GRAPHICAL USER INTERFACE DESIGN

Chapter 7

Software Engineering
Computer Science School
DSIC – UPV

Goal

- Understand the principles of visual applications.
- Understand the design of the graphical user interface (use of controls and events).
- Understand the communication between the presentation and the business logic layers.

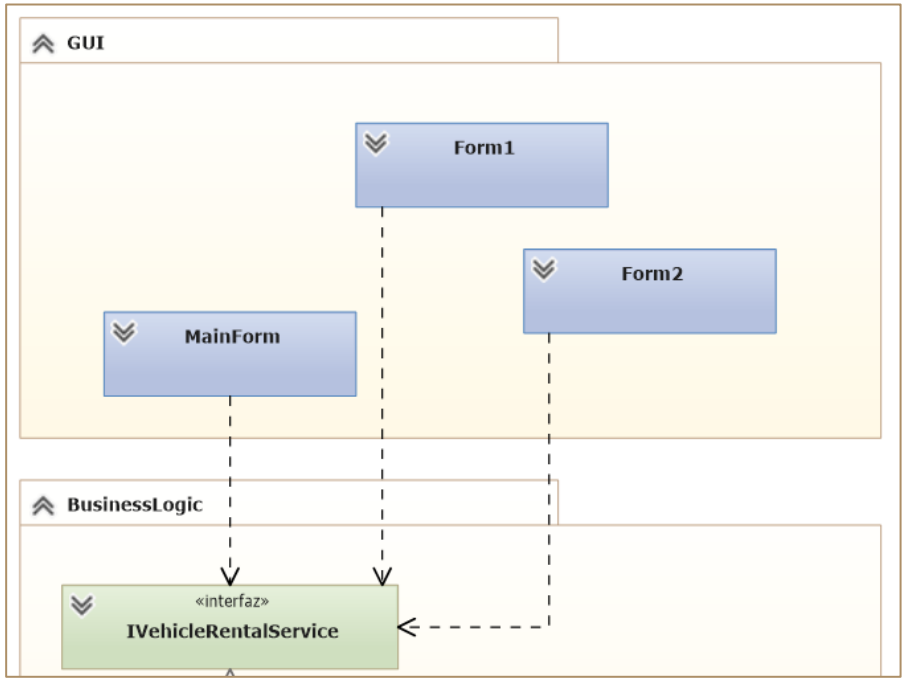
Contents

1. Creating a Basic Windows Application
2. Forms with controls
3. Events in forms
4. Designing and using menus
5. Apps with several forms
    1. Designed by the coder
    2. Dialog forms
6. Displaying data sets
7. Advanced operations: Visual Inheritance

Architectural Design. Presentation

- Collection of forms (one of them MainForm)
- All forms will access the services provided by the Business Logic Layer by means of an interface (e.g. IVehicleRentalService)

- All forms need a reference to an object of type IVehicleRentalService, passed as a parameter in the constructor.



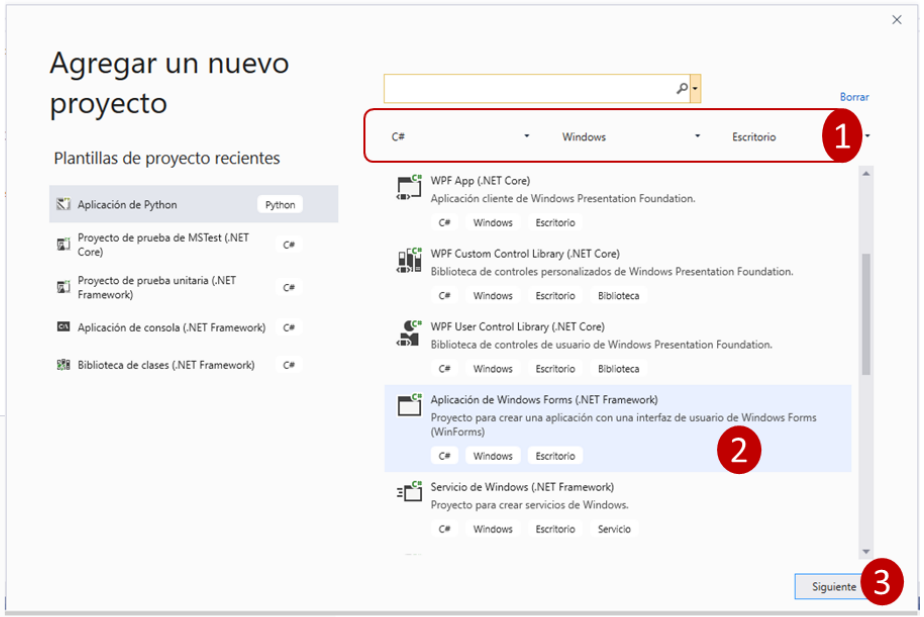
Introduction

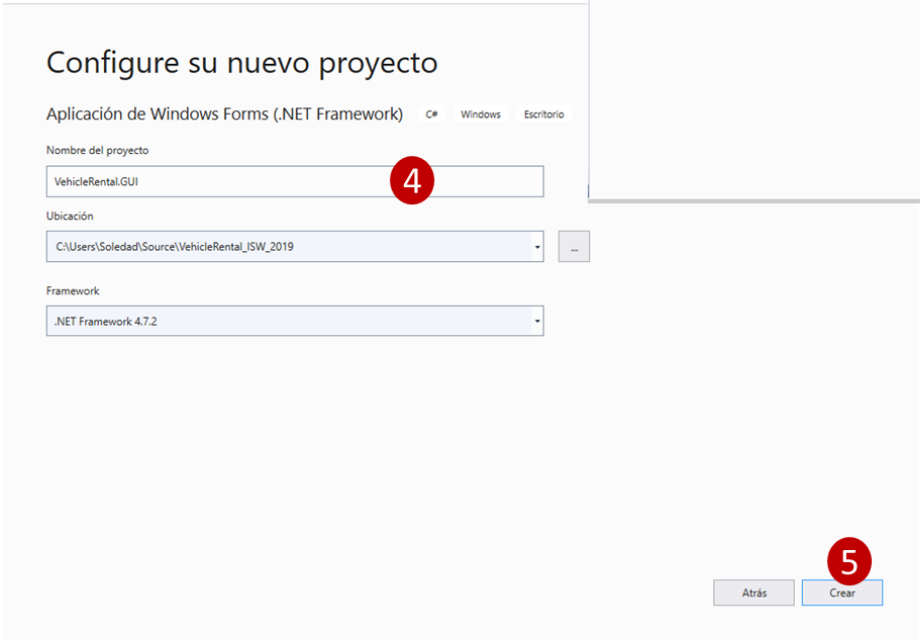
- The creation of **Visual Apps for Windows** may be done, among others with the namespace `System.Windows.Forms` which includes classes, structures, interfaces, etc. to develop these types of applications.

- The namespace `System.Windows.Forms` includes the following classes:
  - **`Application`**: The core of a Windows app. Its methods are used to process Windows messages and visual apps are created and destruyed.
  - **`Form`**: Represents a window or a dialog box in a visual application.
  - **`Button`**, **`ListBox`**, **`TextBox`**, **`PictureBox`**, **`Label`**,...: Providing the functionality of common Windows controls.
  - **`StatusBar`**, **`ToolBar`**,...:Windows utilities.
  - **`ColorDialog`**, **`FileDialog`**,...: Standard dialog boxes.
  - **`StripMenu`**, **`StripMenuItem`**,...: Use to create different types of menus.
  - **`ToolTip`**, **`Timer`**,...: To ease the interactivity of applications.

Creating a Windows Application

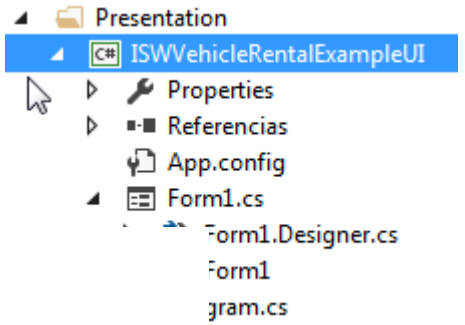
- Add a new project of type Aplicación de Windows Forms to the solution folder Presentation.
- (category C#, Windows, Escritorio)





Creating a Windows Application

- If the app is run, a Windows with the standard basic features is created.
- The files in this Project are:
  - Form1.cs: contains the design of the form. If opened the form may be modified in a visual designer.
    - Form1 has
    constructo
    InicializeC
    - Form1.Des
    generated
  - Program.cs
  method().

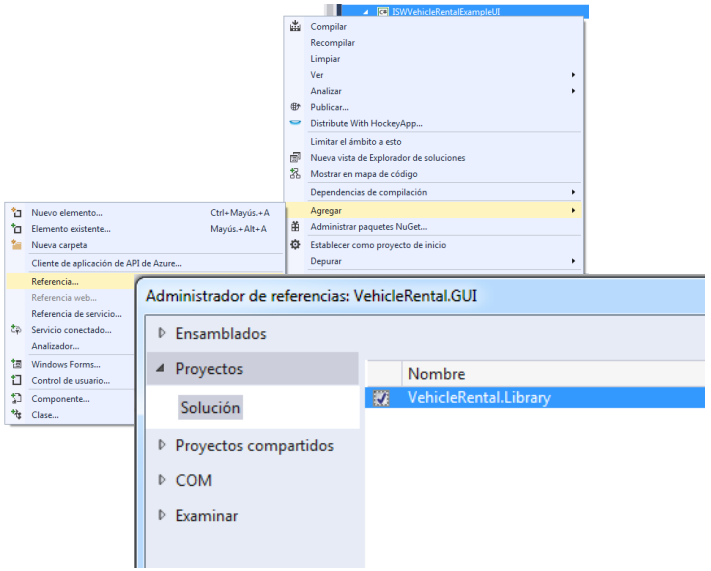



```
namespace ISWVehicleRentalExampleUI
{
    0 referencias
    static class Program
    {
        /// <summary>
        /// Punto de entrada principal para la aplicación.
        /// </summary>
        [STAThread]
        0 referencias
        static void Main()
        {
            Application.EnableVisualStyles();
            Application.SetCompatibleTextRenderingDefault(false);
            Application.Run(new Form1());
        }
    }
}
```

Dependencies Management

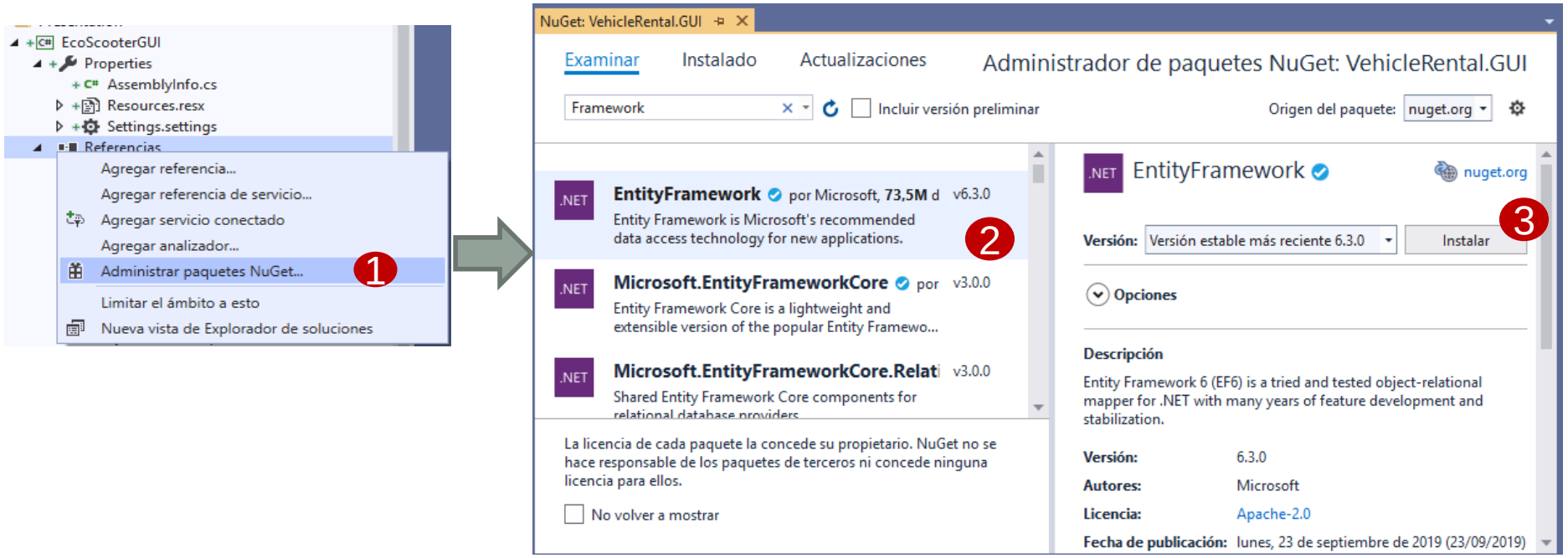
- This Project will depend on `IVehicleRentalService` and on the domain clases located at `VehicleRental.Services`. Thus, a reference has to be added

```
using VehicleRental.Services;

namespace VehicleRental.Presentation
{
    2 referencias
    public partial class VehicleRentalApps : Form
    {
        private IVehicleRentalService service;
        0 referencias
        public VehicleRentalApps(IVehicleRentalService service)
        {
            InitializeComponent();
            this.service = service;
        }
    }
}
```



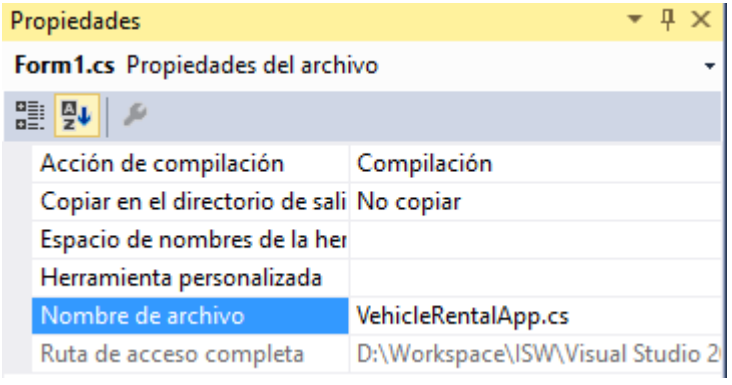
Dependencies Management

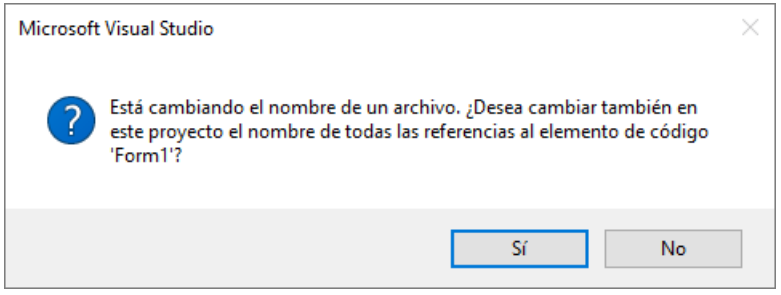
- This app will use Entity Framework, and the corresponding NuGet package must be added:

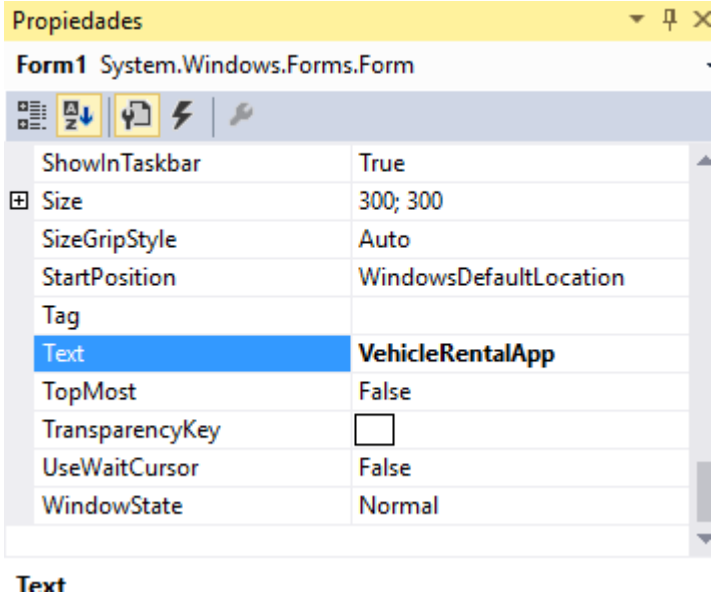


First steps…

- Give an appropriate name to the elements in the Project (e.g. change the name of the file **Form1.cs** to **VehicleRentalApp**).



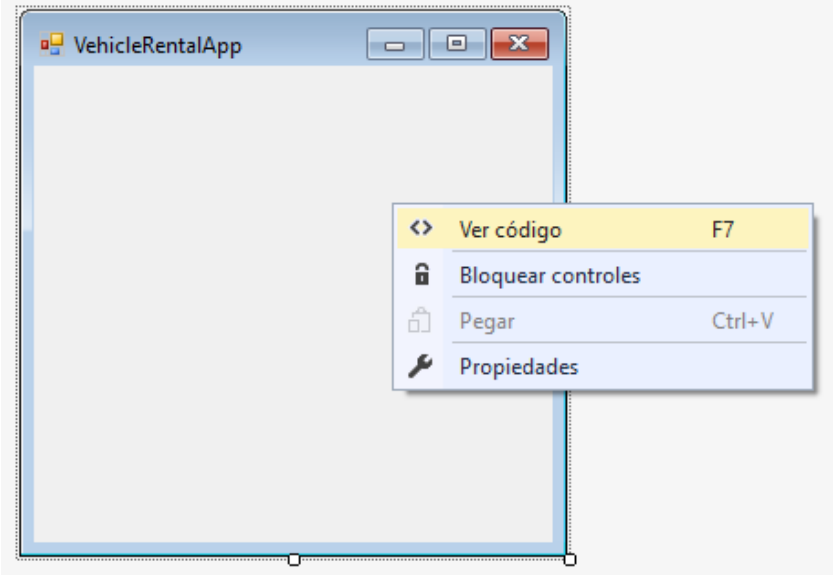




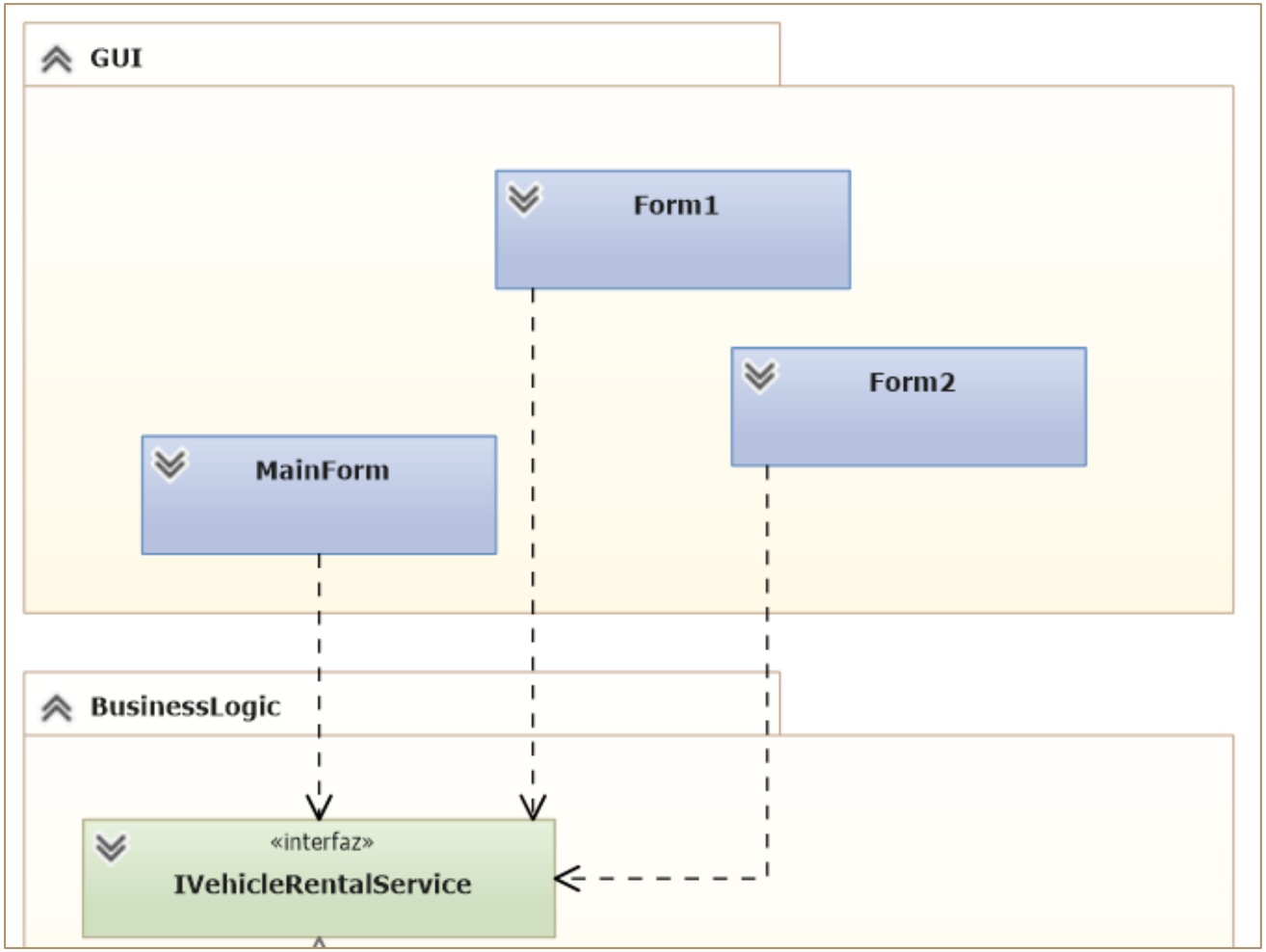
Code Inspection…

- Two ways to Access C# editable code of the form:
  - Double click on 

  - Select the form *right button click* > **Ver código**, or **F7**



Connect with Business Logic Layer



Connect with Business Logic Layer

Modify class **VehicleRentalApp** to have an attribute of type **IVehicleRentalService,** which is passed as a parameter in the constructor.

```
using VehicleRental.Services;

namespace VehicleRentalUI

 public partial class VehicleRentalApp:Form
    {
        private IVehicleRentalService service;

        public VehicleRentalApp(IVehicleRentalService service)
        {
            InitializeComponent();
            this.service = service;        }
  }
}
```

Connect with Business Logic Layer

Modify the Main method (Program class) to create an object **IVehicleRentalService** and pass it to the main form.

```
static void Main()
{
    IVehicleRentalService service = new VehicleRentalService(new
EntityFrameworkDAL(new VehicleRentalDbContext()));

    Application.EnableVisualStyles();
    Application.SetCompatibleTextRenderingDefault(false);
    Application.Run(new VehicleRentalApp(service));
```

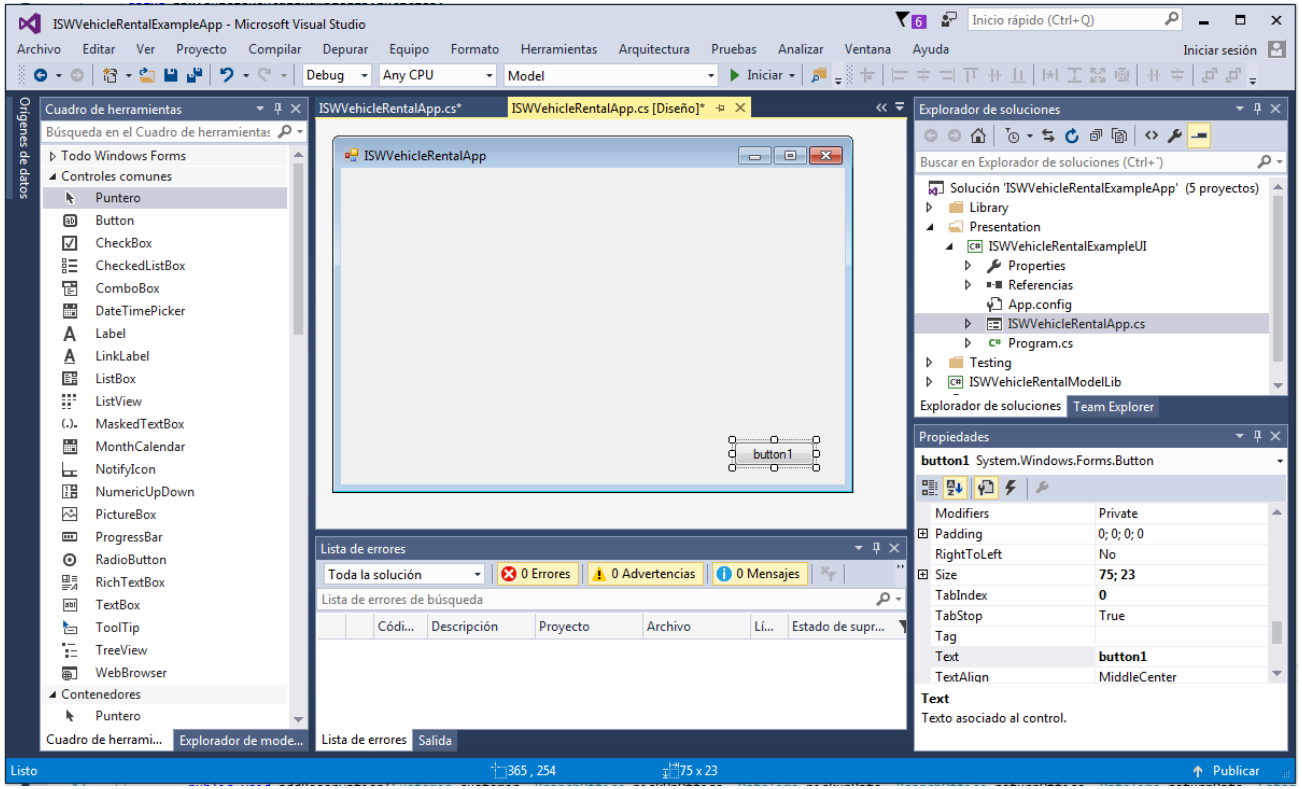
Connect with Persistence Layer

Modify App.config to add the configuration of the connection to the database:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
  <startup>
    <supportedRuntime version="v4.0" sku=".NETFramework,Version=v4.5.2" />
  </startup>
  <connectionStrings>
    <clear />
    <add name="VehicleRentalDbConnection"
         connectionString="Server=(localdb)\mssqllocaldb;Database=VehicleRentalDemo;Trusted_Connection=True;MultipleActiveResultSets=true"
         providerName="System.Data.SqlClient" />
  </connectionStrings>
</configuration>
```

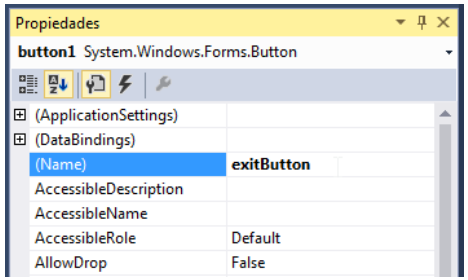
Forms with controls

- Controls are objects of the Control class: buttons, textboxes, ...
- Can be added at design time (visual editor and toolbox) or at execution time.

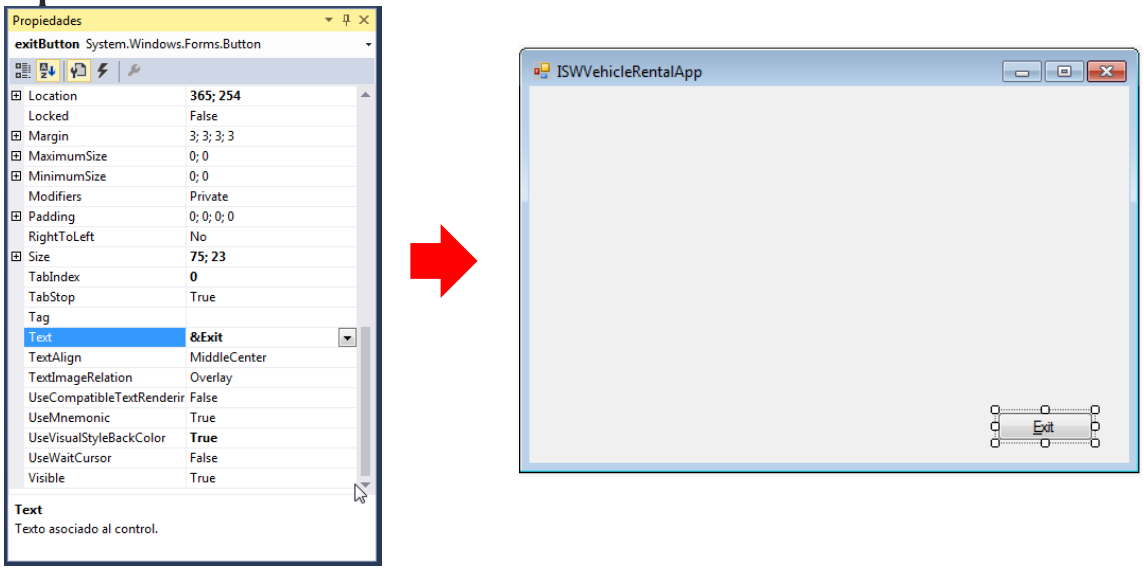


Controls: Properties

- **Name**: The name of the control. It is important to select a meaningful name.

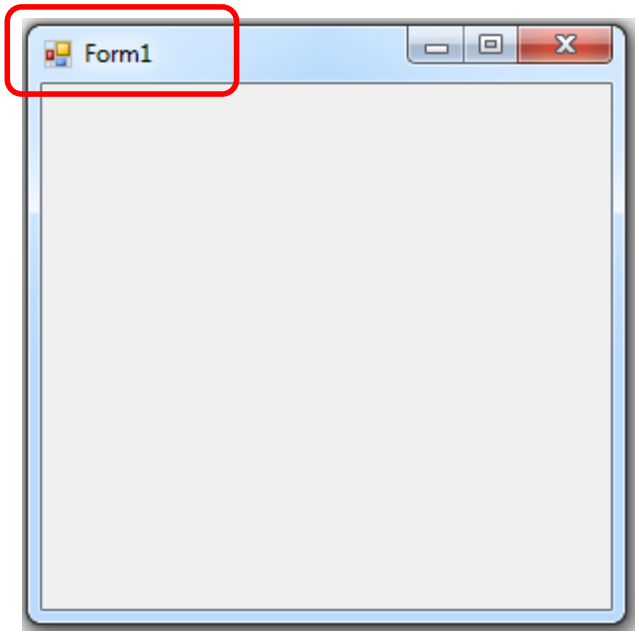


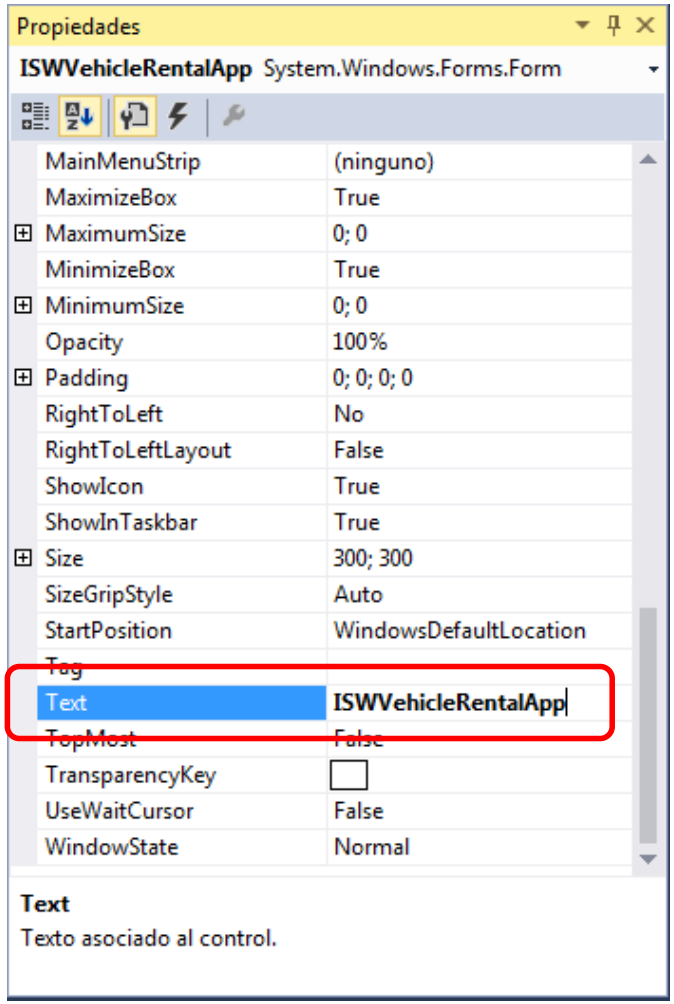
- **Text**: Represents the title of the control



First steps…

- Modify the properties of the form elements:



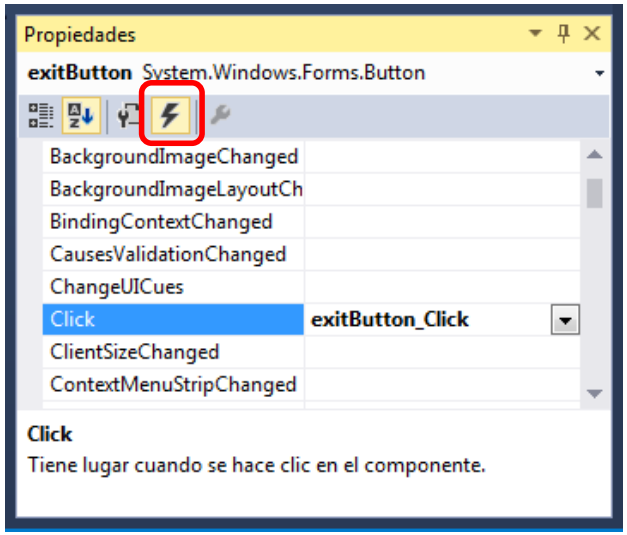


Events in forms

- An event describes a situation to which the application must respond.
- Events are generated by:
  - A user action (click a mouse button, hit a key, etc.)
  - The app code.
  - The operating system.
- Windows apps are event-driven:
  - When an event occurs the app may specify methods (event handlers) to process the event and execute the corresponding actions
- Every control exhibits events to which a handler can be associated.

Events: handlers

- When an event occurs the associated handler is executed
- The events that may be raised by a control appear in the properties window.
- A handler may be associated as follows:
  - Writing the name of the handler method.
  - Selecting a handler method from the dropdown list.
  - double *click*, and Visual Studio creates a default handler definition.



Object that raised the event

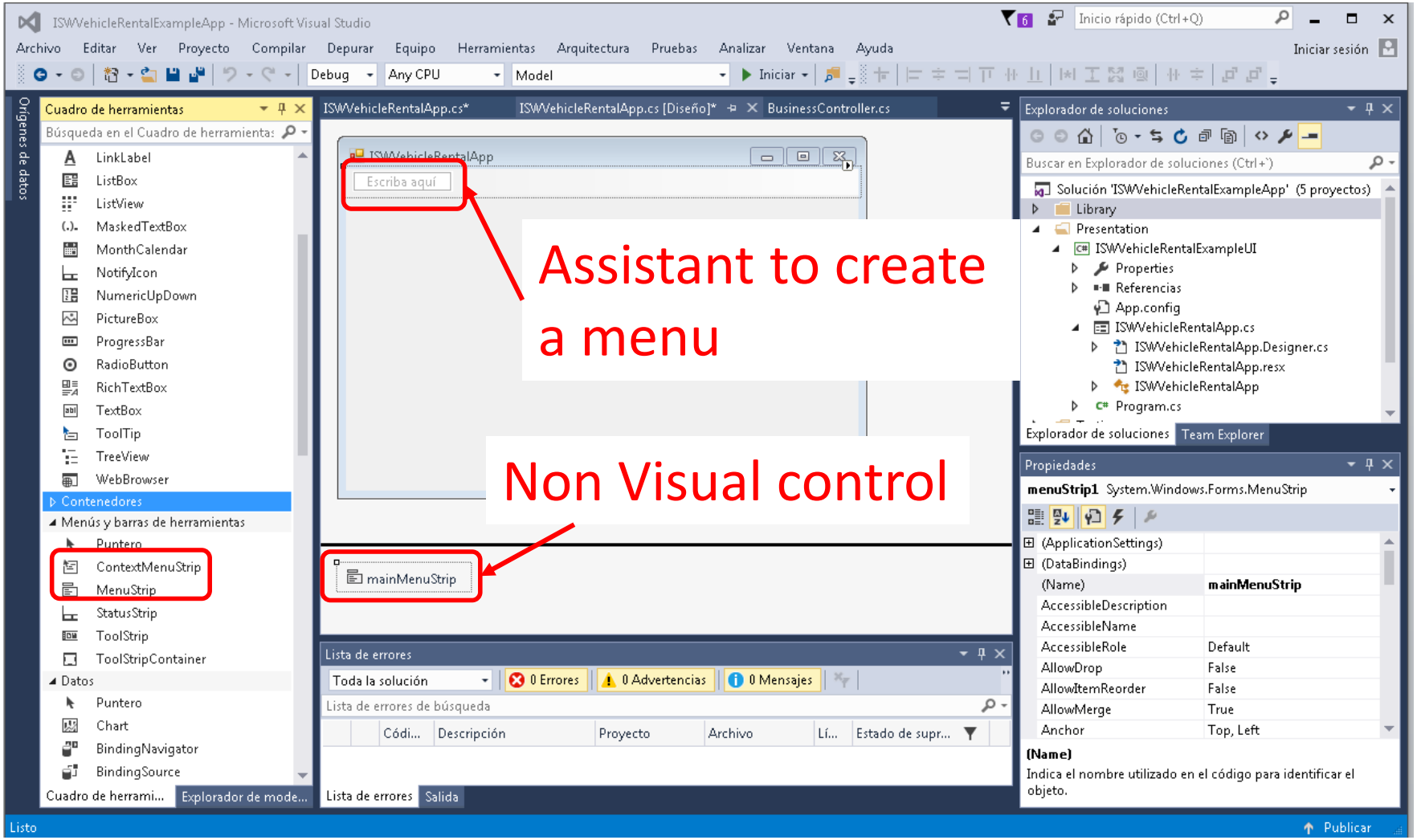
```
1 referencia
private void exitButton_Click(object sender, EventArgs e)
{
    Application.Exit();
}
```

Event information

Designing and using menus

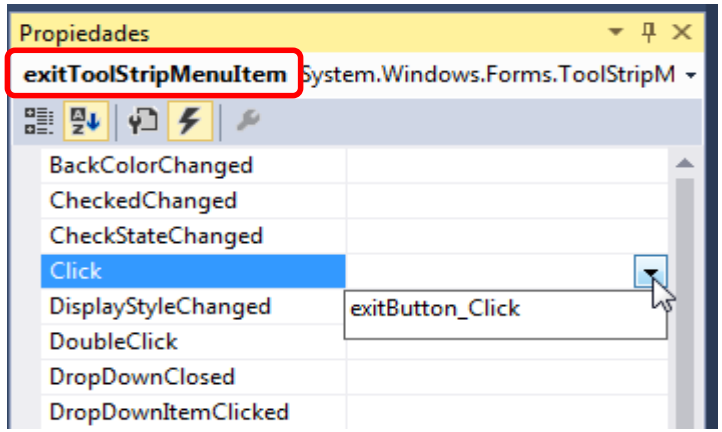
- Most Windows applications have menus
- There are two types of menus:
  - MenuStrip: a main menu
  - ContextMenuStrip: a contextual menu
- All the elements of a menu are stored in the Item property which is a collection of objects belonging to the class ToolStripMenuItem. These elements may contain other submenus.

Designing and using menus



Example Menu

- Assigning a handler is done in the same way as with other controls.

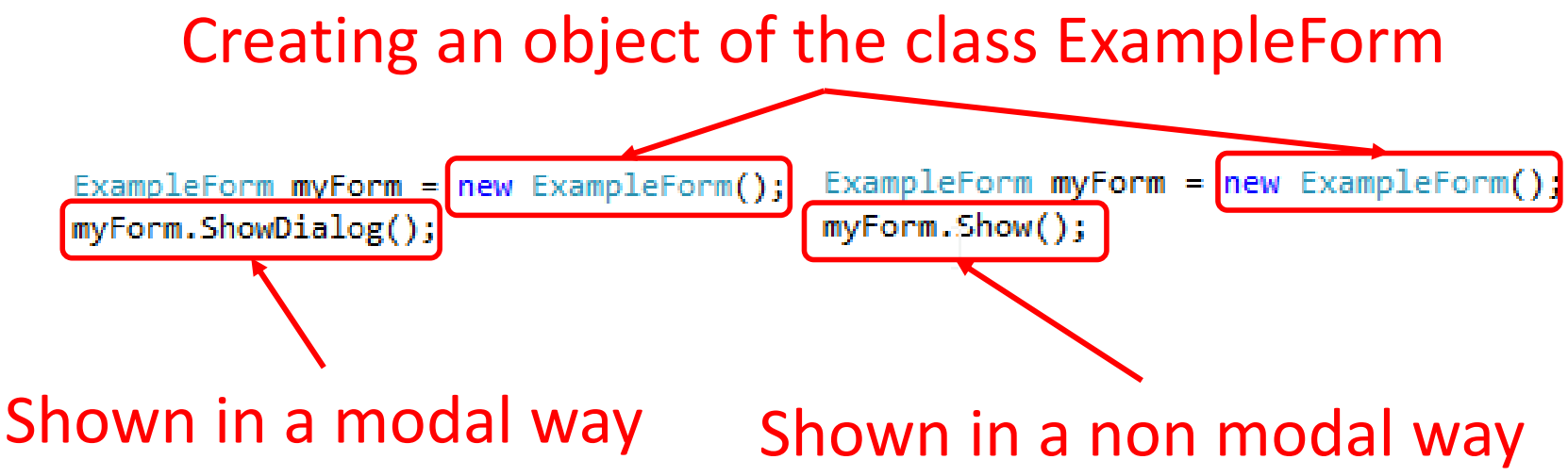


Applications with several forms

- Usually several forms are used.
- The predefined aspect of a form is defined by the property FormBorderStyle.
- There are several types of forms:
  - User designed: added to the Project with Proyecto|Agregar Windows Forms.
  - Predefined in the environment: dialog box.

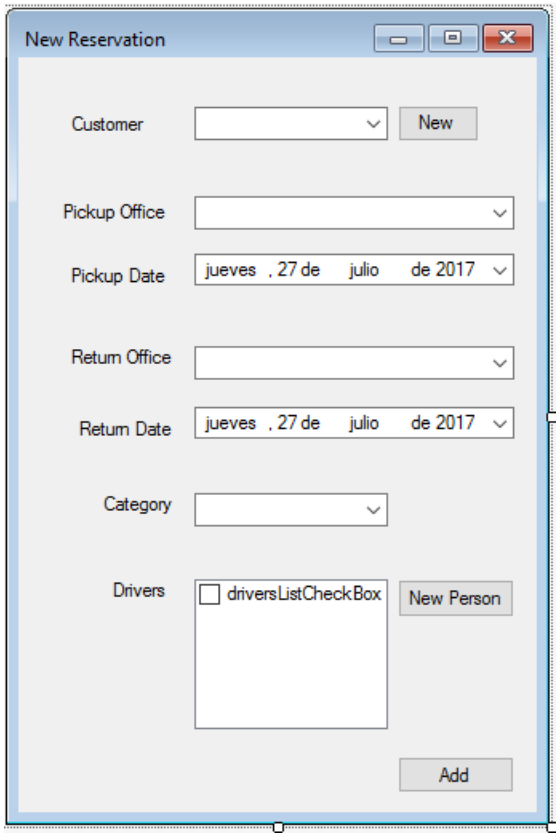
User Defined Forms

- Modal: It must be closed to return to the main form. It is shown using the method ShowDialog().
- Non Modal: several forms may be used simultaneously. Shown using the method Show().

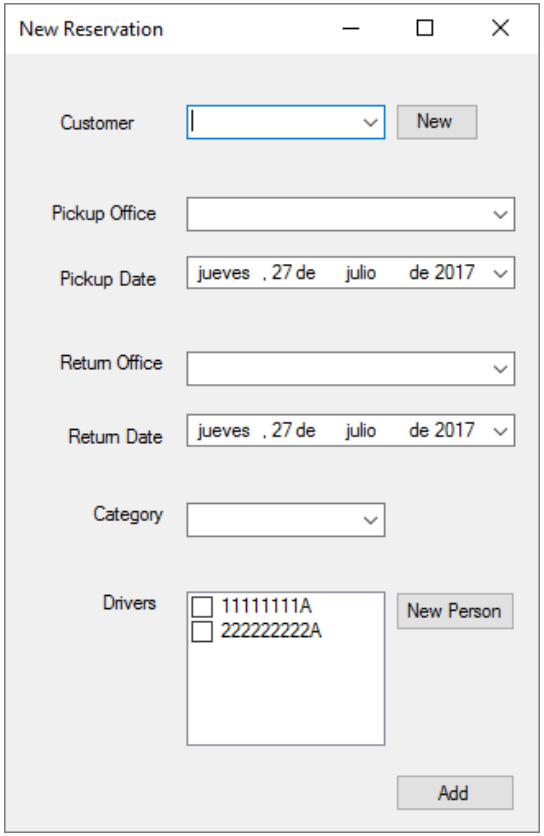


Forms: Example

- Design view



- Run time view



Forms: Example of Main Form

```
public partial class VehicleRentalApp : Form
{
  private IVehicleRentalService service;
  private NewReservationForm newReservationForm;
  private ListReservationsForm listReservationForm;

  public VehicleRentalApp(IVehicleRentalService service)
  {
    InitializeComponent();
    listReservationForm = new ListReservationsForm(service);
    newReservationForm = new NewReservationForm(service);

  }

  private void newToolStripMenuItem_Click(object sender, EventArgs e)
  {
    newReservationForm.ShowDialog();
  }
…
```

Passing parameters in constructor

New form is shown “Modal”

Forms: Example of Secondary Form

```
public partial class NewReservationForm : Form
{
  private IVehicleRentalService service;
  private NewPersonForm newPersonForm;
  private NewCustomerForm newCustomerForm;
  private Customer previousCustomerAdded;
  private string previousSelectedCustomerDNI;

  public NewReservationForm(IVehicleRentalService service)
  {
    InitializeComponent();
    this.service = service;
    newPersonForm = new NewPersonForm(service);
    newCustomerForm = new NewCustomerForm(service);
    LoadData();
  }…
```

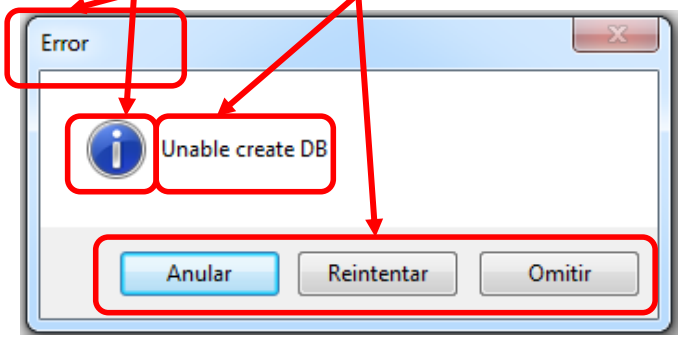
Receives parameters in constructor

Method to implement to load all data in this form

Dialog boxes

- The class **MessageBox** provides simple dialog boxes and modal behavior.
- The title, the descriptive message and the icon may be customized using the Show method

```
DialogResult answer = MessageBox.Show(this, "Unable create DB", "Error",
    MessageBoxButtons.AbortRetryIgnore,
    MessageBoxIcon.Asterisk);
if (answer == DialogResult.Retry) //retry operation
{ }
```

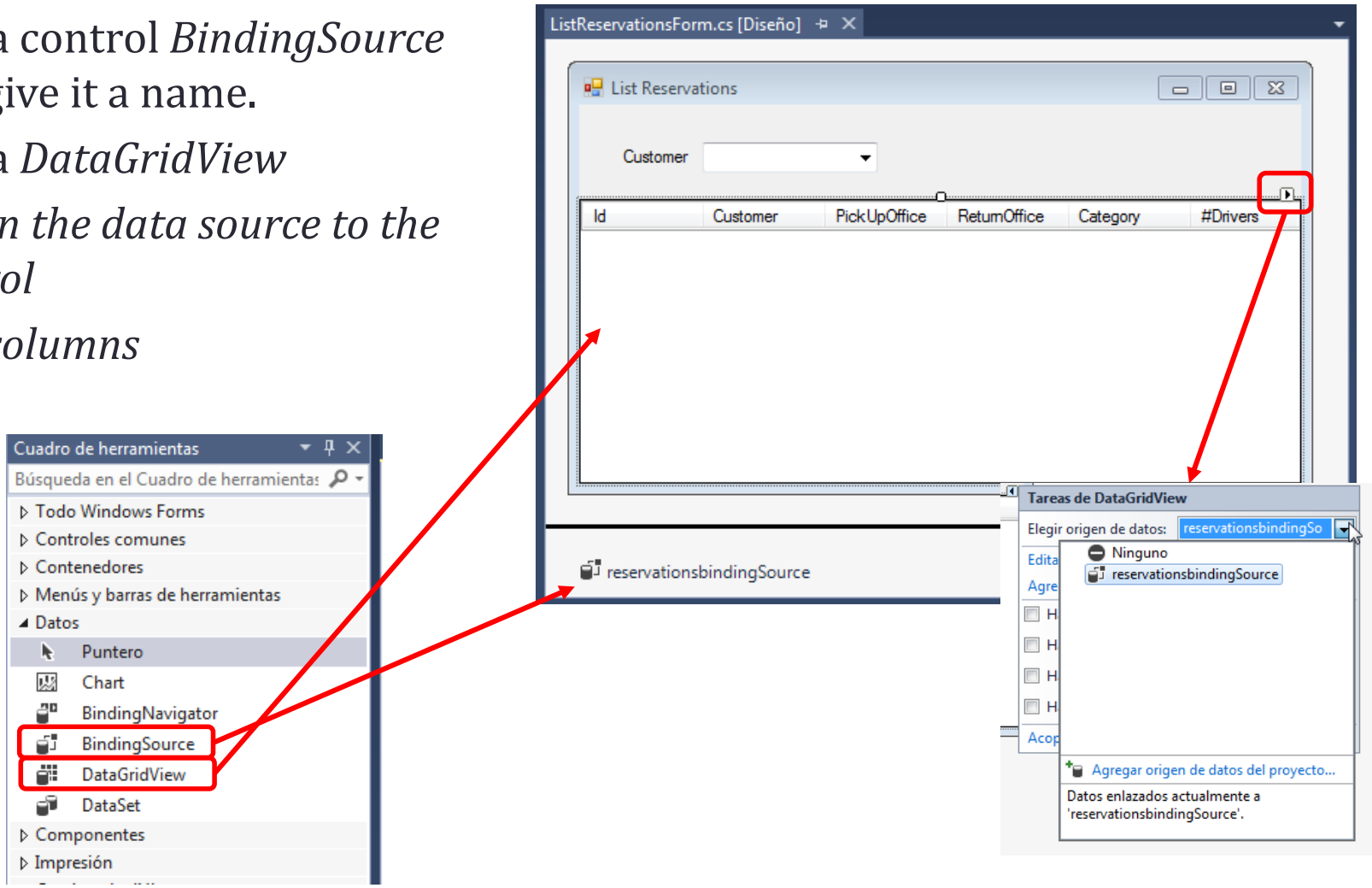


Dialog Boxes

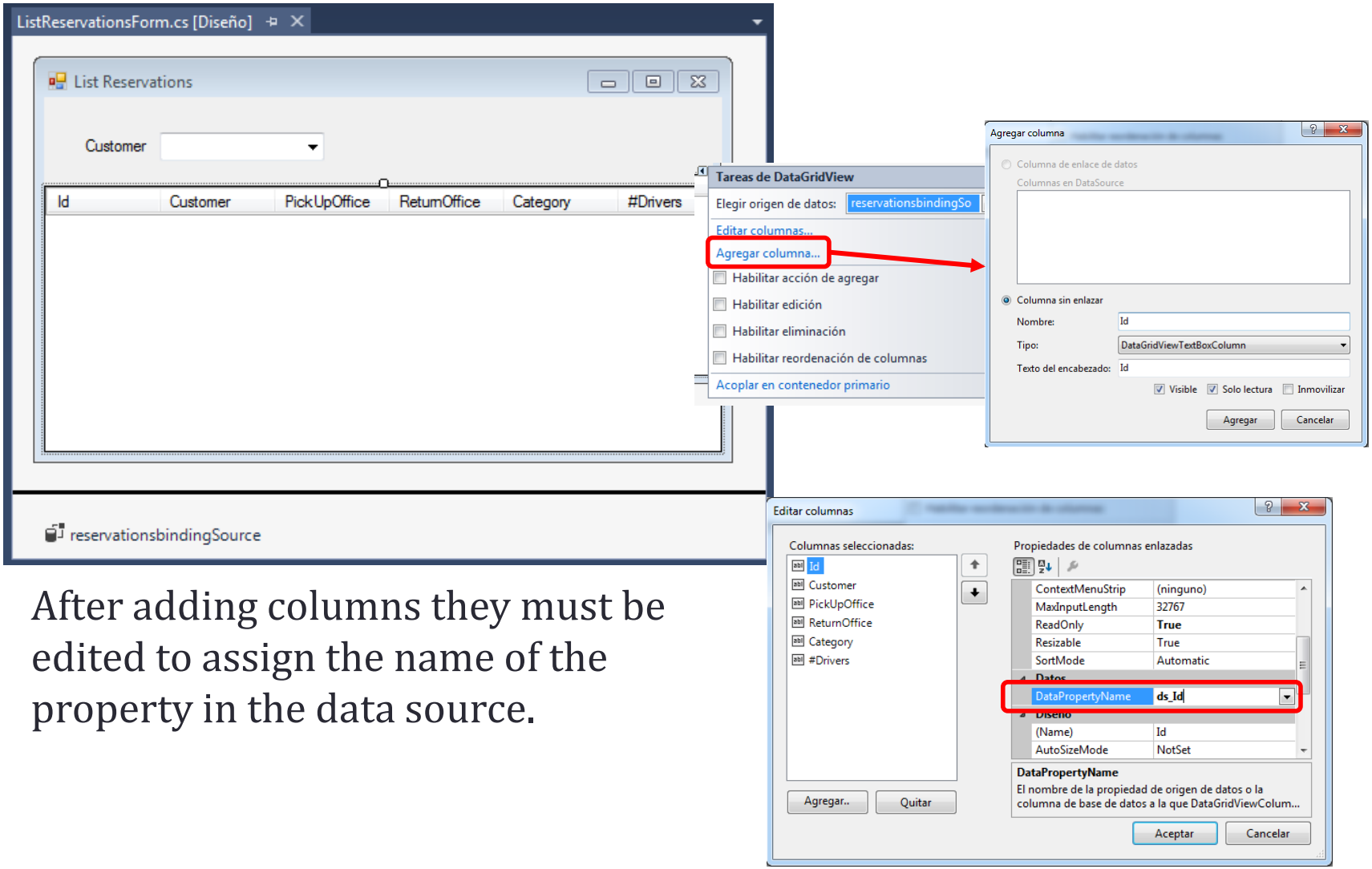
- **Standard Dialog Boxes**
  - These allow carrying out operations such as opening and storing files, printing, selecting colors, etc: ***OpenFileDialog, SaveFileDialog, FolderBrowserDialog, ColorDialog, FontDialog, PageSetupDialog*** and ***PrintDialog***.
  - Inherit from the class CommonDialog. The most imporant method is ShowDialog(), that shows the form and returns an object DialogResult :
    - DialogResult.OK if the user clicks the OK button
    - DialogResult.CANCEL otherwise.

Displaying Data Sets

1. Add a control *BindingSource* and give it a name.
2. Add a *DataGridView*
3. *Assign the data source to the control*
4. *Add columns*

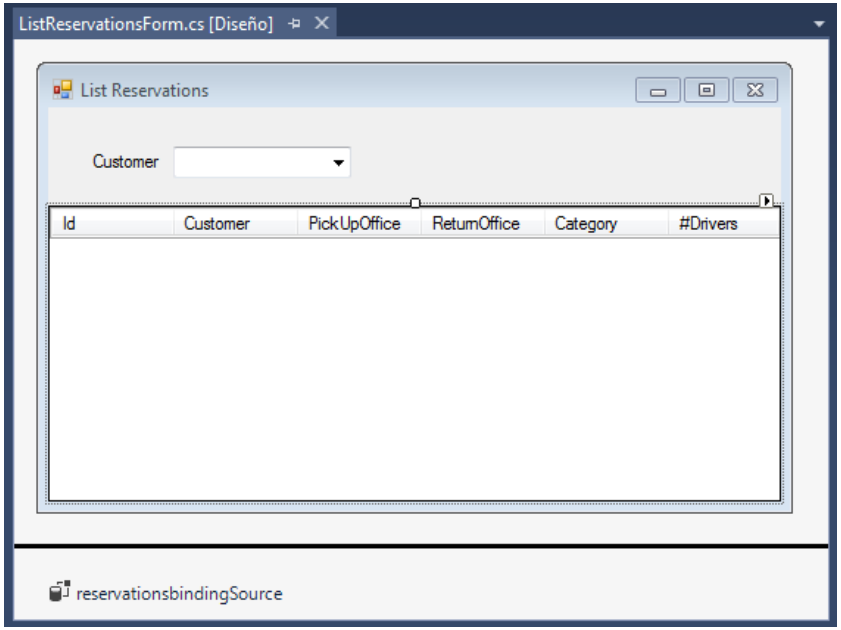


Displaying data sets



After adding columns they must be edited to assign the name of the property in the data source.

Displaying data sets



Functionality

1. When the form is shown a Customer may be selected.
2. After selecting the customer the information is displayed in the *DataGridView*.

Displaying data sets

- When the form is created the *ComboBox* is populated.

  The method *LoadData* populates the ComboBox *customersComboBox:*

```
 public ListReservationsForm(IVehicleRentalService service) : base(service)
{
    InitializeComponent();
    LoadData();
}

public void LoadData()
{
    ICollection<string> customersDNIs = service.findAllCustomers();
    customersComboBox.Items.Clear();
    if (customersDNIs!=null)
    foreach (string Dni in customersDNIs)
           customersComboBox.Items.Add(Dni);
    customersComboBox.SelectedIndex = -1;
    customersComboBox.ResetText();
    reservationsbindingSource.DataSource = null;
}
```

Displaying data sets

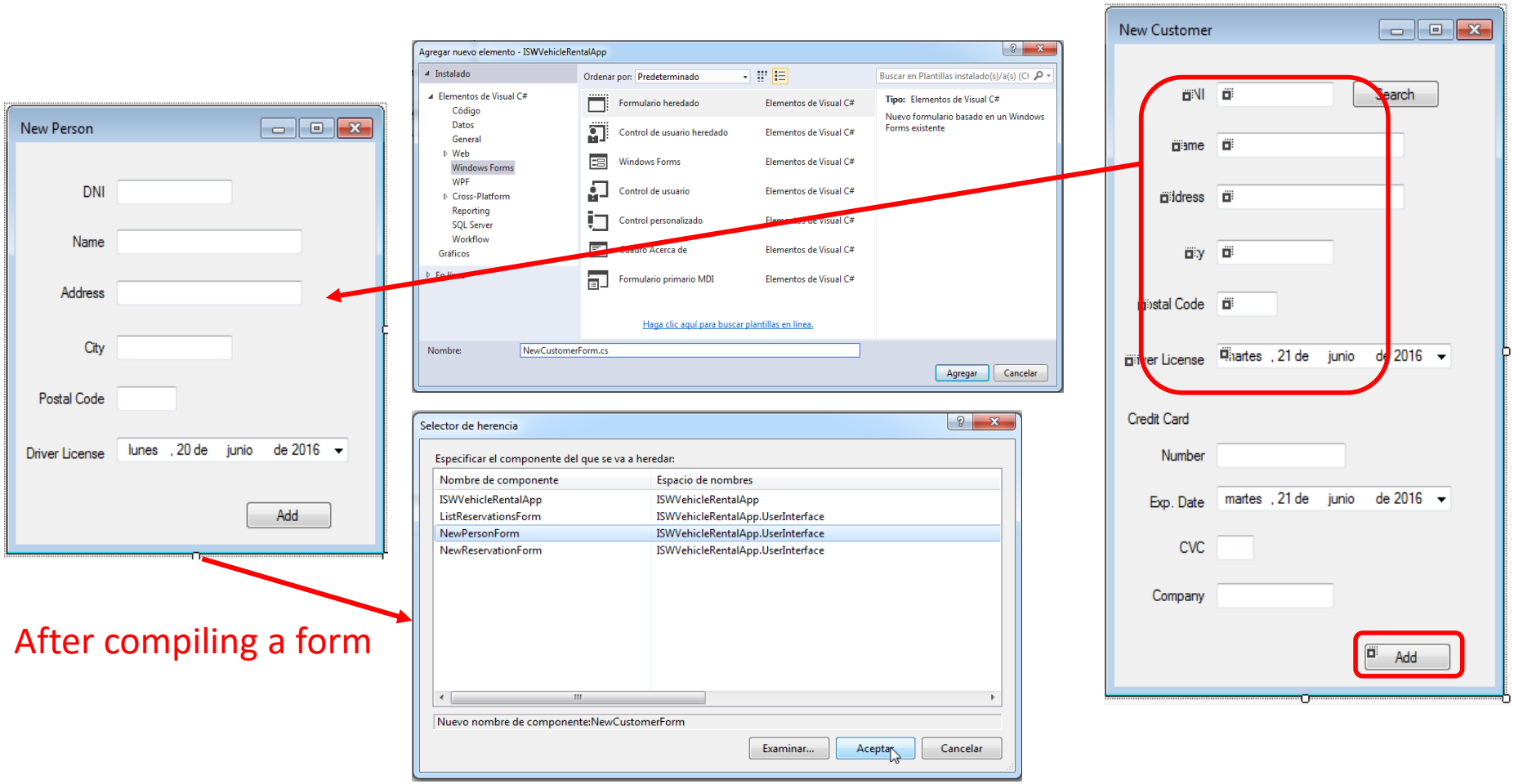
When an element is selected in the *ComboBox* the *DataGridView* is populated.

The event handler *SelectedIndexChanged* of the *ComboBox* object is executed.

```
private void customersComboBox_SelectedIndexChanged(object sender, EventArgs e)
{
    string dni = (string) customersComboBox.SelectedItem;
    ICollection<Reservation> reservations = service.findReservationsbyCustomerID(dni);

    //A BindingList of anonymous objects is used to provide the data model to the DataGrid

    BindingList<object> bindinglist = new BindingList<object>();
    foreach (Reservation r in reservations)
    //Adding one anonymous object for each reservation obtained
    bindinglist.Add(new
        {
          //ds_... are DataPropertyNames defined in the DataGridView object
          //see DataGridView column definitions in Visual Studio Designer
            ds_Id = r.Id,
            ds_Customer = r.Customer.Name,
            ds_PickUpOffice = r.PickUpOffice.Address,
            ds_ReturnOffice = r.ReturnOffice.Address,
            ds_Category = r.Category.Name,
            ds_NumDrivers = r.Drivers.Count
         });
    reservationsbindingSource.DataSource = bindinglist;
}
```

Advanced Operations: Visual Inheritance

Forms may inherit from other forms so that the behavior and visual appeareance is reused



Visual inheritance. Reusing behaviour

All forms use `IVehicleRentalService`. Therefore, we may use a base form `VehicleRentalFormBase` with this reference and all forms will inherit from it

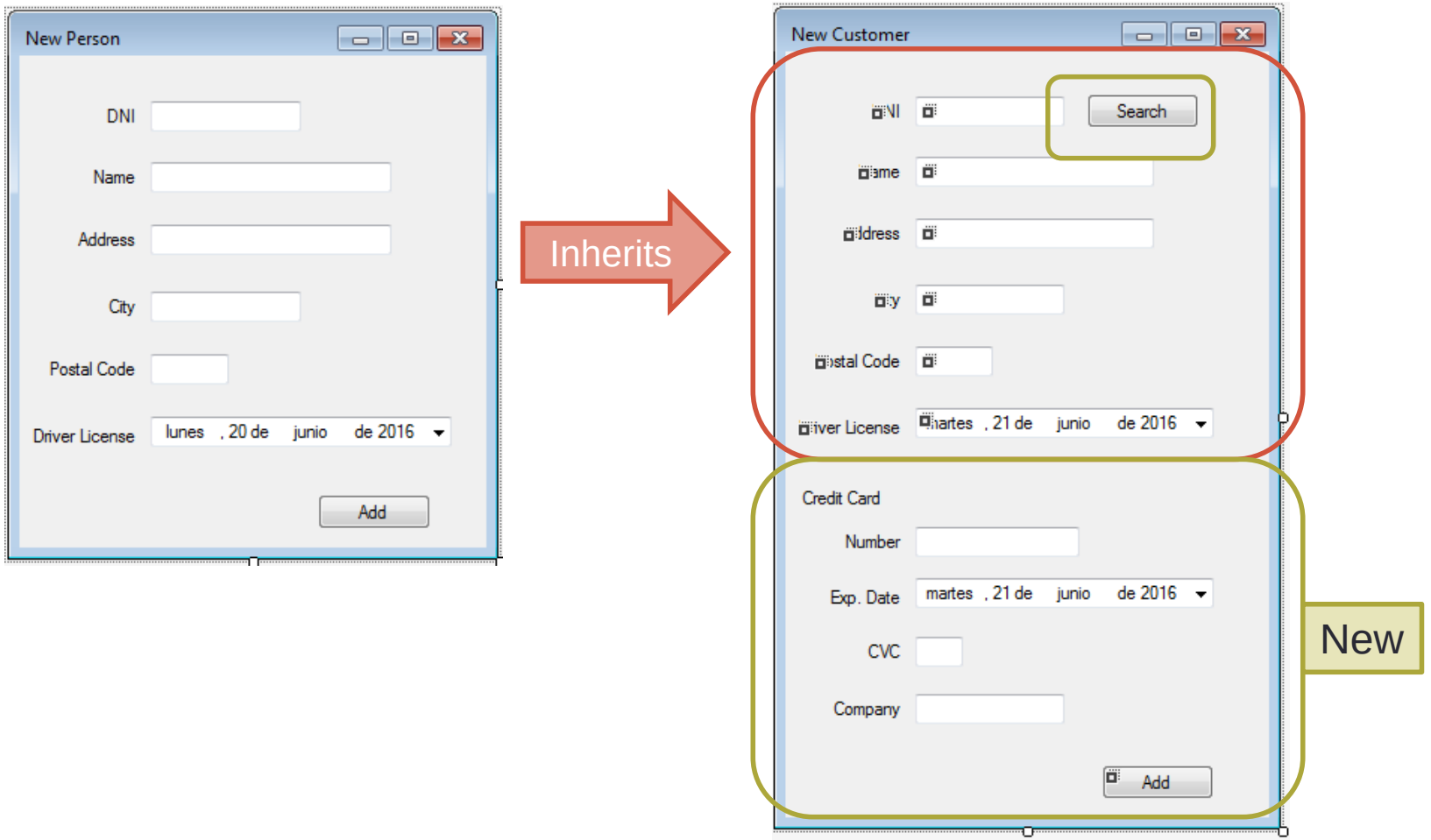
```
// Visual Studio no lo permite, pero VehicleRentalFormBase sería una clase abstracta
public partial class VehicleRentalFormBase : Form
{
   private IVehicleRentalService service;  // también podría ser atributo protected

   public VehicleRentalFormBase()
   {
      InitializeComponent();
   }

   public VehicleRentalFormBase(IVehicleRentalService service) : this()
   {
      this.service = service;
   }
}
```

Visual inheritance. Reusing behaviour

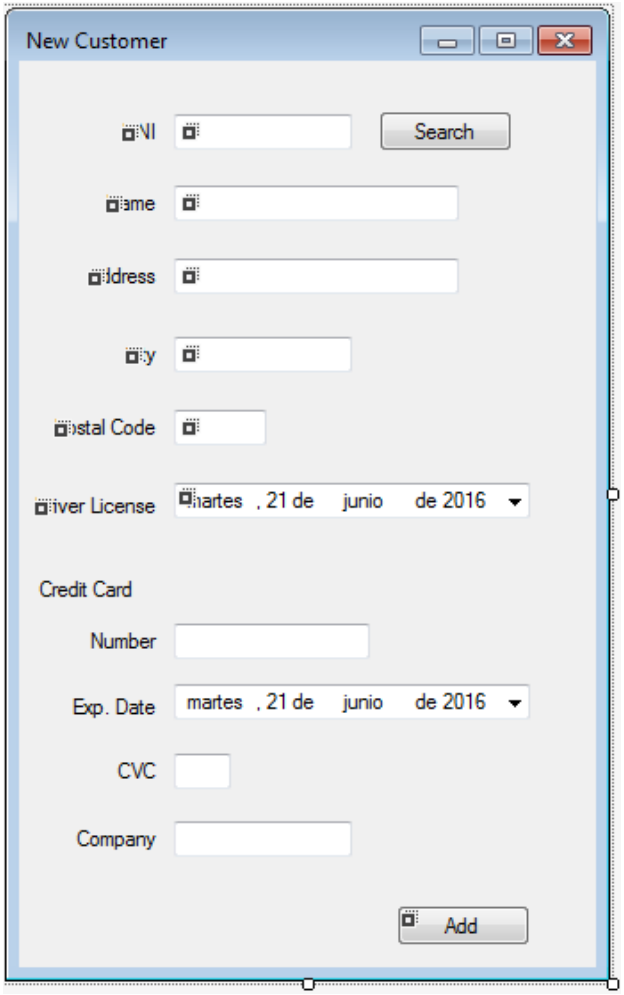
For instance the VehicleRentalApp form

```
public partial class VehicleRentalApp : VehicleRentalFormBase
{
   private ListReservationsForm listReservationForm;
   private NewReservationForm newReservationForm;

   public VehicleRentalApp(IVehicleRentalService service) : base(service)
   {
      InitializeComponent();
      listReservationForm = new ListReservationsForm(service);
      newReservationForm = new NewReservationForm(service);
   }

   …

   private void exitButton_Click(object sender, EventArgs e)
   {
            Application.Exit();
   }
}
```

Visual inheritance. Appearence reuse



Visual inheritance. Appearence reuse




```
public partial class NewCustomerForm : NewPersonForm
{

    public NewCustomerForm() : base()
    {
        InitializeComponent();
    }

    public NewCustomerForm(IVehicleRentalService service)
  : base(service)
    {
        InitializeComponent();
    }
}
```

Bibliography

- D. Stone, C. Jarrett, M. Woodroffe. User Interface Design and Evaluation. Morgan Kaufmann, 2005
- S. Lauesen. User Interface Design. A Software Engineering Perspective. Addison Wesley, 2005
- Shneiderman, B. y Plaisant, C. Designing the User Interface. Pearson 5th ed., 2010

Resources

- Qwindows Forms tutorials

  https://msdn.microsoft.com/es-es/library/zftbwa2b(v=vs.110).aspx
- Tutorial 1: Create an image viewer

  https://msdn.microsoft.com/es-es/library/dd492135.aspx