

Lecture 7. Language-integrated query (LINQ)

Programming II

School of Business Informatics

Autumn 2016

*(: Before software can be reusable it first has to be usable
:)*

Lecture 7

Query basics

Introduction to LINQ

Main LINQ operators

LINQ under the hood

A **query** is a request of information from a data source.

Queries are mainly used to filter, order, group, join data or to calculate aggregate characteristics (sum, min, max, etc.)

Queries arise from a subject area

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- Find employees whose contract expires this year
- Get a list of students ordered by their rating
- Get an average number of goals scored in a tournament match

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- Many data sources:
 - Files of different formats
 - Databases
 - Remote services
 - Collections in memory
- Each source has its own interface
- Developer needs to master many specific technologies, libraries and frameworks

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Query basics

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- Introduced in C# 3.0 (VS 2008)
- Unifies data query mechanisms
- Contains over 50 operators that cover typical queries
- Supports two syntactic forms (SQL-like and extension methods)

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- Filtering (Where)
- Sorting (OrderBy, OrderByDescending)
- Grouping (Group)
- Join
- Projection (Select, SelectMany)
- Aggregation (Max, Min, Sum, Count)

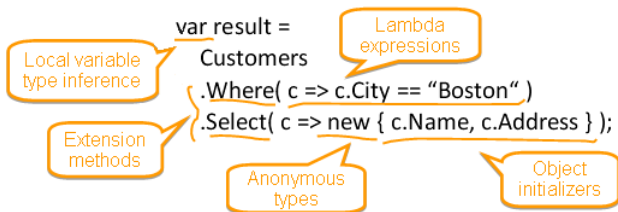
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+ special SQL-like syntax

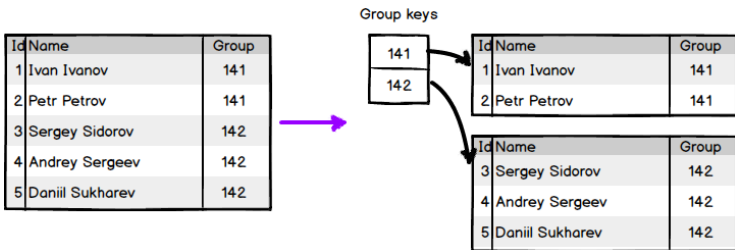
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Join (Inner join / Equijoin)

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Id	Name	Group
1	Ivan Ivanov	141
2	Petr Petrov	142
3	Sergey Sidorov	142

Id	Date	Time	Dir
1	30.10.2015	09:30	<
1	30.10.2015	10:05	>
1	30.10.2015	10:15	<
1	30.10.2015	12:50	>
2	30.10.2015	09:32	<
2	30.10.2015	11:40	>



Id	Name	Group	Date	Time	Dir
1	Ivan Ivanov	141	30.10.2015	09:30	<
1	Ivan Ivanov	141	30.10.2015	10:05	>
1	Ivan Ivanov	141	30.10.2015	10:15	<
1	Ivan Ivanov	141	30.10.2015	12:50	>
2	Petr Petrov	142	30.10.2015	09:32	<
2	Petr Petrov	142	30.10.2015	11:40	>

Group join / left outer join

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Most LINQ operators use deferred execution. This means that a query is not evaluated until the resulting data is required.

```
1 var query = r.GetBlogs()
2   .Where(b => b.Author.StartsWith("J") && b.
   SubscribersNum > 100);
3
4 // The query will be executed on the first iteration
   of foreach
5 foreach (var b in query)
6   Console.WriteLine("Some info about a blog");
```

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Several LINQ operators make immediate execution of the whole query (Min, Max, Sum, ToList and others)

```
1 int num = r.GetBlogs()  
2     .Where(b => b.Author.StartsWith("J") && b.  
3         SubscribersNum > 100)  
4     .Count();
```

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- First, FirstOrDefault
- Last, LastOrDefault
- Single, SingleOrDefault

The versions with “OrDefault” suffix never generate exceptions. In case an item is not found they return a default value of the type.

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- LINQ is based on a set of extension methods declared inside the Enumerable static class
- These methods extend the IEnumerable interface thus they are available for all containers
- To access LINQ operators a program should contain the “using System.Linq” directive (added by default in Visual Studio)

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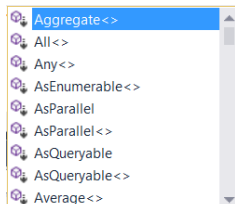
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- In C# v3.0 an elegant way to extend existing classes was introduced - extension methods
- Only methods (not fields or properties) can be added to an existing class
- See extension methods project in the supplement



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- Iterators allow forming a collection of items, one item at a time
- Deferred execution is enabled through iterators
- Very non-intuitive. They seem to allow entering into the middle of a method
- An iterator method returns an `IEnumerable<T>` and contains special **yield** statements

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```

1  static IEnumerable<int> Power(int number, int
    exponent)
2  {
3      int result = 1;
4
5      for (int i = 0; i < exponent; i++)
6      {
7          result = result * number;
8          yield return result;
9      }
10 }
11
12 // Call to Power(2, 6) produces 2 4 8 16 32 64
    
```