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Learn C#: Lists and LINQ

Lists in C#

In C#, a *list* is a generic data structure that can hold any type. Use the `new` operator and declare the element type in the angle brackets `< >`.
In the example code, `names` is a list containing `string` values. `someObjects` is a list containing `Object` instances.

```
List<string> names = new List<string>();
List<Object> someObjects = new List<Object>();
```

Generic Collections

Some collections, like lists and dictionaries, can be associated with various types. Instead of defining a unique class for each possible type, we define them with a generic type `T`, e.g. `List<T>`.
These collections are called *generic collection* types. They are available in the `System.Collections.Generic` namespace.
The generic type `T` will often show up in documentation. When using a generic collection in your code, the actual type is specified when the collection is declared or instantiated.

```
using System.Collections.Generic;

List<string> names = new List<string>();
List<Object> objs = new List<Object>();
Dictionary<string,int> scores = new Dictionary<string, int>
();
```

Limitless Lists

Unlike a C# array, a C# list does not have a limited number of elements. You can add as many items as you like.

```
// Initialize array with length 2
string[] citiesArray = new string[2];
citiesArray[0] = "Los Angeles";
citiesArray[1] = "New York City";
citiesArray[2] = "Dubai"; // Error!

// Initialize list; no length needed
List<string> citiesList = new List<string>();
citiesList.Add("Los Angeles");
citiesList.Add("New York City");
citiesList.Add("Dubai");
```

Count Property

The number of elements in a list is stored in the `Count` property.
In the example code, the `Count` of `citiesList` changes as we add and remove values.

```
List<string> citiesList = new List<string>();
citiesList.Add("Los Angeles");
Console.WriteLine(citiesList.Count);
// Output: 1

citiesList.Add("New York City");
Console.WriteLine(citiesList.Count);
// Output: 2

citiesList.Remove("Los Angeles");
Console.WriteLine(citiesList.Count);
// Output: 1
```

Contains()

In C#, the list method `Contains()` returns `true` if its argument exists in the list; otherwise, `false`.
In the example code, the first call to `Contains()` returns `true` because “New York City” is in the list. The second call returns `false` because “Cairo” is not in the list.

```
List<string> citiesList = new List<string> { "Los Angeles",
"New York City", "Dubai" };

result1 = citiesList.Contains("New York City");
// result1 is true

result2 = citiesList.Contains("Cairo");
// result2 is false
```

LINQ

LINQ is a set of language and framework features for writing queries on collection types. It is useful for selecting, accessing, and transforming data in a dataset.

Using LINQ

LINQ features can be used in a C# program by importing the `System.Linq` namespace.

```
using System.Linq;
```

var

Since the type of an executed LINQ query's result is not always known, it is common to store the result in an implicitly typed variable using the keyword `var` .

```
var custQuery = from cust in customers
                where cust.City == "Phoenix"
                select new { cust.Name, cust.Phone };
```

Method & Query Syntax

In C#, LINQ queries can be written in *method syntax* or *query syntax*.
Method syntax resembles most other C# method calls, while query syntax resembles SQL.

```
// Method syntax
var custQuery2 = customers.Where(cust => cust.City ==
"London");

// Query syntax
var custQuery =
    from cust in customers
    where cust.City == "London"
    select cust;
```

Where

In LINQ queries, the `Where` operator is used to select certain elements from a sequence.

- It expects an expression that evaluates to a boolean value.
- Every element satisfying the condition will be included in the resulting query.
- It can be used in both method syntax and query syntax.

```
List<Customer> customers = new List<Customer>
{
  new Customer("Bartleby", "London"),
  new Customer("Benjamin", "Philadelphia"),
  new Customer("Michelle", "Busan" )
};

// Query syntax
var custQuery =
    from cust in customers
    where cust.City == "London"
    select cust;

// Method syntax
var custQuery2 = customers.Where(cust => cust.City ==
"London");

// Result: Customer("Bartleby", "London")
```

From

In LINQ queries, the `from` operator declares a range variable that is used to traverse the sequence. It is only used in query syntax.
In the example code, `n` represents each element in `names`. The returned query only contains those elements for which `n.Contains("a")` is true.

```
string[] names = { "Hansel", "Gretel", "Helga", "Gus" };

var query =
  from n in names
  where n.Contains("a")
  select n;

// Result: Hansel, Helga
```

Select

In LINQ queries, the `Select` operator determines what is returned for each element in the resulting query. It can be used in both method and query syntax.

```
string[] trees = { "Elm", "Banyon", "Rubber" };

// Query syntax
var treeQuery =
  from t in trees
  select t.ToUpper();

// Method syntax
var treeQuery2 = names.Select(t => t.ToUpper());

// Result: ELM, BANYON, RUBBER
```

LINQ & foreach

You can use a `foreach` loop to iterate over the result of an executed LINQ query.
In the example code, `query` is the result of a LINQ query, and it can be iterated over using `foreach`. `name` represents each element in `names`.

```
string[] names = { "Hansel", "Gretel", "Helga", "Gus" };

var query = names.Where(n => n.Contains("a"));

foreach (var name in query)
{
  Console.WriteLine(name);
}
```

Count()

The result of an executed LINQ query has a method `Count()`, which returns the number of elements it contains.
In the example code, `Count()` returns `2` because the resulting `query` contains 2 elements containing "a".

```
string[] names = { "Hansel", "Gretel", "Helga", "Gus" };

var query = names.Where(x => x.Contains("a"));

Console.WriteLine(query.Count());
// Output: 2
```

Object Initialization

Values can be provided to a `List` when it is constructed in a process called *object initialization*.
Instead of parentheses, use curly braces after the list's type.
Note that this can ONLY be used at the time of construction.

```
List<string> cities = new List<string> { "Los Angeles", "New York City", "Dubai" };
```

Remove()

Elements of a list can be removed with the `Remove()` method. The method returns `true` if the item is successfully removed; otherwise, `false`.
In the example code, attempting to remove `"Cairo"` returns `false` because that element is not in the `citiesList`.

```
List<string> citiesList = new List<string>();
citiesList.Add("Los Angeles");
citiesList.Add("New York City");
citiesList.Add("Dubai");

result1 = citiesList.Remove("New York City");
// result1 is true

result2 = citiesList.Remove("Cairo");
// result2 is false
```

Clear()

All elements of a list can be removed with the `Clear()` method. It returns nothing.
In the example code, the list is initialized with three items. After calling `Clear()`, there are zero items in the list.

```
List<string> citiesList = new List<string> { "Delhi", "Los Angeles", "Kiev" };
citiesList.Clear();

Console.WriteLine(citiesList.Count);
// Output: 0
```

List Ranges

Unlike elements in a C# array, multiple elements of a C# list can be accessed, added, or removed simultaneously. A group of multiple, sequential elements within a list is called a range.

Some common range-related methods are:

- AddRange()
- InsertRange()
- RemoveRange()

```
string[] african = new string[] { "Cairo", "Johannesburg" };
string[] asian = new string[] { "Delhi", "Seoul" };
List<string> citiesList = new List<string>();

// Add two cities to the list
citiesList.AddRange(african);
// List: "Cairo", "Johannesburg"

// Add two cities to the front of the list
citiesList.InsertRange(0, asian);
// List: "Delhi", "Seoul", "Cairo", "Johannesburg"

// Remove the second and third cities from the list
citiesList.RemoveRange(1, 2);
// List: "Delhi", "Johannesburg"
```