

# **Векторная Графика WPF**

# Иерархия наследования классов графики

System.Object

System.Windows.Threading.DispatcherObject

System.Windows.DependencyObject

System.Windows.Media.Visual

System.Windows.UIElement

System.Windows.FrameworkElement

System.Windows.Shapes.**Shape**

System.Windows.Shapes.**Ellipse**

System.Windows.Shapes.**Line**

System.Windows.Shapes.**Path**

System.Windows.Shapes.**Polygon**

System.Windows.Shapes.**Polyline**

System.Windows.Shapes.**Rectangle**

# Свойства графических классов

- **Stroke**
- **StrokeThickness**
- **Fill**
- Свойства размеров и положения:
  - 1) [Line](#), [Path](#), [Polygon](#), [Polyline](#) - [Point](#)
  - 2) [Ellipse](#) и [Rectangle](#) – **присоединенные свойства**  
(Canvas.Left, Canvas.Top, . . . )

[Canvas.ZIndex](#)

Классы элементарных геометрических форм:  
Ellipse, Line, Polygon, Polyline, Rectangle.

# Андреевский флаг

```
<!-- Geom01.xaml - Андреевский флаг -->
```

```
<Page Background="LightGray"
```

```
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
```

```
  <Canvas Height="200" Width="300" Background="White">
```

```
    <Line X1="0" Y1="0" X2="300" Y2="200" Stroke="Blue" StrokeThickness="30" />
```

```
    <Line X1="0" Y1="200" X2="300" Y2="0" Stroke="Blue" StrokeThickness="30" />
```

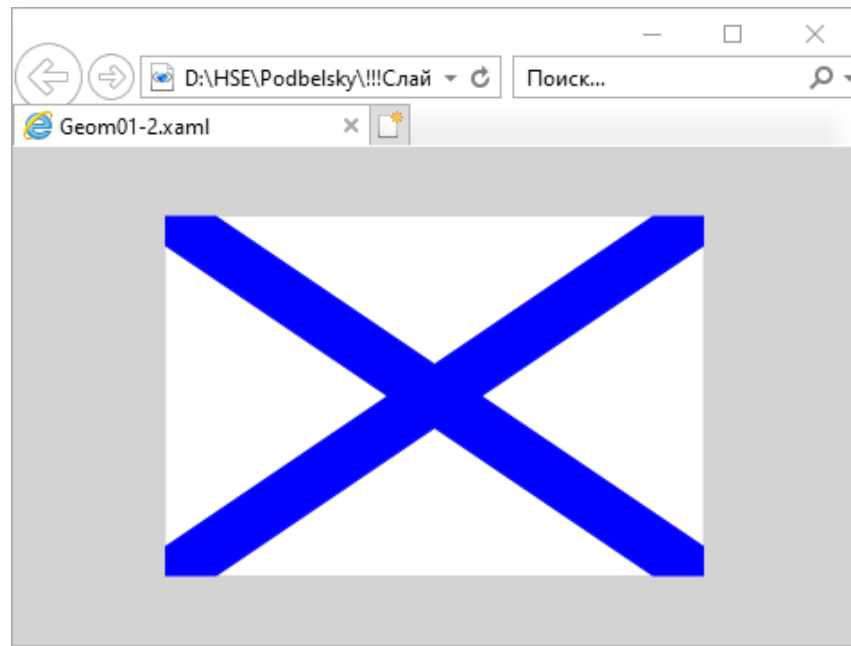
```
  </Canvas>
```

```
</Page>
```



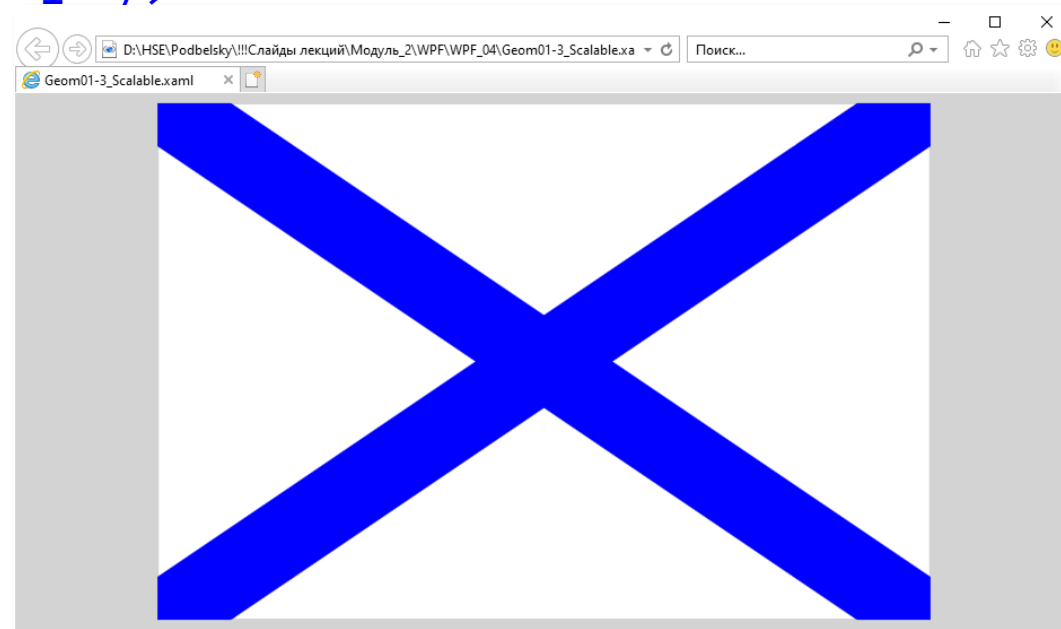
# Андреевский флаг (аккуратный)

```
<!-- Geom01-2.xaml - Андреевский флаг Polygon -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
  <Canvas Height="200" Width="300" Background="White">
    <Polygon Stroke="Blue" Fill="Blue"
      Points="0,0 28,0 300,184 300,200 272,200 0,16 0,0"
      StrokeThickness="1" />
    <Polygon Stroke="Blue" Fill="Blue"
      Points="300,0 300,16 28,200 0,200 0,184 272,0 300,0"
      StrokeThickness="1" />
  </Canvas>
</Page>
```



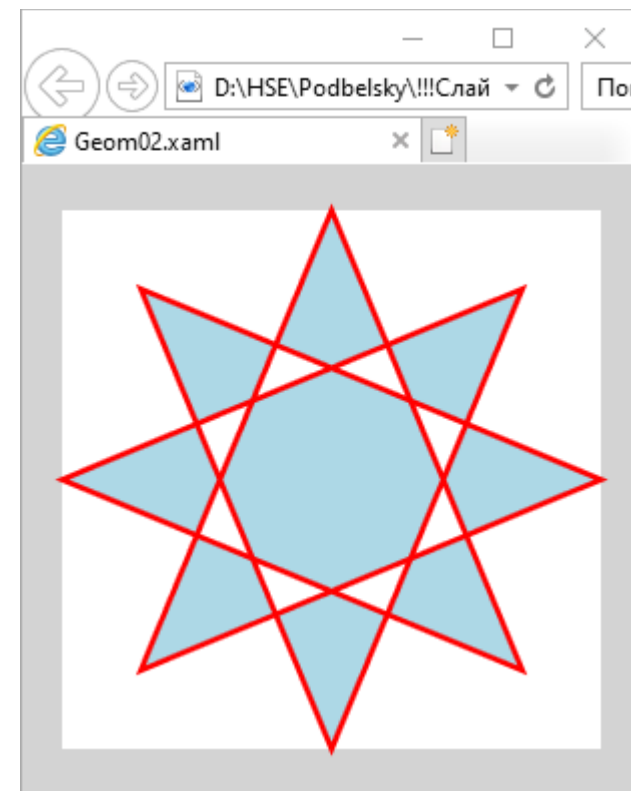
# Андреевский флаг (масштабируемый)

```
<!-- Geom01-3.xaml - масштабируемый Андреевский флаг -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <Viewbox Margin="10">
        <Canvas Height="200" Width="300" Background="White">
            <Polygon Stroke="Blue" Fill="Blue"
                Points="0,0 28,0 300,184 300,200 272,200 0,16 0,0"
                StrokeThickness="1" />
            <Polygon Stroke="Blue" Fill="Blue"
                Points="300,0 300,16 28,200 0,200 0,184 272,0 300,0"
                StrokeThickness="1" />
        </Canvas>
    </Viewbox>
</Page>
```



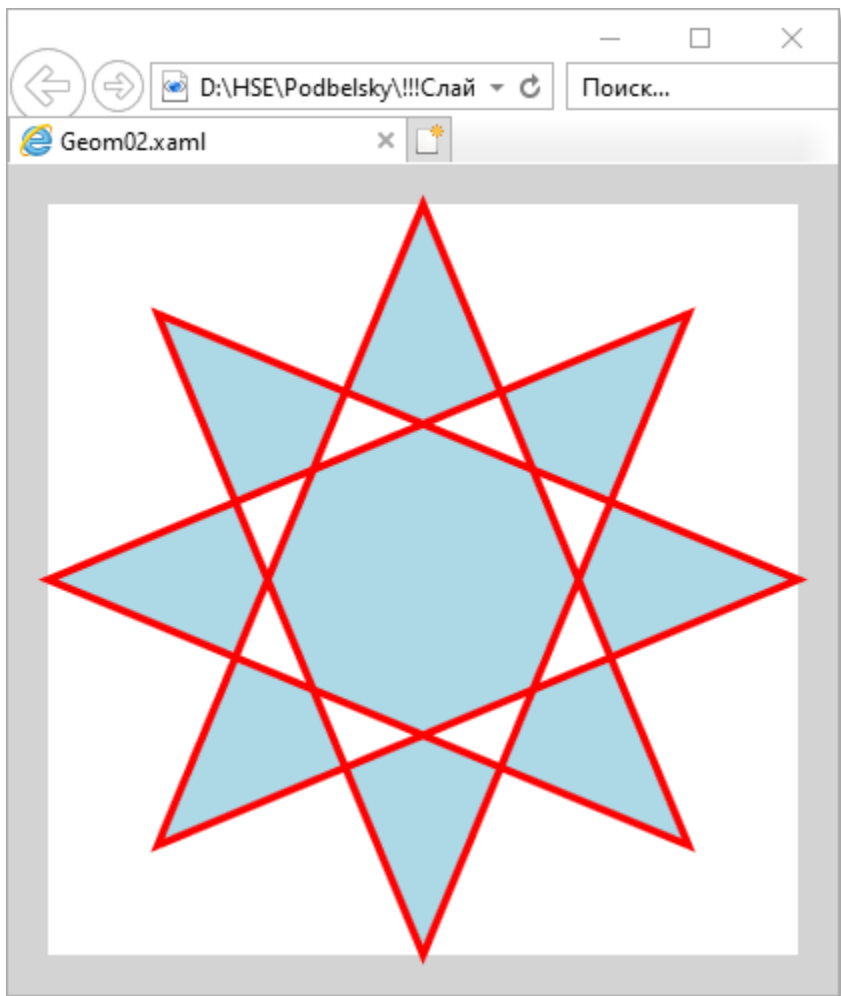
# Вершины на окружности

```
<!-- Geom02.xaml - Вершины на окружности -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <Viewbox Margin="20">
        <Canvas Height="100" Width="100" Background="White">
            <Polygon Stroke="Red" Fill="LightBlue"
                Points="0,50 85.4,14.6 50,100 14.6,14.6 100,50
                    14.6,85.4 50,0 85.4,85.4"
                StrokeThickness="1" FillRule="EvenOdd" />
        </Canvas>
    </Viewbox>
</Page>
```

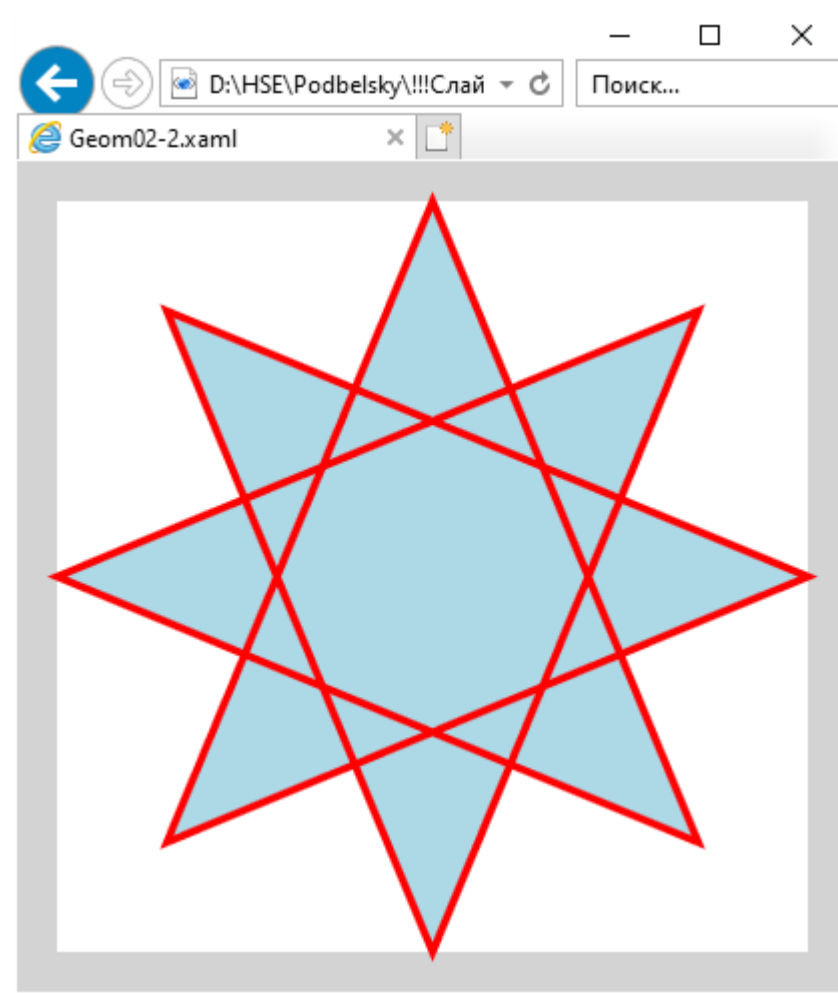


# Свойство FillRule

**FillRule="EvenOdd"**



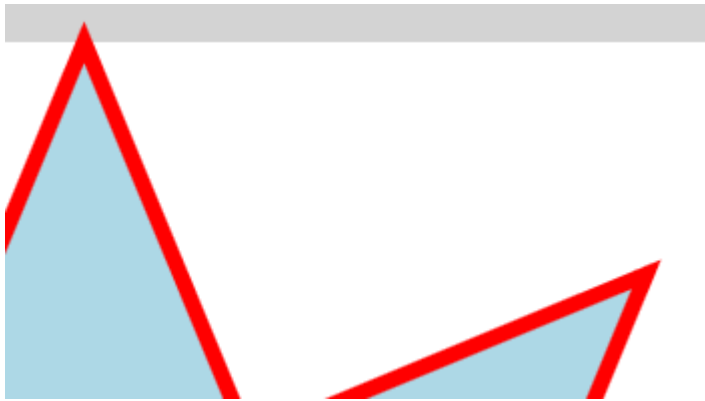
**FillRule="NonZero"**





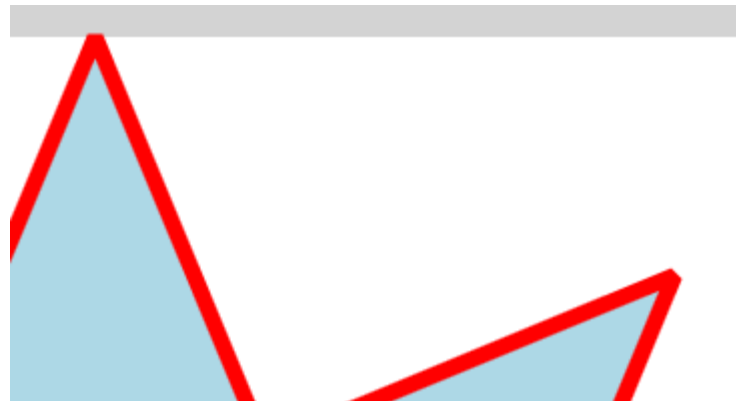
# Свойство StrokeLineJoin

StrokeLineJoin="Miter"



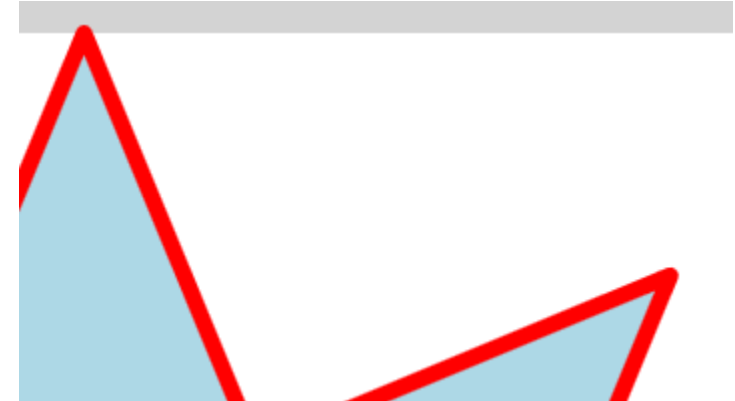
**Miter**

StrokeLineJoin="Bevel"



**Bevel**

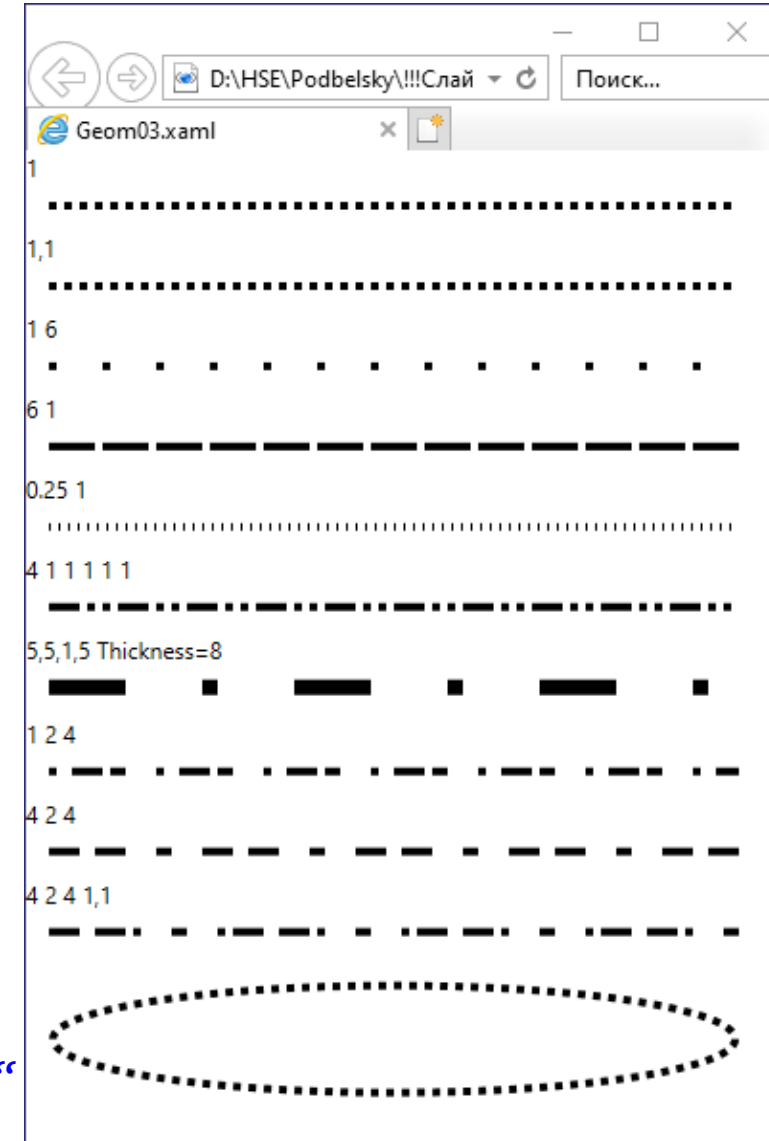
StrokeLineJoin="Round"



**Round**

# StrokeDashArray

```
<!-- Geom03.xaml -->
<Page Background="White"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <StackPanel>
        <StackPanel.Resources>
            <Style TargetType="Line">
                <Setter Property="X1" Value="0"/>
                <Setter Property="X2" Value="360"/>
                <Setter Property="Stroke" Value="Black"/>
                <Setter Property="StrokeThickness" Value="4"/>
                <Setter Property="Margin" Value="12"/>
            </Style>
        </StackPanel.Resources>
        <Line StrokeDashArray="1"/>
        <Line StrokeDashArray="1,1"/>
        <Line StrokeDashArray="1 6"/>
        <Line StrokeDashArray="6 1"/>
        <Line StrokeDashArray="0.25 1"/>
        <Line StrokeDashArray="4 1 1 1 1 1"/>
        <Line StrokeDashArray="5,5,1,5" StrokeThickness="8"/>
        <Line StrokeDashArray="1 2 4"/>
        <Line StrokeDashArray="4 2 4"/>
        <Line StrokeDashArray="4 2 4 1,1"/>
        <Ellipse Height="60" Width="360" Stroke="Black" StrokeThickness="4"
        StrokeDashArray="1" HorizontalAlignment="Left" Margin="12"/>
    </StackPanel>
</Page>
```



# StrokeDashCap

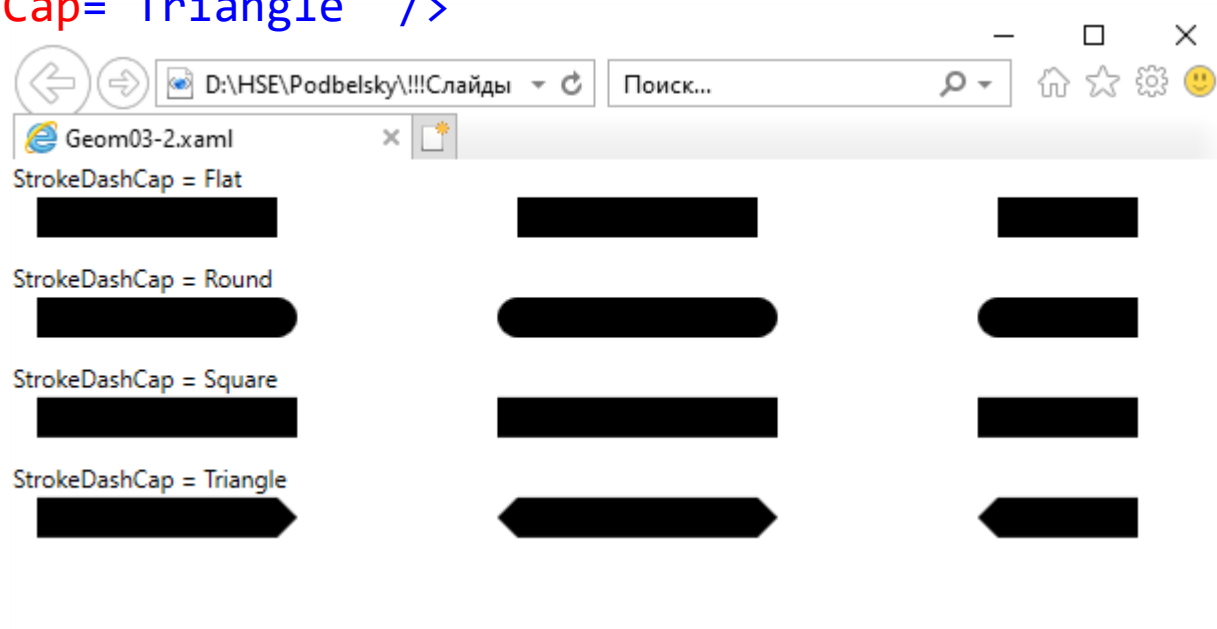
Flat

Round

Square

Triangle

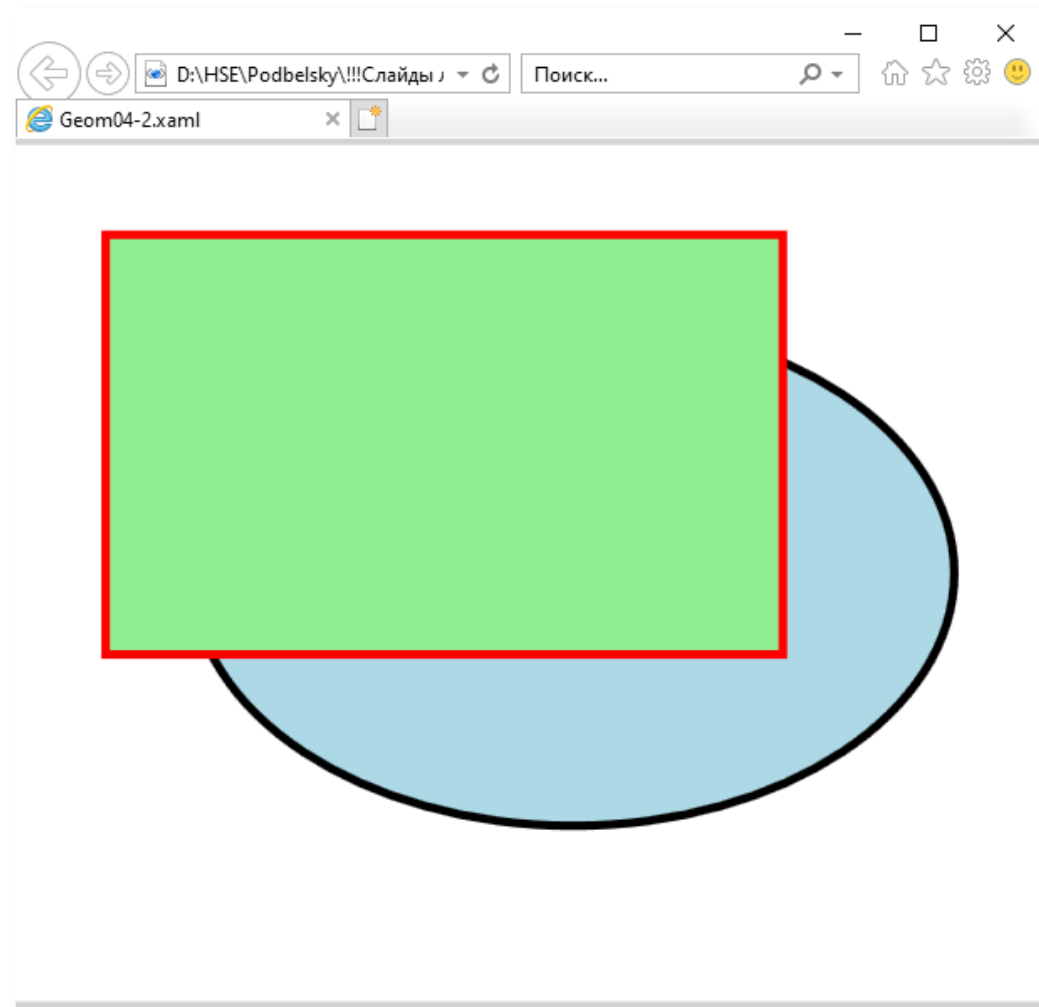
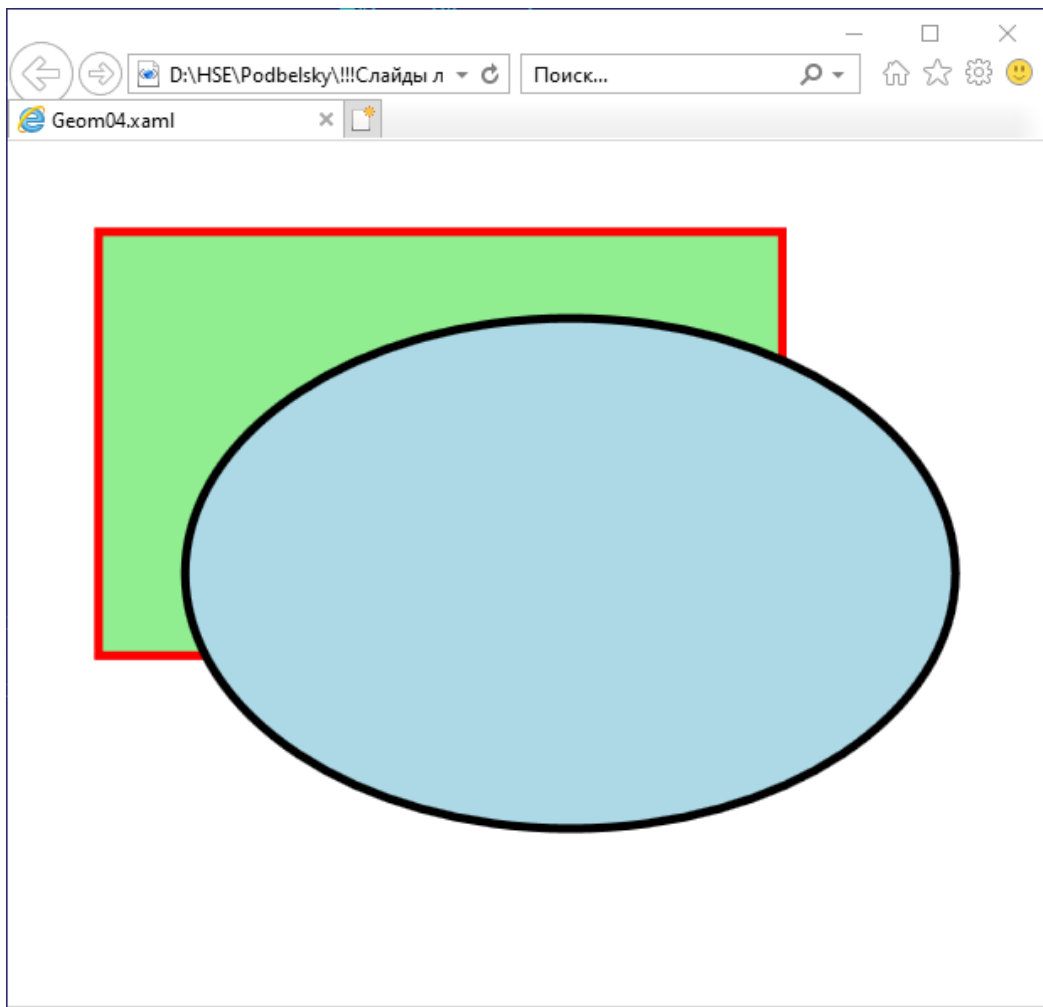
```
<TextBlock Text="StrokeDashCap = Flat"/>
<Line StrokeDashArray="6 6" StrokeDashCap="Flat" />
<TextBlock Text="StrokeDashCap = Round"/>
<Line StrokeDashArray="6 6" StrokeDashCap="Round" />
<TextBlock Text="StrokeDashCap = Square"/>
<Line StrokeDashArray="6 6" StrokeDashCap="Square" />
<TextBlock Text="StrokeDashCap = Triangle"/>
<Line StrokeDashArray="6 6" StrokeDashCap="Triangle" />
```



# Элементы Rectangle и Ellipse

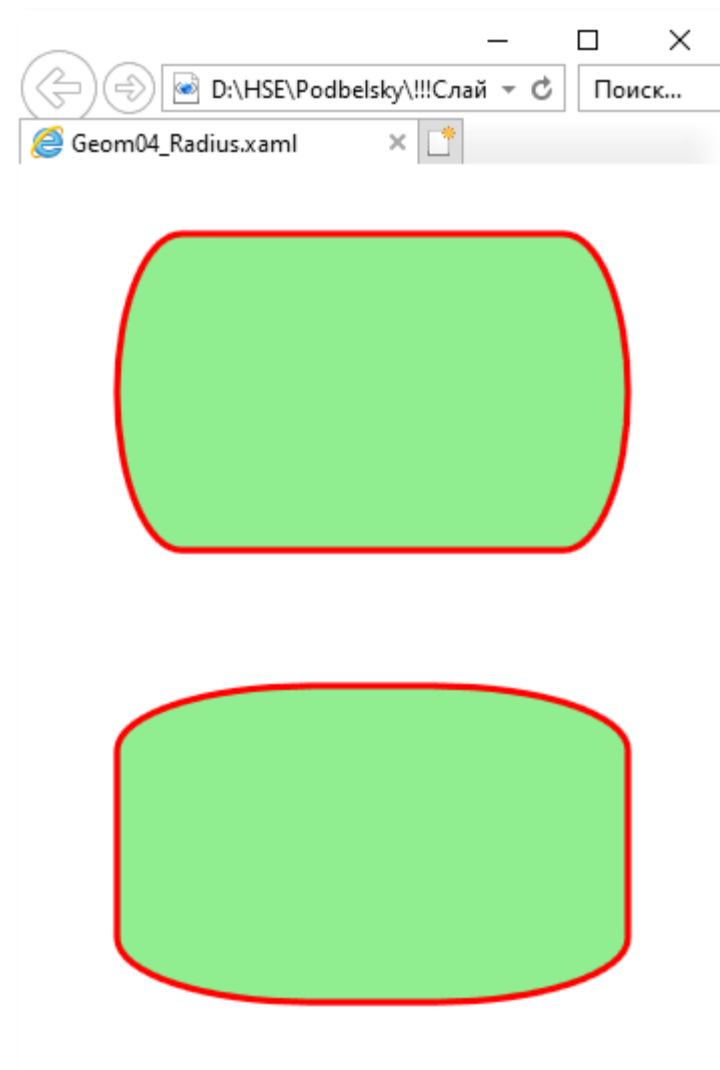
```
<!-- Geom04.xaml - элементы Rectangle и Ellipse -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <Viewbox>
        <Canvas Height="100" Width="120" Background="White">
            <Rectangle Stroke="Red" Fill="LightGreen"
                StrokeThickness="1" Margin="10"
                Height="50" Width="80" Canvas.ZIndex="0"/>
            <Ellipse Stroke="Black" Fill="LightBlue"
                StrokeThickness="1" Margin="10"
                Height="60" Width="90"
                Canvas.Top="10" Canvas.Left="10"/>
        </Canvas>
    </Viewbox>
</Page>
```

Для Rectangle: Canvas.ZIndex=  
0



# Rectangle.RadiusX и Rectangle.RadiusY

```
<!-- Geom04_Radius.xaml - элементы Rectangle и Ellipse -->
<Page
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
  <Viewbox>
    <StackPanel>
      <Rectangle Stroke="Red" Fill="LightGreen"
StrokeThickness="1" Margin="10"
Height="50" Width="80" RadiusX="10" RadiusY="30" />
      <Rectangle Stroke="Red" Fill="LightGreen"
StrokeThickness="1" Margin="10"
Height="50" Width="80" RadiusX="30" RadiusY="10" />
    </StackPanel>
  </Viewbox>
</Page>
```



# Класс Geometry и элемент Path

Geometry – абстрактный класс

CombinedGeometry

EllipseGeometry \*\*\*

GeometryGroup

LineGeometry \*\*\*

PathGeometry

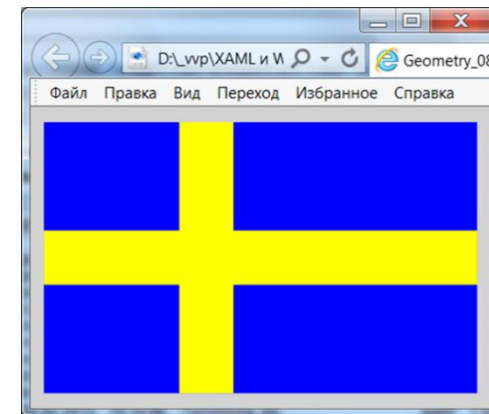
RectangleGeometry \*\*\*

StreamGeometry

**Свойства элемента Path:** Data, Stroke, Fill,

# Флаг Швеции

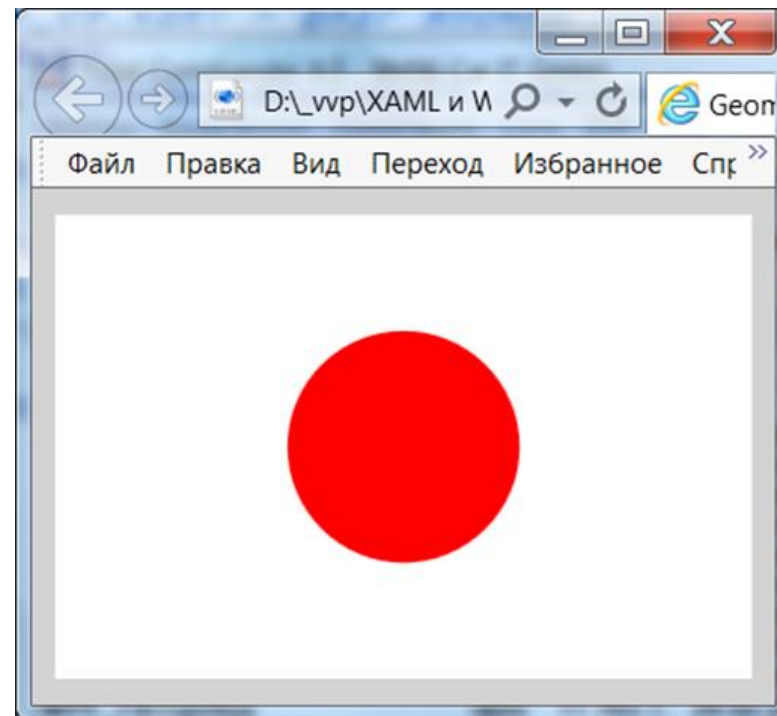
```
<!-- Geom05.xaml - флаг Швеции -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
  <Viewbox>
    <Canvas Height="200" Width="320" Background="Blue" Margin="10">
      <Path Stroke="Yellow" StrokeThickness="40">
        <Path.Data>
          <LineGeometry StartPoint="0 100" EndPoint="320 100" />
        </Path.Data>
      </Path>
      <Path Stroke="Yellow" StrokeThickness="40">
        <Path.Data>
          <LineGeometry StartPoint="120 0" EndPoint="120 200" />
        </Path.Data>
      </Path>
    </Canvas>
  </Viewbox>
</Page>
```





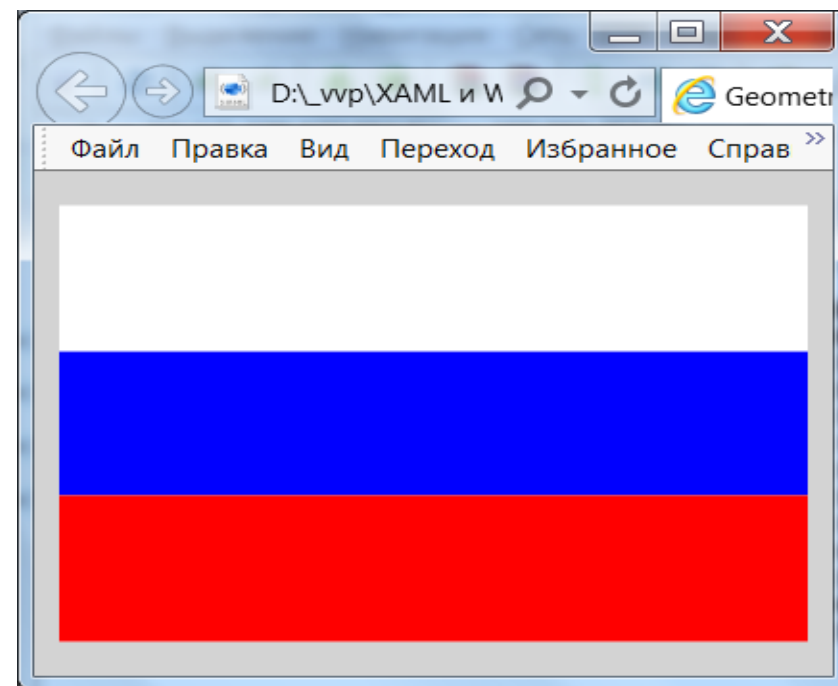
# Флаг Японии

```
<!-- Geom06.xaml - флаг Японии -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <Viewbox>
        <Canvas Height="200" Width="300" Background="White" Margin="10">
            <Path Fill="Red">
                <Path.Data>
                    <EllipseGeometry Center="150 100" RadiusX="50" RadiusY="50" />
                </Path.Data>
            </Path>
        </Canvas>
    </Viewbox>
</Page>
```



# Флаг России

```
<!-- Geom07.xaml - флаг России -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
  <Viewbox>
    <Canvas Height="200" Width="300" Background="White" Margin="10">
      <Path Fill="Blue">
        <Path.Data>
          <RectangleGeometry Rect="0 67 300 66 " />
        </Path.Data>
      </Path>
      <Path Fill="Red">
        <Path.Data>
          <RectangleGeometry Rect="0 133 300 67 " />
        </Path.Data>
      </Path>
    </Canvas>
  </Viewbox>
</Page>
```



# Объединение геометрических фигур

## Классы для объединения геометрических фигур:

- **CombinedGeometry**
- **GeometryGroup**
- **PathGeometry**
- **StreamGeometry**

# PathGeometry

Свойство `Figures` – **коллекция элементов** `PathFigure`.  
`PathFigure` - **связный** фрагмент траектории (сегмент)

Свойства элемента `PathFigure`:

- `StartPoint`
- `IsFilled`
- `IsClosed`
- `Segments` – **коллекция сегментов**

Сегмент – элемент, производный от `PathSegment`

# Абстрактный класс PathSegment

## Виды сегментов:

- LineSegment
- PolyLineSegment
- ArcSegment
- BesierSegment
- QuadraticBezierSegment
- PolyBezierSegment
- PolyQuadraticBezierSegment

# Рисование отрезками прямых

```
<!-- GeoPath01.xaml - Рисование отрезками прямых -->
```

```
<Page Background="LightGray"
```

```
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
```

```
  <Viewbox>
```

```
    <Canvas Height="100" Width="200" Background="White" Margin="10">
```

```
      <Path Stroke="Black" StrokeThickness="5" StrokeLineJoin="Bevel">
```

```
        <Path.Data>
```

```
          <PathGeometry>
```

```
            <PathGeometry.Figures>
```

```
              <PathFigure StartPoint="25, 15" >
```

```
                <LineSegment Point="40, 90" />
```

```
                <LineSegment Point="55, 20" />
```

```
                <LineSegment Point="70, 90" />
```

```
                <LineSegment Point="85, 15" />
```

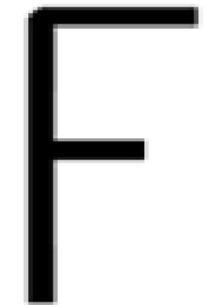
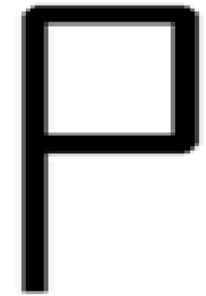
```
            </PathFigure>
```



```

    <PathFigure StartPoint="100, 90" >
        <LineSegment Point="100, 15" />
        <LineSegment Point="130, 15" />
        <LineSegment Point="130, 50" />
        <LineSegment Point="100, 50" />
    </PathFigure>
    <PathFigure StartPoint="150, 90" >
        <LineSegment Point="150, 50" />
        <LineSegment Point="170, 50" />
        <LineSegment Point="150, 50" />
        <LineSegment Point="150, 15" />
        <LineSegment Point="180, 15" />
    </PathFigure>
</PathGeometry.Figures>
</PathGeometry>
</Path.Data>
</Path>
</Canvas>
</Viewbox>
</Page>

```



# Мини-язык разметки траекторий

M - Move

L - Line

H - Horizontal Line

V - Vertical Line

A - Arc

C - Cubic Bezier

S - Smooth Cubic Bezier

Q - Quadratic Bezier

T - Smooth Quadratic Bezier

Z - Close

F - Fill



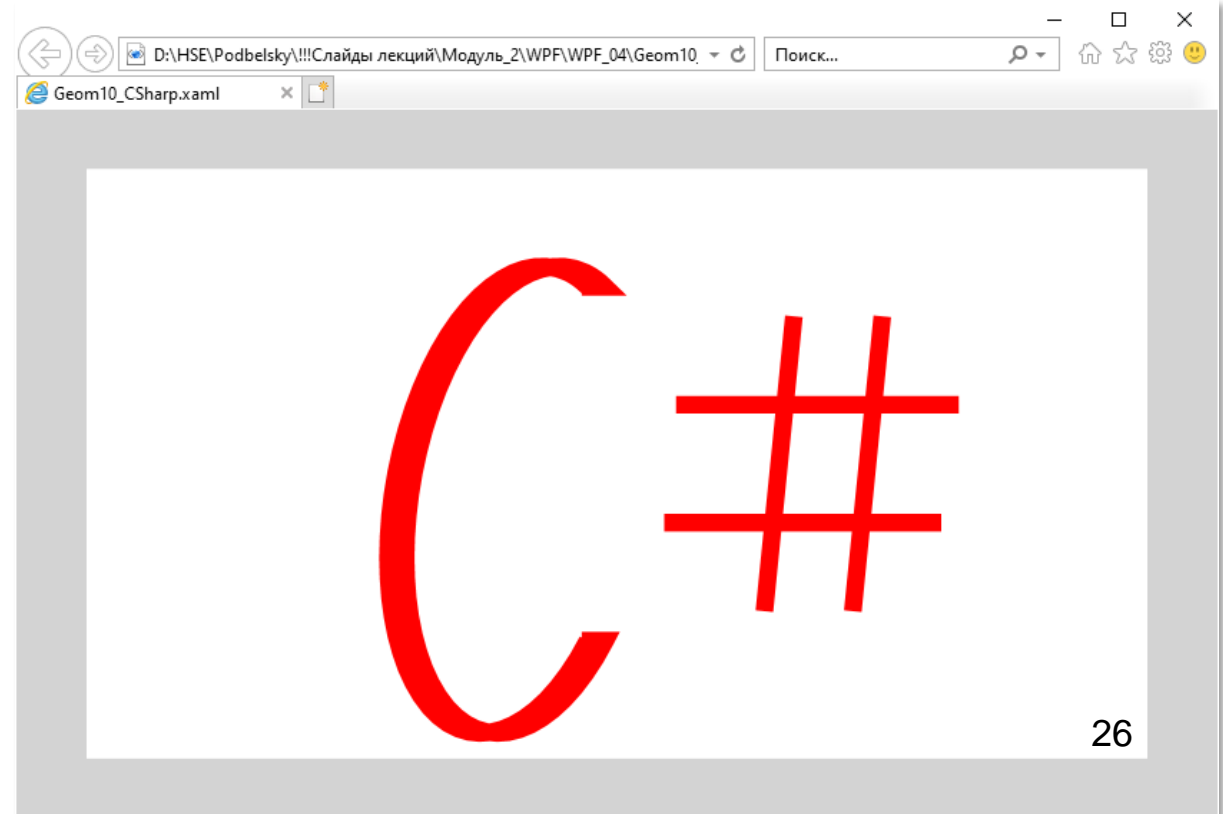
# Использование языка разметки траекторий

```
<!-- GeoPath.xaml - Мини-язык геометрии -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
  <Viewbox>
    <Canvas Height="100" Width="200" Background="White" Margin="10">
      <Path Stroke="Black" StrokeThickness="5" StrokeLineJoin="Bevel"
Data="M 25, 15 L 40, 90 55, 20 70, 90 85, 15
M 100, 90 L 100, 15 130, 15 130, 50 100, 50
M 150, 90 L 150, 50 170, 50 150, 50 150, 15 180, 15" >
    </Path>
  </Canvas>
</Viewbox>
</Page>
```



# Использование языка разметки траекторий

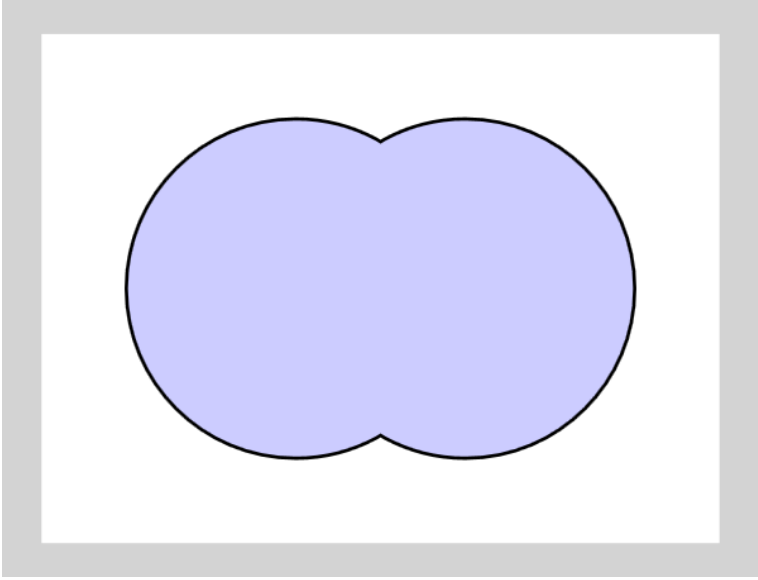
```
<!-- GeoPath10.xaml - CSharp -->
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <Viewbox>
        <Canvas Height="100" Width="180" Background="White" Margin="10">
            <Path Stroke="Red" StrokeThickness="3">
                <Path.Data>
                    <PathGeometry Figures="M 100 40 H 148
M 98 60 H 145
M 120 25 L 115 75
M 135 25 L 130 75
M 85 20 A 20 40 10 1 0 85 80
M 84 20 H 88 A 20 40 10 1 0 88 80 H 84" />
                </Path.Data>
            </Path>
        </Canvas>
    </Viewbox>
</Page>
```



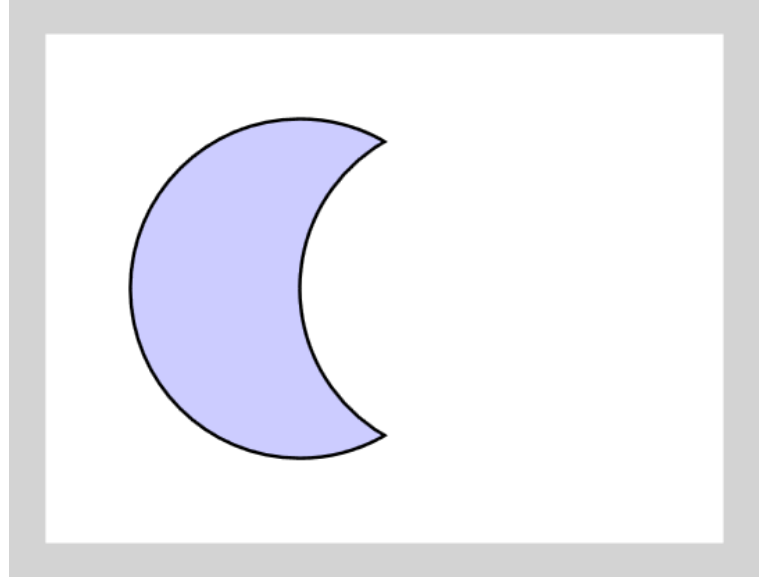
# Объединенные геометрические объекты

```
<Page Background="LightGray"
xmlns="http://schemas.microsoft.com/winfx/2006/xaml/presentation">
    <Viewbox>
        <Canvas Height="150" Width="200" Background="White" Margin="10">
            <Path Stroke="Black" StrokeThickness="1" Fill="#CCCCFF">
                <Path.Data>
                    <!-- GeometryCombineMode: Union, Intersect, Xor, Exclude -->
                    <CombinedGeometry GeometryCombineMode="Union">
                        <CombinedGeometry.Geometry1>
                            <EllipseGeometry RadiusX="50" RadiusY="50" Center="75,75" />
                        </CombinedGeometry.Geometry1>
                        <CombinedGeometry.Geometry2>
                            <EllipseGeometry RadiusX="50" RadiusY="50" Center="125,75" />
                        </CombinedGeometry.Geometry2>
                    </CombinedGeometry>
                </Path.Data>
            </Path>
        </Canvas>
    </Viewbox>
</Page>
```

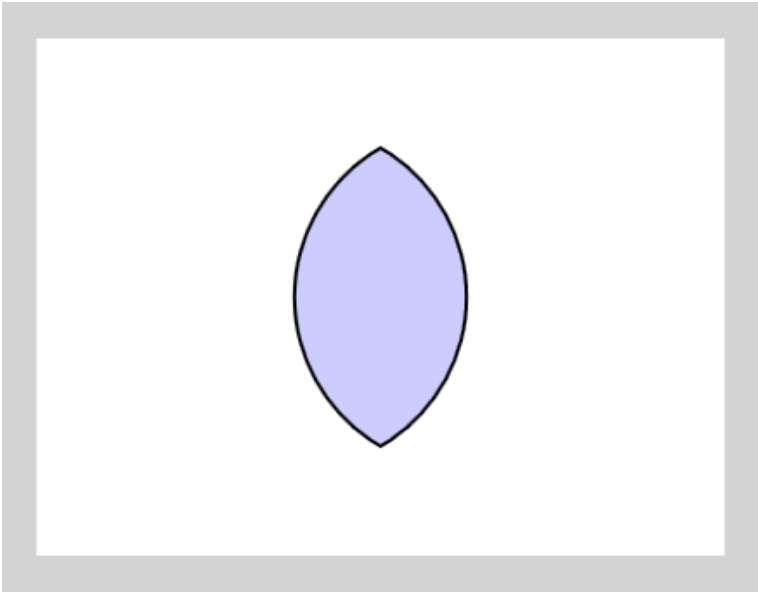
# GeometryCombineMode: Union, Exclude, Intersect, Xor



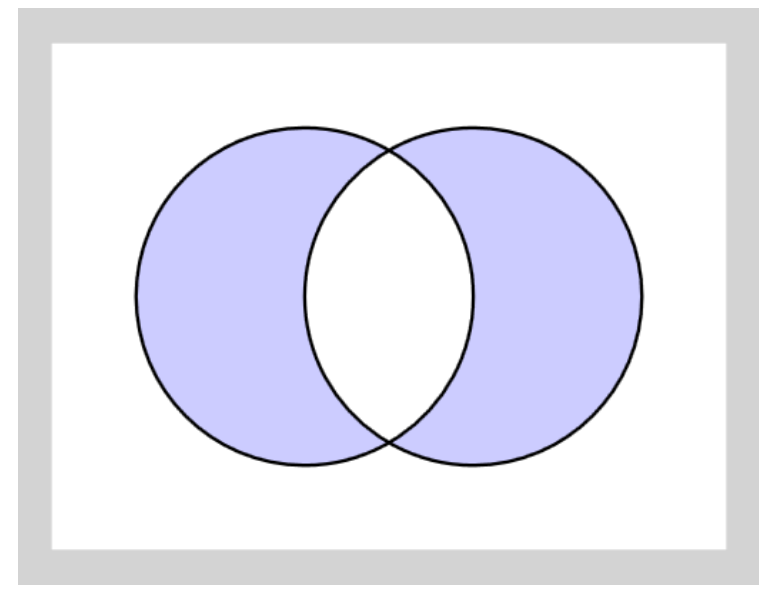
**Union**



**Exclude**



**Intersect**



**Xor**

# Свойства класса RenderTransform

- RotateTransform - вращение
- ScaleTransform - масштабирование
- SkewTransform - скос
- TranslateTransform - сдвиг
- MatrixTransform – обобщенные преобразования

Элемент

<TranslateTransform X="100" Y="100"/>