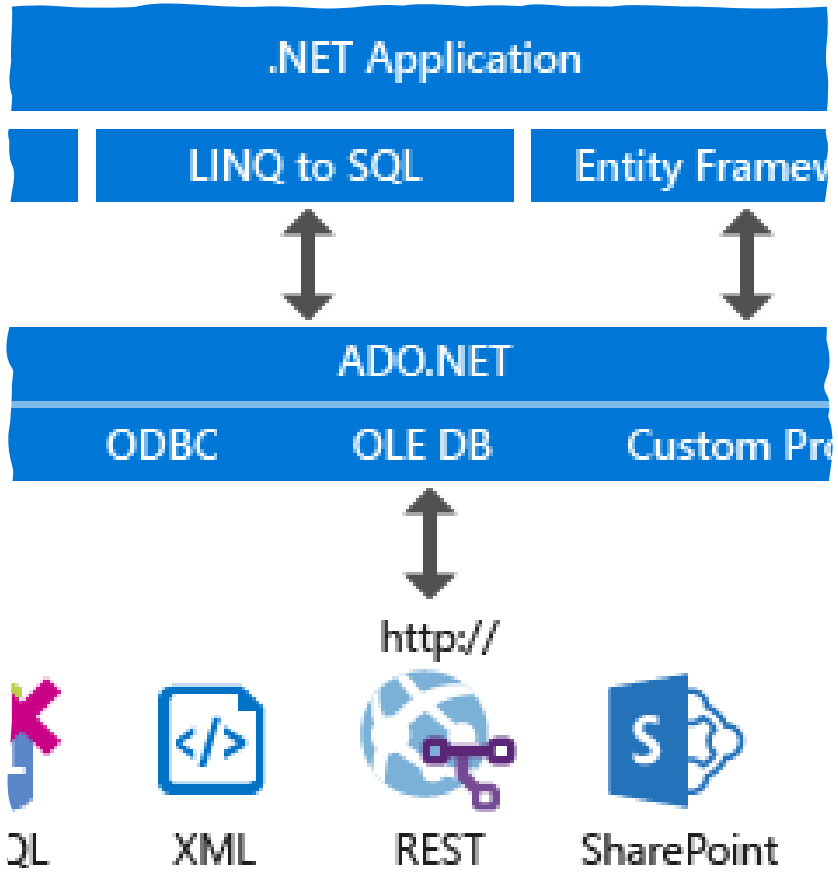
C# and SQL

CRUD (Create, Read, Update, and Delete)

CRUD operations are fundamental in database management and essential for any application that interacts with a database, whether a web application, desktop software, or a mobile app. These operations provide the basic building blocks for managing data throughout its lifecycle in a database system.

- **Create:** This operation involves adding new data records or entries to a database. In the context of a database, it usually means inserting new rows into a table to store new information.
- **Read:** The Read operation involves retrieving or querying existing data from a database. It is used to access and display data stored in the database. In SQL, this is often done using SELECT statements.
- **Update:** Updating refers to modifying or changing existing data in the database. Typically, this is done to update the values of specific fields within a record or row.
- **Delete:** The Delete operation involves removing data or records from the database. It is used to eliminate data that is no longer needed or is obsolete.

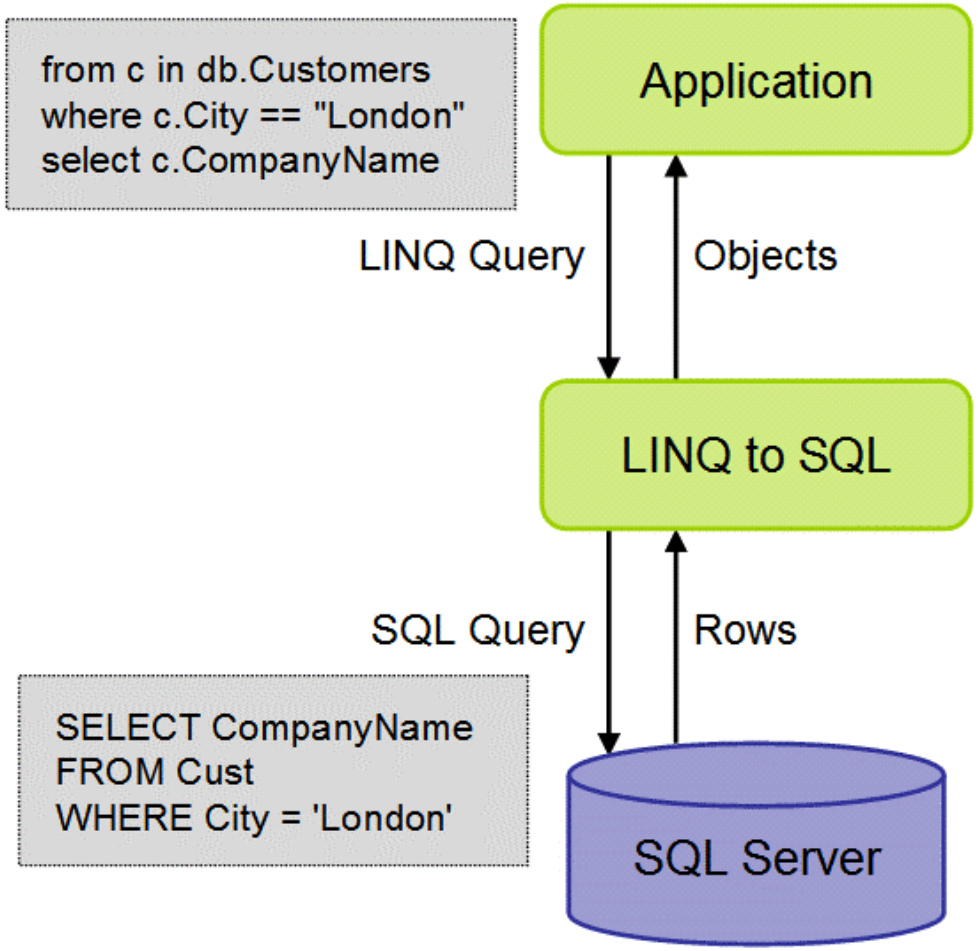
ADO.NET Architecture



- ADO.NET provides consistent access to data sources such as SQL Server and XML, and to data sources exposed through OLE DB and ODBC.
- Data-sharing consumer applications can use ADO.NET to connect to these data sources and retrieve, handle, and update the data that they contain.
- ADO.NET separates data access from data manipulation into discrete components that can be used separately or in tandem.

ADO.NET Architecture LINQ to SQL

- In LINQ to SQL, the data model of a relational database is mapped to an object model expressed in the programming language of the developer.
- When the application runs, LINQ to SQL translates into SQL the language-integrated queries in the object model and sends them to the database for execution.
- When the database returns the results, LINQ to SQL translates them back to objects that you can work within your own programming language.



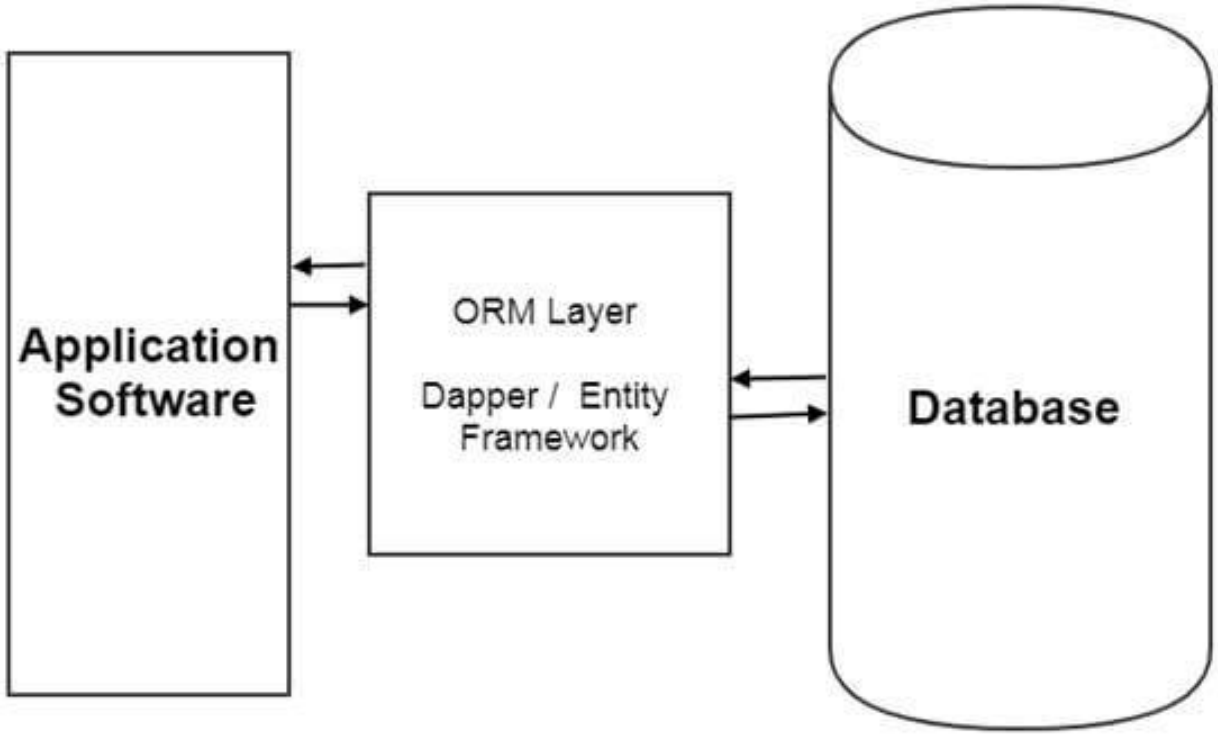
Standard ADO.NET C# code for retrieving data from a database and materialising it as a **collection of Product objects**:

SQL database table

- ProductId – int
- ProductName – varchar
- SupplierId – int
- CategoryId – int
- …

```
var sql = "select * from products";
var products = new List<Product>();
using (var connection = new SqlConnection(connString))
{
    connection.Open();
    using (var command = new SqlCommand(sql, connection))
    {
        using (var reader = command.ExecuteReader())
        {
            var product = new Product
            {
                ProductId = reader.GetInt32(reader.GetOrdinal("ProductId")),
                ProductName = reader.GetString(reader.GetOrdinal("ProductName")),
                SupplierId = reader.GetInt32(reader.GetOrdinal("SupplierId")),
                CategoryId = reader.GetInt32(reader.GetOrdinal("CategoryId")),
                QuantityPerUnit = reader.GetString(reader.GetOrdinal("QuantityPerUnit")),
                UnitPrice = reader.GetDecimal(reader.GetOrdinal("UnitPrice")),
                UnitsInStock = reader.GetInt16(reader.GetOrdinal("UnitsInStock")),
                UnitsOnOrder = reader.GetInt16(reader.GetOrdinal("UnitsOnOrder")),
                ReorderLevel = reader.GetInt16(reader.GetOrdinal("ReorderLevel")),
                Discontinued = reader.GetBoolean(reader.GetOrdinal("Discontinued")),
                DiscontinuedDate = reader.GetDateTime(reader.GetOrdinal("DiscontinuedDate"))
            };
            products.Add(product);
        }
    }
}
```

ORM (Object Relational Mapping Database Tools) Layer



- ORM layer **maps database tables to C# entities and vice versa**.
- We have many ORM libraries available in C#, out of which the below are some main libraries.
  - Entity framework
  - Dapper
  - Nhibernate

https://www.freecodecamp.org/news/what-is-an-orm-the-meaning-of-object-relational-mapping-database-tools/

Dapper

https://dappertutorial.net/

Dapper

- Dapper is a micro-ORM (Object-Relational Mapping) library for .NET.
- It provides a lightweight and efficient way to work with databases, including MSSQL.
- Dapper maps database query results to C# objects.
- It automates the process, reducing the need for manual data mapping code.
- Resulting objects closely resemble your database schema, simplifying development.
- Dapper was written in C# and is a popular choice for data access in C# applications because of its simplicity and efficiency.
- Dapper does not translate queries written in .NET languages to SQL like a full-blown ORM. So, you need to be comfortable writing queries in SQL or have someone write them for you.

https://www.learndapper.com/

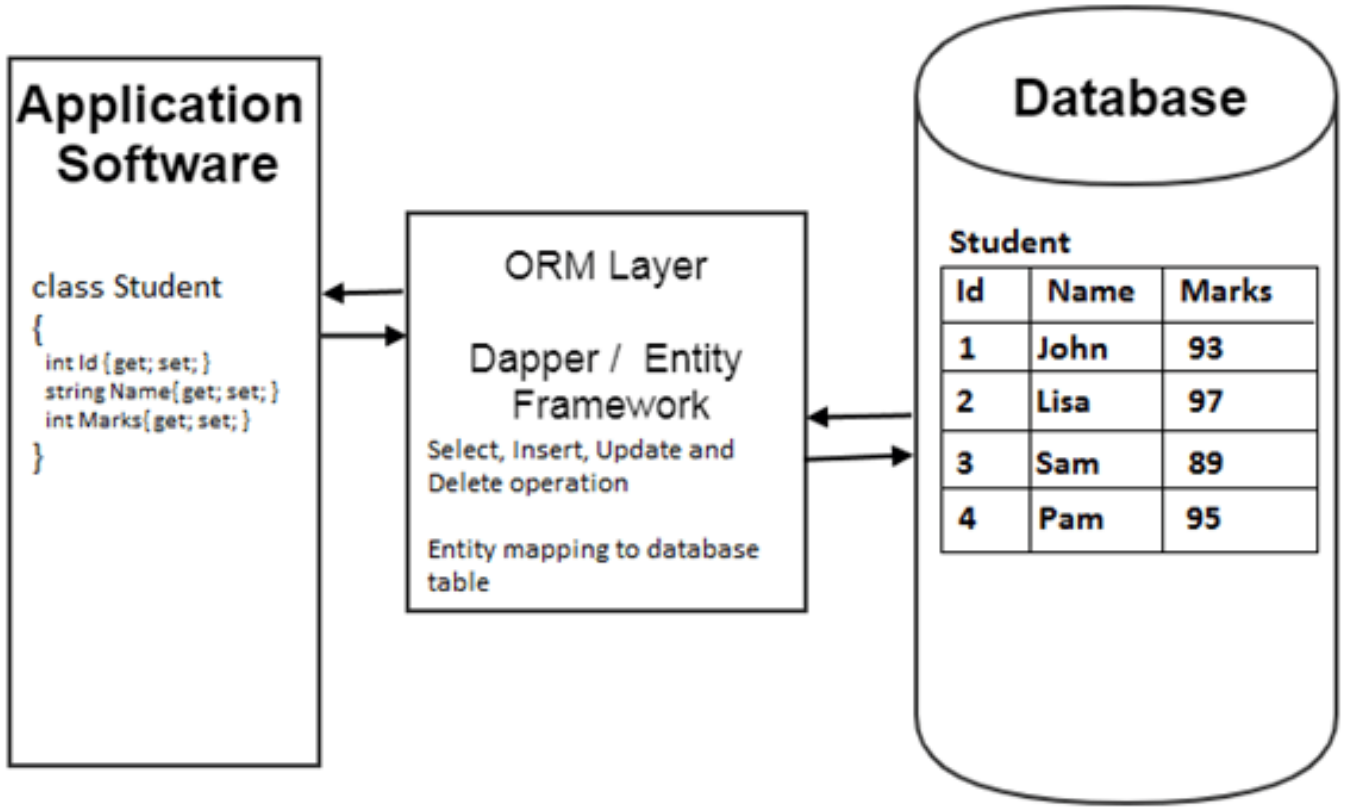
Standard ADO.NET C# code for retrieving data from a database

```
var sql = "select * from products";
var products = new List<Product>();
using (var connection = new SqlConnection(connString))
{
    connection.Open();
products = connection.Query<Product>(sql).ToList();
}
```

```
            var product = new Product
            {
                ProductId = reader.GetInt32(reader.GetOrdinal("ProductId")),
                ProductName = reader.GetString(reader.GetOrdinal("ProductName")),
                SupplierId = reader.GetInt32(reader.GetOrdinal("SupplierId")),
                CategoryId = reader.GetInt32(reader.GetOrdinal("CategoryId")),
                QuantityPerUnit = reader.GetString(reader.GetOrdinal("QuantityPerUnit")),
                UnitPrice = reader.GetDecimal(reader.GetOrdinal("UnitPrice")),
                UnitsInStock = reader.GetInt16(reader.GetOrdinal("UnitsInStock")),
                UnitsOnOrder = reader.GetInt16(reader.GetOrdinal("UnitsOnOrder")),
                ReorderLevel = reader.GetInt16(reader.GetOrdinal("ReorderLevel")),
                Discontinued = reader.GetBoolean(reader.GetOrdinal("Discontinued")),
                DiscontinuedDate = reader.GetDateTime(reader.GetOrdinal("DiscontinuedDate"))
            };
            products.Add(product);
        }
    }
}
```

Dapper methods

- Execute
- Query
- QueryFirstOrDefault
- QuerySingle
- QuerySingleOrDefault
- QueryMultiple



Is Dapper a real ORM?

- **Dapper falls into a family of tools known as micro-ORMs.** These tools perform only a subset of the functionality of full-blown Object Relations Mappers, such as Entity Framework Core, but Dapper is known for its speed and simple implementation compared to others.
- Dapper concentrates its efforts on the **O** and **M** of *ORM* - **O**bject **M**apping.

	Micro ORM	ORM
Map queries to objects	✔	✔
Caching results	✘	✔
Change tracking	✘ [1]	✔
SQL generation	✘ [2]	✔
Identity management	✘	✔
Association management	✘	✔
Lazy loading	✘	✔
Unit of work support	✘	✔
Database migrations	✘	✔

Dapper SQL Server

Using Dapper to query SQL Server is straightforward. The first step is to install Microsoft.Data.SqlClient NuGet package.

```
// Connect to the database
using (var connection = new SqlConnection(connectionString))
{
    // Create a query that retrieves all books with an author name of "John Smith"
    var sql = "SELECT * FROM Books WHERE Author = @authorName";

    // Use the Query method to execute the query and return a list of objects
    var books = connection.Query<Book>(sql, new { authorName = "John Smith"}).ToList();
}
```

Connection

To work with the data in a database, the first obvious step is the connection. The connection to a database normally consists of the below-mentioned parameters.

- **Database name or Data Source** – The first important parameter is the database name to which the connection needs to be established. Each connection can only work with one database at a time.
- **Credentials** – The next important aspect is the username and password which needs to be used to establish a connection to the database. It ensures that the username and password have the necessary privileges to connect to the database.
- **Optional parameters** – For each database type, you can specify optional parameters to provide more information on how .net should handle the connection to the database. For example, one can specify a parameter for how long the connection should stay active. If no operation is performed for a specific period of time, then the parameter would determine if the connection has to be closed.

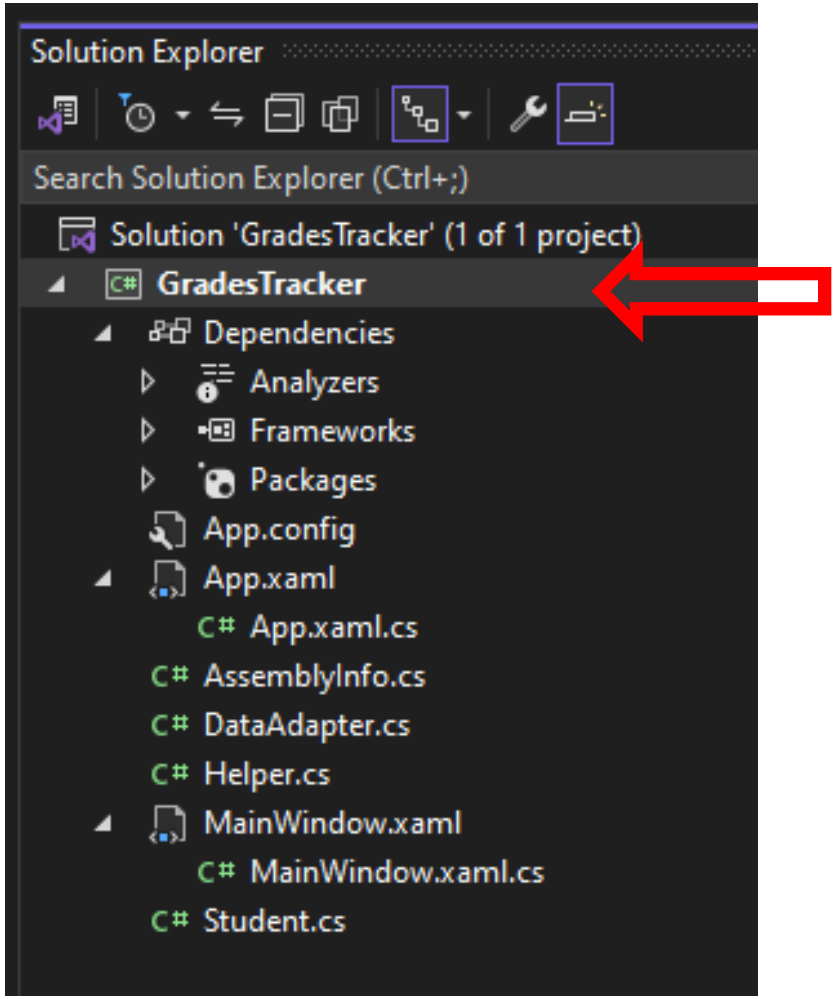
Operations

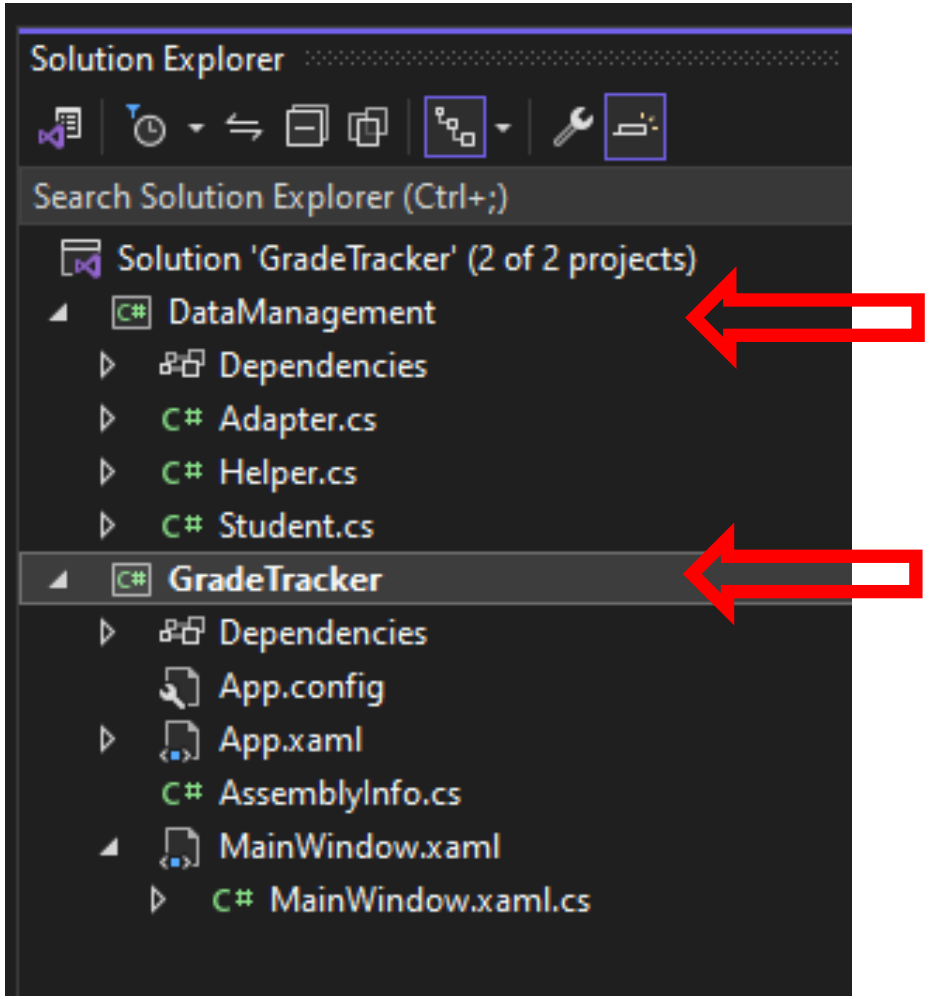
- **Selecting data from the database** – Once the connection has been established, the next important aspect is to fetch the data from the database. C# can execute the ‘SQL’ select command against the database. The ‘SQL’ statement can be used to fetch data from a specific table in the database.
- **Inserting data into the database** – C# can also be used to insert records into the database. Values can be specified in C# for each row that needs to be inserted into the database.
- **Updating data into the database** – C# can also be used to update existing records in the database. New values can be specified in C# for each row that needs to be updated in the database.
- **Deleting data from a database** – C# can also be used to delete records into the database. Select commands to specify which rows need to be deleted can be specified in C#.

Grade Tracker. DAPPER_SQL_WPF guide.docx

1. **App.config** - configuration file to your C# project to store the details of your connection string and allow you to connect to your database.
2. **Data Management Architecture (project)**
   - **Helper class** -to generate the SQL connections when we need them in our other classes
     - **System.Data.SqlClient** library
     - **GetConnectionString()** method - access the **App.config** file and return the connection string
     - **CreateConnection()** method - create a new **SQLConnection**
   - **Class to map sql table**
   - **DataAdapter class** - to handle our data requests to and from our SQL database
3. **Dapper** - Object-Relational Mapping library

Solution structure

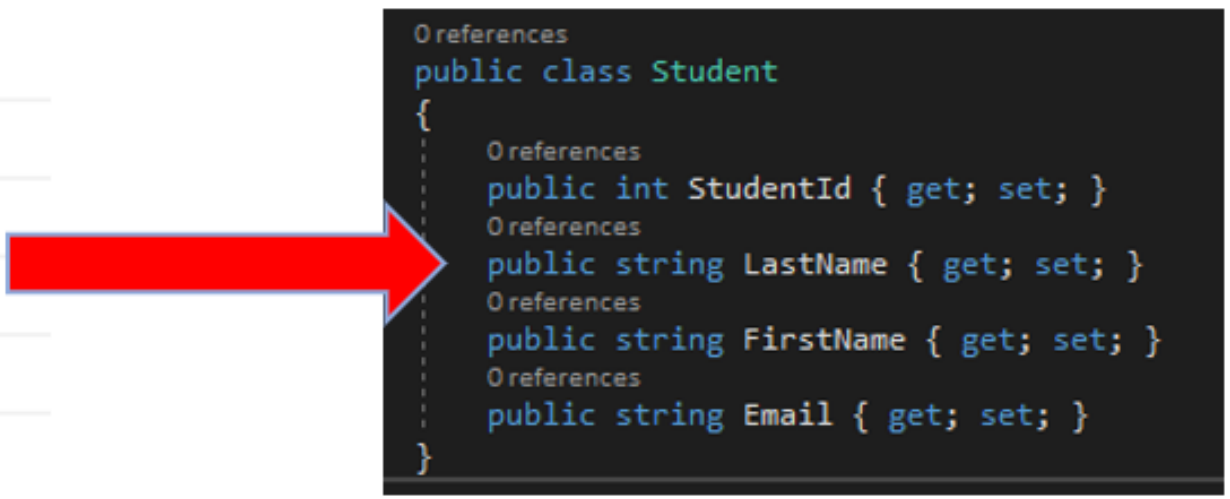




Common SQL data types and their C# equivalents

SQL Data Type	C# Data Type
int	int
decimal	decimal
bit	boolean
varchar	string
DateTime	DateTime

StudentId	int
LastName	varchar(50)
FirstName	varchar(50)
Email	varchar(50)

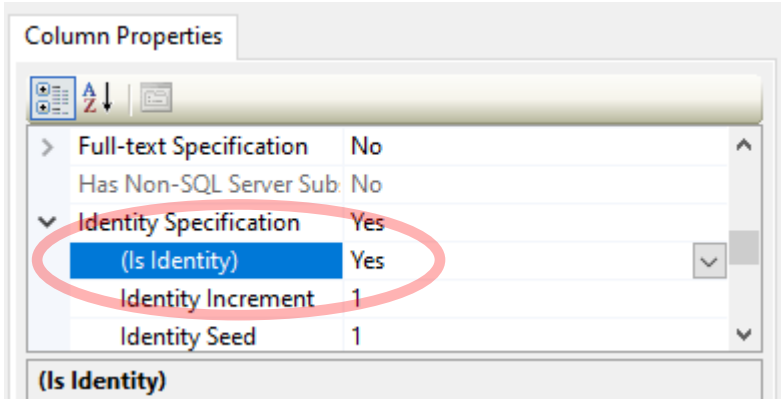


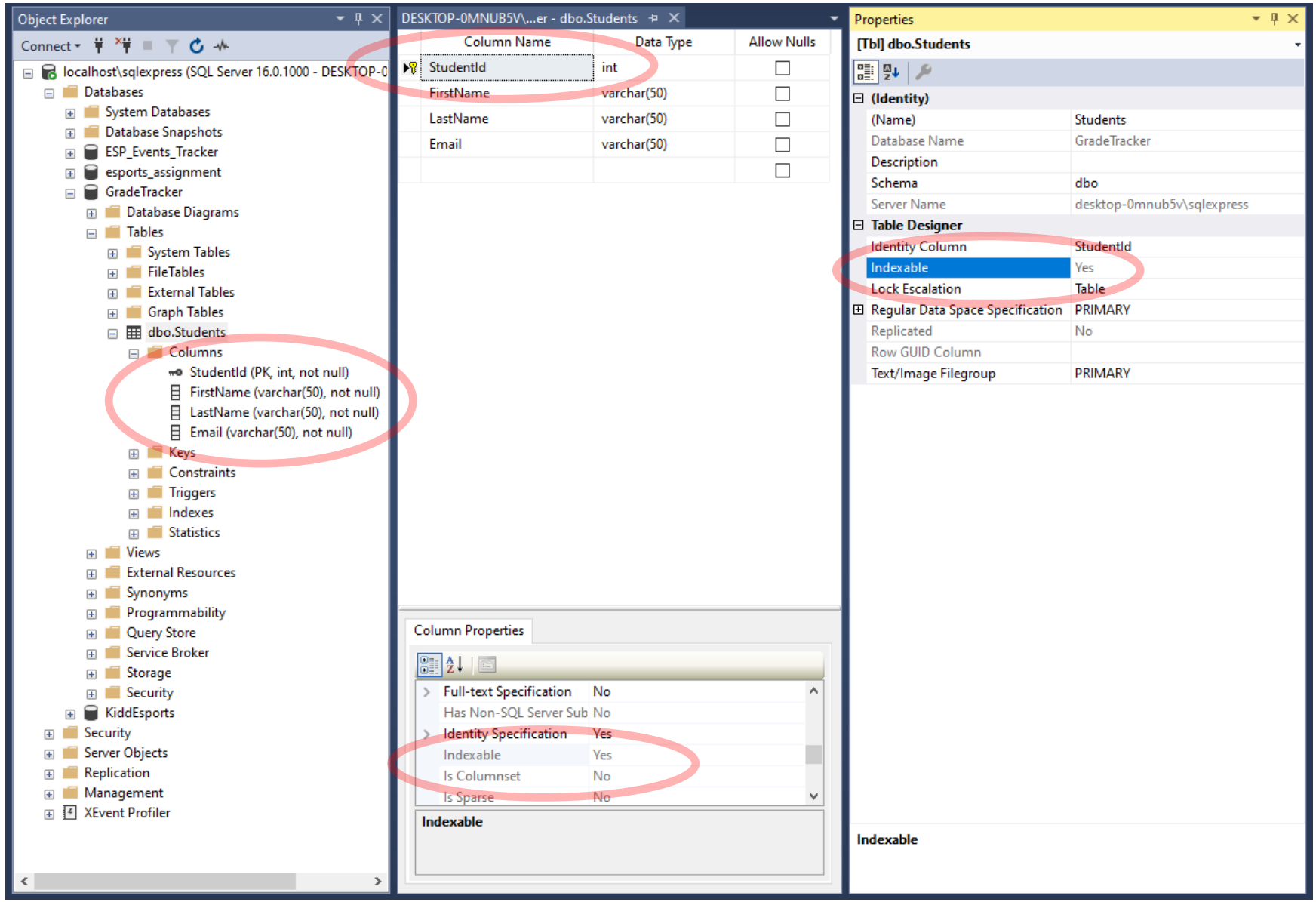
```
0 references
public class Student
{
    0 references
    public int StudentId { get; set; }
    0 references
    public string LastName { get; set; }
    0 references
    public string FirstName { get; set; }
    0 references
    public string Email { get; set; }
}
```

Attention!!! Do it BEFORE you save a table!!!

StudentId MUST be:

- **Primary Key**
- **Auto Incremental**





APP SETUP FOR SQL CONNECTIVITY

- Adding packages to project
  - Dapper
  - System.Data.SQLClient
  - System.Configuration.ConfigurationManager
- Creating app.config file
- Setting Up Connection String
- Build New project – DataManagement
- Setup Connection Between Classes
- Building Helper Class for Connection Setup
- Build DataManager Class

Expense tracker. Program structure

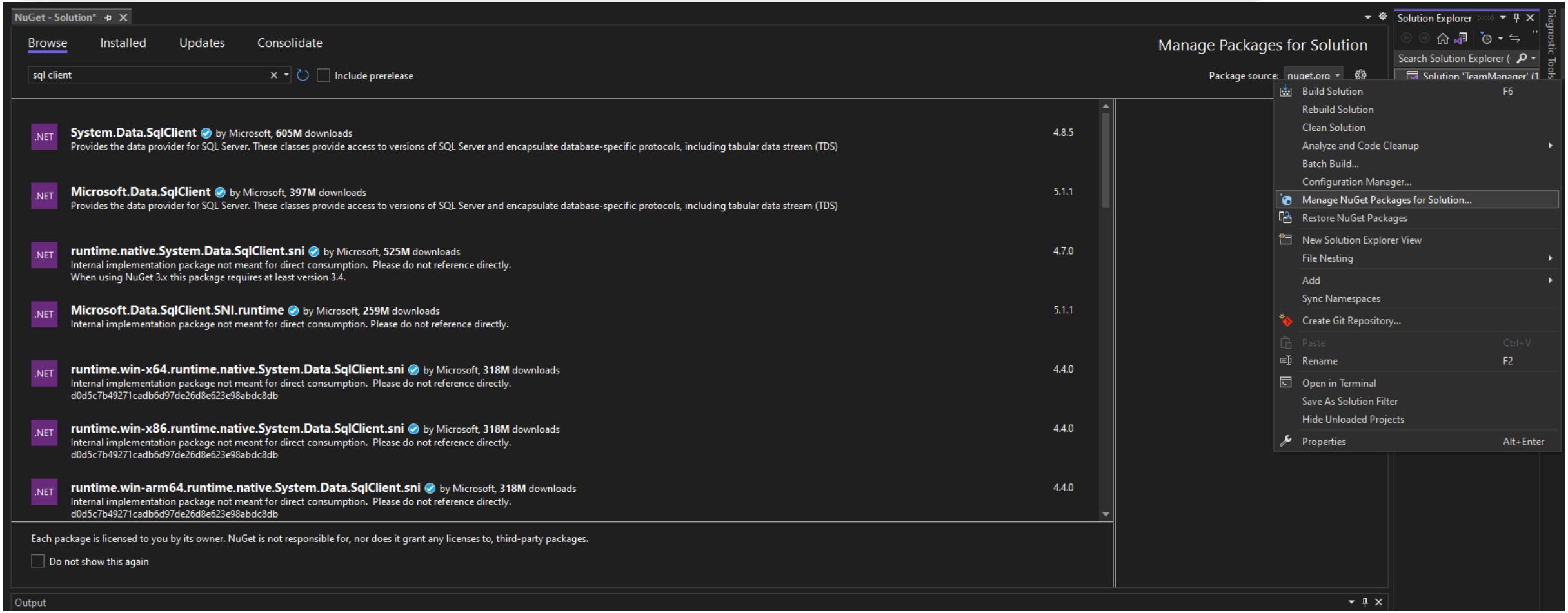
Modules

- **DataManagement project** – to create an open connection to our Server which can then be used by our application to send and receive data from our database
  - **Helper Class** - to be used to generate the SQL connections when we need them
  - **Data Model(s) class(es)** – representation(s) of the data from our table(s) to retrieve it and use it in our application
  - **DataManager class** – to CRUD

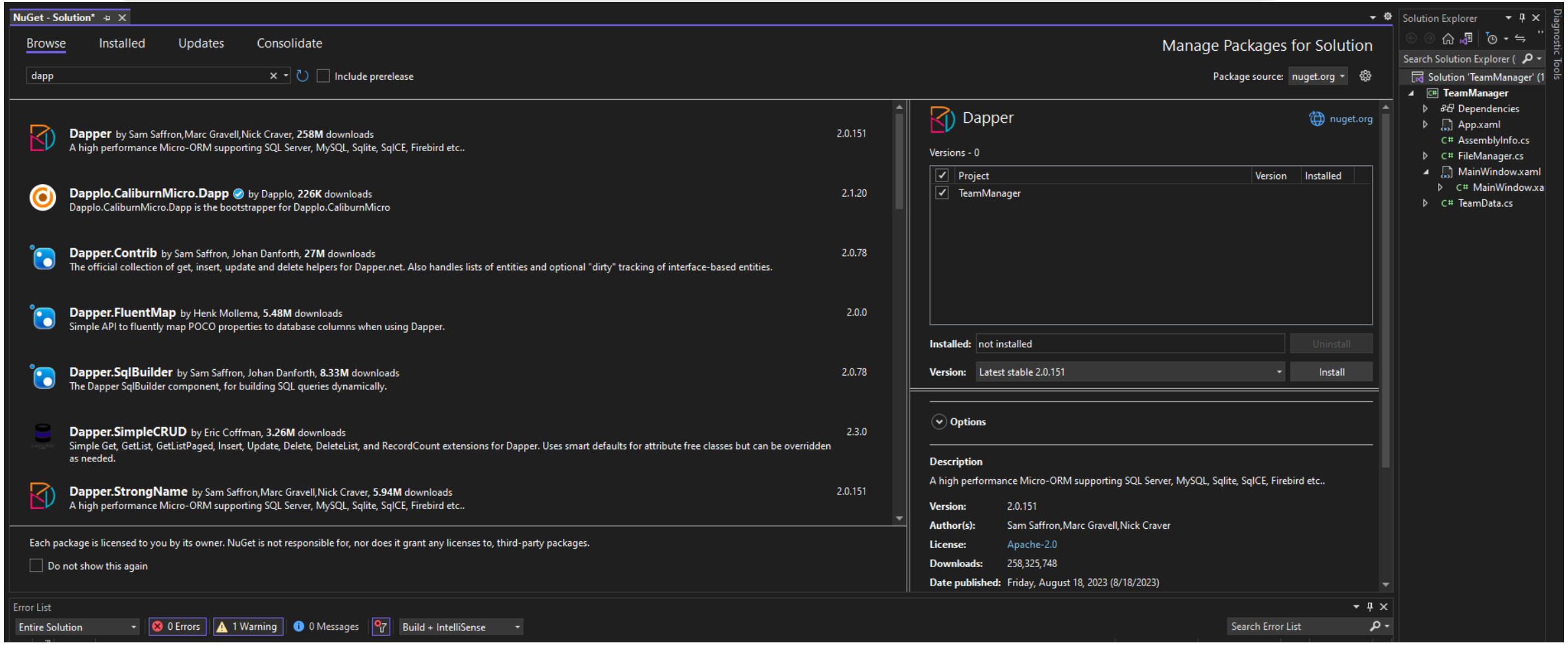
Packages

- Dapper
- System.Data.SQLClient
- System.Configuration.ConfigurationManager

System.Data.SQLClient



Dapper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AssemblyInfo.cs
FileManager.cs
MainWindow.xaml
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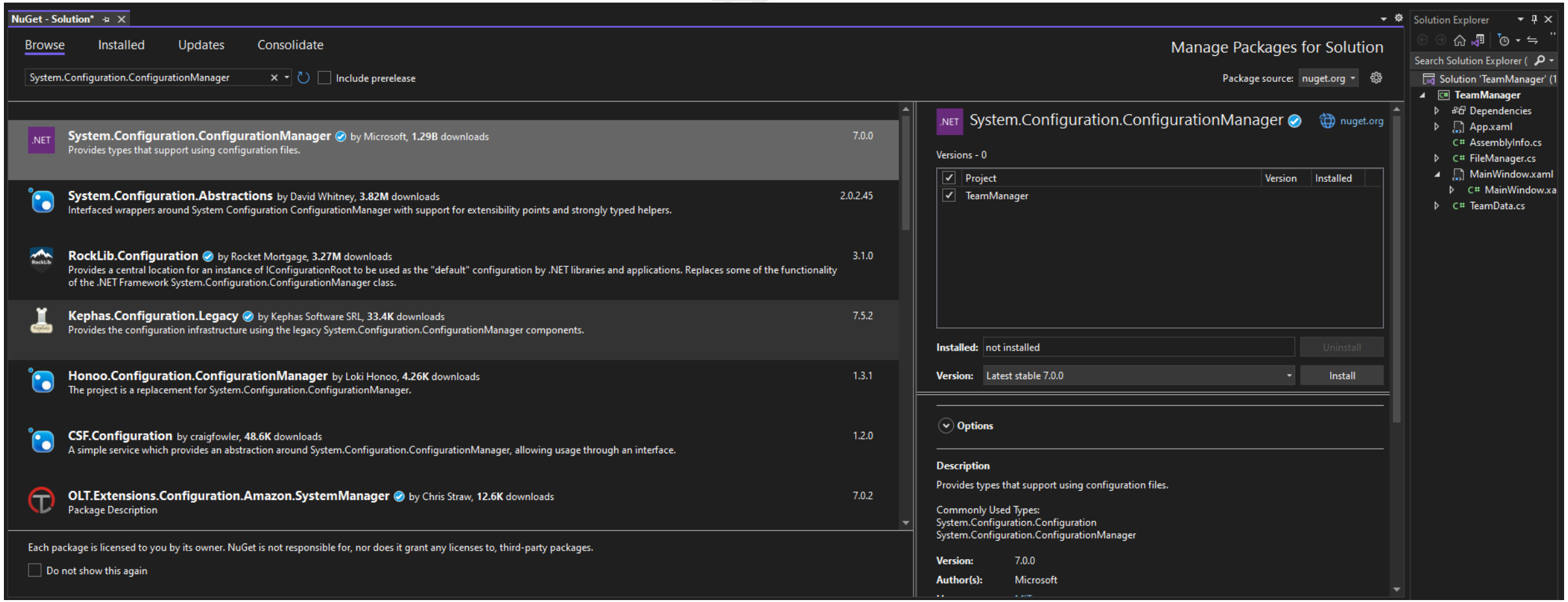
Diagnostic Tools
Error List
Entire Solution
0 Errors
1 Warning
0 Messages
Build + IntelliSense
Search Error List

System.Configuration.ConfigurationManager



Creating app.config

- **app.config** is an XML file with many predefined configuration sections available and support for custom configuration sections. A "configuration section" is a snippet of XML with a schema meant to store some type of information.
- Settings can be configured using built-in configuration sections such as connectionStrings or appSettings. You can add your own custom configuration sections; this is an advanced topic, but very powerful for building strongly-typed configuration files.
- **Your project -> add -> item -> Application Configuration File**