LINQ

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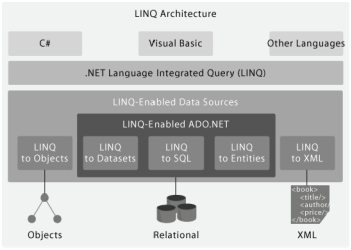
Introduction

- LINQ Architecture



Query Expression

- SQL-like:
  from s in names
  where s.Length == 5 orderby sselect s.ToUpper();
- OO-style:
  names.Where(s => s.Length==5)
  .OrderBy(s => s)
  .Select(s => s.ToUpper());
- Where, OrderBy, and Select are operators. The arguments to these operators are Lambda Expression.

Lambda Expressions

- Examples:
  - s => s.Length == 5
- Executable function
  - Anonymous functional. Can be assigned to a delegate variable.
  - No need to indicate the types
  - Can be passed to methods as parameters.
- Expression Tree
  - Efficient in-memory data representations of lambda expressions
  - Changing the behaviors of the expressions
  - Applying your own optimization

Methods Extension

You can control not only by Lambda Expression, but also by methods extension

```
public static class Enumerable {
public static IEnumerable<T> Where<T>(
this IEnumerable<T> source,
Func<T, bool> predicate) {

foreach (T item in source)
if (predicate(item))
yield return item;
}
}
```

LINQ Operations

- Join
  - When there is relationship (e.g. foreign key) between two tables, no explicit join operation is needed
  - Using dot notation to access the relationship properties, and navigate all the matching objects.

```
var q =
from o in db.Orders where o.Customer.City == "London" select o;
```

  - To join any two data sources on any attribute, you need an explicit join operation.
    - var query = names.Join(people, n => n, p => p.Name, (n,p) => p);

    The lambda expression for shaping (n, p) => p will be applied on each matching pairs.

LINQ Operations (cont.)

- Group Join
  - The lambda expression for shaping is applied on the outer element and the set of all the inner elements that matches the outer one.
  - Shape the result at a set level

```
var query = names.GroupJoin(people, n => n, p => p.Name,
(n, matching) => new { Name = n, Count = matching.Count() })
```

LINQ Operations (cont.)

- Select Many
  - Each object in the result set may contain a collection or array
  - Select many help decompose the structure and flatten the result

```
var query = names.SelectMany(n =>
people.Where(p => n.Equals(p.Name))
```

  - All the elements could be traversed in one foreach loop.
- Aggregation
  - Standard aggregation operators.
    Min, Max, Sum, Average.
    - Int totalLength=names.Sum(s => s.Length);
  - General purpose (generic) operator.

```
static U Aggregate<T, U>(this IEnumerable<T> source,
U seed, Func<U, T, U> func)
```

Spotlight

- IQueryable<T> interface will defer the evaluation of the query.
- An expression tree will represent all the deferred queries as a whole.
- Several operations could be “merged”, only one SQL query will be generated and sent to database (Similar to Django)
- Multi-level defer

Spotlight (cont.)

- Nested defer

```
var q =
    from c in db.Customers
    where c.City == "London"
    select new { c.ContactName, c.Phone };
var q2 =
    from c in q.AsEnumerable()
    select new MyType {
        Name = DoNameProcessing(c.ContactName),
        Phone = DoPhoneProcessing(c.Phone)
    };
```

What if you want the intermediate result?

```
Dim lastName As String = "Simpson"
Dim persons = From p In personList _ Where p.LastName = lastName _ Select p
lastName = "Flanders"
For Each pers In persons Console.WriteLine("{0} {1}", pers.FirstName, pers.LastName)
```

Spotlight (cont.)

- Defer Execution
  - Advantages
    - Performance!
    - Query dependency!
  - Disadvantages
    - Divide one query into multiple ones
    - You iterate the result set 100 times, the query will be executed 100 times.
    - Users have to be very careful

Spotlight (cont.)

- Object of new type could be generated on the fly without first define it. This is useful for projection to select one or more fields of another structure.
- The type will be dynamically generated with setters and getters to corresponding members. Some common methods is also provided.
- No other methods will be added to this type. But that is already enough!
- The object is created and initialized by Anonymous Object Initializer.

LINQ to SQL

- Data Model

```
[Table(Name="Customers")]
public class Customer
{
      [Column(Id=true)]
      public string CustomerID;
      ...
      private EntitySet<Order> _Orders;
      [Association(Storage="_Orders", OtherKey="CustomerID")]
      public EntitySet<Order> Orders {
            get { return this._Orders; }
            set { this._Orders.Assign(value); }
      }
}
```

- LINQ to SQL helps connect to relational and manipulate the relational data as objects in memory. It achieves this by translating the operations into SQL statements.

Consistency

- Every object will be tracked by LINQ the moment it is loaded from database.
- The tracking mechanism monitor the manipulation on relationship properties. Once you modify one side of the relationship, LINQ will modify the other to keep it consistent.
- When an object is deleted, it could still exist in memory, but it will not cause inconsistency.

Concurrency

- Optimistic concurrency
- Conflict checking when SubmitChanges() is called
- By default, transaction will abort and an exception will be thrown when a conflict is detected.
- User can handle the conflict in the exception catch block.
- User can set whether or not to detect the conflict when one column get updated.

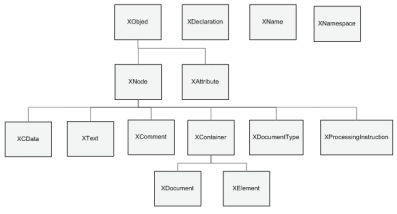
Transaction/Update

- When update, first check whether new object is added (by tracking mechanism) if yes, insert statement will be generated. What does Django do here?
- Modification will not hit the database until the SubmitChanges() method is called
- All operations will be translated into SQL statements
- All modifications will be encapsulated into a transaction.

Transaction/Update (cont.)

- If an exception is throw during the update, all the changes will be rolled back
- One SubmitChanges() is actually one transaction. (pros and cons?)
- Users can also explicitly indicate a new transaction scope.

LINQ to XML



- http://msdn.microsoft.com/en-us/library/bb308960.aspx

LINQ to XML

- LINQ to XML

```
var query = from p in people
            where p.CanCode
            select new XElement("Person",
                                new XAttribute("Age", p.Age),
                                p.Name);
```

- XML to LINQ

```
var x = new XElement("People",
                     from p in people
                     where p.CanCode
                     select
                         new XElement("Person",
                                      new XAttribute("Age", p.Age),
                                      p.Name));
```

Performance

- LINQ has more control and efficiency in O/R Mapping than NHibernate
  - LINQ: Externl Mapping or Attribute Mapping
  - NHibernate: Externl Mapping
- Because of mapping, LINQ is lower than database tools such as SqlDataReader or SqlDataAdapter
  - In large dataset, their performance are more and more similar

- Thanks!