LINQ

(Language-Integrated Query)

.NET

Language-Integrated Query (LINQ) *is the name for a set of Libraries and classes based on the integration of query capabilities directly into the C# language.*

https://docs.microsoft.com/en-us/dotnet/csharp/linq/

LINQ - Overview

https://docs.microsoft.com/en-us/dotnet/csharp/linq/
https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/concepts/linq/

Traditionally, queries against data (in a DB or file) have been expressed as simple strings without type-checking at compile time or IntelliSense.

You'd have to learn a different query language for each type of data source:

- SQL databases,
- XML documents,
- various Web services, etc.

- With ***LINQ***, a query is a language construct, just like ***classes***, ***methods***, ***events***.
- Query expressions are written in a declarative query syntax.
- You can perform filtering, ordering, and grouping operations on data sources with minimum code.
- You use the same basic query expression patterns to query and transform data in SQL databases, ADO.NET Datasets, XML documents and streams, and .NET collections.

LINQ - Overview

https://docs.microsoft.com/en-us/dotnet/csharp/linq/

A complete LINQ query operation includes:

- creating a data source,
- defining the query expression, and
- executing the query in a ***foreach*** statement.

There are two ***Query Expression*** syntaxes:

- Query Syntax
- Method-Based Syntax

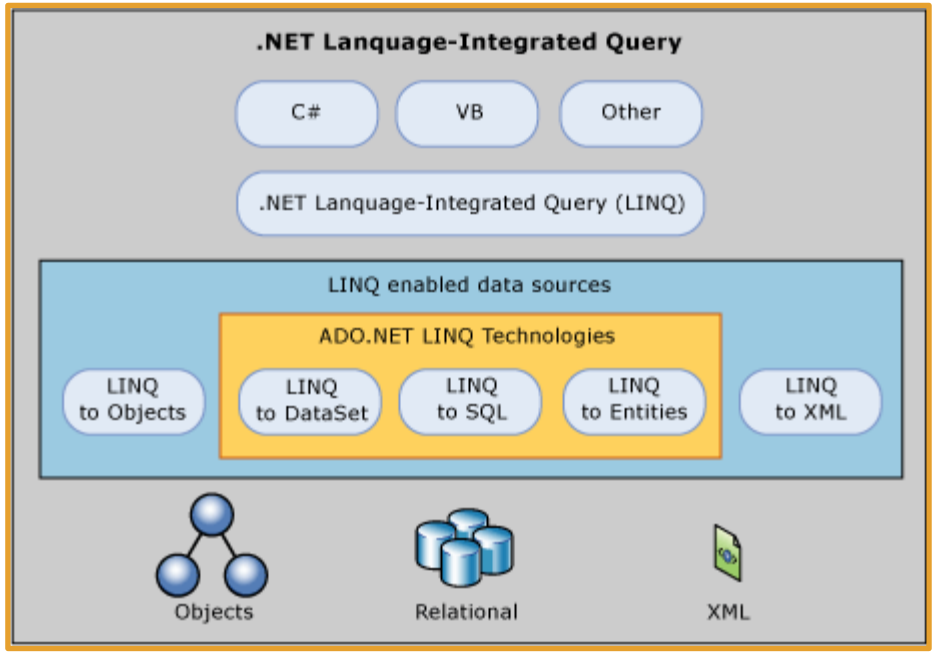
```
class LINQQueryExpressions
{
    static void Main()
    {

        // Specify the data source.
        int[] scores = new int[] { 97, 92, 81, 60 };

        // Define the query expression.
        IEnumerable<int> scoreQuery =
            from score in scores
            where score > 80
            select score;

        // Execute the query.
        foreach (int i in scoreQuery)
        {
            Console.Write(i + " ");
        }
    }
}
// Output: 97 92 81
```

LINQ and ADO.NET (FYI only)

https://docs.microsoft.com/en-us/dotnet/framework/data/adonet/linq-and-ado-net

Transferring data from SQL tables into objects in memory is often tedious and error-prone. The LINQ provider implemented by LINQ to DataSet and LINQ to SQL converts the source data into IEnumerable-based object collections. The programmer always views the data as an IEnumerable collection, both when you query and when you update. Full IntelliSense support is provided for writing queries against those collections.

There are three separate ADO.NET Language-Integrated Query (LINQ) technologies: LINQ to DataSet, LINQ to SQL, and LINQ to Entities. LINQ to DataSet provides richer, optimized querying over the DataSet and LINQ to SQL enables you to directly query SQL Server database schemas, and LINQ to Entities allows you to query an Entity Data Model.



LINQ – Query Expression Basics

A ***query*** is a set of instructions that describes what data to retrieve from a given data source (or sources) and what type and organization the returned data should have. A ***query expression*** is a query expressed in ***query*** syntax.

The source data is organized logically as a sequence of elements of the same kind. For example:

- a SQL database table contains a sequence of rows.
- In an XML file, there is a "sequence" of XML elements
- An ‘in-memory’ collection contains a sequence of objects.

A ***query expression*** must begin with a from clause and must end with a select or group clause. Between the first from clause and the last select or group clause, it can contain one or more of: where, orderby, join, let and even more from clauses. You can also use the into keyword to enable the result of a join or group clause to serve as the source for additional ***query*** clauses in the same query expression.

From an application's viewpoint, the specific ***type*** and structure of the original source data is not important.

The application always sees the source data as an IEnumerable<T> or IQueryable<T> collection.

LINQ – Query Expression Examples

https://docs.microsoft.com/en-us/dotnet/csharp/linq/query-expression-basics
https://docs.microsoft.com/en-us/dotnet/csharp/linq/query-expression-basics#what-is-a-query-expression

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A query can:

1. Retrieve a subset of the elements to produce a new sequence without modifying the individual elements. The query may then sort or group the returned sequence in various ways
2. Retrieve a sequence of elements but transform them to a new type of object.
3. Retrieve a singleton value about the source data, such as:
   - The number of elements that match a certain condition.
   - The element that has the greatest or least value.
   - The first element that matches a condition, or the sum of particular values in a specified set of elements.

```
IEnumerable<int> highScoresQuery =
    from score in scores
    where score > 80
    orderby score descending
    select score;
```

```
IEnumerable<string> highScoresQuery2 =
    from score in scores
    where score > 80
    orderby score descending
    select $"The score is {score}";
```

```
int highScoreCount =
    (from score in scores
     where score > 80
     select score)
     .Count();
```

LINQ – Query Variables

https://docs.microsoft.com/en-us/dotnet/csharp/linq/query-expression-basics#query-variable

A ***query variable*** is any variable that stores a ***query*** instead of the result of a ***query***.

A ***query variable*** is always an ***enumerable type*** that will produce a sequence of elements when it is iterated over in a ***foreach*** statement or a direct call to its ***IEnumerator.MoveNext*** method.

```
static void Main()
{
    // Data source.
    int[] scores = { 90, 71, 82, 93, 75, 82 };

    // Query Expression.
    IEnumerable<int> scoreQuery = //query variable
        from score in scores //required
        where score > 80 // optional
        orderby score descending // optional
        select score; //must end with select or group

    // Execute the query to produce the results
    foreach (int testScore in scoreQuery)
    {
        Console.WriteLine(testScore);
    }
}
// Outputs: 93 90 82 82
```

LINQ – Additional Practice

Starting a query expression

select clause

Filtering, ordering, and joining

orderby clause

let clause

Ending a query expression

*Continuations with "**into**“*

where clause

join clause

Subqueries in a query expression

LINQ – Method Expressions

https://docs.microsoft.com/en-us/dotnet/csharp/programming-guide/concepts/linq/query-syntax-and-method-syntax-in-linq

As a rule, when you write ***LINQ*** queries, it is recommended to use ***query syntax*** whenever possible and ***method syntax*** whenever necessary.

Some queries must be expressed as method calls. Such as:

- to retrieve the number of elements that match a specified condition.
- to retrieve the element that has the maximum value in a source sequence.

```
class QueryVMethodSyntax
{
    static void Main()
    {
        int[] numbers = { 5, 10, 8, 3, 6, 12};

        //Query syntax:
        IEnumerable<int> numQuery1 =
            from num in numbers
            where num % 2 == 0
            orderby num
            select num;

        //Method syntax:
        IEnumerable<int> numQuery2 = numbers.Where(num => num % 2 == 0).OrderBy(n => n);

        foreach (int i in numQuery1)
        {
            Console.Write(i + " ");
        }
        Console.WriteLine(System.Environment.NewLine);
        foreach (int i in numQuery2)
        {
            Console.Write(i + " ");
        }

        // Keep the console open in debug mode.
        Console.WriteLine(System.Environment.NewLine);
        Console.WriteLine("Press any key to exit");
        Console.ReadKey();
    }
}
/*
    Output:
    6 8 10 12
    6 8 10 12
 */
```

LINQ – Activity

https://docs.microsoft.com/en-us/dotnet/csharp/tutorials/working-with-linq

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1. Complete the tutorial at the above link.
2. Then change all queries in Method Syntax.