ADO.NET
Disconnected Models

Disconnected Model

Steps used in the disconnected model:

1. Create the `SqlConnection` object.
   - You'll need the connection string to create it.
2. Create the `SqlDataAdapter` object.
   - You need the SQL SELECT query in string format.
   - And `SqlConnection` object created in the previous step.
3. Create `DataSet` object.
   - It'll be used to store the local copy of the database.
4. Fill the `DataSet` object using `SqlDataAdapter` object.
   - `adapterObj.Fill(dataSetObj);`
5. Use the `DataSet` object to display the result.

SqlDataAdapter Class

- The SqlDataAdapter manages connections with the data source and gives us the disconnected behavior.
- The SqlDataAdapter opens a connection only when required and closes it as soon as it has performed its task.
- For example: the SqlDataAdapter performs the following tasks when filling a DataSet with data:
  1. Open connection.
  2. Store data into DataSet.
  3. Close connection.

- And it performs the following actions when updating the data source with DataSet changes:
  - Open connection.
  - Save changes from DataSet to the data source.
  - Close connection.

`SqlDataAdapter` Class

- The `SqlDataAdapter` has two very useful methods:

- `Fill`:
  - This method opens the connection, stores data from data source into `DataSet` and then closes the connection.

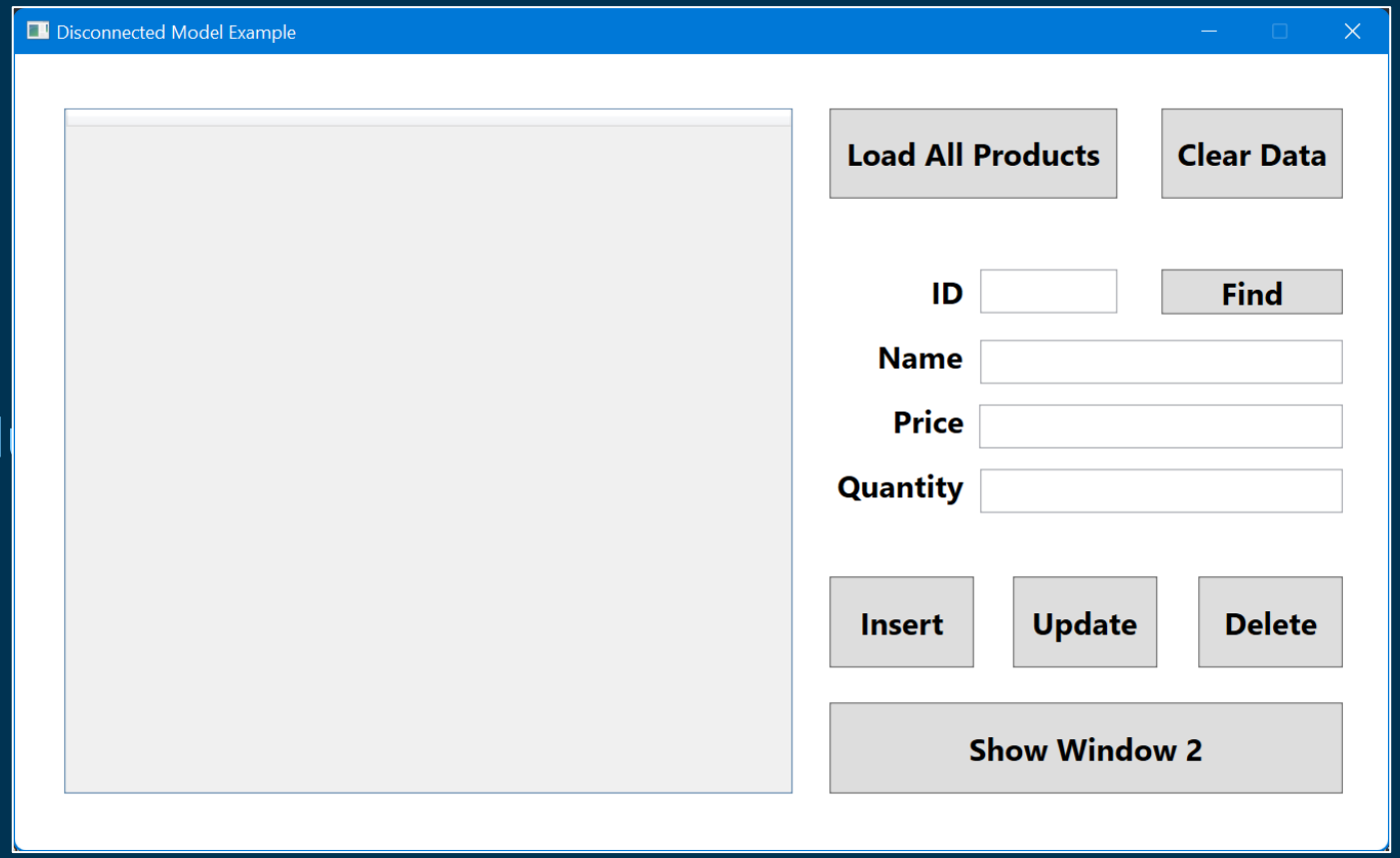
- `Update`:
  - This method opens the connection, saves data from `DataSet` to the data source and then closes the connection.

DataSet Class

- In the disconnected scenario, the data retrieved from the database is stored in a local buffer called DataSet.
- This class is defined in the System.Data namespace.
  - Notice that DataSet is not prefixed with Sql like in SqlDataAdapter and SqlConnection.
  - This is because DataSet is independent of the data source.
  - You can populate DataSet with data from various data sources such as SQL Server, Oracle, Excel files, XML files, text files etc.
- A DataSet object is an in-memory representation of the data and can hold multiple tables.
- It is specially designed to manage data in memory and to support disconnected operations on data.
- A DataSet is a collection of DataTables and DataRelations.
- Each DataTable is a collection of DataColumns, DataRows and Constraints.

Create WPF App

- Create a new WPF app.
- Design a window that looks something like this.
- Give meaningful names to all the controls:
  - DataGrid: `grdProducts`
  - Load All Products: `btnLoadAllProd`
  - Clear Data button: `btnClearData`
  - ID textbox: `txtId`
  - Find button: `btnFind`
  - Name: `txtName`
  - Price: `txtPrice`
  - Quantity: `txtQuantity`
  - Insert button: `btnInsert`
  - Update button: `btnUpdate`
  - Delete button: `btnDelete`
  - Show Window 2 button: `btnShowWindow2`



Create Data Class

- Add a class and name it something like Data.
- Add a private static field which stores the connection string.
- Add a public static property that returns the connection string.

```
public class Data
{
   private static string connStr =  @"Data Source=(LocalDB)\MSSQLLocalDB;
                                    Initial Catalog=Northwind;
                                    Integrated Security=True";

   public static string ConnectionString { get => connStr; }
}
```

Install NuGet Package

- We need to use the NuGet Package Manager to install a package.
- Right-click on project name in the Solution Explorer and select Manage NuGet Packages….

- Click on the Browse tab and search for the following package:
  - Microsoft.Data.SqlClient

- Install this package.
  - Accept any license agreement that might pop up.

Getting All The Products

- Go into `Data` class.
- Include the namespaces at the top:
  - `using Microsoft.Data.SqlClient;`
  - `using Microsoft.Data;`

- To fetch all the products, create a method `GetAllProducts()`.
- Set its return type to `DataTable`.

```
public DataTable GetAllProducts()
{

}
```

SqlConnection Object

- Within the `GetAllProducts` method, create the `SqlConnection` object.
  - Requires the connection string.

```
public DataTable GetAllProducts()
{
  SqlConnection conn = new SqlConnection(ConnectionString);
}
```

SqlDataAdapter Object

- Create the `SqlDataAdapter` object.
  - Need the SQL SELECT query in string format.
    - SELECT query is required because first it needs to fetch data and store it within `DataSet`.
  - Need the `SqlConnection` object created in the previous step.

```
public DataTable GetAllProducts()
{
        SqlConnection conn = new SqlConnection(ConnectionString);

        string query = "Select ProductID, ProductName, UnitPrice,
                         UnitsInStock from Products";
        SqlDataAdapter adapter = new SqlDataAdapter(query, conn);
}
```

DataSet Object

- Create the DataSet object.

```
public DataTable GetAllProducts()
{
        SqlConnection conn = new SqlConnection(ConnectionString);

        string query = "Select ProductID, ProductName, UnitPrice,
                         UnitsInStock from Products";
        SqlDataAdapter adapter = new SqlDataAdapter(query, conn);

        DataSet ds = new DataSet();
}
```

Fill the DataSet

- Call the SqlDataAdapter's Fill method to populate the DataSet.
- The Fill method takes two parameters: a DataSet and a table name.
  - The second parameter is the name of the table that will be created in the DataSet.
  - You can name the table anything you want. Typically, I'll give it the same name as the database table.

```
public DataTable GetAllProducts()
{
        SqlConnection conn = new SqlConnection(ConnectionString);

        string query = "Select ProductID, ProductName, UnitPrice,
                        UnitsInStock from Products";
        SqlDataAdapter adapter = new SqlDataAdapter(query, conn);
        DataSet ds = new DataSet();

        adapter.Fill(ds, "Products");
}
```

Return the DataTable

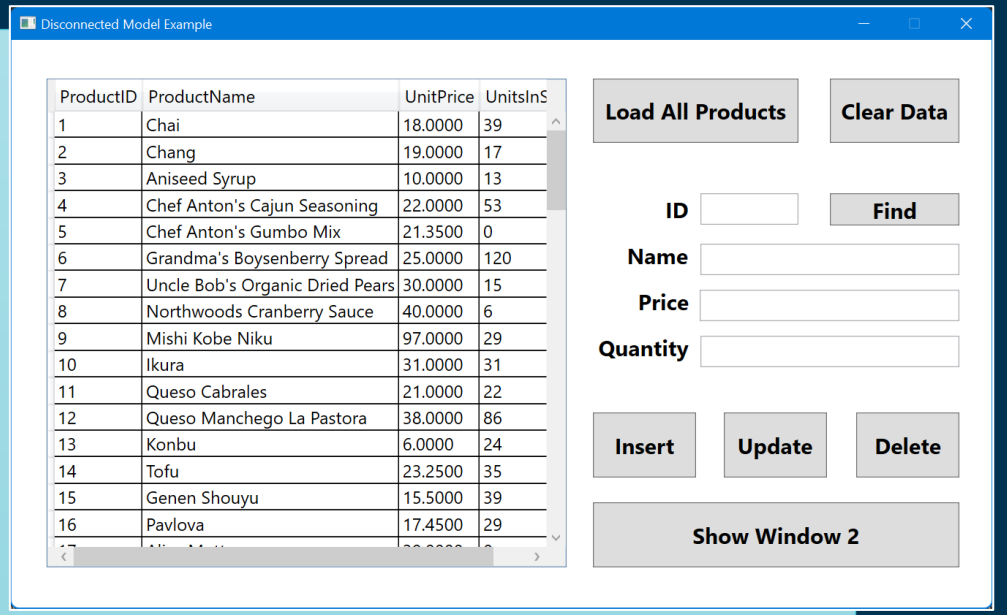
- Then, read and assign the table from the DataSet to DataTable.
- And return the DataTable.

```
public DataTable GetAllProducts()
{
        SqlConnection conn = new SqlConnection(ConnectionString);

        string query = "Select ProductID, ProductName, UnitPrice,
                         UnitsInStock from Products";
        SqlDataAdapter adapter = new SqlDataAdapter(query, conn);
        DataSet ds = new DataSet();

        adapter.Fill(ds, "Products");

        DataTable tblProducts = ds.Tables["Products"];
        return tblProducts;
}
```

Implement the Load All Products Click Event

- Now, add the click event handler to the Load All Products button.
- In the Code View, instantiate the `Data` class.
- And call the `GetAllProducts` method in the Load All Products click event.

```
public partial class MainWindow : Window
{
    private Data data = new Data();

    public MainWindow()
    {
        InitializeComponent();
    }

    private void btnLoadAllProducts_Click(object sender, RoutedEventArgs e)
    {
        grdProducts.ItemsSource = data.GetAllProducts().DefaultView;
    }
}
```



`DataSet` having Multiple Tables

- `DataSet` is the in-memory representation of database.
- Just like how there can be multiple tables in a database, `DataSet` can also have multiple tables.
- When you fill `DataSet` with multiple tables, the first table is named `Table`, the second table is `Table1`, then `Table2`, and so on.
- `DataSet` does not maintain table names.
  - You have to manually name them.
- Also, the data types of columns are not maintained.
- Each column is of type `object`.
- This type of `DataSet` is called Untyped DataSet.
- Like real databases, tables in a `DataSet` can have relations as well.

CRUD Operations in DataSet

- Lets look at an example of CRUD operations in DataSet.
- With DataSet, we only need the SELECT SQL query to fetch the data for the first time.
- There is no need to write INSERT, UPDATE or DELETE queries.
- These queries are auto-generated with the help of SqlCommandBuilder.
- SqlCommandBuilder needs the SqlDataAdapter object to be passed to its constructor.
- That SqlDataAdapter object already contains the SELECT query.
- So, based on that SELECT query information, SqlCommandBuilder generates the INSERT, UPDATE and DELETE queries.

CRUD Operations in DataSet

- For this example, we'll work on the table Products and the user can perform the following operations:

1. Get all Products
2. Get Product by ID
3. Insert Product
4. Update Product
5. Delete Product

- This will be the SELECT query:
  - `SELECT ProductID, ProductName, UnitPrice, UnitsInStock FROM Products;`

CRUD Operations in DataSet

- The following classes will be used in this example:

- SqlConnection:
  - Used to create the connection.

- SqlDataAdapter:
  - Used to fill and update the DataSet.

- SqlCommandBuilder:
  - Used to auto-generate the INSERT, UPDATE, DELETE queries.

- DataSet:
  - Used for in-memory storage and representation of data.

- DataTable:
  - Used to read the table from DataSet.

CRUD Operations in `DataSet`

- First, create a class that'll perform these actions.
- Ideally, this class should be named `DataAccess` or something similar.
- But for now, I'll name it `CrudOperationsInDataSet`.
- Declare the previous mentioned class objects as fields.
- And use the constructor to initialize these objects.

CRUD Operations in DataSet

- Make a method `FillDataSet` that'll fetch the fresh copy of the data from the database.
- Since, this `DataSet` is Untyped, I'll also define the primary key column.
- Call this method in the constructor of the `CrudOperationsInDataSet` class.

```
private void FillDataSet()
{
    // reset the dataset
    ds = new DataSet();

    adapter.Fill(ds);
    tblProducts = ds.Tables[0];

    // define primary key
    DataColumn[] pk = new DataColumn[1];
    pk[0] = tblProducts.Columns["ProductID"];
    pk[0].AutoIncrement = true;
    tblProducts.PrimaryKey = pk;
}
```

CRUD Operations in DataSet

- A method called `GetAllProducts()` to display all the products fetched from the database.
- This method first calls the `FillDataSet` method.
- Then simply returns the `DataTable`.

```
public DataTable GetAllProducts()
{
    FillDataSet();
    return tblProducts;
}
```

CRUD Operations in DataSet

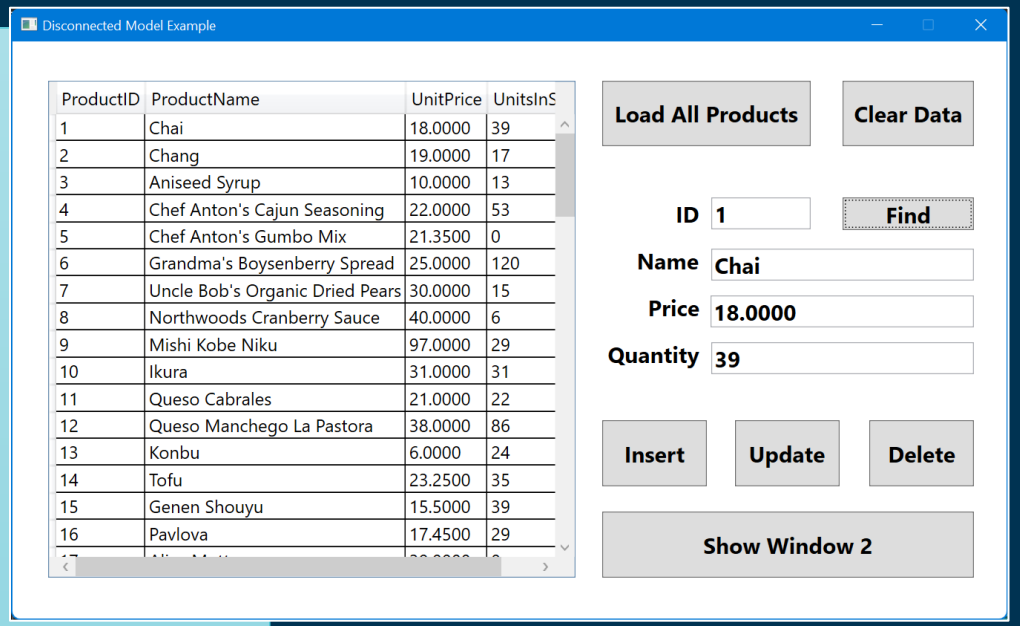
- A method called `GetProductById(int id)` to get a single product found by its primary key.
- `Find` method can be used to get a single row based on primary key of the `DataTable`.
- Then return the fetched row.

```
public DataRow GetProductById(int id)
{
    // find a row based on its primary key
    DataRow row = tblProducts.Rows.Find(id);

    return row;
}
```

CRUD Operations in DataSet

- Implement the Find button's click event.
- Read the ID from the textbox and pass it to the `GetProductById`.
- If a row is returned, display the data in the respective textboxes.

```
private void btnFind_Click(object sender,
                           RoutedEventArgs e)
{
    int id = int.Parse(txtId.Text);
    DataRow row = crud.GetProductById(id);

    if (row != null)
    {
        txtName.Text = row["ProductName"].ToString();
        txtPrice.Text = row["UnitPrice"].ToString();
        txtQuantity.Text = row["UnitsInStock"].ToString();
    }
    else
        MessageBox.Show("Invalid Product ID. Please try again.");
}
```



CRUD Operations in DataSet

- A method called `InsertProduct(string name, decimal price, short quantity)` to insert a new product.
- First, create a new row in the `DataTable`.
- Assign the values to this new row.
- Notice that ID isn't required because it is set as Identity (Auto-increment).
- Then, add this new row to the `Rows` collection of the `DataTable`.

- Now, read the INSERT query from the `SqlCommandBuilder` object and assign it to the `InsertCommand` property of the `SqlDataAdapter` object.

```
adapter.InsertCommand = cmdBuilder.GetInsertCommand();
```

- Call the `SqlDataAdapter`'s `Update` method which can take in the `DataTable` object to commit the changes to the database.
- Code on next slide.

CRUD Operations in DataSet

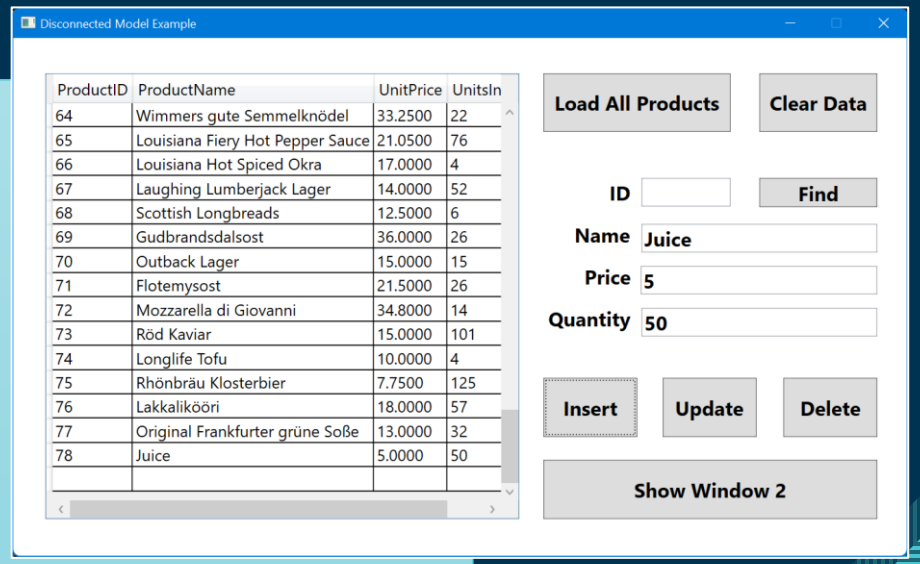
- A method called `InsertProduct(string name, decimal price, short quantity)` to insert a new product.

```
public void InsertProduct(string name, decimal price, short quantity)
{
    DataRow newRow = tblProducts.NewRow(); // create a new row

    // assign the values from variables to the new row
    newRow["ProductName"] = name;
    newRow["UnitPrice"] = price;
    newRow["UnitsInStock"] = quantity;

    tblProducts.Rows.Add(newRow); // add the new row to the Rows collection

    adapter.InsertCommand = cmdBuilder.GetInsertCommand();
    adapter.Update(tblProducts);
}
```

CRUD Operations in DataSet

- Implement the Insert button's click event.
- Read the values from the textboxes and pass them to the `InsertProduct` method.
- Then refresh (or reload) the `DataGrid` using the `GetAllProducts` method.

```
private void btnInsert_Click(object sender,
                             RoutedEventArgs e)
{
        string name = txtName.Text;
        decimal price = decimal.Parse(txtPrice.Text);
        short quantity = short.Parse(txtQuantity.Text);

        crud.InsertProduct(name, price, quantity);
        grdProducts.ItemsSource = crud.GetAllProducts().DefaultView;
}
```



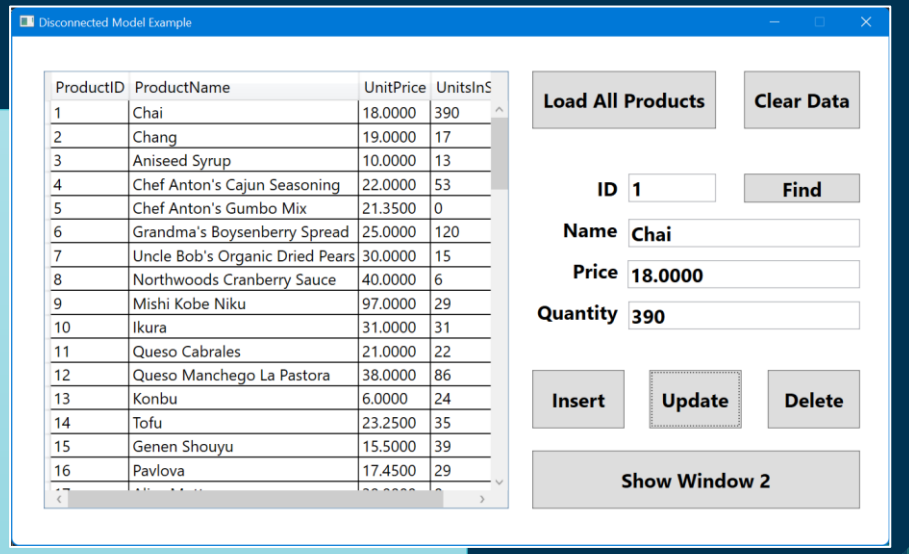
CRUD Operations in DataSet

- A method called `UpdateProduct(int id, string name, decimal price, short quantity)` to update a product.
- While updating, you need the ID of the product so that only that product is updated.
- Remaining code is almost similar to `InsertProduct`.

```
public void UpdateProduct(int id, string name, decimal price, short quantity)
{
    DataRow row = tblProducts.Rows.Find(id);

    row["ProductName"] = name;
    row["UnitPrice"] = price;
    row["UnitsInStock"] = quantity;

    adapter.UpdateCommand = cmdBuilder.GetUpdateCommand();
    adapter.Update(tblProducts);
}
```

CRUD Operations in DataSet

- Implement the Update button's click event.
- Read the values from the textboxes and pass them to the `UpdateProduct` method.
- Then refresh (or reload) the `DataGrid` using the `GetAllProducts` method.




```
private void btnUpdate_Click(object sender,
                             RoutedEventArgs e)
{
        int id = int.Parse(txtId.Text);
        string name = txtName.Text;
        decimal price = decimal.Parse(txtPrice.Text);
        short quantity = short.Parse(txtQuantity.Text);

        crud.UpdateProduct(id, name, price, quantity);
        grdProducts.ItemsSource = crud.GetAllProducts().DefaultView;
}
```

CRUD Operations in DataSet

- A method called `DeleteProduct(int id)` to delete a product.
- While deleting, you only need the ID of the product.
- **Note:**
  - With Northwind database, you can only delete the products you've inserted yourself.
  - The built-in products will throw an exception because of the foreign key constraint with other tables.

```
public void DeleteProduct(int id)
{
    DataRow row = tblProducts.Rows.Find(id);

    row.Delete();

    adapter.DeleteCommand = cmdBuilder.GetDeleteCommand();
    adapter.Update(tblProducts);
}
```

CRUD Operations in DataSet

- Implement the Delete button's click event.
- Read the ID from the textbox and pass them to the DeleteProduct method.
- Then refresh (or reload) the DataGrid using the GetAllProducts method.

```
private void btnDelete_Click(object sender, RoutedEventArgs e)
{
        int id = int.Parse(txtId.Text);

        crud.DeleteProduct(id);
        grdProducts.ItemsSource = crud.GetAllProducts().DefaultView;
}
```

Do It Yourself!

- Create and design a WPF app where the user can perform the following actions:
  1. Get all Employees
  2. Search Employee by first name
  3. Search Employee by last name

- Use Employee table in Northwind database.
- Allow partial matches when searching by first name or last name.
  - For example: If searching by first name user enters **an**, it should display all employees that contain **an** in their name.
  - Hint: Use SQL's LIKE operator.

- Use disconnected model.

Do It Yourself!

- In the Northwind database, CategoryID of Categories table is a foreign key in Products table.
- Refer to the following diagram:
  - https://docs.yugabyte.com/images/sample-data/northwind/northwind-er-diagram.png
- Create and design a WPF app where the user can get all products filtered by a category.
- If the user enters CategoryID, fetch all the products based on that CategoryID.
- Use either connected or disconnected model.

Do It Yourself!

- Use the Categories and Products tables in the Northwind database.
- Fetch all records from the Products table and display the following columns:
  - ProductID ProductName CategoryName
- Note that CategoryName doesn't belong to Products table, but CategoryID does.
- Use SQL's INNER JOIN to replace CategoryID with CategoryName.
- Refer to the following diagram:
  - https://docs.yugabyte.com/images/sample-data/northwind/northwind-er-diagram.png
- Use either connected or disconnected model.

Thank You

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References

Material has been taken from:

- Basics of ADO.NET:
  - https://www.c-sharpcorner.com/UploadFile/18fc30/understanding-the-basics-of-ado-net/
- Professional C# 7 and .NET Core 2.0:
  - https://learning.oreilly.com/library/view/professional-c-7/9781119449270/c25.xhtml
- Working with Disconnected Data – The DataSet and SqlDataAdapter:
  - https://csharp-station.com/Tutorial/AdoDotNet/Lesson05