IBM ILOG Diagram for .NET V2.0

Programming with IBM ILOG Diagram for .NET Silverlight Controls

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Contents

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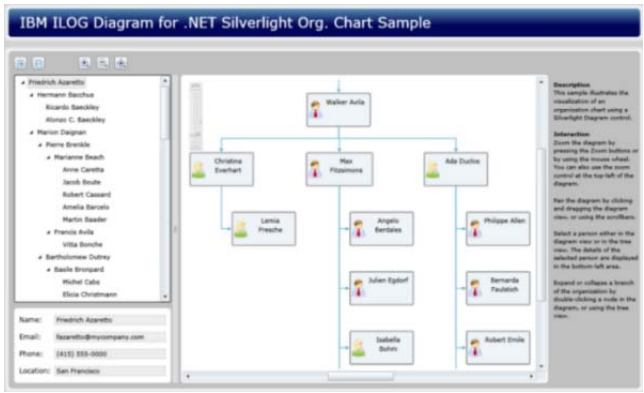
IBM® ILOG® Diagram for .NET offers the ability to integrate graph displays inside your Silverlight application. IBM ILOG Diagram for .NET brings a dedicated set of Silverlight elements that ease the creation of graph representations. With these classes you may create your graph directly from a data source, by specifying the node and links that compose your graph in XAML (the XML language of Silverlight) or directly by code. Thanks to the power of Silverlight, it is possible to create very appealing graph representations through the styling and templating features of Silverlight combined with the power of the Graph Layout library of IBM ILOG Diagram for .NET.

If you are already familiar with the IBM ILOG Diagram for .NET WPF components, you will see that Silverlight components are very similar to the WPF ones. However, some differences do exist, mainly because of the limitations of the Silverlight platform compared to the WPF platform.



The specific Silverlight classes are located in the DLL named **ILOG.Controls.Diagram**. The namespace for those classes is ILOG.Controls.Diagram.

In This Section

Overview

Provides a short overview of the main Silverlight controls and classes.

Creating a Graph Display from a Data Source Using the Diagram Control

Describes how to create a graph representation in Silverlight by using the Diagram class.

Creating a Graph by Specifying Nodes and Links

Explains how to create a graph through instances of the Node and Link classes and use them directly inside any Silverlight container.

Specifying Graph Layout

Briefly describes how to use the Graph Layout classes.

Overview

IBM® ILOG® Diagram for .NET defines a set of predefined Silverlight controls, elements and classes dedicated for displaying and interacting with graphs in the Silverlight platform. Here is an overview of the main classes and controls:

- The Diagram control

  The **Diagram** control allows you to present the information as a graph display while leveraging the most powerful and flexible Silverlight features available. The **Diagram** control can be populated in two ways: by using a data source such as a collection or a list, or by adding nodes and links by code to create a graph. The **Diagram** control provides many advanced styling and layout capabilities and supports scrolling and zooming. The graph can be automatically arranged by a large variety of graph layout algorithms that you can specify and tune both in XAML or by code. The **Diagram** control allows you to customize nodes and links in many different ways, through the styling and templating features of the Silverlight platform it enables the creation of very aesthetic user interfaces.

- The Graph control

  The **Graph** control is used to display graph representations. Unlike the **Diagram** class, the **Graph** control is not bound to a data source. Instead, you can specify the graph data by adding nodes and links (instances of the Node and Link classes) as the children of the **Graph** control. Elements in a **Graph** can be positioned through the Graph.Left and Graph.Top attached properties, but node and links can optionally be arranged automatically by a variety of graph layout algorithms. The Graph control does not

support zooming or scrolling. If you want to create a graph that supports zooming and scrolling, you should use a **Diagram** instead of a **Graph**.

- The Node and Link classes

  The **Node** and **Link** classes are used to compose a graph. The **Diagram** control generates instances of the **Node** and **Link** classes from its data source. You can also add nodes and links manually using the collections contained in the **Nodes** and **Links** properties of the **Diagram**. When you need to style a graph displayed by a **Diagram**, you define a specific style for the **Node** and **Link** classes. You can use the **Node** and **Link** elements in various places. When **Node** and **Link** instances are inside a **Graph** control, the **Graph** control is responsible for arranging the graph through graph layout algorithms, like a Silverlight **Grid** control arranges its children as a grid. **Node** and **Links** can also be used in any Silverlight containers. For example, you may use the **Node** and **Link** elements inside a Silverlight **Canvas**. Inside a **Canvas** or any Silverlight container the links will stay connected to the nodes when the nodes change location or size. Note that the **Node** class is a subclass of the Silverlight **ContentControl** class and therefore you can place any Silverlight element inside a **Node**. For example, it is possible to place a **Graph** control inside a Node to create the notion of a *subgraph*.

- The Graph Layout classes

  Graph Layout classes are also present in the ILOG.Controls.Diagram namespace so that you can specify both by code or in XAML how your graph should be arranged. The classes are providing the same algorithms as the classes provided for the Windows Forms and ASP.NET classes of IBM ILOG Diagram for .NET but are implemented as Silverlight dependency objects. See *Using Graph Layout Algorithms* to learn about the various options available for Graph Layout algorithms, such as Tree Layout or Hierarchical Layout algorithms. Note that some of the advanced functionalities of the Graph Layout library are not available in Silverlight.

Creating a Graph Display from a Data Source Using the Diagram Control

An easy way to create a graph representation in Silverlight is to use the Diagram class. The **Diagram** class is a Silverlight control that can automatically create a graph composed of nodes and links from any source of data. If you are familiar with Silverlight then you must have already used a Silverlight ListBox bound to a data source. A Silverlight ListBox bound to a data source will automatically be filled with items that are instances of ListBoxItem. Then, it is possible to provide a data template to specify how a ListBoxItem is rendered depending on the data. For the **Diagram** class, the concept is very similar: once the diagram is bound to a data source, the **Diagram** control is automatically filled with Node objects that represent the nodes of the graph. For each item in the data source a **Node** instance is created to represent the item. Of course, it is also necessary to specify the relations between items in the data source so that links between the nodes (instance of the Link class) can be created and rendered. The relations between items will also be expressed using the Silverlight binding system.

In This Section

A First Example Using the Diagram Control

Provides an example that shows how to use the Diagram control.

Specifying the Data Sources of a Diagram

Explains how to specify the data sources of a diagram.

Making the Diagram Reflect the Changes in my Data Source

Explains how to make the diagram reflect the changes in a data source.

Populating a Diagram Using the Nodes and Links Collections

Explains how to populate a diagram using nodes and links collections.

Styling Nodes and Links in a Diagram

Describes how to customize the representation of the nodes and links to your particular needs.

Selection in a Diagram

Explains how to select nodes in a diagram.

Zoom in a Diagram

Explains how to zoom in and out the graph displayed.

Specifying Graph Layout Algorithms in a Diagram

Describes the graph layout algorithms in a diagram.

A First Example Using the Diagram Control

In this basic example you will create a collection of objects representing employees and render a graph that represents these objects. Each employee is represented by an instance of the Employee class:

```
public class Employee
 {
     public string Name { get; set; }
     public Employee Manager { get; set; }
 }
```

This code creates the collection of employees:

```
List<Employee> employees = new List<Employee>();

employees.Add(new Employee() { Name = "employee 1" });
employees.Add(new Employee() { Name = "employee 2", Manager = employees[0] });
employees.Add(new Employee() { Name = "employee 3", Manager = employees[0] });
employees.Add(new Employee() { Name = "employee 4", Manager = employees[2] });
employees.Add(new Employee() { Name = "employee 5", Manager = employees[2] });
employees.Add(new Employee() { Name = "employee 6", Manager = employees[0] });
```

Employee 1 manages employees 2, 3 and 6; employee 3 manages employees 4 and 5.

The following line will then assign the list of employees to the NodesSource property of the Diagram control:

```
diagram.NodesSource = employees;
```

The following XAML file defines a simple Silverlight page containing the **Diagram** control that will render these `Employee` objects.

```
<UserControl x:Class="DocExample1.Page"
 xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
 xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
xmlns:ilog="clr-namespace:ILOG.Controls.Diagram;assembly=ILOG.Controls.Diagram
 Width="400" Height="300">
 <Grid x:Name="LayoutRoot" Background="White">
      <ilog:Diagram x:Name="diagram"
                      ParentBinding="{Binding Manager}"
                      DisplayMemberBinding="{Binding Name}"/>
 </Grid>
</UserControl>
```

As you can see, the first thing to do is to declare the XML namespaces for the Silverlight classes. The following line declares a new XML namespace named `ilog` that will be used later with the IBM® ILOG® Diagram for .NET Silverlight classes:

```
xmlns:ilog="clr-namespace:ILOG.Controls.Diagram;assembly=ILOG.Controls.Diagram"
```

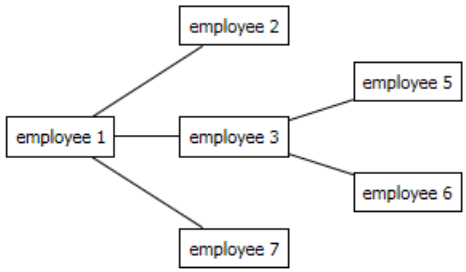
Then, a Silverlight Grid control is defined, and a **Diagram** control is defined inside the Grid:

```
<Grid x:Name="LayoutRoot" Background="White">
    <ilog:Diagram x:Name="diagram"
                    ParentBinding="{Binding Manager}"
                    DisplayMemberBinding="{Binding Name}"/>
</Grid>
```

The ParentBinding property is used to indicate the relations (the links) between the nodes. There are several ways to indicate the relations between the nodes; the **ParentBinding** property is a simple way to define parent/child relations to create a tree-style graph. In our example, the `Employee` class has a `Manager` property that contains another `Employee` object representing the manager of the employee. The **ParentBinding** declaration tells the **Diagram** control to create a link between each employee and its manager. For more information on how to specify the relations between nodes, see *Specifying the Data Sources of a Diagram*.

The DisplayMemberBinding specifies what you want to display inside a node. Here, it specifies that you want to display the `Name` property of the `Employee` object. The **DisplayMemberBinding** specifies a simple representation in the nodes of the graph. For a more complex representation you would use styling and templating as described in *Styling Nodes and Links in a Diagram.*

This XAML declaration will give the following result:



By default, the **Diagram** control will automatically arrange the resulting graph with a Hierarchical Layout algorithm. To change the layout algorithm use the GraphLayout property and choose between the various algorithms such as TreeLayout, HierarchicalLayout, ForceDirectedLayout and more. Each algorithm has many options that allow you to tailor the placement of nodes and the shape and connection points of the links.

Specifying the Data Sources of a Diagram

Within a Diagram control, the data source that represents all the nodes of the graph can be specified through the NodesSource property of the **Diagram** class. This property is of type **IEnumerable** so anything that can be enumerated can be used as the source of data, in particular the data source provider classes that are part of Silverlight, like the List or Collection classes.

The **NodesSource** property is not sufficient to represent graph data, it is also necessary to specify the relations between the items in the data source. There are two ways to do this: using bindings that will define implicit relationships between nodes, or using a second data source, **LinksSource**, which contains explicit relationships between nodes. Note that these two ways of defining links are not exclusive; you can use both in the same diagram.

In This Section

Defining Links Using Implicit Relations

Describes the properties that allow you to specify implicit relations between the items.

Defining Links Using Explicit Relations

Explains how to specify explicit relations between nodes.

Defining Links Using Implicit Relations

The **Diagram** class contains three properties that allow you to specify implicit relations between the items. You only need to use one of these three properties and choose the one that best corresponds to the way your data source is organized. The three binding properties are SuccessorsBinding, PredecessorsBinding and ParentBinding.

The **SuccessorsBinding** property allows you to specify a Silverlight binding from an item in the data source to its "successors". The source of this binding is one item in the data source and the result must be the list of the successors of this item. Each successor should also be part of the data source that you have specified through the **NodesSource** property. Through this binding specification you notify the **Diagram** that there is a relation between an item in the data source and other items (successors) in the data source. By knowing these relations, the **Diagram** can render directed links from an item to its successors. For each relation a Link instance is created.

The **PredecessorsBinding** is similar to the **SuccessorsBinding**. The source of the binding is also an item in the data source and the result must be a list of items (also in the data source) that represents the predecessors of the item. By knowing these relations, the **Diagram** will generate a directed link from each predecessor to its successor. Again, a **Link** instance will be created for each relation.

The **ParentBinding** is similar to the **PredecessorsBinding**. The source of the binding is an item in the data source but the result is another item of the data source that represents the parent of the item. Only one single link will be created from the parent to the child. Therefore, the **ParentBinding** is equivalent to a **PredecessorsBinding** with a single predecessor. The **ParentBinding** is used to simplify the binding when each item has only a single parent item.

For example, suppose that you need to represent an organization chart. The data source will be a list of employees represented by the `Employee` class.

The `Employee` class provides a property that represents the manager of this employee and a property that represents the list of employees managed by this employee. We will obtain a C# class with the following skeleton:

```
public class Employee {
  public Employee Manager {get; set;}
  public List<Employee> ResponsibleFor {get;}
}
```

If your data source is a list of all the employees of the company, you can specify the relation in two different ways:

In XAML (assuming the **NodesSource** property of the **Diagram** has been set by code to a collection of Employee objects):

```
<ilog:Diagram SuccessorsBinding="{Binding ResponsibleFor}"/>
```

or

```
<ilog:Diagram ParentBinding="{Binding Manager}"/>
```

In C#:

```
List<Employee> allEmployees = …
Diagram diagram = new Diagram();
diagram.NodesSource = allEmployees;
diagram.SuccessorsBinding = new Binding("ResponsibleFor");
```

or

```
List<Employee> allEmployees = …
Diagram diagram = new Diagram();
diagram.NodesSource = allEmployees;
diagram.ParentBinding = new Binding("Manager");
```

> ***Note:*** *The resulting type of the binding specified in the* ***SuccessorsBinding*** *or* ***PredecessorsBinding*** *properties must be* ***IEnumerable*** *which is the case in the example, where the* `ResponsibleFor` *property is defined with the type* `List<Employee>`.

Through the **PredecessorsBinding** and **SuccessorsBinding** properties you can create any type of graph. There is no constraint in the successors or predecessors of an item, except that they must be part of the data source. For example, the same item may appear several times in the successors or predecessors of an item. An item can be the successor of himself and this will generate a 'self link' (a link from the item to itself). You can easily create cyclic graphs or a graph composed of several disconnected parts. As you are specifying only one relation from an item to its parent item, the **ParentBinding** property is more suitable for defining a simple hierarchy that can be displayed as a tree.

Note that the example is rather simple and this is mainly because our `Employee` class provides properties that are easy to bind to. It may happen that the relations between items are more complex and require some computation. In this case it is still possible to use a binding and the **Converter** property of the binding. By specifying a converter in the binding you will be able to code more complex relations between items of the data source.

When using a converter in the binding, the value to convert is the item in the data source from which you want to find the successors or predecessors and the result should be the collection (**IEnumerable**) of the successors or predecessors of this item.

Defining Links Using Explicit Relations

Instead of (or in addition to) defining implicit relations between nodes using the **SuccessorsBinding**, **PredecessorsBinding** or **ParentBinding** properties, you can use the **LinksSource** property to specify a collection of explicit relations between nodes.

Like the **NodesSource** property, the **LinksSource** property must contain an **IEnumerable** object. The items in the **LinksSource** will be enumerated, and each item will be represented by a **Link** in the **Diagram**.

To tell the **Diagram** which nodes a link will be connected to, you need to specify two more bindings through the **StartBinding** and **EndBinding** properties. These properties specify the items in the **NodesSource** that represent the start and end of the link.

For example, in the above organization chart example, sometimes you need to define "dotted-line" relationships between employees (for example, an employee may have a direct manager and another supervisor). Such relations can be represented by a **DottedLineRelation** class:

```
public class DottedLineRelation
{
   Employee From { get; set; }
   Employee To { get; set; }
}
```

You would then add dotted-line relations in your code as follows:

```
    List<DottedLineRelation> relations = new List<DottedLineRelation>();

    relation = new DottedLineRelation();
    relation.From = employee1;
    relation.To = employee2;
    relations.Add(relation);

    diagram.LinksSource = relations;
```

And you would define the **StartBinding** and **EndBinding** properties as follows:

In XAML:

```
<ilog:Diagram StartBinding="{Binding From}" EndBinding="{Binding To}"/>
```

In C#:

```
diagram.StartBinding = new Binding("From");
diagram.EndBinding = new Binding("To");
```

Note that, instead of specifying direct references to the node items as in this example, the **StartBinding** and **EndBinding** properties can also specify the names of the start or end nodes. In that case, it is necessary to specify the **NodeNameBinding** that defines the property used to identify each node uniquely in the data source.

Making the Diagram Reflect the Changes in my Data Source

You can create a graph over any collection of items that implements **IEnumerable**. However, to set up dynamic bindings so that insertions or deletions in the collection of nodes

or in the predecessors or successors collection update the graph automatically, the collections must implement the **INotifyCollectionChanged** interface. This interface exposes the **CollectionChanged** event that is raised whenever the underlying collection changes.

Silverlight provides the **ObservableCollection< T>** class, which is a built-in implementation of a data collection that exposes the **INotifyCollectionChanged** interface.

When using the ParentBinding property, the modification of the property that represents the parent must be notified to the Diagram. This must be done by implementing the **INotifyPropertyChanged** interface of the .NET platform.

If we need dynamic binding in the above example, we would implement the `Employee` class as follow:

```
public class Employee : INotifyPropertyChange {
  public Employee Manager {get; set;}
  public ObservableCollection<Employee> ResponsibleFor {get;}
   …
}
```

An example using dynamic binding can be found in `<install-dir>\Samples\QuickStart\SilverlightDiagram`.

Populating a Diagram Using the Nodes and Links Collections

Instead of using the **NodesSource** and/or **LinksSource** properties, you can add nodes and links directly in a **Diagram** using the **Nodes** and **Links** properties. The initial values of these properties are empty collections. You can add either **Node** or **Link** objects that will be added directly to the underlying **Graph**, or you can add data items that will be translated to **Node** or **Link** objects, using the same process and properties as explained in *Specifying the Data Sources of a Diagram.*

Note that, even if you specified a data source using the **NodesSource** and/or **LinksSource** properties, you can also use the **Nodes** and **Links** properties to add more nodes or links to the **Diagram**, provided that the specified data source(s) are collections and are not read-only.

An example that shows all the different ways of populating a **Diagram** can be found in `<install-dir>\Samples\QuickStart\SilverlightDiagram`.

Styling Nodes and Links in a Diagram

The Diagram component generates instances of the Node class to represent the items in the data source and instances of the Link class to represent the relations between items. By using

the Silverlight styling and templating features, it is possible to tailor the representation of the nodes and links to your particular needs. This section introduces the various ways to style the nodes and the links. For more information on Silverlight styling and templating features see the Silverlight documentation.

In This Section

Styling Nodes and Links Using Basic Style Features

Explains how to use basic features to style nodes and links.

Styling Nodes with Data Templates and Data Template Selectors

Explains how to use data templates to style nodes.

Changing the Control Template of the Node Class

Explains how to change the Control template of the Node class.

Styling Nodes and Links Using Basic Style Features

In a **Diagram** control, you style the nodes of your diagram by using the styling and templating features of Silverlight. In this section, you will find some techniques that can be applied to the nodes of a diagram.

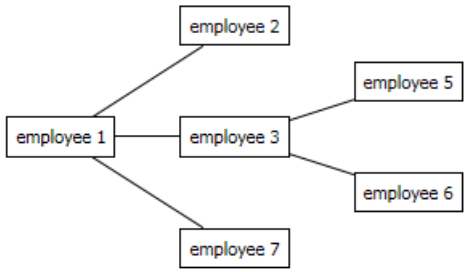
Imagine that you want to display the same object that represents a hierarchy of employee:

```
public class Employee
{
   public string Name { get; set; }
   public Employee Manager { get; set; }
}

…
   List<Employee> employees = new List<Employee>();
   employees.Add(new Employee() { Name = "employee 1" });
   employees.Add(new Employee() { Name = "employee 2", Manager = employees[0]
});
   employees.Add(new Employee() { Name = "employee 3", Manager = employees[0]
});
   employees.Add(new Employee() { Name = "employee 4", Manager = employees[2]
});
   employees.Add(new Employee() { Name = "employee 5", Manager = employees[2]
});
   employees.Add(new Employee() { Name = "employee 6", Manager = employees[0]
});
```

The **Diagram** control is defined with following markup:

```
<ilog:Diagram x:Name="diagram"
                        ParentBinding="{Binding Manager}"
                        DisplayMemberBinding="{Binding Name}"/>
```

Without any styling the diagram appears like this:



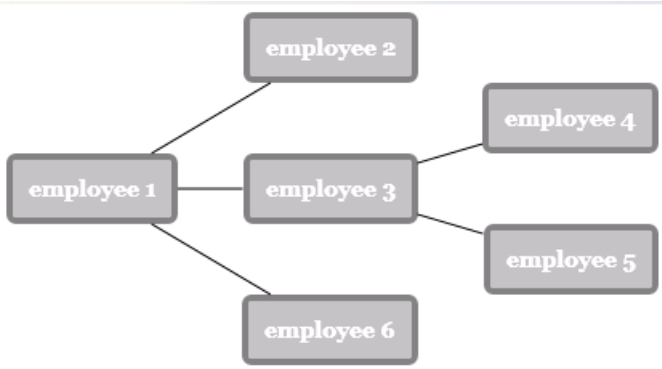
The first thing to do is to define a Silverlight Style that will apply to all the nodes. Here is a style definition that specifies some properties of the **Node** class:

```
<UserControl.Resources>
    <Style TargetType="ilog:Node" x:Key="NodeStyle">
        <Setter Property="Padding" Value="10"/>
        <Setter Property="FontFamily" Value="Georgia"/>
        <Setter Property="FontSize" Value="14"/>
        <Setter Property="FontWeight" Value="bold"/>
        <Setter Property="Background" Value="Silver"/>
        <Setter Property="Foreground" Value="White"/>
        <Setter Property="BorderBrush" Value="Gray"/>
        <Setter Property="BorderThickness" Value="4"/>
        <Setter Property="CornerRadius" Value="4"/>
    </Style>
</UserControl.Resources>
```

This style is defined in the **Resources** property of the Silverlight page. We must now tell the **Diagram** control to use this style to customize the nodes: this is done through the **NodeStyle** property.

```
<ilog:Diagram x:Name="diagram"
                        ParentBinding="{Binding Manager}"
                        DisplayMemberBinding="{Binding Name}"
                        NodeStyle="{StaticResource NodeStyle}" />
```

With this style in place the diagram now appears like this:



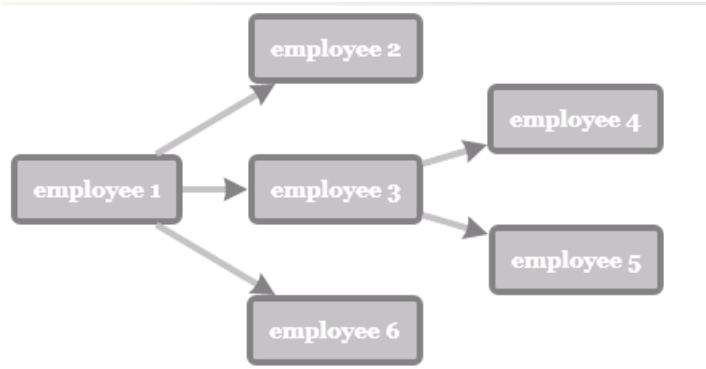
You can also define a style for the **Link** class to change the appearance of all links: the following example defines a specific thickness, a color and an end arrow for all links.

```
<Style TargetType="ilog:Link" x:Key="LinkStyle">
      <Setter Property="StrokeThickness" Value="4"/>
      <Setter Property="Stroke" Value="Silver"/>
      <Setter Property="EndArrowVisibility" Value="Visible"/>
      <Setter Property="EndArrowShape" Value="Curved"/>
      <Setter Property="EndArrowSize" Value="15,15"/>
      <Setter Property="EndArrowFill" Value="Gray"/>
</Style
```

Like for the node style, we must tell the **Diagram** control to use this style to customize the links: this is done through the **LinkStyle** property.

```
<ilog:Diagram x:Name="diagram"
                        ParentBinding="{Binding Manager}"
                        DisplayMemberBinding="{Binding Name}"
                        NodeStyle="{StaticResource NodeStyle}"
                        LinkStyle="{StaticResource LinkStyle}" />
```

The diagram now looks like this:



Note that some properties of the **Link** class that control the connection points and bend points of the links may not be taken into account when the graph is automatically arranged by the graph layout algorithm specified in a **Diagram**. Some graph layout algorithm will completely define the shape and connection points of the links and in this case the properties such as Points, StartAnchorPosition, EndAnchorPosition, StartAnchorOffset, EndAnchorOffset, and ShapeType of the **Link** class will not be taken into account. To change the shape of links or the way they are connected, you will have to change the properties on the Graph Layout instance used to layout the graph. For more information on this, see *Specifying Graph Layout Algorithms in a Diagram*.

Styling Nodes with Data Templates and Data Template Selectors

In a **Diagram** control, you can decide what to display in a **Node** by specifying a Silverlight **DataTemplate** for the nodes generated by the **Diagram**. The **Diagram** control defines the NodeTemplate property (of type **DataTemplate**) that lets you define the appearance of the nodes and the bindings between the properties of the node and the item in the data source.

In our organization chart example, each **Person** object in the data source has a **Name** property that you may want to display in the nodes. The following data template displays the name in a Silverlight **TextBlock** element with a small ellipse on the left using the Silverlight **Ellipse** element.

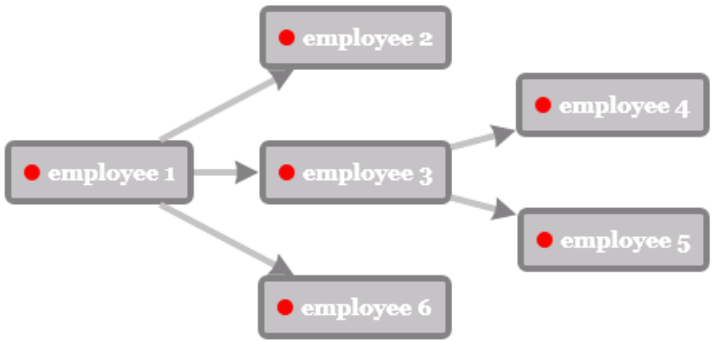
```
<DataTemplate x:Key="nodeTemplate">
      <StackPanel Orientation="Horizontal">
          <Ellipse Fill="red" Width="10" Height="10"/>
          <TextBlock Margin="5,0,0,0" Text="{Binding Name}"/>
      </StackPanel>
</DataTemplate>
```

While specifying a data template for nodes, you can bind to the data that this node represents. The data context of the node is the item in the data source that this node represents, in this case a Person object.

The full markup file would be as follows:

```
<UserControl x:Class="DocExample2.Page"
    xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
    xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
    xmlns:ilog="clr-namespace:ILOG.Controls.Diagram;
                               assembly=ILOG.Controls.Diagram">
    <UserControl.Resources>
        <Style TargetType="ilog:Node" x:Key="NodeStyle">
            <Setter Property="Padding" Value="8"/>
            <Setter Property="FontFamily" Value="Georgia"/>
            <Setter Property="FontSize" Value="14"/>
            <Setter Property="FontWeight" Value="bold"/>
            <Setter Property="Background" Value="Silver"/>
            <Setter Property="Foreground" Value="White"/>
            <Setter Property="BorderBrush" Value="Gray"/>
            <Setter Property="BorderThickness" Value="4"/>
            <Setter Property="CornerRadius" Value="4"/>
        </Style>
        <Style TargetType="ilog:Link" x:Key="LinkStyle">
            <Setter Property="StrokeThickness" Value="4"/>
            <Setter Property="Stroke" Value="Silver"/>
            <Setter Property="EndArrowVisibility" Value="Visible"/>
            <Setter Property="EndArrowShape" Value="Curved"/>
            <Setter Property="EndArrowSize" Value="15,15"/>
            <Setter Property="EndArrowFill" Value="Gray"/>
        </Style>
        <DataTemplate x:Key="NodeTemplate">
            <StackPanel Orientation="Horizontal">
                <Ellipse Fill="red" Width="10" Height="10"/>
                <TextBlock Margin="5,0,0,0" Text="{Binding Name}"/>
            </StackPanel>
        </DataTemplate>
    </UserControl.Resources>
    <Grid x:Name="LayoutRoot" Background="White">
        <ilog:Diagram x:Name="diagram" ParentBinding="{Binding Manager}"
                      NodeStyle="{StaticResource NodeStyle}"
                      LinkStyle="{StaticResource LinkStyle}"
                      NodeTemplate="{StaticResource NodeTemplate}">
        </ilog:Diagram>
    </Grid>
</UserControl>
```

And the resulting graph looks like this:



Through the NodeTemplate property, you can combine all the Silverlight elements to create any kind of representation for the nodes.

You may also decide to have different data templates depending on some logic that you want to code. In this case, create a subclass of the NodeTemplateSelector class and override the SelectTemplate method.

For example, define a different template for managers and non-managers:

```
<UserControl.Resources>
   ...
    <DataTemplate x:Key="managerNodeTemplate">
        <StackPanel>
            <TextBlock
           HorizontalAlignment='Center'
           Margin="5"
           FontSize='10'
           FontStyle="Italic"
           Foreground="Black"
           Text="Manager"/>
            <TextBlock Text="{Binding Name}"/>
        </StackPanel>
    </DataTemplate>

    <DataTemplate x:Key="nodeTemplate">
        <StackPanel Orientation="Horizontal">
            <Ellipse Fill="red" Width="10" Height="10"/>
            <TextBlock Margin="5,0,0,0" Text="{Binding Name}"/>
        </StackPanel>
    </DataTemplate>
</UserControl.Resources>
```

In the following example, the **SelectTemplate** method provides logic to return the appropriate template wether the `Employee` element represents a manager or not. The template to return is found in the resources of the enveloping page (a **UserControl** element).

```
public class EmployeeDataTemplateSelector : NodeTemplateSelector
```

```
{
    public override DataTemplate SelectTemplate(Diagram diagram, object item,
Node node)
    {
        Employee employee = item as Employee;
        if (item != null)
        {
            UserControl window = Application.Current.RootVisual as UserControl;
            bool isManager = false;
            foreach (Employee e in diagram.Nodes)
            {
                if (e.Manager == employee)
                {
                    isManager = true;
                    break;
                }
            }
            if (isManager)
                return window.Resources["managerNodeTemplate"] as DataTemplate;
            else
                return window.Resources["nodeTemplate"] as DataTemplate;
        }
        return null;
    }
}
```

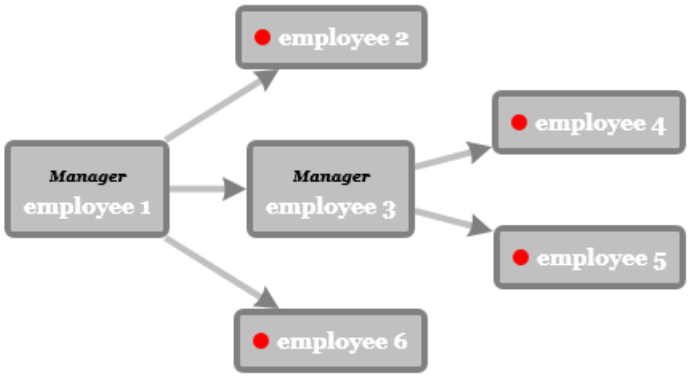
Then, you can declare the data template selector as a resource:

```
<UserControl.Resources>
    …
    <local: EmployeeDataTemplateSelector x:Key="employeeDataTemplateSelector"/>
    …
</UserControl.Resources>
```

To use the template selector resource, assign it to the NodeTemplateSelector property of the **Diagram** class. The **Diagram** calls the **SelectTemplate** method of the **EmployeeDataTemplateSelector** for each of the items in the underlying collection. The call passes the data object as the item parameter. The **DataTemplate** returned by the method is applied to that data object.

```
<ilog:Diagram
     ParentBinding="{Binding Manager}"
     NodeStyle="{StaticResource NodeStyle}"
     LinkStyle="{StaticResource LinkStyle}"
     NodeTemplateSelector="{StaticResource employeeDataTemplateSelector}"/>
```

With the template selector in place the graph looks like this:



Changing the Control Template of the Node Class

The Node class is a subclass of the **ContentControl** class, thus a **Node** is a Silverlight control and has a **ControlTemplate** that you can modify. By default, the control template of the node represents a node by a Silverlight Border that encapsulates a **ContentPresenter** (remember that the content presenter is there for representing the content of a **ContentControl**, in this case the content of the node). One way to change the appearance of nodes is to change the control template of the **Node** class. Here is the default control template:

```
<Style TargetType="local:Node">
        <Setter Property="Background" Value="Transparent"/>
        <Setter Property="BorderBrush" Value="Black"/>
        <Setter Property="BorderThickness" Value="1"/>
        <Setter Property="Padding" Value="3"/>
        <Setter Property="HorizontalContentAlignment" Value="Center"/>
        <Setter Property="VerticalContentAlignment" Value="Center"/>
        <Setter Property="Template">
            <Setter.Value>
                <ControlTemplate TargetType="local:Node">
                    <Border x:Name="border"
                        BorderBrush="{TemplateBinding BorderBrush}"
                        BorderThickness="{TemplateBinding BorderThickness}"
                        CornerRadius="{TemplateBinding CornerRadius}"
                        Background="{TemplateBinding Background}"
                        Padding="{TemplateBinding Padding}">
                        <vsm:VisualStateManager.VisualStateGroups>
                            <vsm:VisualStateGroup x:Name="SelectionStates">
                                <vsm:VisualState x:Name="Unselected" />
                                <vsm:VisualState x:Name="Selected">
                                    <Storyboard>
                                        <ObjectAnimationUsingKeyFrames
                                                Storyboard.TargetName="border"
```

```
Storyboard.TargetProperty="Background"
                                                    Duration="0">
                                                <DiscreteObjectKeyFrame
Value="#FFBADDE9"
                                                        KeyTime="0"/>
                                            </ObjectAnimationUsingKeyFrames>
                                        </Storyboard>
                                    </vsm:VisualState>
                                </vsm:VisualStateGroup>
                            </vsm:VisualStateManager.VisualStateGroups>
                            <Grid>
                                <ContentPresenter x:Name="contentPresenter"
                                  Content="{TemplateBinding Content}"
                                  ContentTemplate="{TemplateBinding
ContentTemplate}"
                                  HorizontalAlignment="{TemplateBinding
HorizontalContentAlignment}"
                                  VerticalAlignment="{TemplateBinding
VerticalContentAlignment}"/>
                            </Grid>
                        </Border>
                    </ControlTemplate>
                </Setter.Value>
            </Setter>
        </Style>
```

In the default template, please note the `<vsm:VisualStateManager.VisualStateGroups>` section. In the Silverlight platform, Visual States are the preferred way to specify dynamic changes in the visual appearance of a control according to the internal state of the control. The **Node** control has two predefined states: **Selected** and **Unselected**. The visual state is changed by the **Node** control's code depending on whether the node is selected or not. The default control template contains definitions for the **Selected** and **Unselected** visual states that change the background color of the node.

Let's change the control template for a new one that adds a **Path** element representing an employee on the left of the **ContentPresenter**.

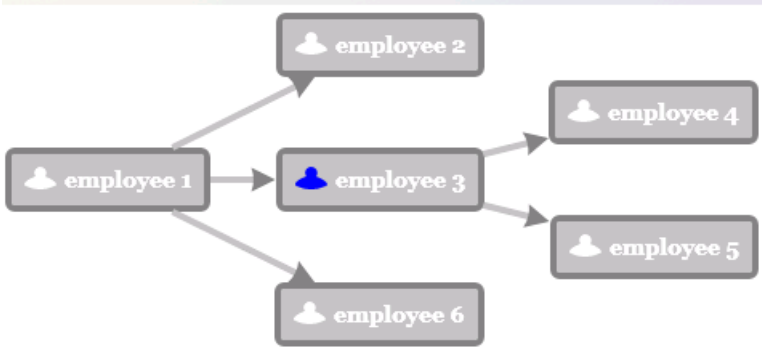
The full markup file would be as follows:

```
<UserControl x:Class="DocExample2.Page"
    xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
    xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"

xmlns:ilog="clr-namespace:ILOG.Controls.Diagram;assembly=ILOG.Controls.Diagram"
    xmlns:vsm="clr-namespace:System.Windows;assembly=System.Windows">
    <UserControl.Resources>
        <Style TargetType="ilog:Node" x:Key="NodeStyle">
            <Setter Property="Padding" Value="8"/>
            <Setter Property="FontFamily" Value="Georgia"/>
            <Setter Property="FontSize" Value="14"/>
            <Setter Property="FontWeight" Value="bold"/>
            <Setter Property="Background" Value="Silver"/>
            <Setter Property="Foreground" Value="White"/>
            <Setter Property="BorderBrush" Value="Gray"/>
            <Setter Property="BorderThickness" Value="4"/>
```

```
            <Setter Property="CornerRadius" Value="4"/>
            <Setter Property="Template">
                <Setter.Value>
                    <ControlTemplate TargetType="ilog:Node">
                        <Border x:Name="border"
                        BorderBrush="{TemplateBinding BorderBrush}"
                        BorderThickness="{TemplateBinding BorderThickness}"
                        CornerRadius="{TemplateBinding CornerRadius}"
                        Background="{TemplateBinding Background}"
                        Padding="{TemplateBinding Padding}">
                            <vsm:VisualStateManager.VisualStateGroups>
                                <vsm:VisualStateGroup x:Name="SelectionStates">
                                    <vsm:VisualState x:Name="Unselected" />
                                    <vsm:VisualState x:Name="Selected">
                                        <Storyboard>
                                            <ObjectAnimationUsingKeyFrames
                                              Storyboard.TargetName="user"
                                              Storyboard.TargetProperty="Fill"
Duration="0">
                                                <DiscreteObjectKeyFrame
Value="Blue"
                                                    KeyTime="0"/>
                                            </ObjectAnimationUsingKeyFrames>
                                        </Storyboard>
                                    </vsm:VisualState>
                                </vsm:VisualStateGroup>
                            </vsm:VisualStateManager.VisualStateGroups>
                            <StackPanel Orientation="Horizontal">
                                <Path x:Name="user" Fill="{TemplateBinding
Foreground}"
                                      Data="M9.93 0C7.82 0 6.12 1.70 6.12
3.80C6.12 4.62 6.38
5.38 6.82  6.01C3.14 6.88 -1.91 10.58 0.62 11.85Q9.79 16.35 19.24  11.85C21.83
10.67 16.54 7.01 13 6.07C13.46 5.44 13.74
 4.66 13.74 3.80C13.74 1.70 12.03 0 9.93 0z"/>
                                <ContentPresenter
                              Content="{TemplateBinding Content}"
                              ContentTemplate="{TemplateBinding
ContentTemplate}"/>
                            </StackPanel>
                        </Border>
                    </ControlTemplate>
                </Setter.Value>
            </Setter>
        </Style>
        <Style TargetType="ilog:Link" x:Key="LinkStyle">
            <Setter Property="StrokeThickness" Value="4"/>
            <Setter Property="Stroke" Value="Silver"/>
            <Setter Property="EndArrowVisibility" Value="Visible"/>
            <Setter Property="EndArrowShape" Value="Curved"/>
            <Setter Property="EndArrowSize" Value="15,15"/>
            <Setter Property="EndArrowFill" Value="Gray"/>
        </Style>
        <DataTemplate x:Key="NodeTemplate">
            <TextBlock Text="{Binding Name}" Margin="5,0,0,0"/>
        </DataTemplate>
    </UserControl.Resources>
    <Grid x:Name="LayoutRoot" Background="White">
```

```
        <ilog:Diagram x:Name="diagram" ParentBinding="{Binding Manager}"
                      NodeStyle="{StaticResource NodeStyle}"
                      LinkStyle="{StaticResource LinkStyle}"
                      NodeTemplate="{StaticResource NodeTemplate}">
        </ilog:Diagram>
    </Grid>
</UserControl>
```

The new **ControlTemplate** for the **Node** is specified in the style defined for the **Node** class through the **Template** property. A visual state in the template changes the **Fill** property of the **Path** to blue when the node is selected. This control template gives the following result when `employee 3` is selected.



Selection in a Diagram

The Diagram control has a built-in selection system that allows you to select the nodes in a graph. The node gets selected when you click it. The selection system is similar to the system in the Silverlight ListBox: for example, you can use the SelectionMode property to specify a single or multiple selection mode.

You can also select the links of the graph, provided that they were created from items contained in the **LinksSource** data source or that they have been added to the **Links** collection. In other terms, you cannot select a link that was created implicitly by the **SuccessorsBinding**, **PredecessorsBinding** or **ParentBinding** properties, because in that case there is no data item associated with the **Link**.

When the **SelectionMode** property is Single, you can select only one single node and you may get or set the item selected in the data source through the SelectedItem property. When the **SelectionMode** is Multiple or Extended, you may select several nodes and the SelectedItems property reflects the items that are selected in the data source. You may add or remove an item from the selection by adding or removing items in the **SelectedItems** collection.

When items get selected or deselected, the **Diagram** control fires events that you can listen through the SelectionChanged event.

The **SelectedItem** and **SelectedItems** property are dependency properties. For example, you can use these properties with the Silverlight binding system to keep some parts of your interface synchronized with the selection in the diagram.

Note that the **Node** and **Link** classes have a dependency property named **IsSelected** that is **true** when the node or link is selected and **false** otherwise. The **Node** and **Link** classes also define two visual states, **Selected** and **Unselected**, which are set when the node or link is selected or deselected. These visual states are very useful when changing the control template of nodes or links: you may have a Silverlight visual state that changes the look of the node based on the selected state You can see an example of this technique in *Changing the Control Template of the Node Class*.

Zoom in a Diagram

The Diagram control allows you to zoom in and out the graph displayed through the Zoom property. A Zoom value of 100 represents the normal size of the diagram. You can control the minimum and maximum zoom level through the MinZoom and MaxZoom properties.

The **Diagram** class has the following methods that allow you to easily control the zoom level:

- ZoomIn: multiplies the current **Zoom** by **ZoomFactor**,
- ZoomOut: divides the current **Zoom** by **ZoomFactor**,
- ZoomToFit: zooms so that the graph fits in the diagram control

The graph itself is displayed inside a Silverlight scroll viewer. As you zoom in, scroll bars appear to allow you to scroll in the graph. The HorizontalScrollBarVisibility and VerticalScrollBarVisibility allows you to control the visibility of the scroll bars.

Finally, the HorizontalDiagramAlignment and VerticalDiagramAlignment properties allow you to control the alignment of the graph inside the scroll viewer.

Specifying Graph Layout Algorithms in a Diagram

Inside a Diagram control, the nodes and links that are generated from the data source are automatically arranged by a Graph Layout algorithm that places the nodes and the links. You can specify the algorithm through the GraphLayout property of the **Diagram** class. By default, a HierarchicalLayout instance is specified in this property, but a set of algorithms are present to cover various types of graph data.

The following example specifies a TreeLayout algorithm on a **Diagram** object:

```
<ilog:Diagram …>
    <ilog:Diagram.GraphLayout>
        <ilog:TreeLayout FlowDirection="Bottom"
                         LinkStyle="Orthogonal"/>
    </ilog:Diagram.GraphLayout>
</ilog:Diagram>
```

Note that most of the Graph Layout algorithms have per-node and per-link properties, they are implemented as attached properties that you can specify on the Node or Link instance. For example, in the **TreeLayout** algorithm you can specify an attached property named Alignment for each **Node** instance. This property defines the alignment of a node with respect to its children. You can set these attached properties in your code to specify custom behaviors for individual nodes or links or the graph.

Creating a Graph by Specifying Nodes and Links

The Diagram control (as explained in *Creating a Graph Display from a Data Source Using the Diagram Control*) creates a graph from a data source and generates nodes and links instances of the Node and Link classes to render the data inside the data source. However, it is also possible to create a graph by creating instances of the **Node** and **Link** classes and use them directly inside any Silverlight container.

There are various ways to create a graph using the **Node** and **Link** classes.

You can use **Node** and **Link** instances in any Silverlight container, for example a **Canvas**. In this case you create **Node** instances connected by **Link** instances and you add them as children of the **Canvas**. Then, you are responsible for placing the nodes in the **Canvas** and specifying the link shape. The **Canvas** does not do an automatic layout of your graph, but you may execute a Graph Layout algorithm as needed.

You may also use **Node** and **Link** instances inside a Graph control. This control is very similar to a Silverlight **Canvas** and allows you to specify the position of nodes through the Graph.Left and Graph.Top attached properties, as when you specify the positions in a **Canvas** using the **Canvas.Left**, **Canvas.Top**, **Canvas.Bottom** and **Canvas.Right** properties. The difference is that the **Graph** control has a property named GraphLayout and a property named LinkLayout. You may use these properties to specify a Graph Layout algorithm to layout the graph automatically, for example you may specify a **TreeLayout** instance in the **GraphLayout** properties and the nodes and links will be automatically

arranged as a tree when you add/remove nodes and links or as the desired size of node changes.

Finally, a third possibility is to create **Node** and **Link** instances and add them to the **Nodes** and **Links** properties of a **Diagram**. This technique is similar to the previous one (adding nodes and links in a **Graph** control), but the advantage is that the **Diagram** control offers zooming and scrolling.

In This Section

Creating Nodes and Links

Explains how to create nodes and links.

Example of Nodes and Links in a Canvas

Provides examples of nodes and links in a Canvas.

Example of Nodes and Links in a Graph with TreeLayout

Provides examples of nodes and links in a graph with TreeLayout.

Controlling the Connection Points of Links

Explains how the link is connected to the start and end nodes.

Specifying the Link Shape

Explains how to control the shape of the link.

Color, Thickness and Other Appearance Properties of a Link

Describes how to control appearance properties of a link.

Customizing the Arrows of a Link

Describes how to customize the arrows of a link.

Creating Nodes and Links

Using the Node and Link classes you can create a graph representation. The **Node** class is a Silverlight 'content control'. This means that you may add any kind of content inside a node, thus you may combine any Silverlight elements to create any kind of representation inside a node.

The following example shows how to create a node represented by an ellipse:

```
<ilog:Node BorderThickness="0" Padding="0">
      <Ellipse Width="50" Height="50" Fill="red"/>
</ilog:Node>
```

You connect two nodes by an instance of the **Link** class. The **Link** class defines two properties, Start and End, that specify where the link should visually start and end.

Alternatively, you can use the StartName and EndName property of the **Link** class to specify the start and end node. Then, you will use the **StartName** and **EndName** properties to define the names of the start and end nodes respectively.

Note that it is not necessary to have the link, the start and the end nodes inside the same container. For example, two nodes can be placed inside two different **Canvas** and the link in another one. The only restriction is that the start and end nodes should have a common ancestor with the link.

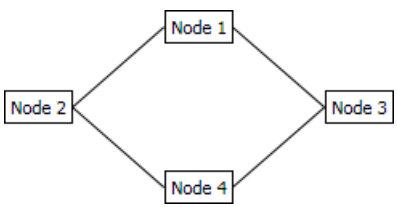
The links that are starting at a node can be retrieved through the FromLinks property of the **Node** class, while the links that are ending at a node can be retrieved through the ToLinks property.

Example of Nodes and Links in a Canvas

Here is a small markup declaration for four nodes and four links in a **Canvas**:

```
<Canvas>
    <ilog:Node Canvas.Top="0"   Canvas.Left="100" x:Name="node1" Content="Node
1"/>
    <ilog:Node Canvas.Top="50" Canvas.Left="0" x:Name="node2" Content="Node
2"/>
    <ilog:Node Canvas.Top="50" Canvas.Left="200" x:Name="node3" Content="Node
3"/>
    <ilog:Node Canvas.Top="100" Canvas.Left="100" x:Name="node4" Content="Node
4"/>
    <ilog:Link StartName="node2" EndName="node1"/>
    <ilog:Link StartName="node1" EndName="node3"/>
    <ilog:Link StartName="node3" EndName="node4"/>
    <ilog:Link StartName="node4" EndName="node2"/>
</Canvas>
```

This markup will produce the following graph:



The same graph can be created in C# using the following code:

```
public void CreateNodeAndLinks(Canvas canvas)
{
    Node node1 = new Node();
    node1.Content = "node 1";
    Canvas.SetTop(node1, 0);
    Canvas.SetLeft(node1, 100);
```

```
            Node node2 = new Node();
            node2.Content = "node 2";
            Canvas.SetTop(node2, 50);
            Canvas.SetLeft(node2, 0);
            Node node3 = new Node();
            node3.Content = "node 3";
            Canvas.SetTop(node3, 50);
            Canvas.SetLeft(node3, 200);
            Node node4 = new Node();
            node4.Content = "node 4";
            Canvas.SetTop(node4, 100);
            Canvas.SetLeft(node4, 100);
            canvas.Children.Add(node1);
            canvas.Children.Add(node2);
            canvas.Children.Add(node3);
            canvas.Children.Add(node4);
            canvas.Children.Add(new Link(node2, node1));
            canvas.Children.Add(new Link(node1, node3));
            canvas.Children.Add(new Link(node3, node4));
            canvas.Children.Add(new Link(node4, node2));
        }
```

Example of Nodes and Links in a Graph with TreeLayout

The following example shows how to use a Graph control in XAML and how to specify the nodes and links as children of the **Graph**:

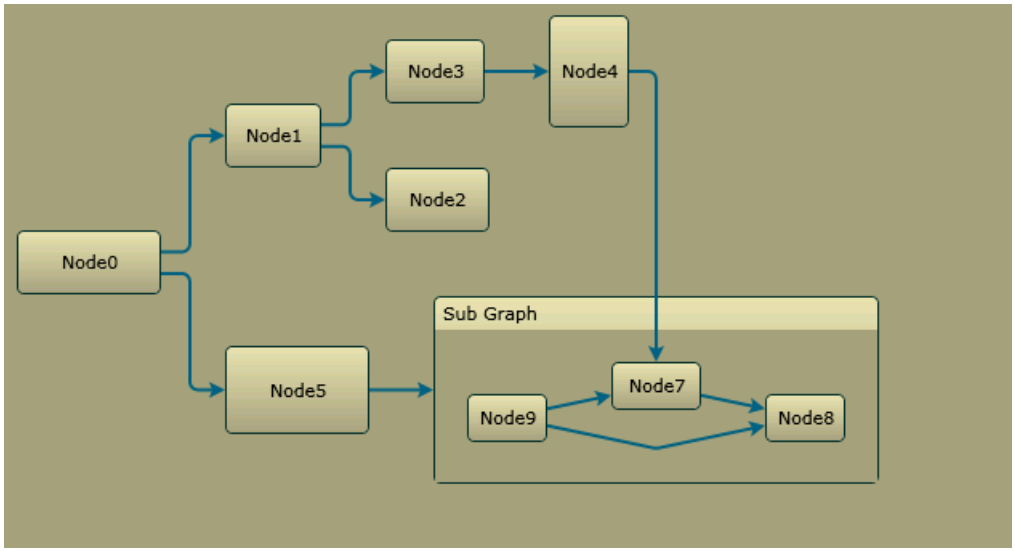
```
<UserControl x:Class="DocExample4.Page"
    xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation"
    xmlns:x="http://schemas.microsoft.com/winfx/2006/xaml"
xmlns:ilog="clr-namespace:ILOG.Controls.Diagram;assembly=ILOG.Controls.Diagram"
xmlns:sltk="clr-namespace:Microsoft.Windows.Controls.Theming;assembly=Microsoft
.Windows.Controls.Theming">
    <Grid x:Name="LayoutRoot">
        <ilog:Graph  Background='#a7a37e'
sltk:ImplicitStyleManager.ApplyMode="Auto">
            <ilog:Graph.Resources>

                <LinearGradientBrush x:Key="nodeback" StartPoint="0,0"
EndPoint="0,1">
                    <GradientStop Color="#FFE6E2AF" Offset="0"/>
                    <GradientStop Color="#FFA7A37E" Offset="1"/>
                </LinearGradientBrush>

                <SolidColorBrush x:Key="linkcolor" Color="#ff046380"/>

                <!-- The style for nodes-->

                <Style TargetType="ilog:Node">
                    <Setter Property="Background" Value="{StaticResource
nodeback}"/>
                    <Setter Property="HorizontalContentAlignment"
Value="Center"/>
                    <Setter Property="VerticalContentAlignment"
Value="Center"/>
```

```
                    <Setter Property="BorderBrush" Value="#002f2f"/>
                    <Setter Property="CornerRadius" Value="4"/>
                    <Setter Property="Padding" Value="0"/>
                </Style>

                <!-- The style for links-->
                <Style TargetType="ilog:Link">
                    <Setter Property="EndArrowShape" Value="Sunken"/>
                    <Setter Property="EndArrowVisibility" Value="Visible"/>
                    <Setter Property="Radius" Value="5"/>
                    <Setter Property="Stroke" Value="{StaticResource
linkcolor}"/>
                    <Setter Property="StrokeThickness" Value="2"/>
                </Style>

            </ilog:Graph.Resources>

            <ilog:Graph.GraphLayout>
                <ilog:TreeLayout ConnectorStyle="EvenlySpaced"
LinkStyle="Orthogonal"/>
            </ilog:Graph.GraphLayout>
            <ilog:Node x:Name="node0" Width="90" Height="40" Content="Node0"/>
            <ilog:Node x:Name="node1" Width="60" Height="40" Content="Node1"/>
            <ilog:Node x:Name="node3" Width="62" Height="40" Content="Node3"/>
            <ilog:Node x:Name="node2" Width="65" Height="40" Content="Node2"/>
            <ilog:Node x:Name="node4" Width="50" Height="70" Content="Node4"/>
            <ilog:Node x:Name="node5" Width="90" Height="55" Content="Node5"/>
            <ilog:Node x:Name="node6">
                <Grid>
                    <Grid.RowDefinitions>
                        <RowDefinition Height="auto"/>
                        <RowDefinition Height="*"/>
                    </Grid.RowDefinitions>
                    <TextBlock Text="Sub Graph" Margin="5,2,5,2"/>
                    <Border Grid.Row="1" Padding='20' Background='#a7a37e'>
                        <ilog:Graph  Background="Transparent">
                            <ilog:Graph.GraphLayout>
                                <ilog:HierarchicalLayout/>
                            </ilog:Graph.GraphLayout>
                            <ilog:Link StartName="node9" EndName="node7"/>
                            <ilog:Link StartName="node7" EndName="node8"/>
                            <ilog:Link StartName="node9" EndName="node8"/>
                            <ilog:Node x:Name="node8" Width="50" Height="30"
Content="Node8"/>
                            <ilog:Node x:Name="node9" Width="50" Height="30"
Content="Node9"/>
                            <ilog:Node x:Name="node7" Width="56" Height="30"
Content="Node7"/>
                        </ilog:Graph>
                    </Border>
                </Grid>
            </ilog:Node>
            <ilog:Link StartName="node1" EndName="node2"/>
            <ilog:Link StartName="node0" EndName="node1"/>
            <ilog:Link StartName="node0" EndName="node5"/>
            <ilog:Link StartName="node3" EndName="node4"/>
            <ilog:Link StartName="node5" EndName="node6"/>
            <ilog:Link StartName="node1" EndName="node3"/>
```

```
            <ilog:Link StartName="node4" EndName="node7"
                       ShapeType="Orthogonal"
                       StartAnchorPosition="Right"
                       EndAnchorPosition="Top"/>
        </ilog:Graph>
</Grid>
</UserControl>
```

This XAML example defines a top graph that contains the nodes from node 0 to node 6. The top graph has its **GraphLayout** property set to a **TreeLayout** instance. The node number 6 contains a Silverlight **Grid** that contains another **Graph** instance that contains node 7 to node 9. This second graph has a **GraphLayout** property set to an instance of the Hierarchical layout.

Here is the resulting graph:



Note that the link between node 4 and node 7 is crossing graph boundaries. This is an intergraph link (the start node is not in the same container than the link).

Collections

Example of Nodes and Links in a Diagram using the Nodes and Links

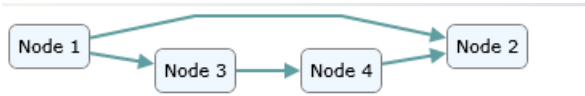
The following example shows how to add nodes and links by code to a **Diagram** using the **Nodes** and **Links** properties.

```
public void CreateNodeAndLinks(Diagram diagram)
{
    Node node1 = CreateNode("Node 1");
    Node node2 = CreateNode("Node 2");
    Node node3 = CreateNode("Node 3");
```

```
    Node node4 = CreateNode("Node 4");
    diagram.Nodes.Add(node1);
    diagram.Nodes.Add(node2);
    diagram.Nodes.Add(node3);
    diagram.Nodes.Add(node4);
    diagram.Links.Add(CreateLink(node1, node2));
    diagram.Links.Add(CreateLink(node1, node3));
    diagram.Links.Add(CreateLink(node3, node4));
    diagram.Links.Add(CreateLink(node4, node2));
}

private Node CreateNode(string content)
{
     Node node = new Node();
     node.Content = content;
     node.Background = new SolidColorBrush(Color.FromArgb(255, 240, 248, 255));
     node.BorderBrush = new SolidColorBrush(Colors.Gray);
      node.CornerRadius = new CornerRadius(5);
      node.Padding = new Thickness(5);
      return node;
}

private Link CreateLink(Node start, Node end)
{
      Link link = new Link(start, end);
      link.Stroke = new SolidColorBrush(Color.FromArgb(255, 95, 158, 160));
      link.StrokeThickness = 2;
      link.EndArrowVisibility = Visibility.Visible;
      return link;
}
```

Here, the appearance of the nodes and links is customized by code.

Here is the resulting graph:



Controlling the Connection Points of Links

You can control how the link is connected to the start and end nodes by means of several properties.

When a Link instance has a start and an end node specified by the Start and End properties the link will automatically connect to the start and end nodes. Some properties specify where the link connects on the shape of the start and end nodes.

The StartAnchorPosition and EndAnchorPosition properties represent the positions where the link is attached on the start and end node. The possible values are defined by the

AnchorPosition enumeration. This enumeration defines 9 points on the bounding box of the node:

- **Top**: the link is connected to the top center of the node.
- **TopLeft**: the link is connected to the top left corner of the node.
- **TopRight**: the link is connected to the top right corner of the node.
- **Left**: the link is centered to the left border of the node.
- **Right**: the link is centered to the right border of the node.
- **Bottom**: the link is centered to the bottom of the node.
- **BottomLeft**: the link is connected to the bottom left corner of the node.
- **BottomRight**: the link is connected to the bottom right of the node.
- **Center**: the link is connected to the center of the node.

Two additional values are possible:

- **Automatic**: the link will choose the position between the 9 positions above the one which best corresponds to its current points and opposite node.
- **Clip**: The link is going to the direction of the center of the node, but the connection point is clipped on the border of the node bounding box.

When the position is specified it is still possible to move the connection point by an offset from the position specified by the **StartAnchorPosition** and **EndAnchorPosition** properties. To do that, use the **StartAnchorOffset** and EndAnchorOffset properties. These offsets are defined as a **Size** object and are expressed as a percentage of the size of the node. Therefore, an offset of (0.25 0) will move the connection point to the right by half of the node size.

Here is a markup example:

```
<ilog:Link … StartAnchorPosition="Center" StartAnchorOffset="0.25,0" />
```

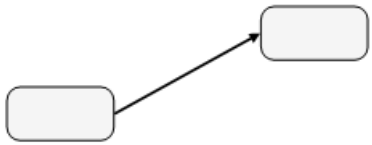
Notes:

1. *When a link is used inside a **Graph** or **Diagram** control and is automatically reshaped by a Graph Layout algorithm, the connection point of the link is controlled by the Graph Layout algorithm and not by the **StartAnchorPosition** and **EndAnchorPosition** properties. In this case, changing the properties has no effect.*
2. *A link may not be connected to a start node or to an end node. When a link is not connected to a start node (that is, when the **Start** property is **null**), the starting point of the link may be specified through the **StartPoint** property. The **Link** class also defines an **EndPoint** property when the **End** property is **null**.*

Specifying the Link Shape

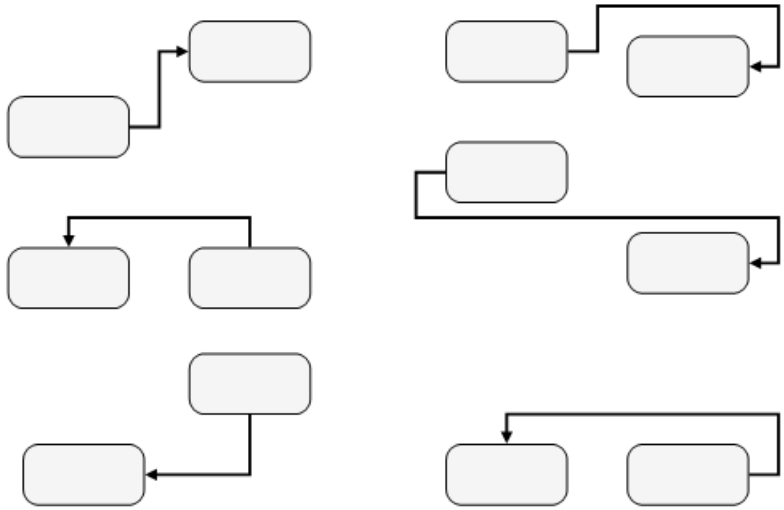
The ShapeType property controls the shape of the link. The type of this property is the LinkShapeType enumeration, and these are the possible values:

- **Straight**: the link is a straight line between the start point and the end point.



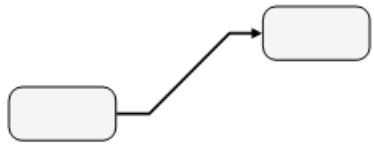
- **Orthogonal**: the link shape is computed automatically to a sequence of vertical or horizontal segments. There can be 2 to 5 segments, depending on the connection points and the bounds of the **Node** elements to which the link is connected.

  The following illustration shows the possible shapes of an orthogonal link.



> ***Note:*** *When* ***ShapeType*** *is* ***Orthogonal*** *and if the CanEditOrthogonalShape property is* ***true****, it is possible to modify the link shape using the Points property, while keeping the link orthogonal.*

- **Oblique**: the link shape is a sequence of one horizontal/vertical segment, one 45-degrees segment, and another vertical/horizontal segment.



- **Free**: the link shape is determined by the **Points** property.

> ***Note:*** *The **ShapeType** property may not be taken into account if the link is automatically arranged by a Graph Layout algorithm, that is, when the link is child of a **Graph** control that has a **GraphLayout** or **LinkLayout** property not null, or when the **Link** is created from a data source in a **Diagram** control. In these cases, shape and connection points of the links may be fully controlled by the Graph Layout algorithm. Some Graph Layout algorithms, such as the **GridLayout**, do not change the shape of links and in this case the **ShapeType** property will be respected.*

The shape of the link can be further customized using the Radius property.

When the **Radius** property is set to a positive value, the bends of the link are replaced by arcs of circle of the specified radius. The following illustration shows an example of an orthogonal link with a radius of 10.

Color, Thickness and Other Appearance Properties of a Link

In the Link class you specify the brush used to render the link through the Stroke property. The thickness is specified through the StrokeThickness property.

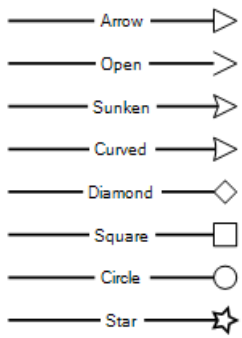
Other properties such as StrokeDashArray, StrokeDashCap, StrokeDashOffset allows you to create dashed links.

Customizing the Arrows of a Link

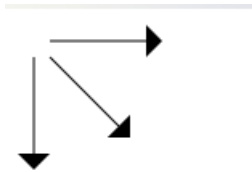
By default, a link has no arrow at its end. You can customize the start or end arrows using the following properties:

StartArrowVisibility and EndArrowVisibility: Set to **Visible** to show an arrow at the start or end of the link.

StartArrowShape and EndArrowShape: Specifies the shape of the arrow. The picture below shows the possible shapes:



StartArrowSize, EndArrowSize: Specifies the size of the arrow. You must specify the width and the height, which are interpreted as if the arrow was drawn on a right-pointing link. For example, if **EndArrowSize** is set to "10,20", the end arrow will be rendered as follows:



StartArrowFill, EndArrowFill: Specifies the fill brush of the arrow. If no fill is specified, the Stroke of the link is used by default.

StartArrowStroke, EndArrowStroke: Specifies the stroke brush of the arrow. This brush is used to draw the outline of the arrow. By default, no outline is drawn.

Specifying Graph Layout

Graph Layout classes are also present in the ILOG.Controls.Diagram namespace so that you can specify both by code or in XAML how your graph should be arranged. The classes are providing the same algorithms as the classes provided for the Windows Forms and ASP.NET classes of IBM® ILOG® Diagram for .NET but they are implemented as Silverlight dependency objects.

The Graph Layout classes are the following:

- HierarchicalLayout
- TreeLayout
- ForceDirectedLayout
- GridLayout
- ShortLinkLayout
- LongLinkLayout

For more details on each Graph Layout algorithm, see *Using Graph Layout Algorithms*. Note that this section is more oriented on using Graph Layout algorithms in a Windows Forms or ASP.NET context, therefore the code samples will not apply to the Silverlight case. The Graph Layout classes defined in the **ILOG.Controls.Diagram** namespace are different from the classes in ILOG.Diagrammer.GraphLayout namespace. Although the classes are not the same, you will find that most of the properties are the same, only some advanced properties may not be present in the Silverlight versions.

How to Use the Graph Layout Classes

A Graph Layout instance can be directly specified through the GraphLayout property of the Diagram class or through the GraphLayout and LinkLayout properties of the Graph class. When used in this way, the graphs represented in the **Diagram** of the **Graph** instance are automatically arranged by the Graph Layout algorithm.

The following example specifies a TreeLayout algorithm on a **Diagram** object:

```
<ilog:Diagram …>
    <ilog:Diagram.GraphLayout>
        <ilog:TreeLayout FlowDirection="Bottom"
                         LinkStyle="Orthogonal"/>
    </ilog:Diagram.GraphLayout>
</ilog:Diagram>
```

The **Diagram** control always requires a Graph Layout to layout the graph resulting from a data source. However, as you can specify the positions of nodes in a **Graph** control, you may or may not specify a Graph Layout in the **GraphLayout** property. In the same way, you may or may not specify a link layout in the **LinkLayout** property. All combinations are possible.

It is also possible to layout a graph composed of nodes and links that are contained in a Silverlight **Canvas**. Unlike the **Graph** control, the **Canvas** cannot automatically layout the graph as nodes and links are added, removed or reshaped. To layout a graph in a **Canvas** you will have to do it by code using the PerformLayout method. The following C# code shows how to layout a **Canvas** by a tree layout algorithm:

```
void ApplyTreeLayout(Canvas canvas)
{
    TreeLayout layout = new TreeLayout();
    layout.Attach(canvas);
    layout.PerformLayout();
}
```

In this case, the **PerformLayout** method will change the position of nodes by changing the **Canvas.Left** and **Canvas.Top** properties on the nodes. It can also change the points of links (**Points** property), the shape of links (**ShapeType** property) and the connection properties of links (**StartAnchorPosition**/**EndAnchorPosition** properties).

When using a **Graph** control, you may also choose to keep the **GraphLayout** and **LinkLayout** to **null** and apply a layout algorithm by using the same code used for the **Canvas**.

```
void ApplyTreeLayout(Graph graph)
{
    TreeLayout layout = new TreeLayout();
    layout.Attach(graph);
    layout.PerformLayout();
}
```

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