 2.20;
```

Creating Dictionaries

- Create an empty list of integers

```
var phoneNumbers = new Dictionary<string, string>();  
// Add elements  
phoneNumbers["Peter"] = "+359 882 11 22 33";  
phoneNumbers["Ana"] = "+359 2 99 88 77";
```

- Using a target-type **new** expression

```
Dictionary<string, int> fruits = new() {  
    { "Kiwi", 3 },  
    { "Apple", 5 }  
};
```

Built-In Methods

- Add(key, value) method

```
var airplanes = new Dictionary<string, int>();  
airplanes.Add("Boeing 737", 130);  
airplanes.Add("Airbus A320", 150);
```

- Remove(key) method

```
var airplanes = new Dictionary<string, int>();  
airplanes.Add("Boeing 737", 130);  
airplanes.Remove("Boeing 737");
```

- ContainsKey(key)

```
var dictionary = new Dictionary<string, int>();  
dictionary.Add("Airbus A320", 150);  
if (dictionary.ContainsKey("Airbus A320"))  
    Console.WriteLine($"Airbus A320 key exists");
```

- ContainsValue(value)

```
var dictionary = new Dictionary<string, int>();  
dictionary.Add("Airbus A320", 150);  
Console.WriteLine(dictionary.ContainsValue(150)); // True  
Console.WriteLine(dictionary.ContainsValue(100)); // False
```

Problem: Count Real Numbers

- Read a list of real numbers and print them in ascending order along with their number of occurrences

```
8 2.5 2.5 8 2.5
```



```
2.5 -> 3  
8 -> 2
```

```
1.5 5 1.5 3
```



```
1.5 -> 2  
3 -> 1  
5 -> 1
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1212#0>

Solution: Count Real Numbers

```
double[] nums = Console.ReadLine().Split(' ')
    .Select(double.Parse).ToArray();

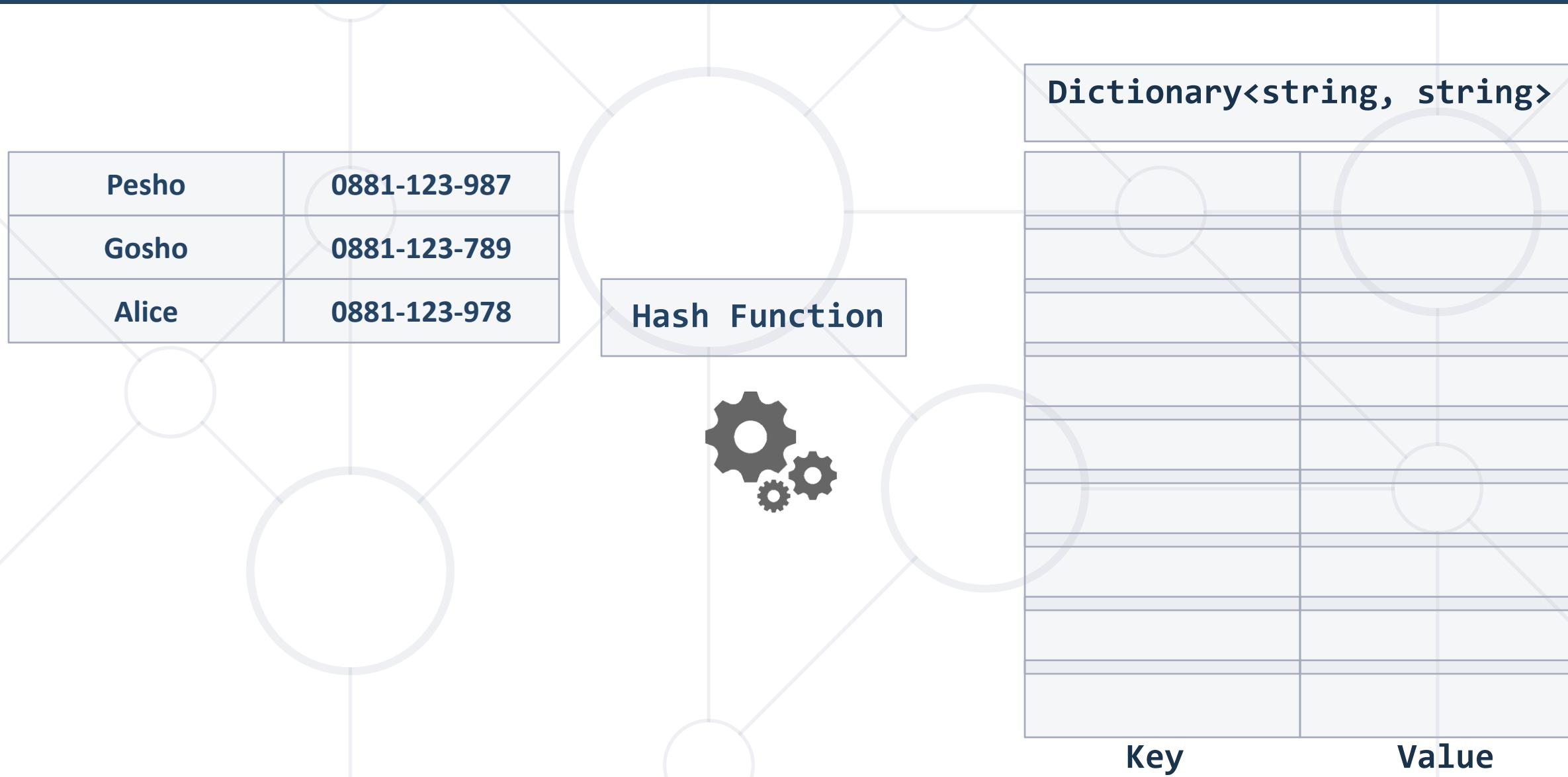
var counts = new SortedDictionary<double, int>();

foreach (var num in nums)
    if (counts.ContainsKey(num))
        counts[num]++;
    else
        counts[num] = 1;

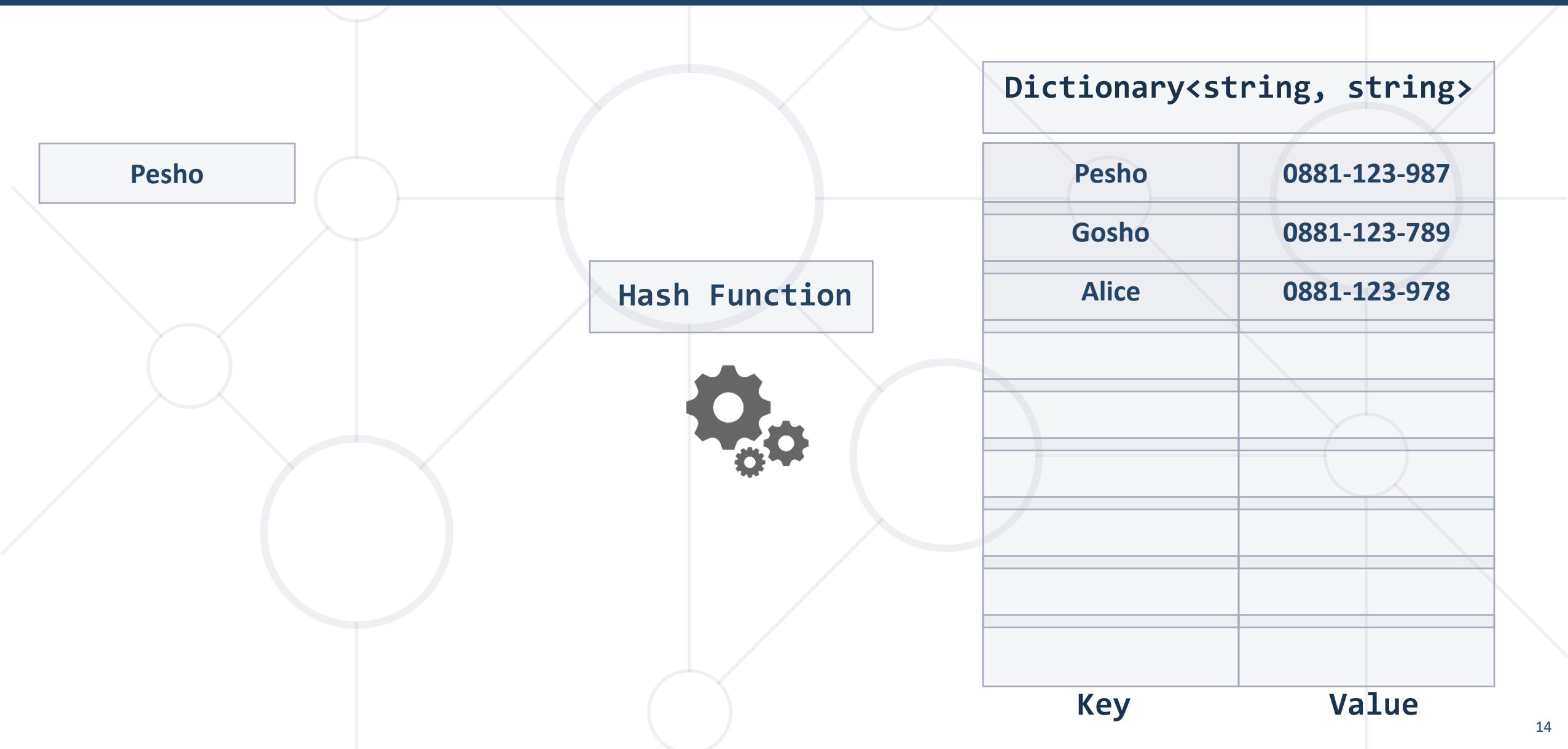
foreach (var num in counts)
    Console.WriteLine($"{num.Key} -> {num.Value}");
```

counts[num] will hold the count of times a num occurs in nums

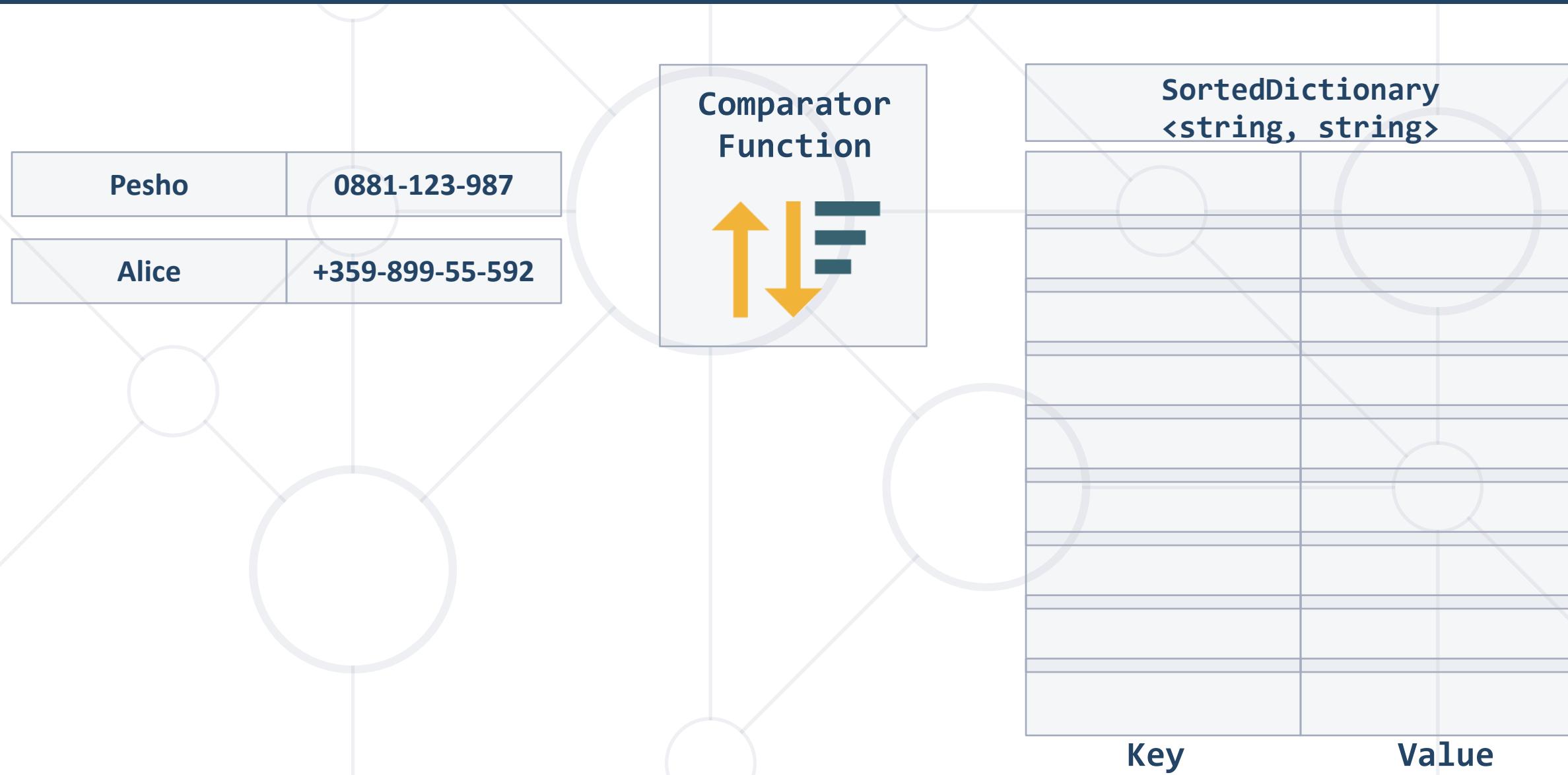
Traditional Dictionary: Add()



Dictionary: Remove()



SortedDictionary<K, V> – Example



Iterating Through a Dictionary

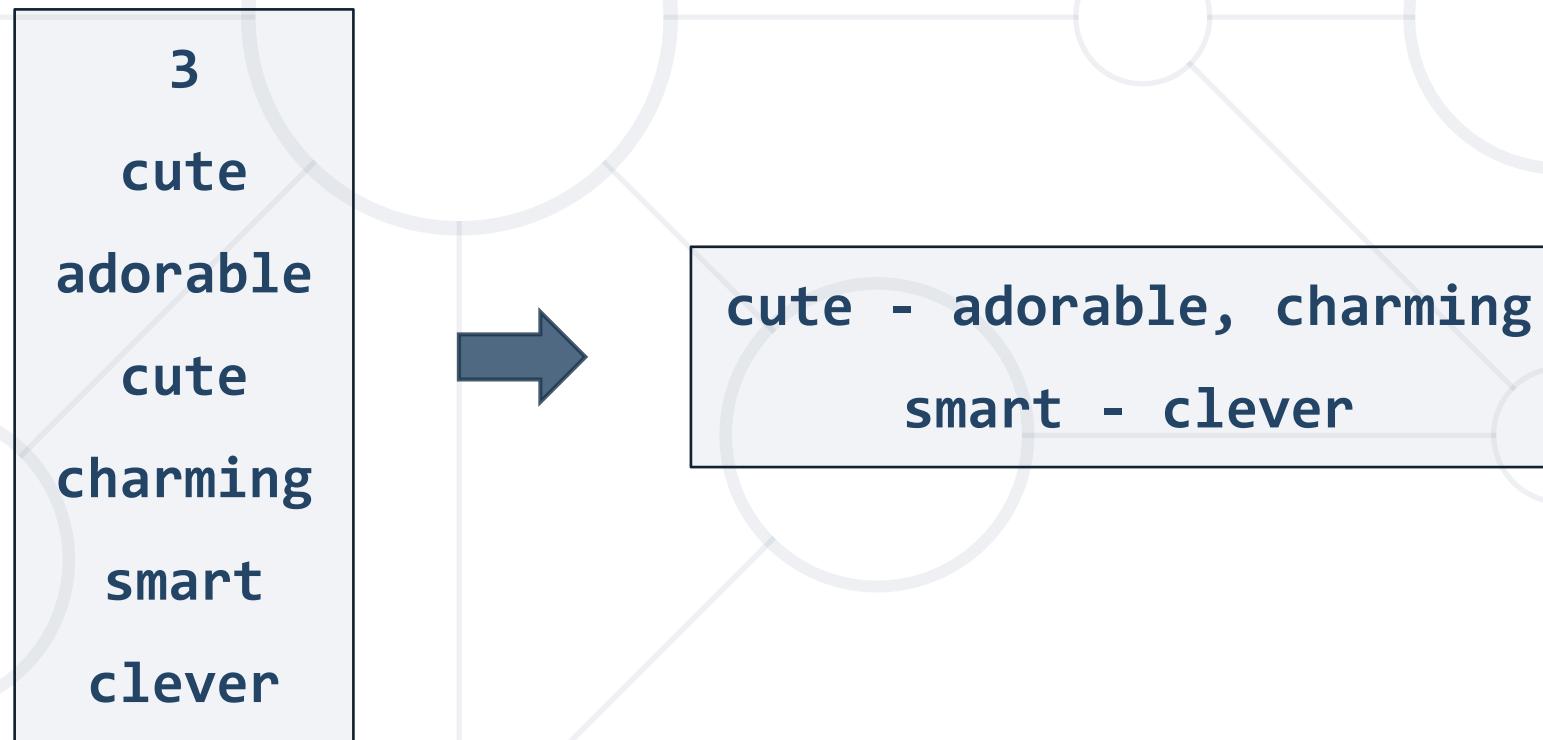
- Using **foreach** loop
- Iterates through objects of type **KeyValuePair<K, V>**
- Cannot modify the dictionary (**read-only**)

```
var fruits = new Dictionary<string, double>();  
fruits.Add("banana", 2.20);  
fruits.Add("kiwi", 4.50);  
foreach (var fruit in fruits)  
    Console.WriteLine($"{fruit.Key} -> {fruit.Value}");
```

fruit.**Key** → fruit name
fruit.**Value** → fruit price

Problem: Word Synonyms

- Read $2 * N$ lines of pairs - word and synonym
- Each word can have multiple synonyms



Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1212#2>

Solution: Word Synonyms

```
int n = int.Parse(Console.ReadLine());  
  
var words = new Dictionary<string, List<string>>();  
  
for (int i = 0; i < n; i++) {  
    string word = Console.ReadLine();  
    string synonym = Console.ReadLine();  
    if (words.ContainsKey(word) == false)  
        words.Add(word, new List<string>());  
    words[word].Add(synonym);  
}
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1212#2>



Anonymous Functions

Lambda Expressions

Lambda Expressions

- A lambda expression is an anonymous function containing expressions and statements

```
a => a > 5;
```



- Lambda expressions
 - Use the lambda operator =>
 - Read as "**goes to**"
 - The **left** side specifies the **input** parameters
 - The **right** side holds the **expression** or **statement**



Lambda Functions

- Lambda functions are inline methods (functions) that take input parameters and return values

```
x => x / 2
```



```
static int Func(int x) { return x / 2; }
```

```
x => x != 0
```



```
static bool Func(int x) { return x != 0; }
```

```
() => 42
```



```
static int Func() { return 42; }
```

Processing Sequences with LINQ

- Min() – finds the **smallest** element in a collection

```
new List<int>() { 1, 2, 3, 4, -1, -5, 0, 50 }.Min() // -5
```

- Max() – finds the **largest** element in a collection

```
new int[] { 1, 2, 3, 40, -1, -5, 0, 5 }.Max() // 40
```

- Sum() – finds the **sum** of all elements in a collection

```
new long[] {1, 2, 3, 4, -1, -5, 0, 50}.Sum() // 54
```

- Average() – finds the **average** of all elements in a collection

```
new int[] {1, 2, 3, 4, -1, -5, 0, 50}.Average() // 6.75
```

Manipulating Collections

- Select() manipulates elements in a collection

```
var nums = Console.ReadLine()  
    .Split()  
    .Select(int.Parse);
```

```
string[] words = { "abc", "def" } ;  
  
var result = words.Select(w => w + "x");  
  
// words -> abcx, defx
```

Converting Collections

- Using ToArray(), ToList() to convert collections

```
int[] nums = Console.ReadLine()  
    .Split()  
    .Select(number => int.Parse(number))  
    .ToArray();
```

```
List<double> nums = Console.ReadLine()  
    .Split()  
    .Select(double.Parse)  
    .ToList();
```

Filtering Collections

- Using Where()

```
int[] nums = Console.ReadLine()  
    .Split()  
    .Select(int.Parse)  
    .Where(n => n > 0)  
    .ToArray();
```



Problem: Word Filter

- Read a string array
- Print only words, whose length is even

```
kiwi orange banana apple
```



```
kiwi  
orange  
banana
```

```
pizza cake pasta chips
```



```
cake
```

Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1212#3>

Solution: Word Filter

```
string[] words = Console.ReadLine()
    .Split()
    .Where(w => w.Length % 2 == 0)
    .ToArray();

foreach (string word in words)
    Console.WriteLine(word);
```

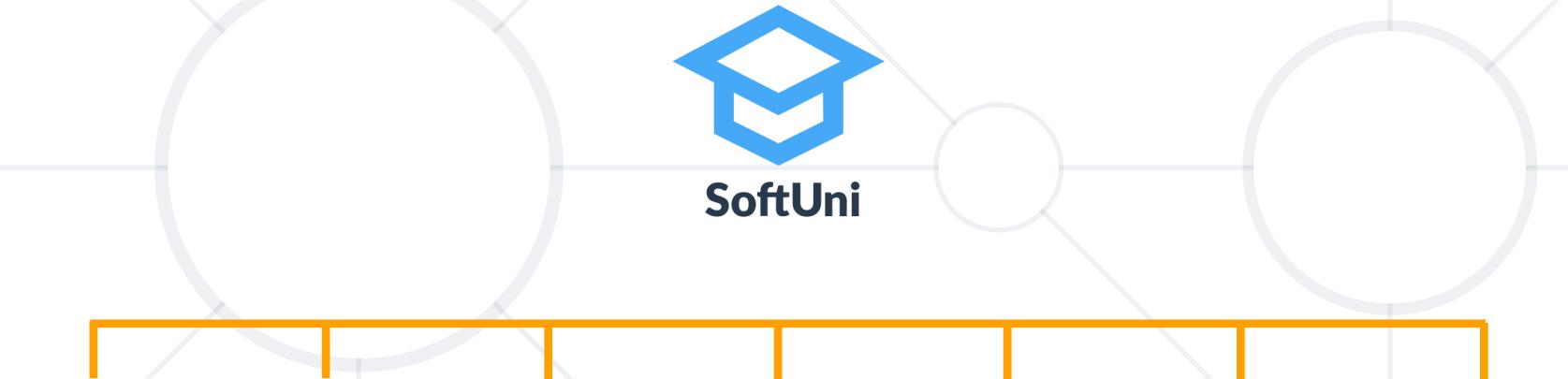
Check your solution here: <https://judge.softuni.org/Contests/Practice/Index/1212#3>

Summary

- Dictionaries hold **{key → value}** pairs
 - Keys holds a set of **unique keys**
 - Values holds a collection of values
 - Iterating over dictionary takes the entries as **KeyValuePair<K, V>**
- Lambda and LINQ helps collection processing



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