ADO.NET

.NET Data Access and Manipulation

Overview

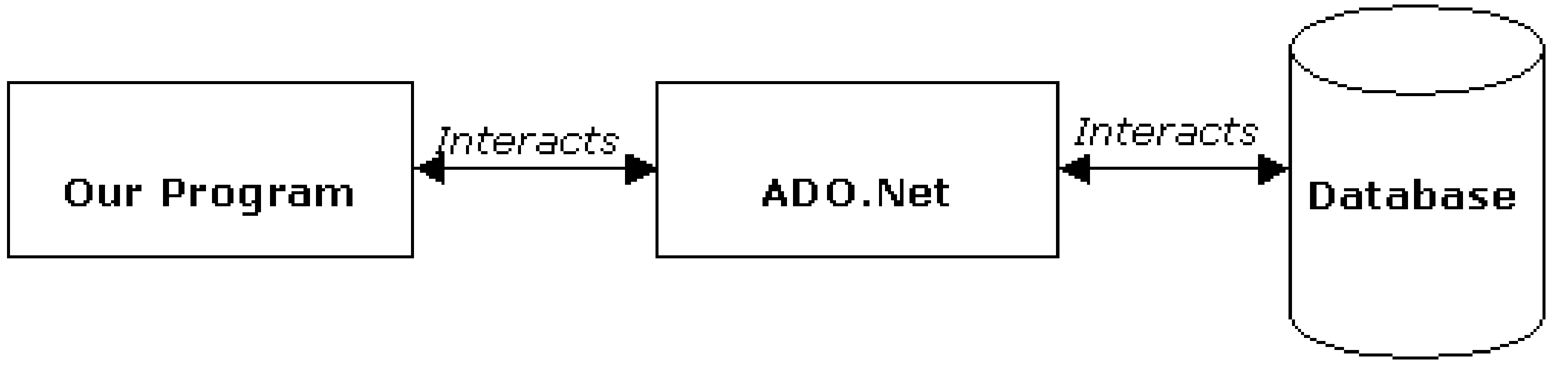
- What is ADO.NET?
- Disconnected vs. connected data access models
- ADO.NET Architecture
- ADO.NET Core Objects
- Steps of Data Access
- Advanced Techniques and UI Tools

What is ADO.NET?

- A data-access technology that enables applications to connect to data stores and manipulate data contained in them in various ways
- Former version was ADO (ActiveX Data Object)

What is ADO.NET?

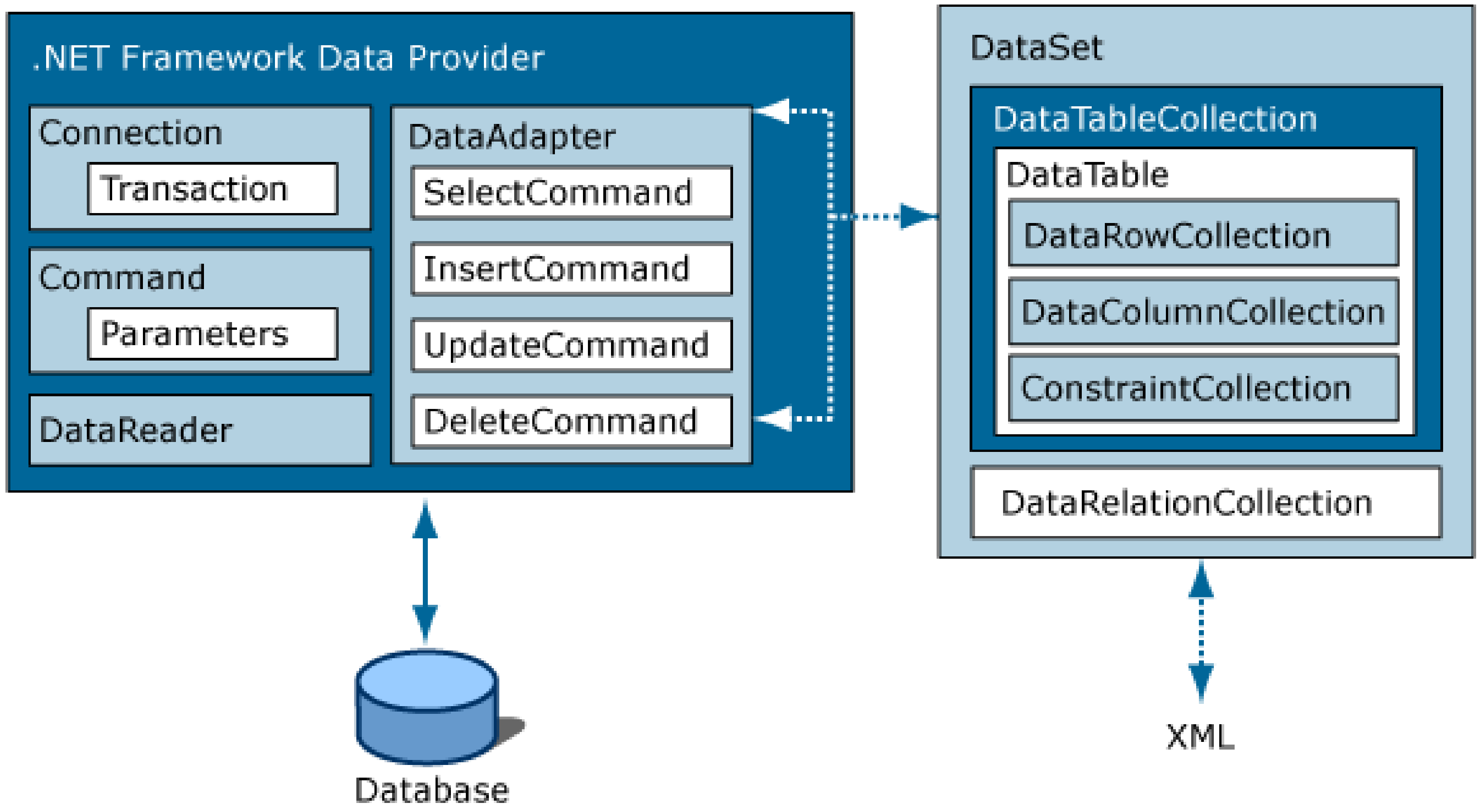
- An object oriented framework that allows you to interact with database systems



Objective of ADO.NET

- Support disconnected data architecture,
- Tight integration with XML,
- Common data representation
- Ability to combine data from multiple and varied data sources
- Optimized facilities for interacting with a database

ADO.NET Architecture



ADO.NET Core Objects

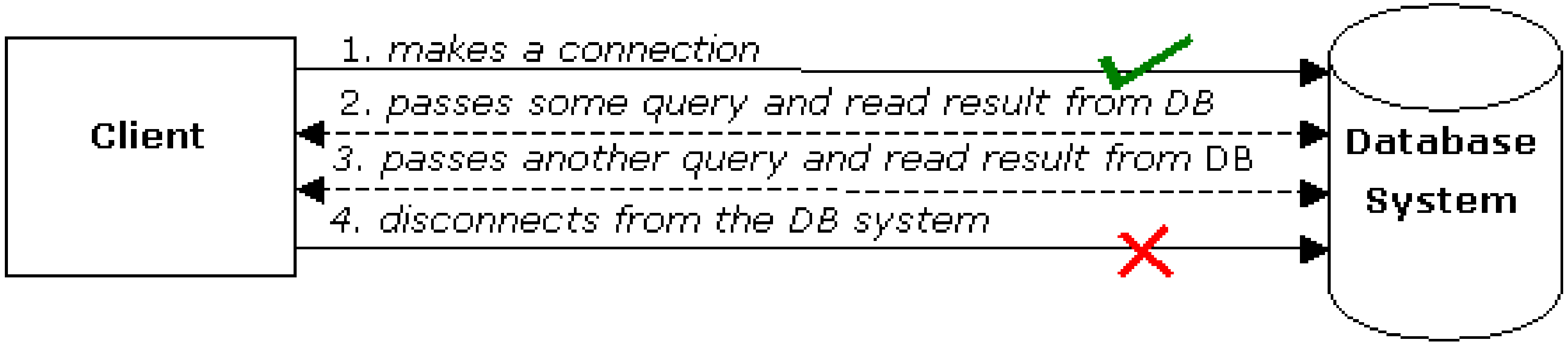
- Core namespace: System.Data
- .NET Framework data providers:

Data Provider	Namespace
SQL Server	`System.Data.SqlClient`
OLE DB	`System.Data.OleDb`
ODBC	`System.Data.Odbc`
Oracle	`System.Data.OracleClient`

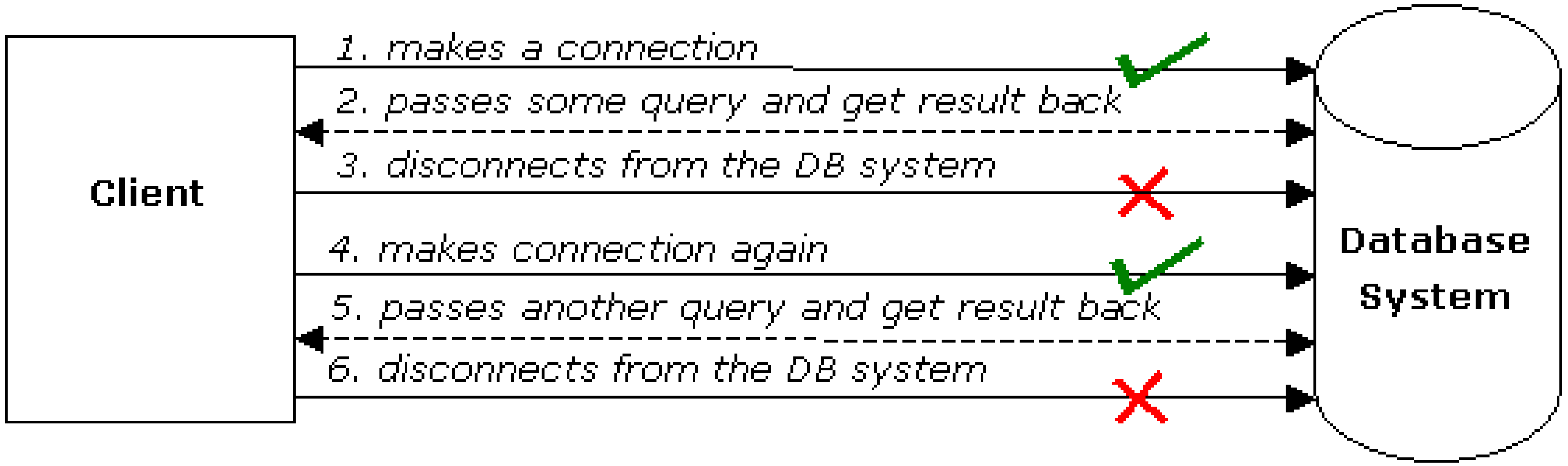
ADO.NET Core Objects

Object	**Description**
`Connection`	Establishes a connection to a specific data source. (Base class: DbConnection)
`Command`	Executes a command against a data source. Exposes **Parameters** and can execute within the scope of a **Transaction** from a **Connection**. (The base class: DbCommand)
`DataReader`	Reads a forward-only, read-only stream of data from a data source. (Base class: DbDataReader)
`DataAdapter`	Populates a **DataSet** and resolves updates with the data source. (Base class: DbDataAdapter)
`DataTable`	Has a collection of DataRows and DataColumns representing table data, used in disconnected model
`DataSet`	Represents a cache of data. Consists of a set of DataTables and relations among them

Connected Data Access Model


Client
1. makes a connection
2. passes some query and read result from DB
3. passes another query and read result from DB
4. disconnects from the DB system
Database System

Disconnected Data Access Model


Client
1. makes a connection
2. passes some query and get result back
3. disconnects from the DB system
4. makes connection again
5. passes another query and get result back
6. disconnects from the DB system
Database System

Pros and Cons

	Connected	**Disconnected**
Database Resources	-	+
Network Traffic	-	+
Memory Usage	+	-
Data Access	-	+

Steps of Data Access: Disconnected Environment

- Defining the connection string
- Defining the connection
- Defining the command
- Defining the data adapter
- Creating a new DataSet object
- SELECT -> fill the dataset object with the result of the query through the data adapter
- Reading the records from the DataTables in the datasets using the DataRow and DataColumn objects
- UPDATE, INSERT or DELETE -> update the database through the data adapter

EXAMPLE

```
using System;
using System.Data;
using System.Data.SqlClient;

namespace SampleClass
{
   class Program
   {
       static void Main(string[] args)
       {
          string connStr =
                    Properties.Settings.Default.connStr;
         SqlConnection conn = new SqlConnection(connStr);
          string queryString = "SELECT * from titles;";
         SqlDataAdapter da = new
                          SqlDataAdapter(queryString,conn);

          DataSet ds = new DataSet();
          da.fill(ds);
          // Work on the data in memory using
          // the DataSet (ds) object
       }
     }
}
```

Disconnected – Update, Delete, Insert

```
SqlDataAdapter da = new SqlDataAdapter();
DataSet ds = new DataSet();
SqlCommandBuilder cmdBuilder = new
SqlCommandBuilder(da);
da.Fill(ds);
```

INITIAL CODE

```
DataRow dr = ds.Tables[0].Rows[0];
dr.Delete();
da.UpdateCommand = builder.GetUpdateCommand();
da.Update(ds);
```

DELETE

```
DataRow dr = ds.Tables[0].Rows[0];
dr["CustomerName"] = "John";
da.UpdateCommand = builder.GetUpdateCommand();
da.Update(ds);
```

UPDATE

```
DataRow dr = ds.Tables[0].NewRow();
dr["CustomerName"] = "John";
dr["CustomerSurName"] = "Smith";
ds.Tables[0].Rows.Add(dr);
da.UpdateCommand = builder.GetUpdateCommand();
da.Update(ds);
```

INSERT

Steps of Data Acces : Connected Environment

- Create connection
- Create command (select-insert-update-delete)
- Open connection
- If SELECT -> use a **`DataReader`** to fetch data
- If UPDATE,DELETE, INSERT -> use command object's methods
- Close connection

```
static void Main()
{
    string connectionString =
                        Properties.Settings.Default.connStr;
    string queryString = "SELECT CategoryID, CategoryName FROM
                                            dbo.Categories;";
    SqlConnection connection = new
                                 SqlConnection(connectionString);

    SqlCommand command = new SqlCommand(queryString,connection);
    try
    {
        connection.Open();
        SqlDataReader reader = command.ExecuteReader();
        while (reader.Read())
        {
            Console.WriteLine("\t{0}\t{1}",reader[0],reader[1]);
        }
        reader.Close();
         connection.close();
    }
    catch (Exception ex)
    {
        Console.WriteLine(ex.Message);
    }
}
```

EXAMPLE

Connected – Update, Delete, Insert

- Command class core methods:
  - **`ExecuteNonQuery`** : Executes a SQL statement against a connection object
  - **`ExecuteReader`**: Executes the CommandText against the Connection and returns a **`DbDataReader`**
  - **`ExecuteScalar`**: Executes the query and returns the first column of the first row in the result set returned by the query

Connected – Update, Delete, Insert

```
string connString =
       Properties.Settings.Default.connStr;
SqlConnection conn = new
        SqlConnection(connString);
SqlCommand cmd = new SqlCommand("delete from
    Customers" + "where custID=12344", conn);
conn.Open();
cmd.ExecuteNonQuery();
conn.Close();
```

Can be an update or insert command

Choosing a DataReader or a Dataset

- The type of functionality application requires should be considered
- Use a dataset to:
  - Cache data locally in your application so that you can manipulate it
  - Remote data between tiers or from an XML Web service
  - Interact with data dynamically such as binding to a Windows Forms control or combining and relating data from multiple sources
  - Perform extensive processing on data without requiring an open connection to the data source, which frees the connection to be used by other clients
- If readonly data is needed use **`DataReader`** to boost performance

Best Practices

- Don’t create a new connection string for every code connecting to DB
- Use app.config file to keep your connection strings through the application scope
  1. Right click on project and select properties
  2. Select settings from the left tabbed menu
  3. add the connection string to the table and save project, Name field is the name of the string to access at runtime
- Accessing settings at runtime:

```
string connStr = Properties.Settings.Default.connStr;
```

- You can keep any other variable to reach at runtime using this technique

After .NET Framework 2.0

- To minimize the code written by developers new UI tools and objects have been intoduced with .NET Framework 2.0

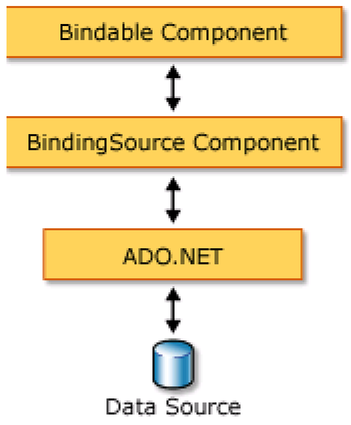
After .NET Framework 2.0

- Strongly Typed vs Untyped Datasets
  - *Untyped*: DataSet and DataTables included are created at runtime completely using code
  - *Strongly Typed*: Dataset is created at design time, it is defined by an xsd schema

After .NET Framework 2.0

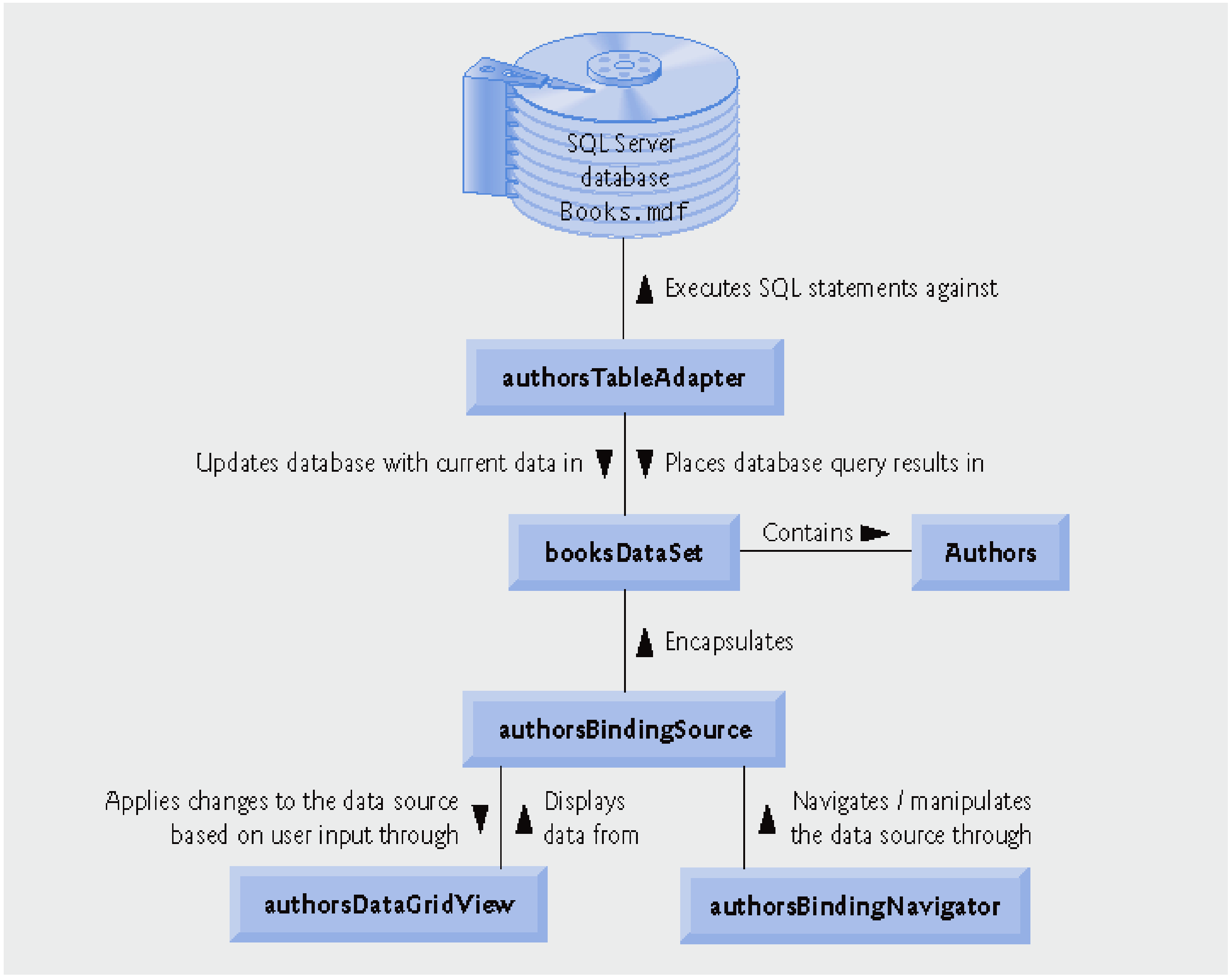
- TableAdapter
  - provides communication between your application and a database
  - Provides update/delete/insert functions
  - Encapsulates a SQLDataAdapter object
  - MSDN link:
  - http://msdn.microsoft.com/en-us/library/bz9tthwx(VS.80).aspx

After .NET Framework 2.0



- BindingSource
  - Binds UI components to a strongly typed Dataset
  - Ex: Binds a DataGridView to a DataTable
  - Sets a DataSet as a datasource and datamember as a dataset table
  - EndEdit() method: Applies changes made to data through a GUI control to the data source bound to that control
  - MSDN link:
  - http://msdn.microsoft.com/en-us/library/xxxf124e(VS.80).aspx

After .NET Framework 2.0


SQL Server database Books.mdf
Executes SQL statements against
authorsTableAdapter
Updates database with current data in
Places database query results in
booksDataSet
Contains
Authors
Encapsulates
authorsBindingSource
Applies changes to the data source based on user input through
Displays data from
Navigates / manipulates the data source through
authorsDataGridView
authorsBindingNavigator

An example of databinding model

After .NET Framework 2.0

- Binding Navigator
  - Used for creating a standardized means for users to search and change data on a Windows Form
  - Used with BindingNavigator with the BindingSource component to enable users to move through data records on a form and interact with the records
  - MSDN link:
  - http://msdn.microsoft.com/en-us/library/8zhc8d2f(VS.80).aspx

After .NET Framework 2.0

- TableAdapterManager
  - New component in Visual Studio 2008
  - Builds upon existing data features (typed datasets and TableAdapters) and provides the functionality to save data in related data tables.
  - Manages inserts/updates/deletes without violating the foreign-key constraints
  - MSDN link:
  - http://msdn.microsoft.com/en-us/library/bb384426.aspx

Hands On: Create a DB Navigator

- Create a DB navigator with UI components and wizards

Hands On: Custom queries

- Create a filter mechanism on an DataGridView with using custom queries
- Manage datatables and TableAdapters

Hands On: Managing multiple tables

- Create a navigation system with using the relations between two tables