Kurs Komputerowy S
System Symboliczny
Mathematica

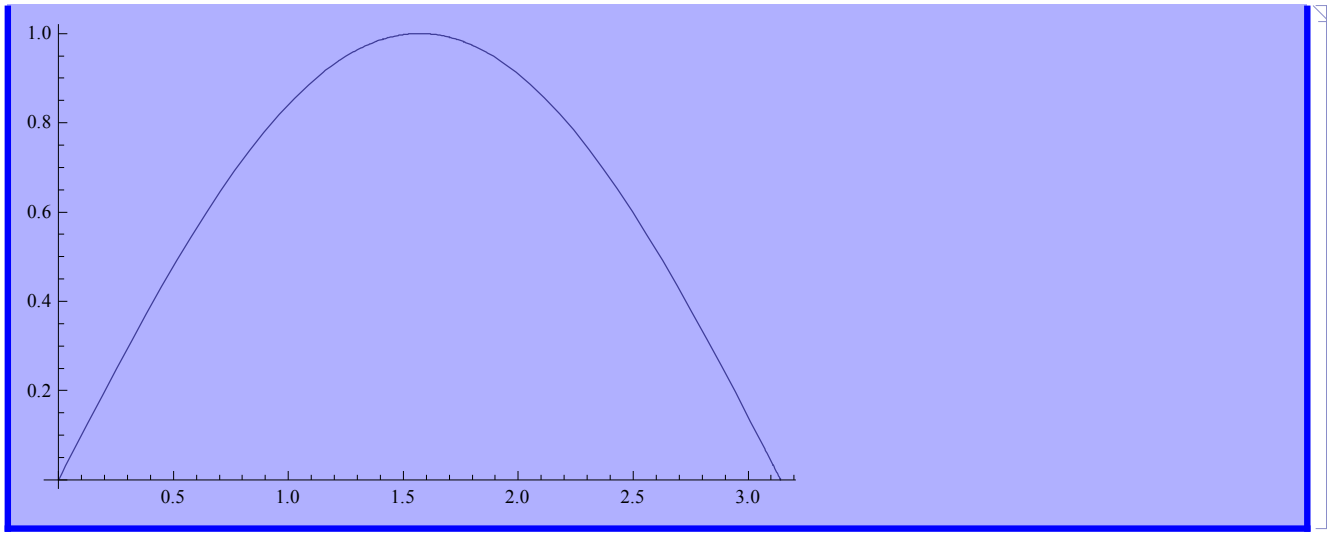
Grafika

{zakres x} = > {x, wart_min, wart_max}

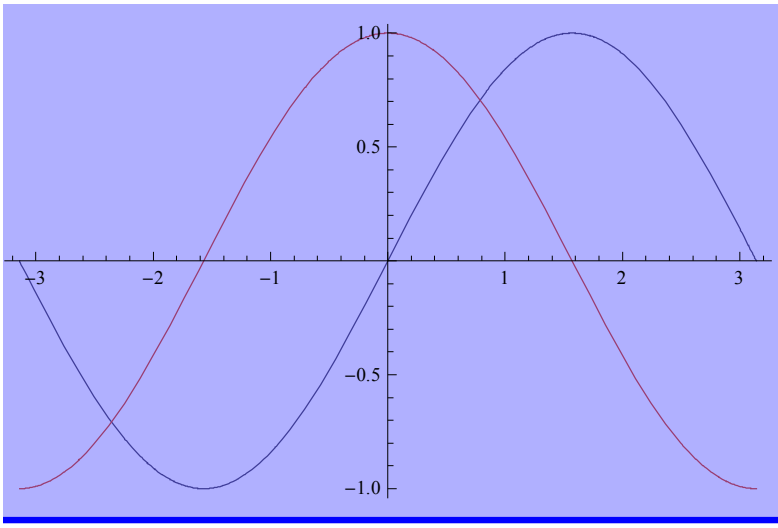
Wykresy 2D

Plot[wyrazenie,{zakres x}]
ParametricPlot[{wyrazenie_x, wyrazenie_y}, {zakres t}]
PolarPlot[promien, {zakres θ}]

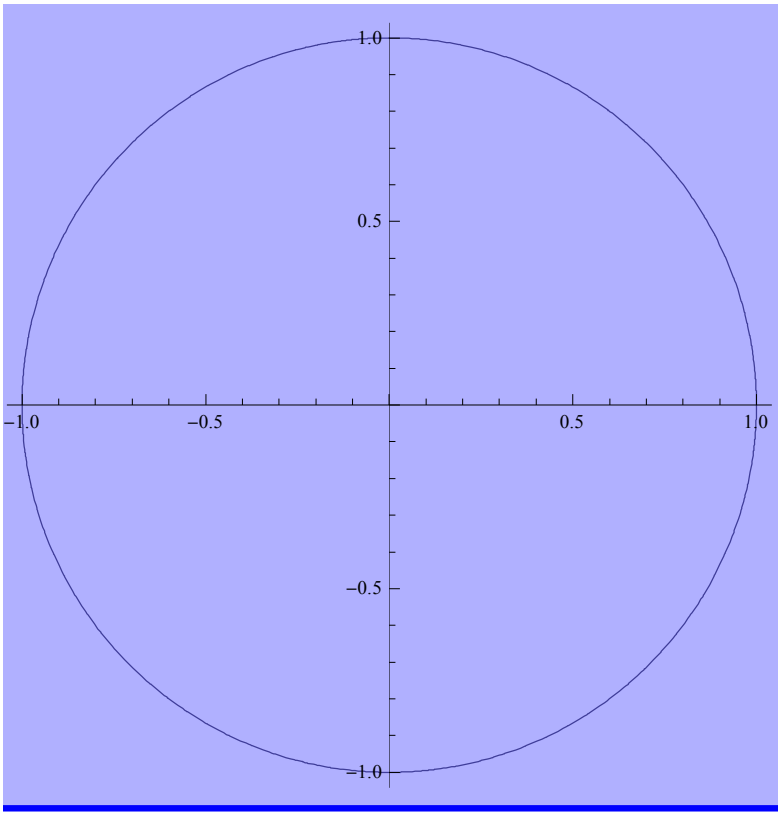
```
Plot[Sin[x], {x, 0, Pi}]
```



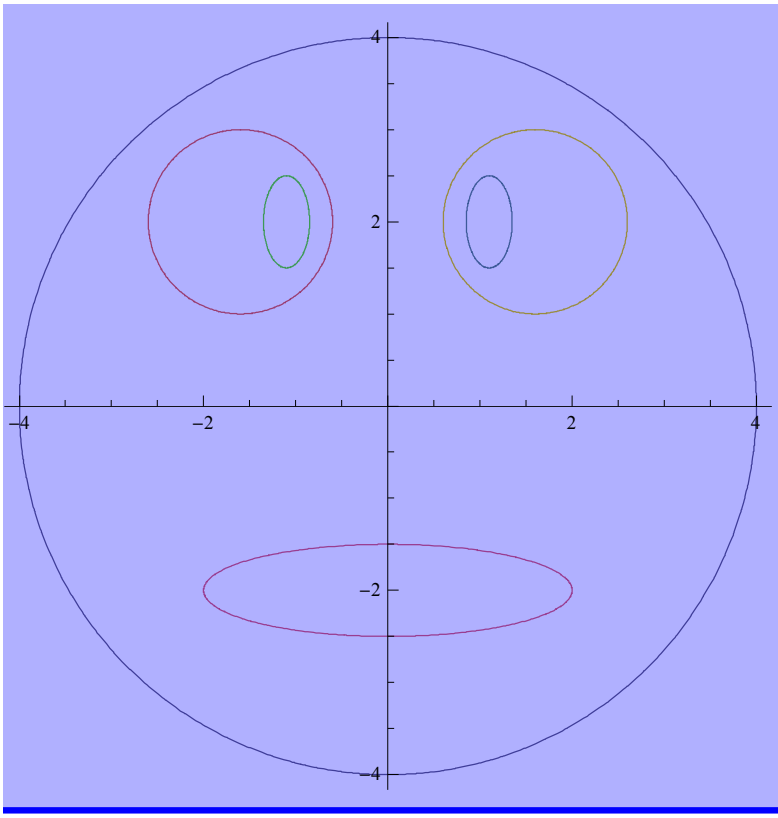
```
Plot[{Sin[x], Cos[x]}, {x, -Pi, Pi}]
```



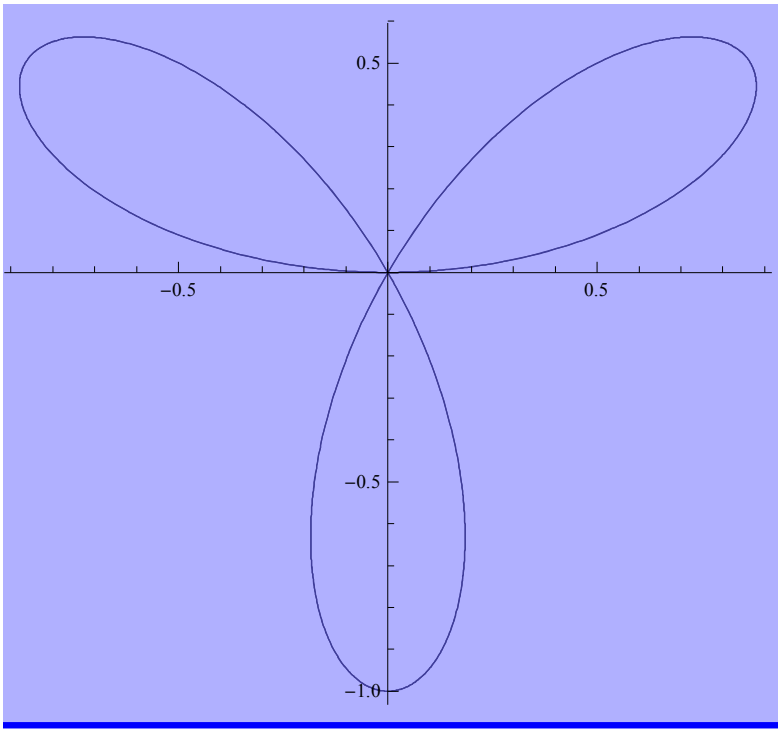

```
ParametricPlot[{Sin[t], Cos[t]}, {t, 0, 2 Pi}]
```



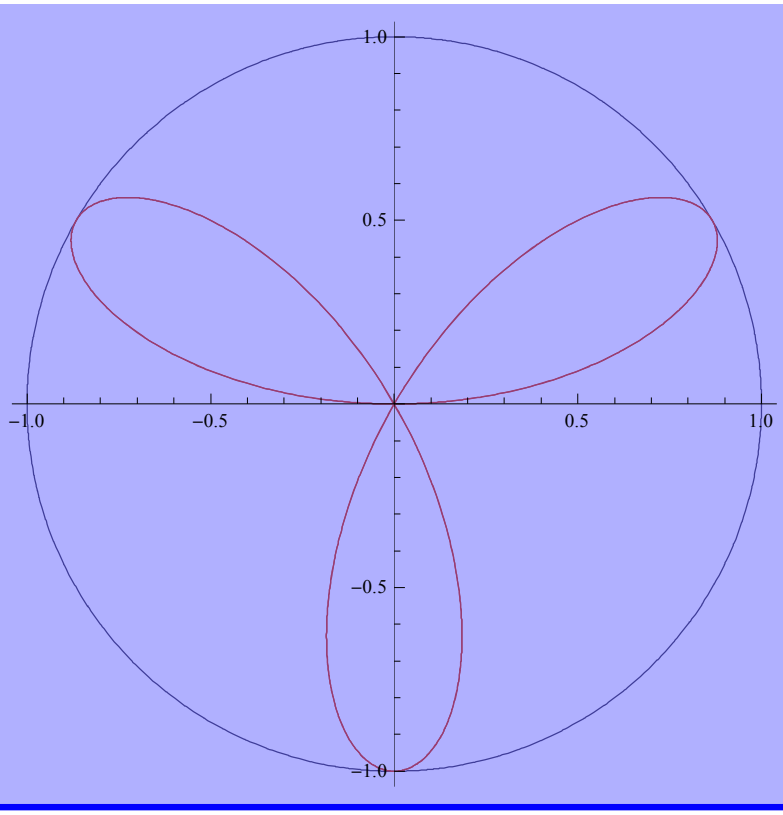
```
ParametricPlot[{{4 Sin[x], 4 Cos[x]}, {Sin[x] - 1.6, Cos[x] + 2},
  {Sin[x] + 1.6, Cos[x] + 2}, {Sin[x] / 4 - 1.1, Cos[x] / 2 + 2},
  {Sin[x] / 4 + 1.1, Cos[x] / 2 + 2}, {2 Sin[x], Cos[x] / 2 - 2}}, {x, 0, 2 Pi}]
```




```
PolarPlot[Sin[3 x], {x, 0, 2 Pi}]
```



```
PolarPlot[{1, Sin[3 x]}, {x, 0, 2 Pi}]
```




```
Options[Plot]
```

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BaselinePosition → Automatic, BaseStyle → {}, ClippingStyle → None,
ColorFunction → Automatic, ColorFunctionScaling → True, ColorOutput → Automatic,
ContentSelectable → Automatic, CoordinatesToolOptions → Automatic,
DisplayFunction :→ $DisplayFunction, Epilog → {}, Evaluated → Automatic,
EvaluationMonitor → None, Exclusions → Automatic, ExclusionsStyle → None,
Filling → None, FillingStyle → Automatic, FormatType :→ TraditionalForm,
Frame → False, FrameLabel → None, FrameStyle → {}, FrameTicks → Automatic,
FrameTicksStyle → {}, GridLines → None, GridLinesStyle → {},
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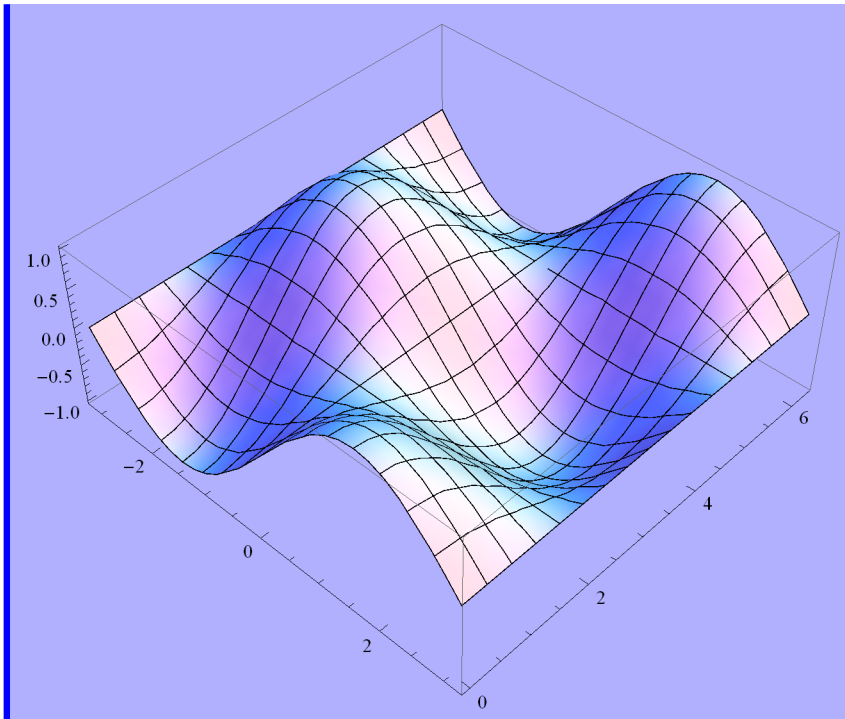
Method → Automatic, PerformanceGoal :→ $PerformanceGoal,
PlotLabel → None, PlotPoints → Automatic, PlotRange → {Full, Automatic},
PlotRangeClipping → True, PlotRangePadding → Automatic, PlotRegion → Automatic,
PlotStyle → Automatic, PreserveImageOptions → Automatic, Prolog → {},
RegionFunction → (True &), RotateLabel → True, Ticks → Automatic,
TicksStyle → {}, WorkingPrecision → MachinePrecision$\}$

Wykresy 3D

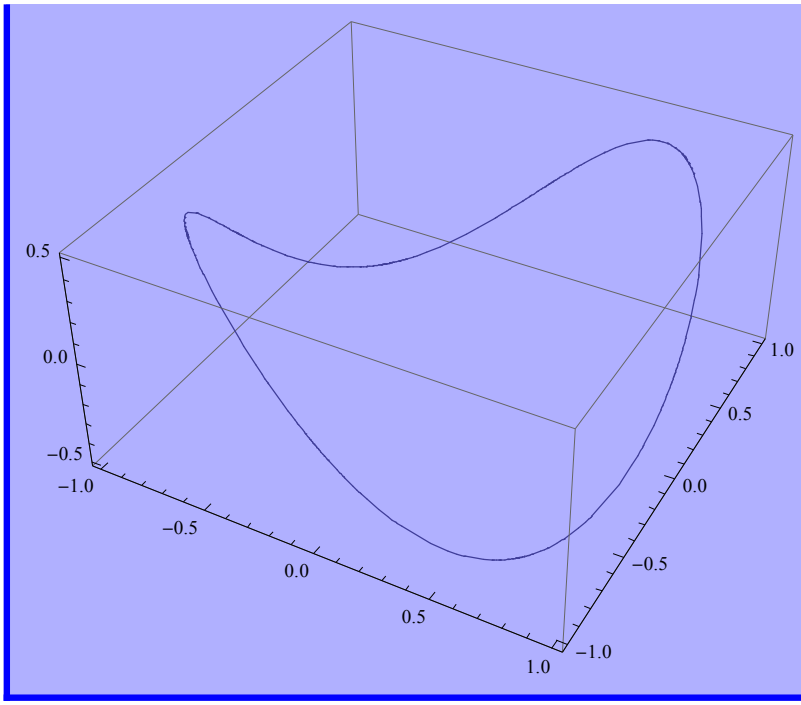
Plot3D[wyrazenie, {zakres x}, {zakres y}]

ParametricPlot3D[{wyrazenie_x, wyrazenie_y, wyrazenie_z}, {zakres t}]
ContourPlot3D[wyrazenie,{zakres x}, {zakres y}]
RegionPlot3D[warunki, {zakres x}, {zakres y}]
RevolutionPlot3D[wyrazenie, {zakres r}]

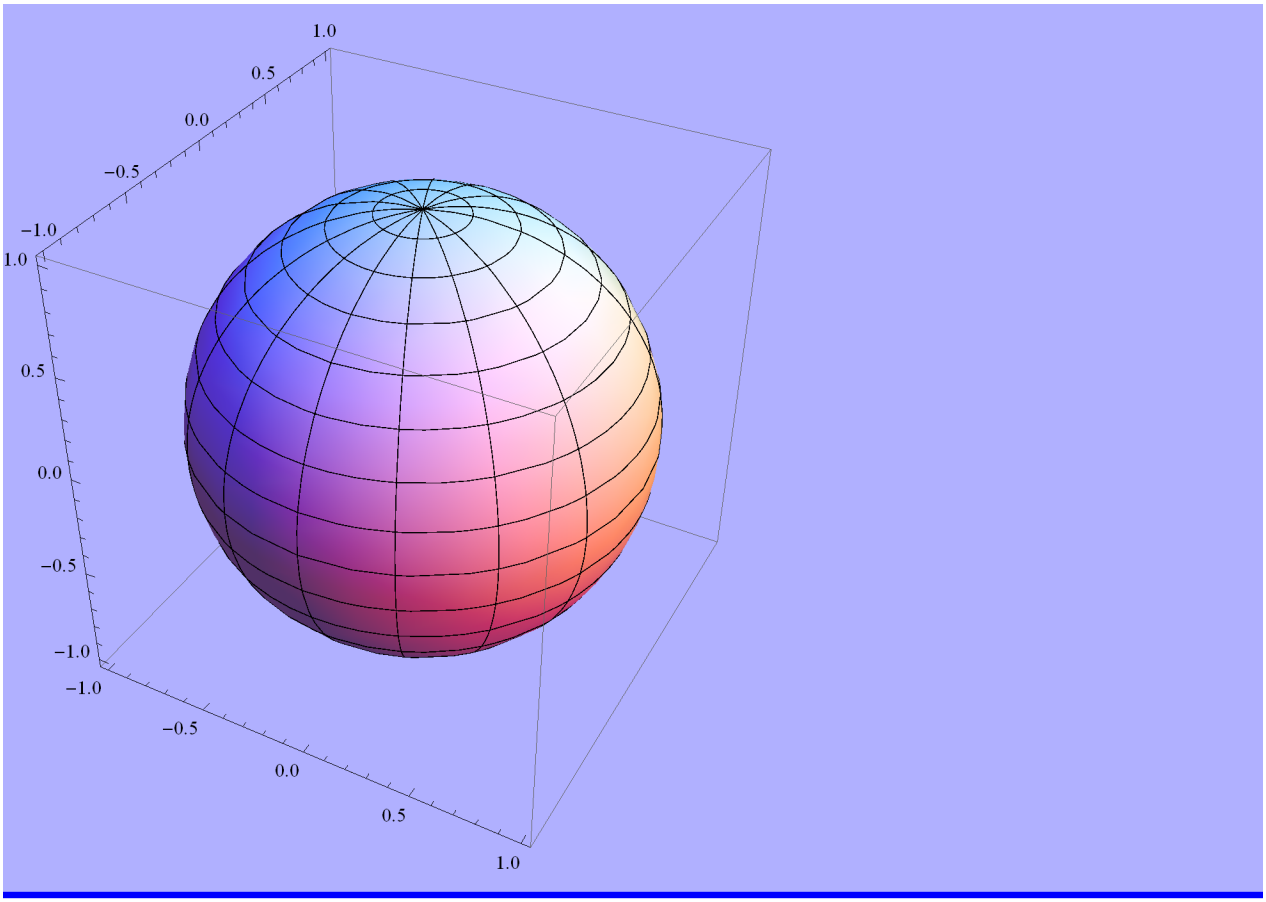
```
Plot3D[Sin[x] * Cos[y], {x, -Pi, Pi}, {y, 0, 2 Pi}]
```



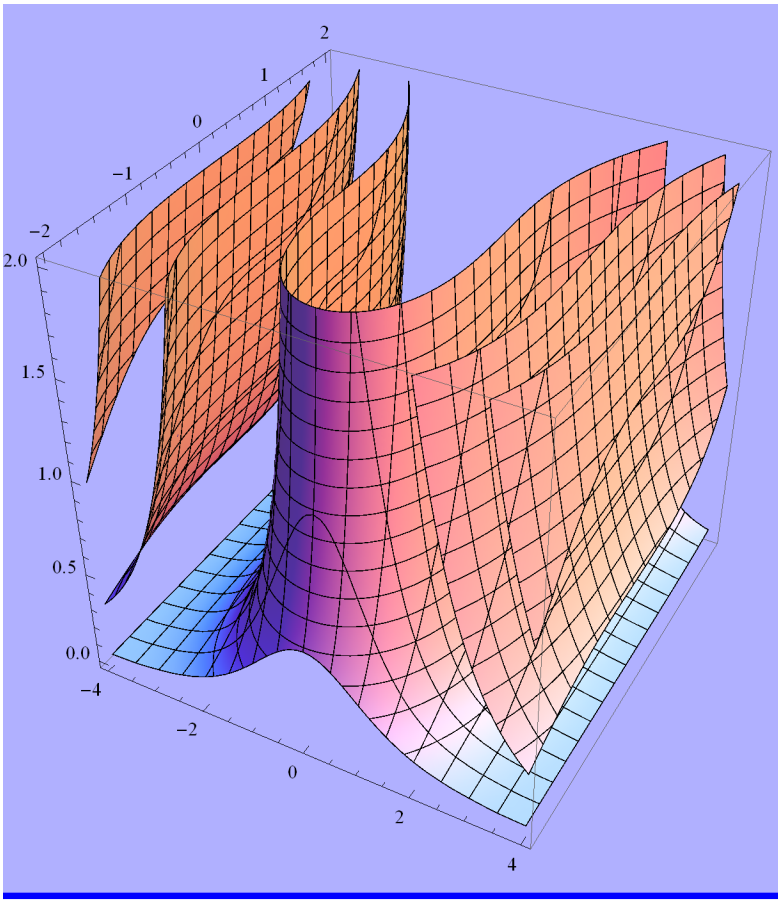

```
ParametricPlot3D[{Sin[x], Cos[x], Sin[x] Cos[x]}, {x, 0, 2 Pi}]
```



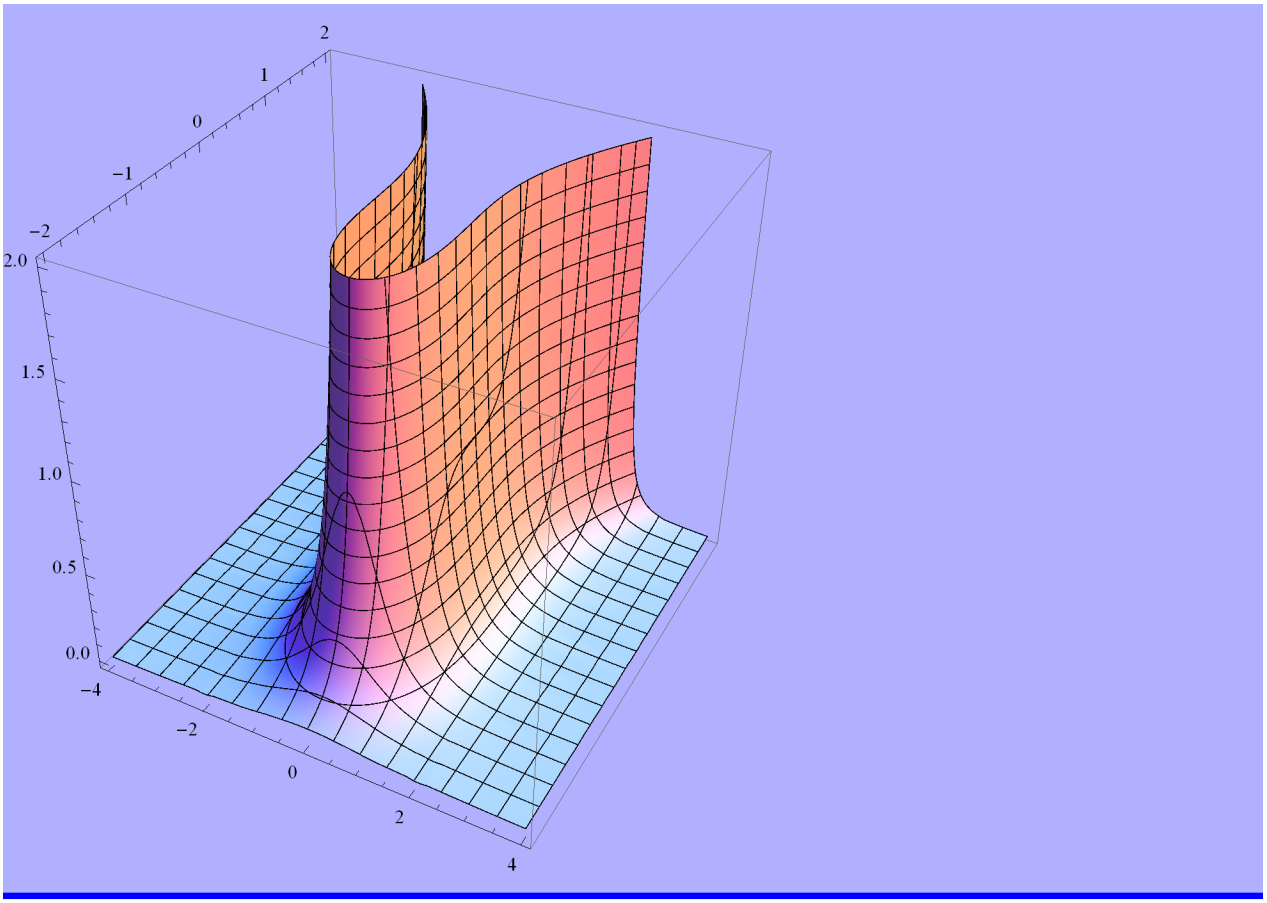
```
ParametricPlot3D[{Cos[x] Cos[y], Sin[x] Cos[y], Sin[y]},
 {x, 0, 2 Pi}, {y, -Pi / 2, Pi / 2}]
```



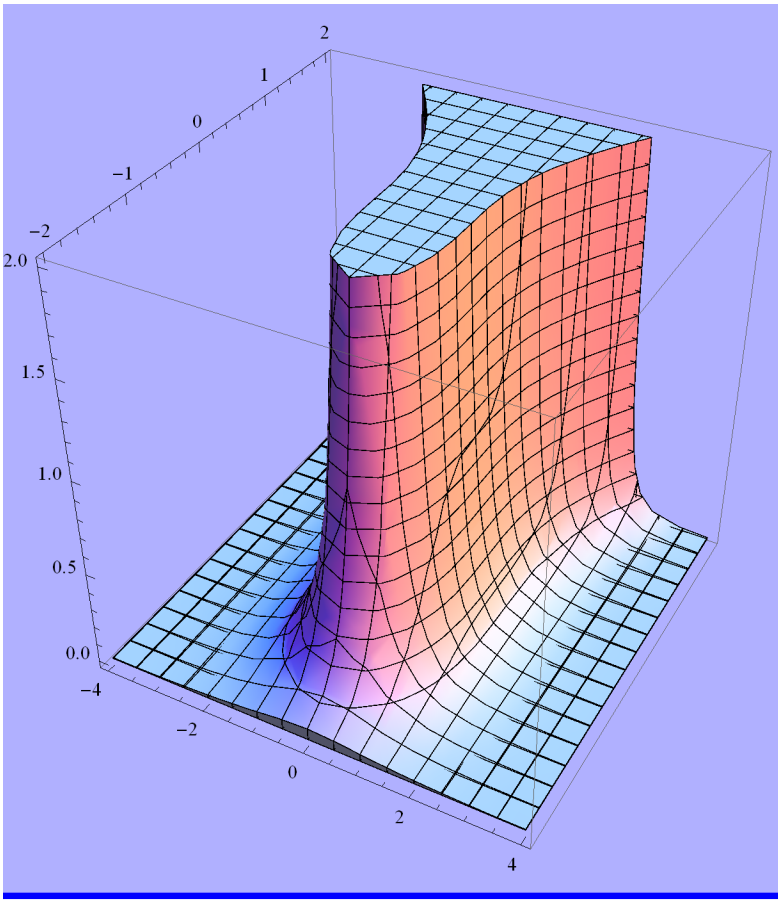
```
ContourPlot3D[(2 x^2 - y^3) * Sqrt[z], {x, -4, 4}, {y, -2, 2}, {z, 0, 2}]
```



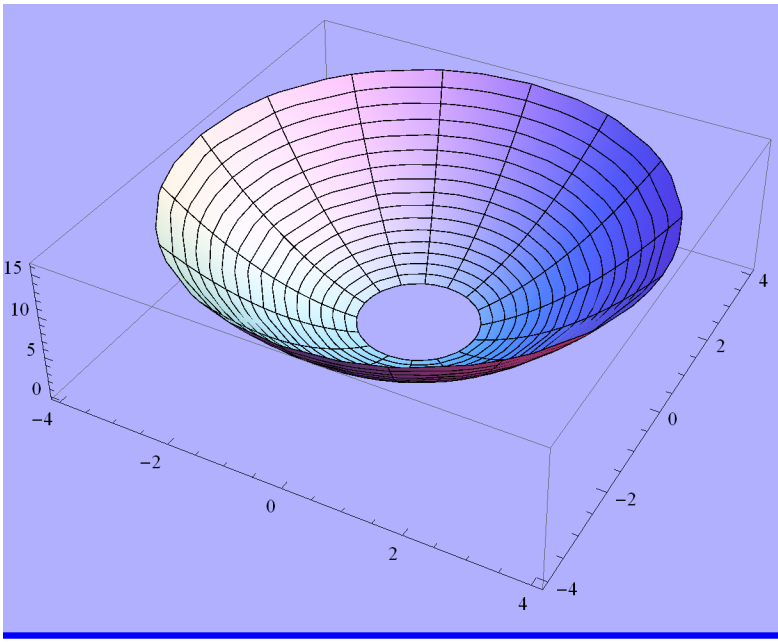
```
ContourPlot3D[(2 x^2 - y^3) * Sqrt[z] == 2, {x, -4, 4}, {y, -2, 2}, {z, 0, 2}]
```



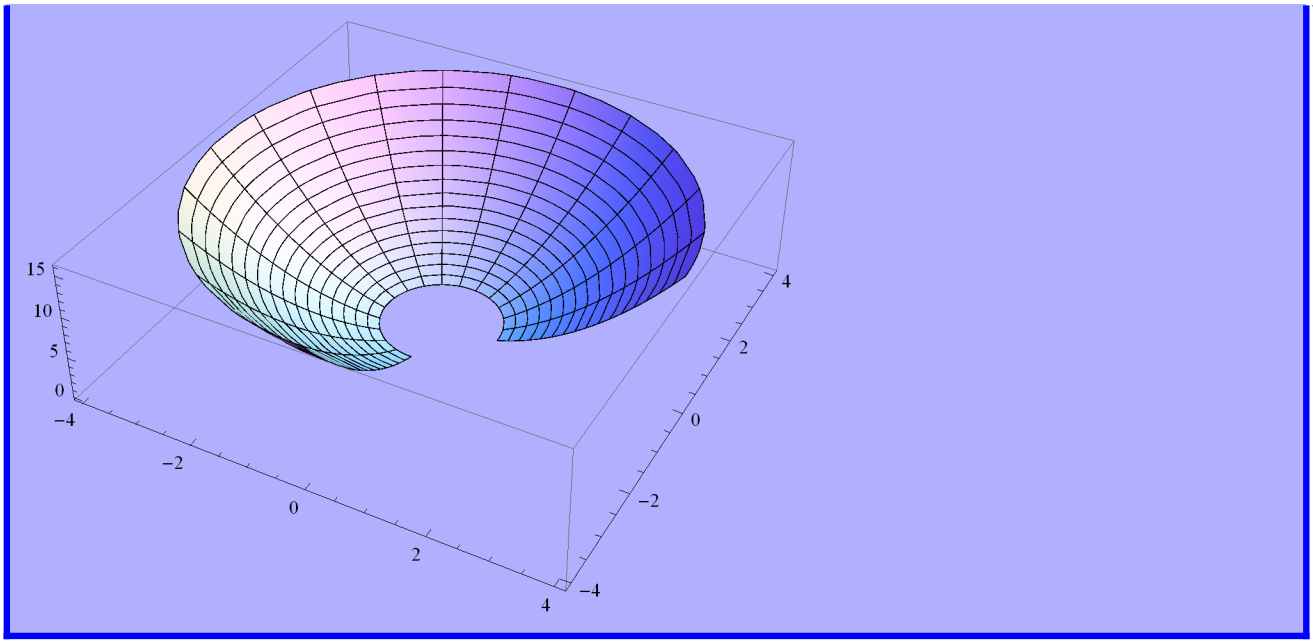
```
RegionPlot3D[(2 x^2 - y^3) * Sqrt[z] < 2, {x, -4, 4}, {y, -2, 2}, {z, 0, 2}]
```




```
RevolutionPlot3D[x^2, {x, 1, 4}]
```



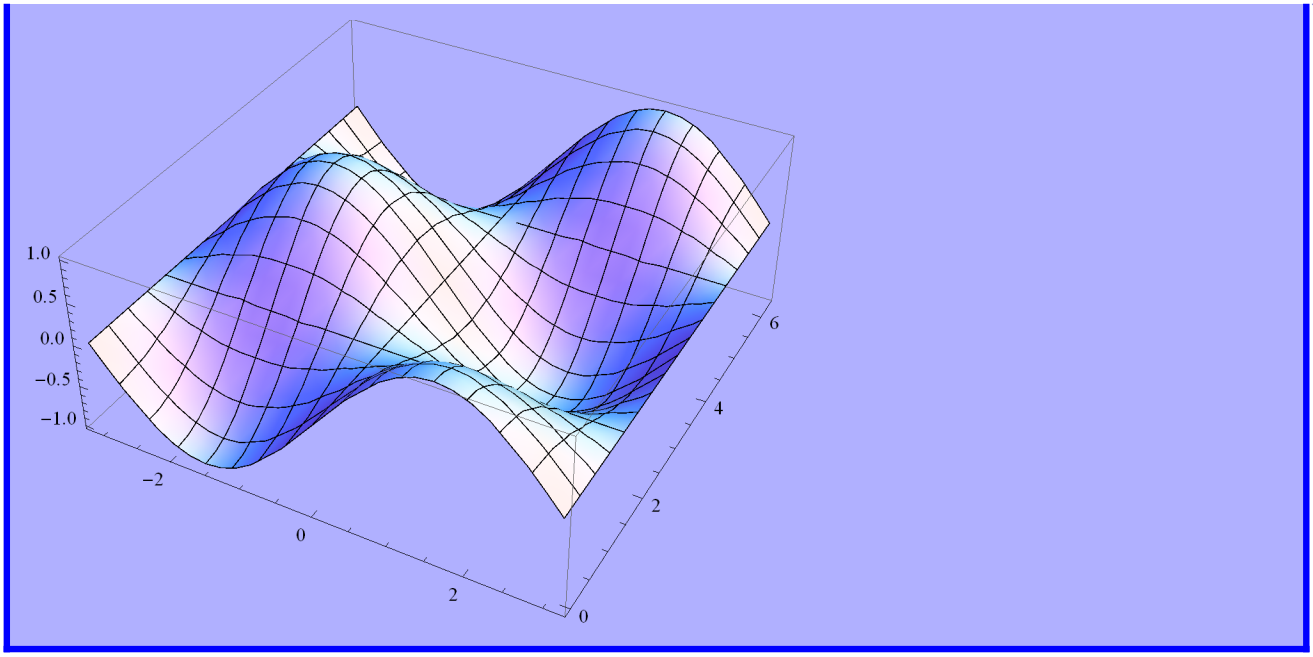
```
RevolutionPlot3D[x^2, {x, 1, 4}, {θ, 0, 3 / 2 Pi}]
```



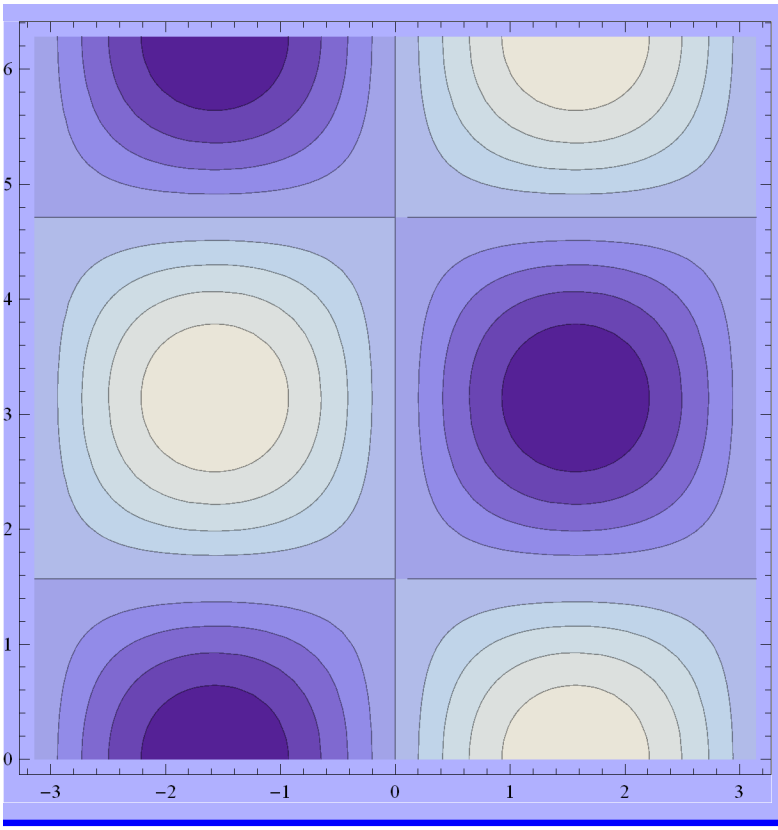
Wykresy 3D na plaszczyznie

ContourPlot[wyrazenie, {zakres x}, {zakres y}]
DensityPlot[wyrazenie, {zakres x}, {zakres y}]
RegionPlot[warunki, {zakres x}, {zakres y}]

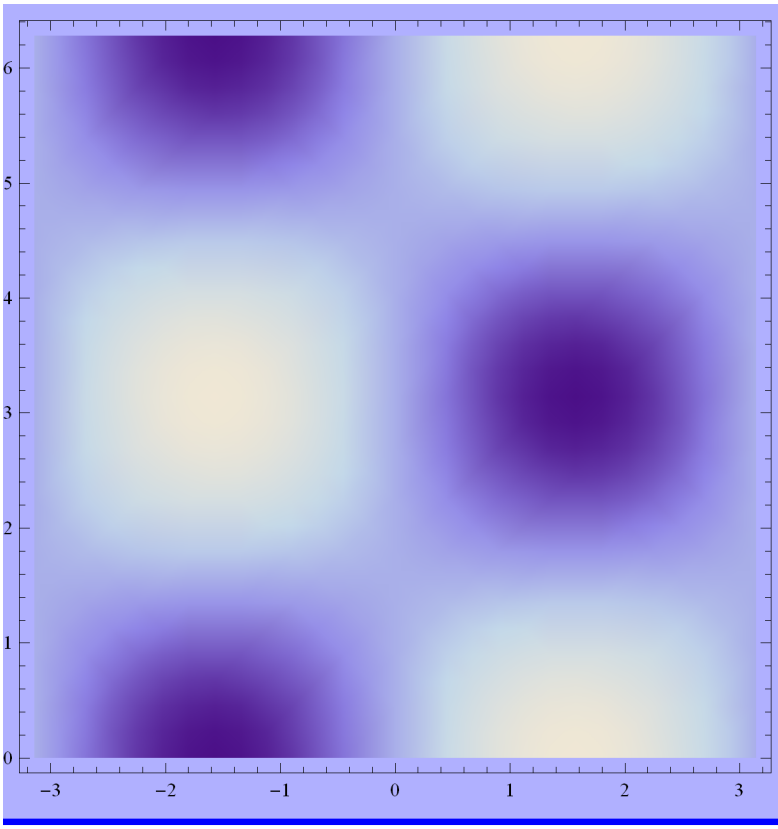
```
Plot3D[Sin[x] * Cos[y], {x, -Pi, Pi}, {y, 0, 2 Pi}]
```



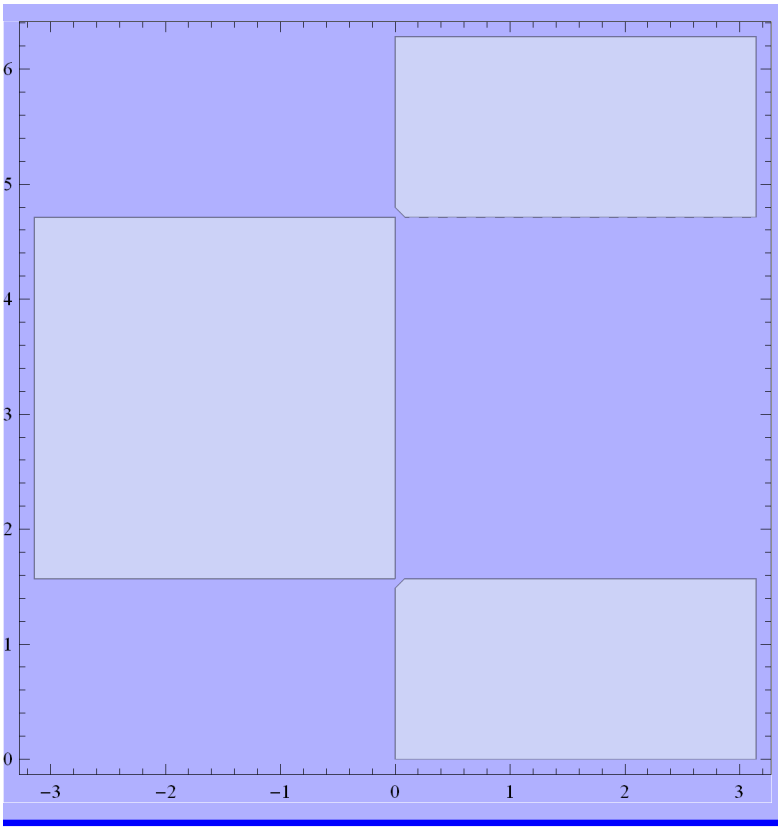
```
ContourPlot[Sin[x] * Cos[y], {x, -Pi, Pi}, {y, 0, 2 Pi}]
```




```
DensityPlot[Sin[x] * Cos[y], {x, -Pi, Pi}, {y, 0, 2 Pi}]
```



```
RegionPlot[Sin[x] * Cos[y] > 0, {x, -Pi, Pi}, {y, 0, 2 Pi}]
```



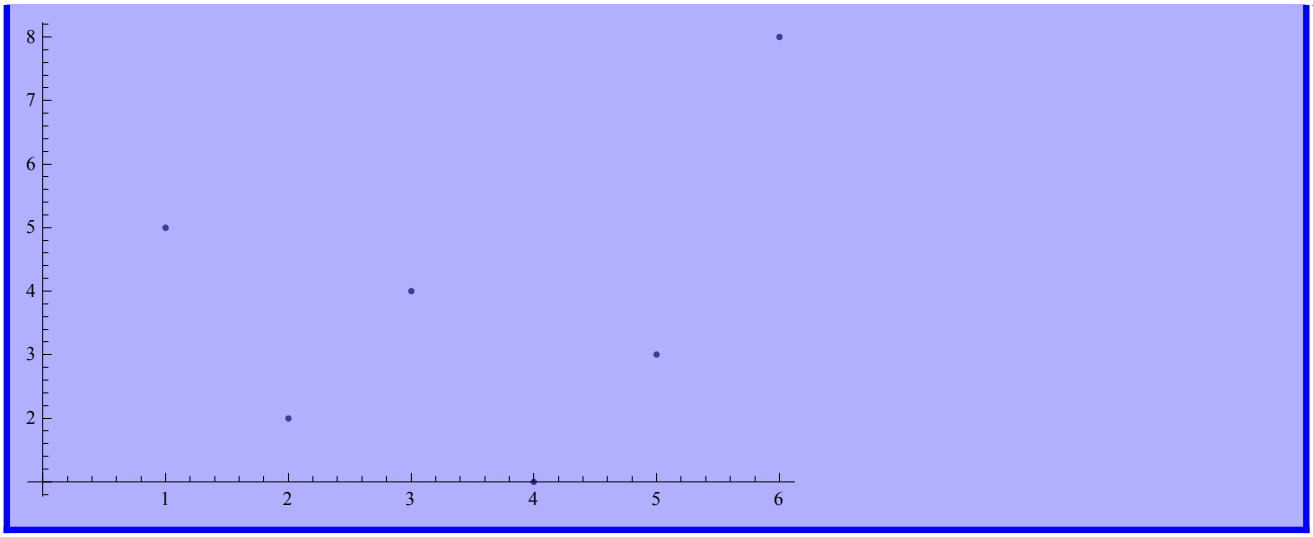
Wykresy funkcji numerycznych

ListPlot[lista]
ListPlot3D[macierz]
ListContourPlot[macierz]
ListDensityPlot[macierz]
ListContourPlot3D[macierz]

ListPointPlot3D[macierz]
DiscretePlot[wyrazenie, iterator]
ListLinePlot[lista]

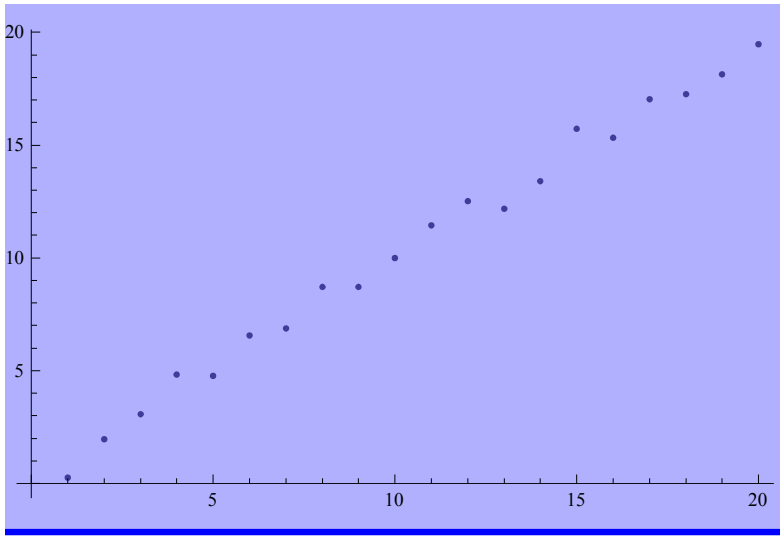
ListPolarPlot[lista]

```
ListPlot[{5, 2, 4, 1, 3, 8}]
```

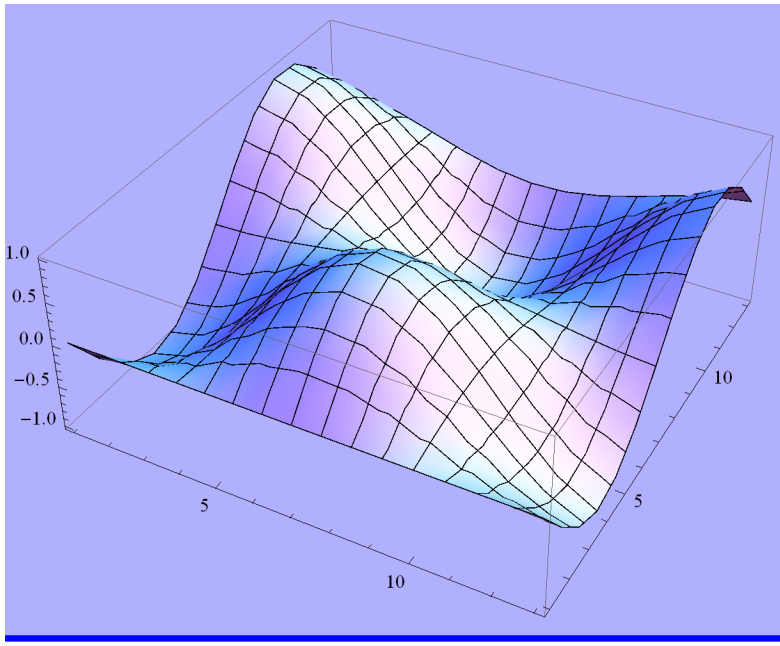


```
d = Table[{x, x + RandomReal[2] - 1}, {x, 20}]
ListPlot[d]
```

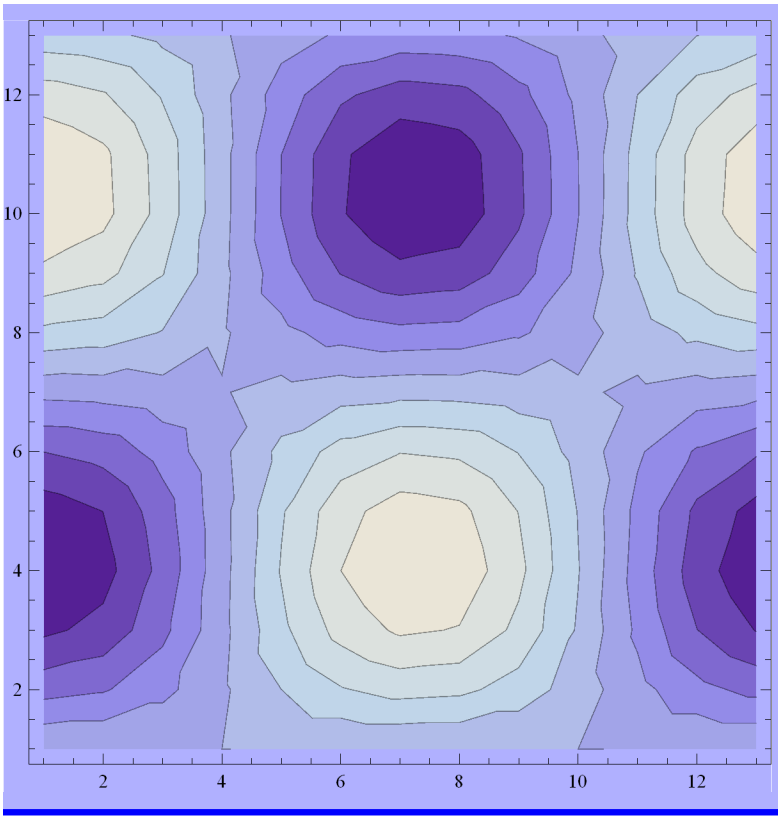
```
{{1, 0.258841}, {2, 1.96198}, {3, 3.07755}, {4, 4.82611}, {5, 4.76084},
 {6, 6.5691}, {7, 6.87782}, {8, 8.7002}, {9, 8.70265}, {10, 9.99063},
 {11, 11.4513}, {12, 12.5059}, {13, 12.1798}, {14, 13.4056}, {15, 15.715},
 {16, 15.3157}, {17, 17.0375}, {18, 17.2501}, {19, 18.1341}, {20, 19.4661}}
```



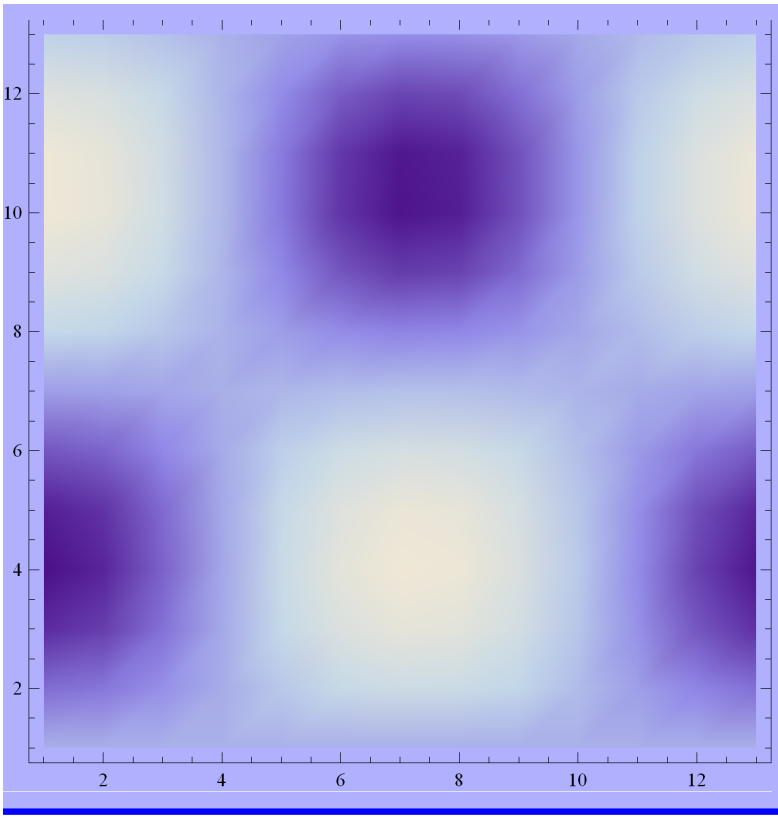

```
d = Table[Sin[x] Cos[y], {x, -Pi, Pi, 0.5}, {y, 0, 2 Pi, 0.5}];
ListPlot3D[d]
```



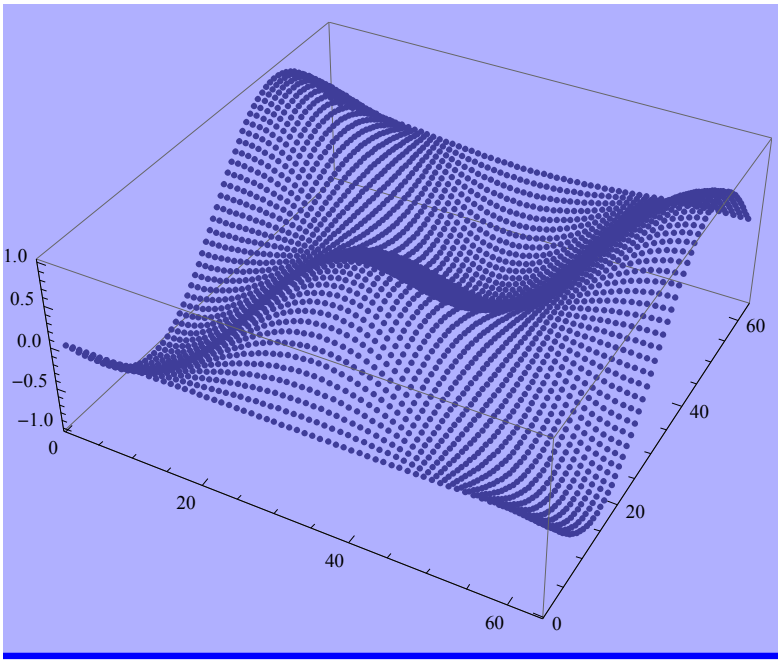
```
ListContourPlot[d]
```



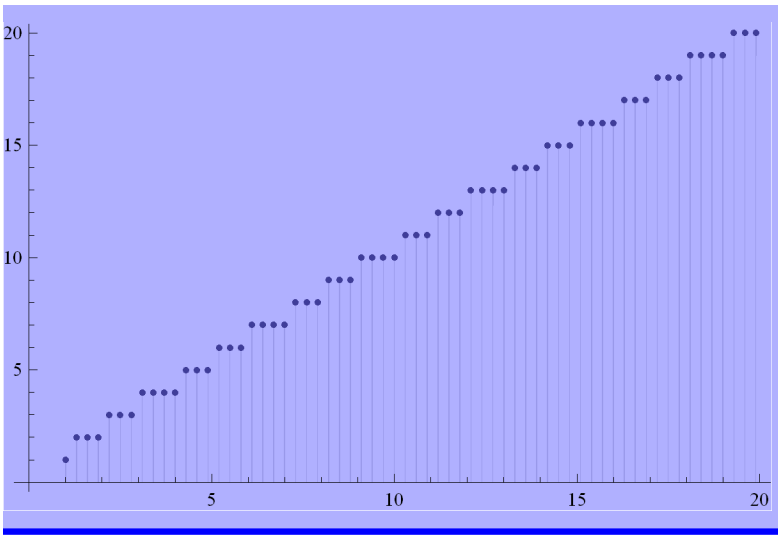

```
ListDensityPlot[d]
```



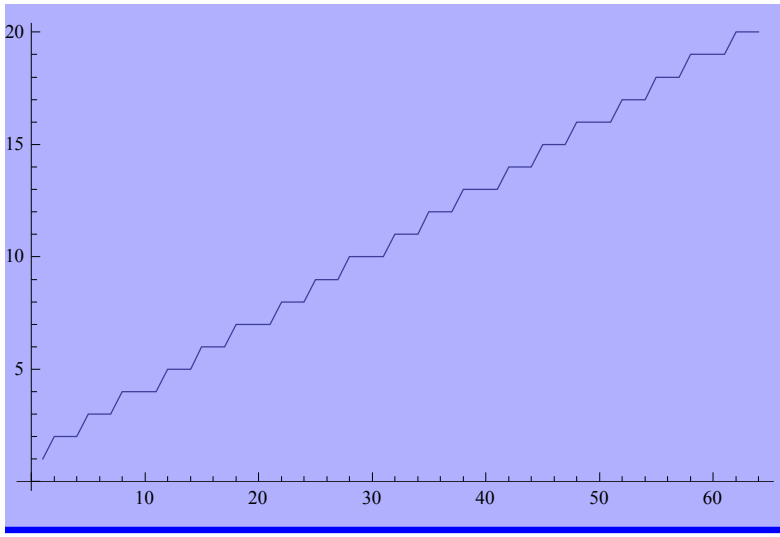
```
d = Table[Sin[x] Cos[y], {x, -Pi, Pi, 0.1}, {y, 0, 2 Pi, 0.1}];
ListPointPlot3D[d]
```



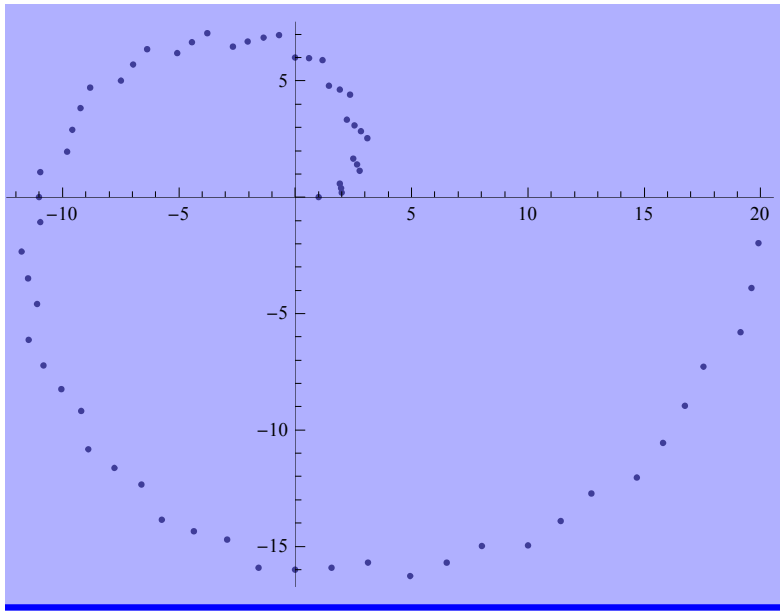

```
DiscretePlot[Ceiling[i], {i, 1, 20, 0.3}]
```



```
ListLinePlot[Table[Ceiling[i], {i, 1, 20, 0.3}]]
```



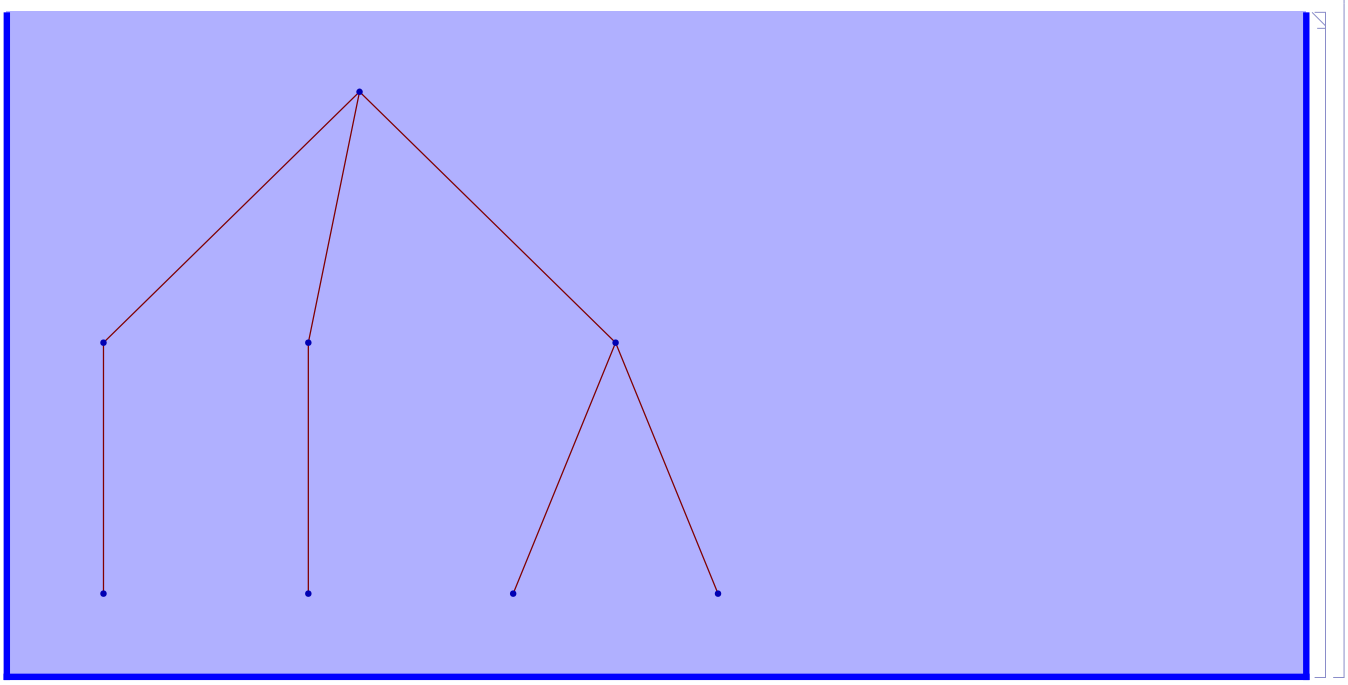

```
ListPolarPlot[Table[Ceiling[i], {i, 1, 20, 0.3}]]
```



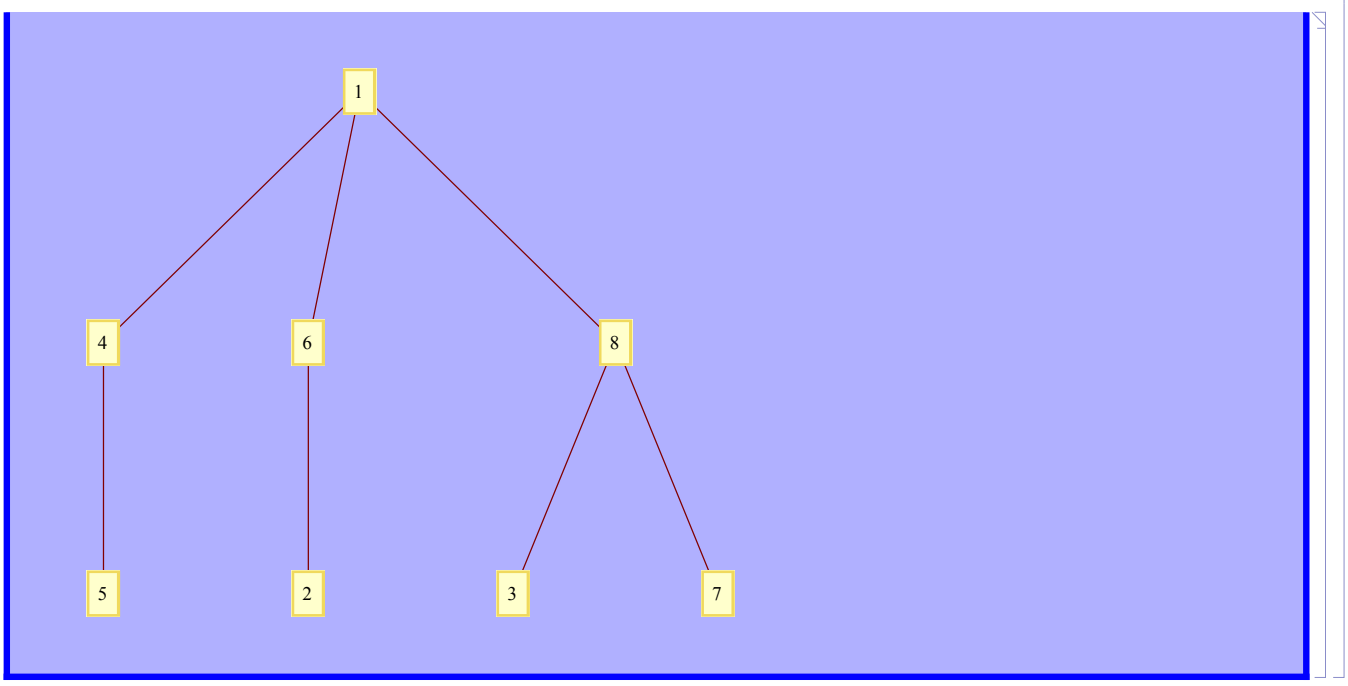
Diagramy

TreePlot[lista_polaczen]
GraphPlot[lista_polaczen]
GraphPlot3D[lista_polaczen]
LayeredGraphPlot[lista_polaczen]

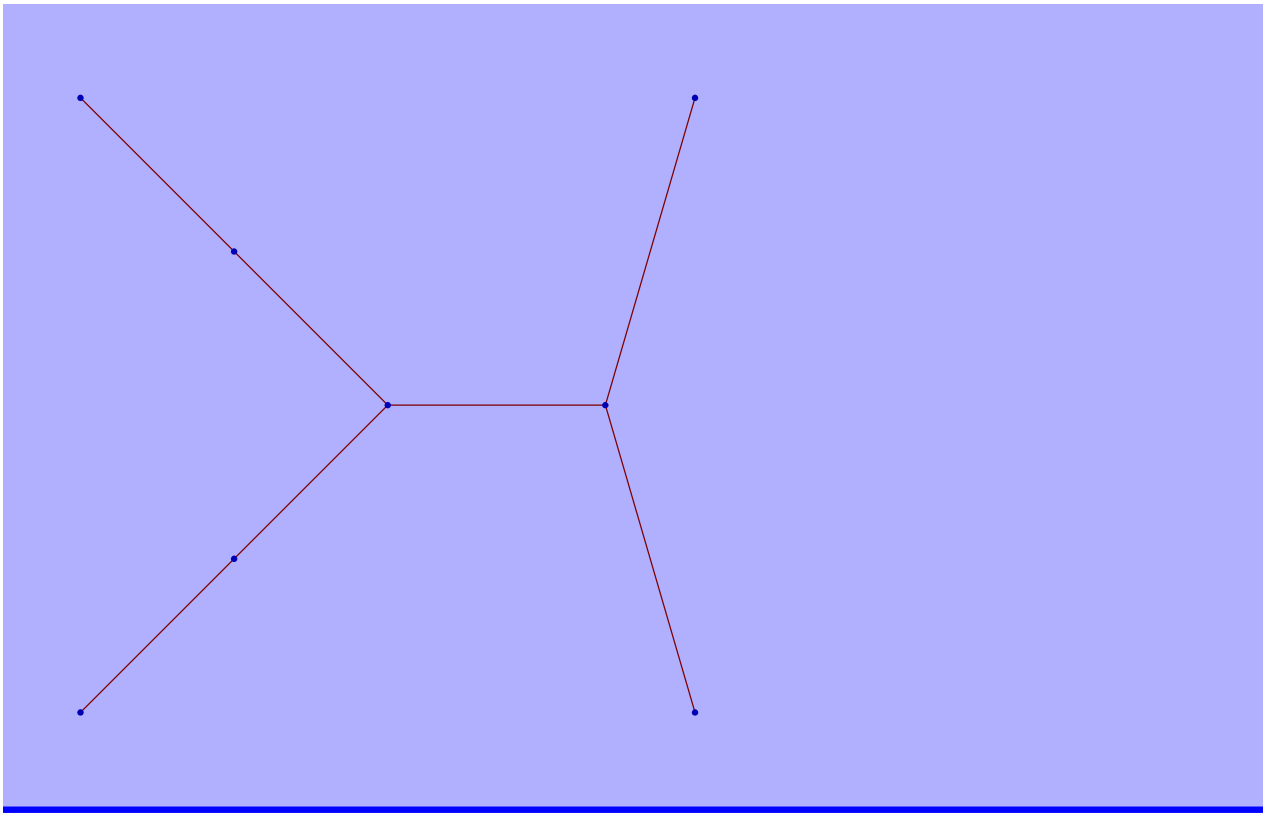
```
TreePlot[{1 → 4, 1 → 6, 1 → 8, 2 → 6, 3 → 8, 4 → 5, 7 → 8}]
```



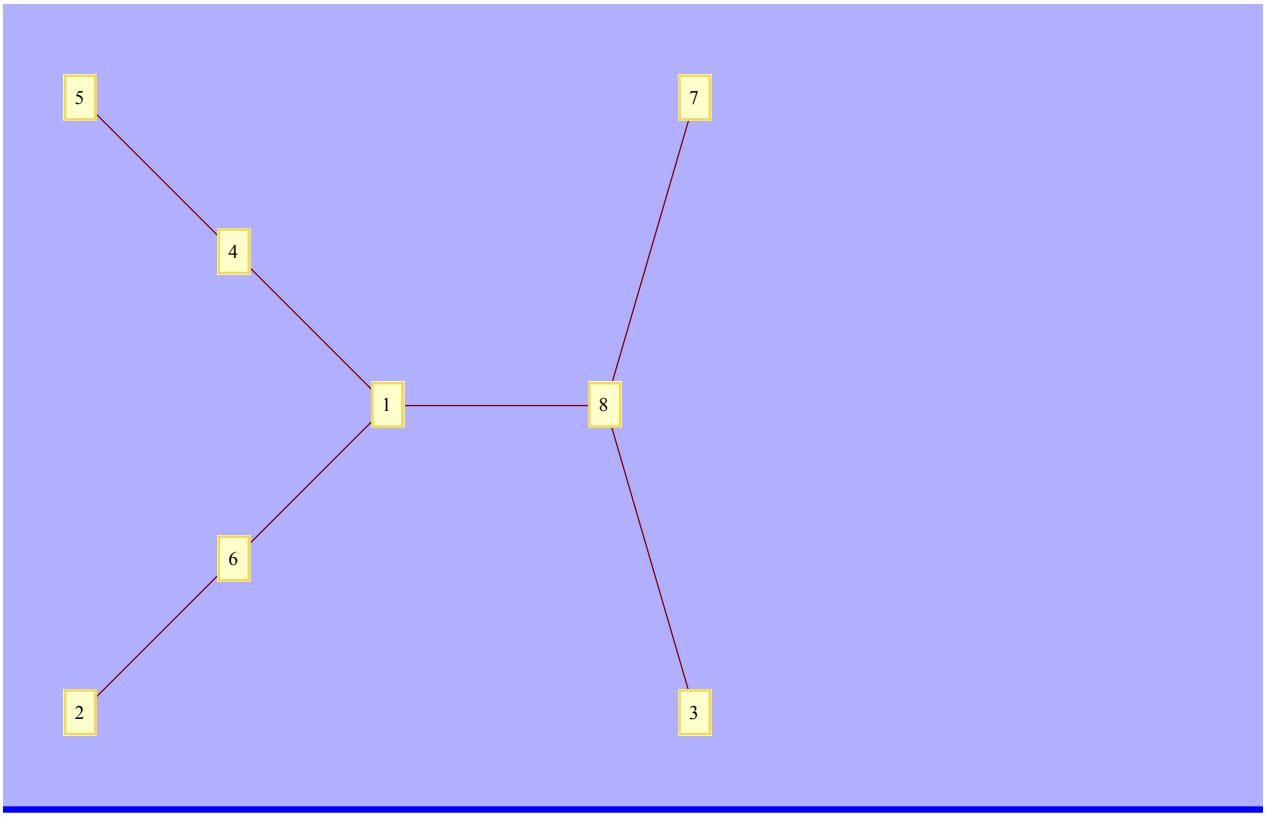
```
TreePlot[{1 → 4, 1 → 6, 1 → 8, 2 → 6, 3 → 8, 4 → 5, 7 → 8}, VertexLabeling → True]
```



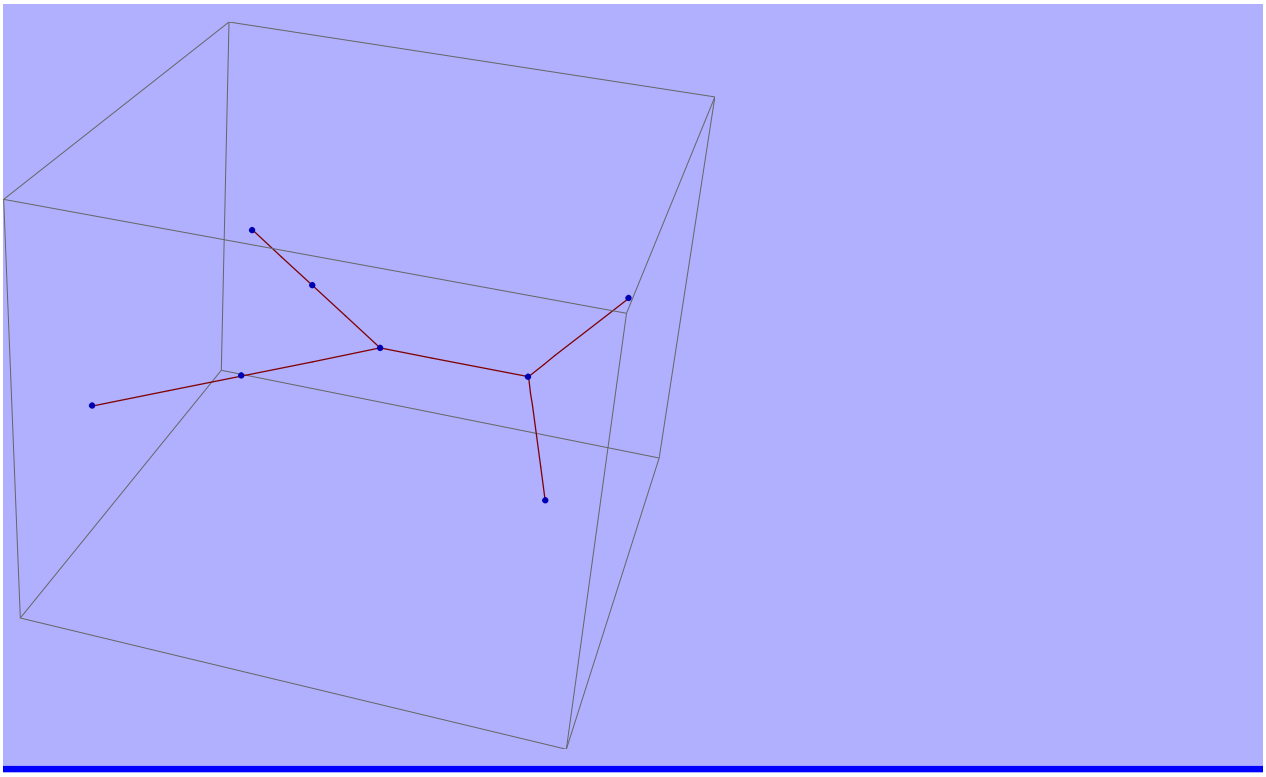
```
GraphPlot[{1 → 4, 1 → 6, 1 → 8, 2 → 6, 3 → 8, 4 → 5, 7 → 8}]
```



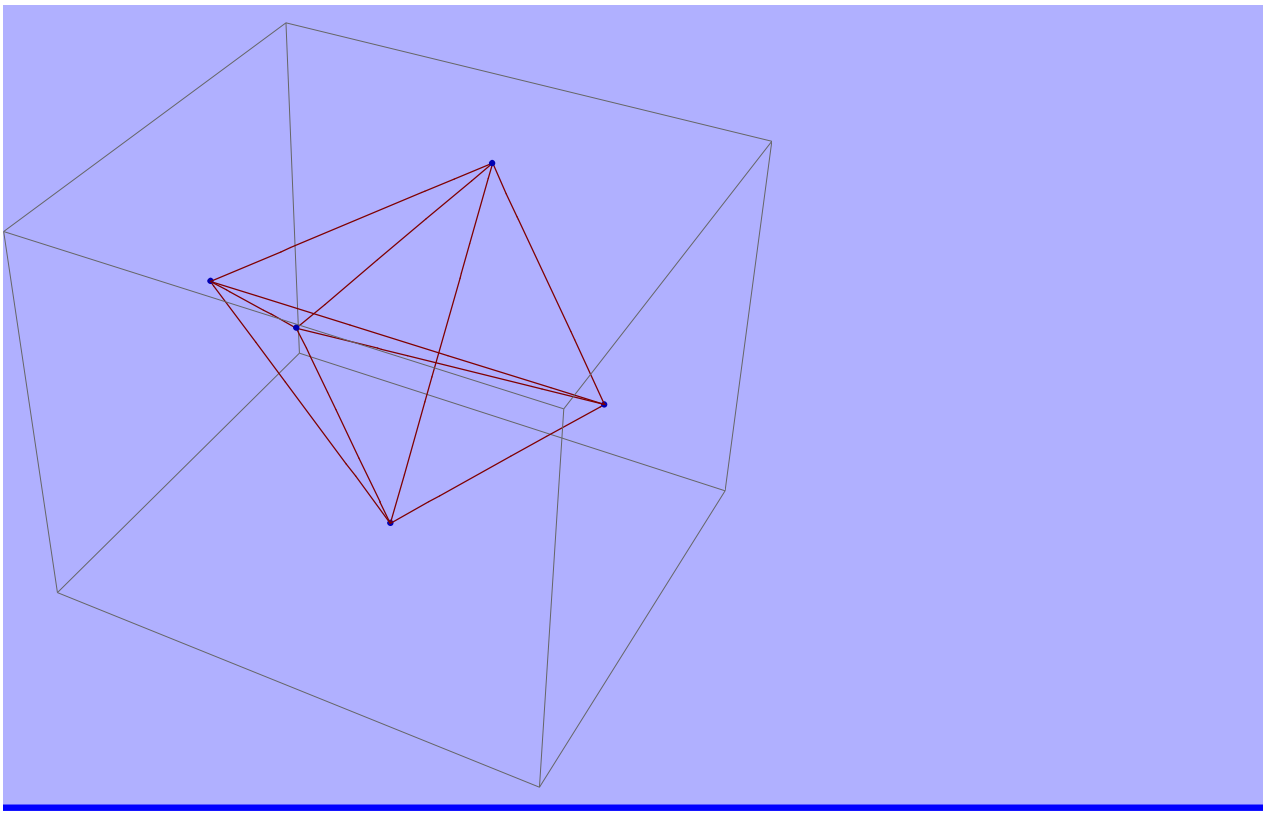
```
GraphPlot[{1 → 4, 1 → 6, 1 → 8, 2 → 6, 3 → 8, 4 → 5, 7 → 8}, VertexLabeling → True]
```



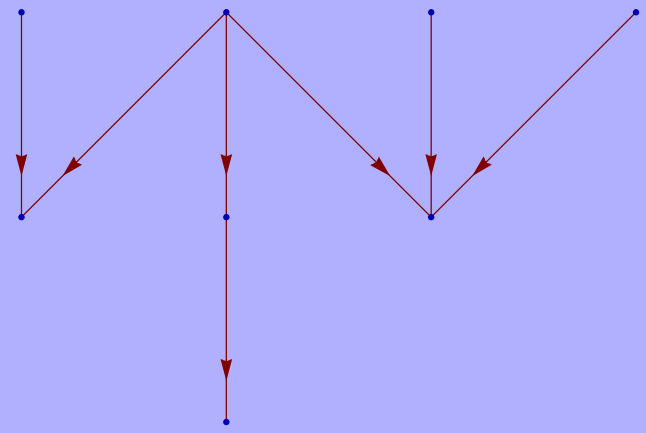
```
GraphPlot3D[{1 → 4, 1 → 6, 1 → 8, 2 → 6, 3 → 8, 4 → 5, 7 → 8}]
```



```
GraphPlot3D[{1 → 2, 1 → 3, 1 → 4, 1 → 5, 2 → 3, 2 → 4, 2 → 5, 3 → 4, 3 → 5, 4 → 5}]
```



```
LayeredGraphPlot[{1 → 4, 1 → 6, 1 → 8, 2 → 6, 3 → 8, 4 → 5, 7 → 8}]
```



```
Options[LayeredGraphPlot]
```

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 ContentSelectable → Automatic, CoordinatesToolOptions → Automatic,
 DataRange → Automatic, DirectedEdges → True, DisplayFunction :→ $DisplayFunction,
 EdgeLabeling → True, EdgeRenderingFunction → Automatic, Epilog → {},
 FormatType :→ TraditionalForm, Frame → False, FrameLabel → None,
 FrameStyle → {}, FrameTicks → None, FrameTicksStyle → {}, GridLines → None,
 GridLinesStyle → {}, ImageMargins → 0., ImagePadding → All,
 ImageSize → Automatic, ImageSizeRaw → Automatic, LabelStyle → {},
 MultiedgeStyle → Automatic, PackingMethod → Automatic, PlotLabel → None,
 PlotRange → All, PlotRangeClipping → False, PlotRangePadding → Automatic,
 PlotRegion → Automatic, PlotStyle → Automatic, PreserveImageOptions → Automatic,
 Prolog → {}, RotateLabel → True, SelfLoopStyle → Automatic,
 Ticks → Automatic, TicksStyle → {}, VertexCoordinateRules → Automatic,
 VertexLabeling → Automatic, VertexRenderingFunction → Automatic}
```

Opcje

Options[polecenie]

```
Options[Plot]
```

```
{AlignmentPoint → Center, AspectRatio → 1/GoldenRatio, Axes → True,
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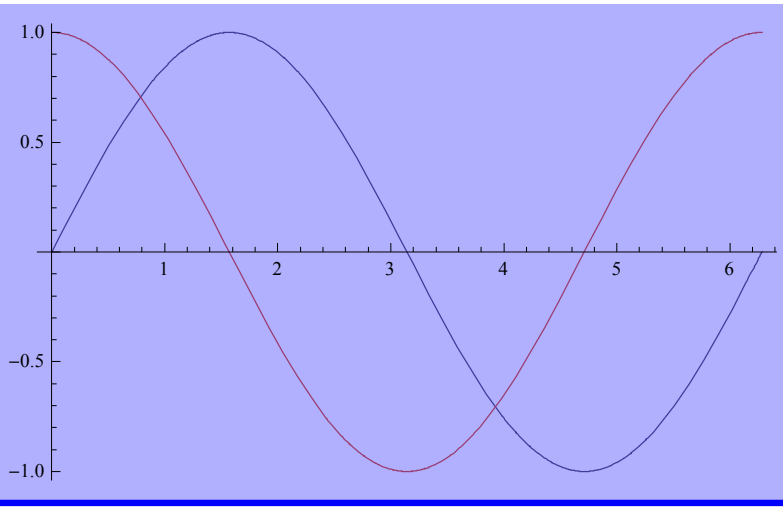
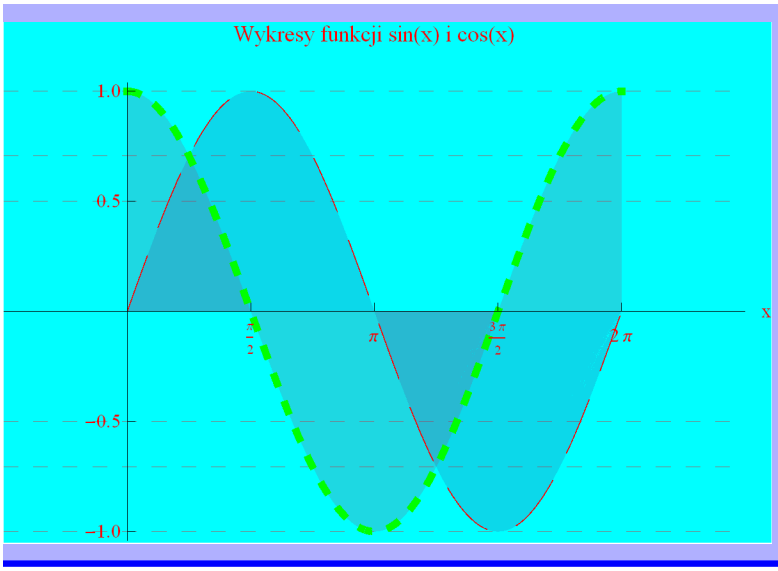
 EvaluationMonitor → None, Exclusions → Automatic, ExclusionsStyle → None,
 Filling → None, FillingStyle → Automatic, FormatType :→ TraditionalForm,
 Frame → False, FrameLabel → None, FrameStyle → {}, FrameTicks → Automatic,
 FrameTicksStyle → {}, GridLines → None, GridLinesStyle → {},
 ImageMargins → 0., ImagePadding → All, ImageSize → Automatic,
 ImageSizeRaw → Automatic, LabelStyle → {}, MaxRecursion → Automatic,
 Mesh → None, MeshFunctions → {#1 &}, MeshShading → None, MeshStyle → Automatic,
 Method → Automatic, PerformanceGoal :→ $PerformanceGoal,
 PlotLabel → None, PlotPoints → Automatic, PlotRange → {Full, Automatic},
 PlotRangeClipping → True, PlotRangePadding → Automatic, PlotRegion → Automatic,
 PlotStyle → Automatic, PreserveImageOptions → Automatic, Prolog → {},
 RegionFunction → (True &), RotateLabel → True, Ticks → Automatic,
 TicksStyle → {}, WorkingPrecision → MachinePrecision}
```

```
Plot[{Sin[x], Cos[x]}, {x, 0, 2 Pi}]
```



```
Plot[{Sin[x], Cos[x]}, {x, 0, 2 Pi},
 PlotStyle → {{RGBColor[1, 0, 0], Dashing[{0.08, 0.04}]},
   {RGBColor[0, 1, 0], Thickness[0.01], Dashing[{0.02}]}},
 PlotLabel → "Wykresy funkcji sin(x) i cos(x)", AxesLabel → {"x", ""}, Ticks →
  {Table[z, {z, 0, 2 Pi, Pi / 2}], {{-1.0, "-1.0"}, -0.5, 0.0, 0.5, {1.0, "1.0"}}},
 Background → RGBColor[0, 1, 1], Filling → Axis, PlotRange → {{-Pi / 2, 5 / 2 Pi}, All},
 GridLines → {None, {-1, -Sqrt[2] / 2, -0.5, 0.5, Sqrt[2] / 2, 1}},
 GridLinesStyle → Dashing[{0.02}], LabelStyle → RGBColor[1, 0, 0]]
```




```
Options[Plot3D]
```

```
{AlignmentPoint → Center, AspectRatio → Automatic, Axes → True, AxesEdge → Automatic,
 AxesLabel → None, AxesOrigin → Automatic, AxesStyle → {}, Background → None,
 BaselinePosition → Automatic, BaseStyle → {}, BoundaryStyle → GrayLevel[0],
 Boxed → True, BoxRatios → {1, 1, 0.4}, BoxStyle → {}, ClippingStyle → Automatic,
 ColorFunction → Automatic, ColorFunctionScaling → True, ColorOutput → Automatic,
 ContentSelectable → Automatic, ControllerLinking → Automatic,
 ControllerMethod → Automatic, ControllerPath → Automatic,
 CoordinatesToolOptions → Automatic, DisplayFunction :→ $DisplayFunction,
 Epilog → {}, Evaluated → Automatic, EvaluationMonitor → None,
 Exclusions → Automatic, ExclusionsStyle → None, FaceGrids → None,
 FaceGridsStyle → {}, Filling → None, FillingStyle → Opacity[0.5],
 FormatType :→ TraditionalForm, ImageMargins → 0., ImagePadding → All,
 ImageSize → Automatic, LabelStyle → {}, Lighting → Automatic,
 MaxRecursion → Automatic, Mesh → Automatic, MeshFunctions → {#1 &, #2 &},
 MeshShading → None, MeshStyle → Automatic, Method → Automatic,
 NormalsFunction → Automatic, PerformanceGoal :→ $PerformanceGoal,
 PlotLabel → None, PlotPoints → Automatic, PlotRange → {Full, Full, Automatic},
 PlotRangePadding → Automatic, PlotRegion → Automatic, PlotStyle → Automatic,
 PreserveImageOptions → Automatic, Prolog → {}, RegionFunction → (True &),
 RotationAction → Fit, SphericalRegion → False, Ticks → Automatic, TicksStyle → {},
 ViewAngle → Automatic, ViewCenter → Automatic, ViewMatrix → Automatic,
 ViewPoint → {1.3, -2.4, 2.}, ViewRange → All, ViewVector → Automatic,
 ViewVertical → {0, 0, 1}, WorkingPrecision → MachinePrecision}
```

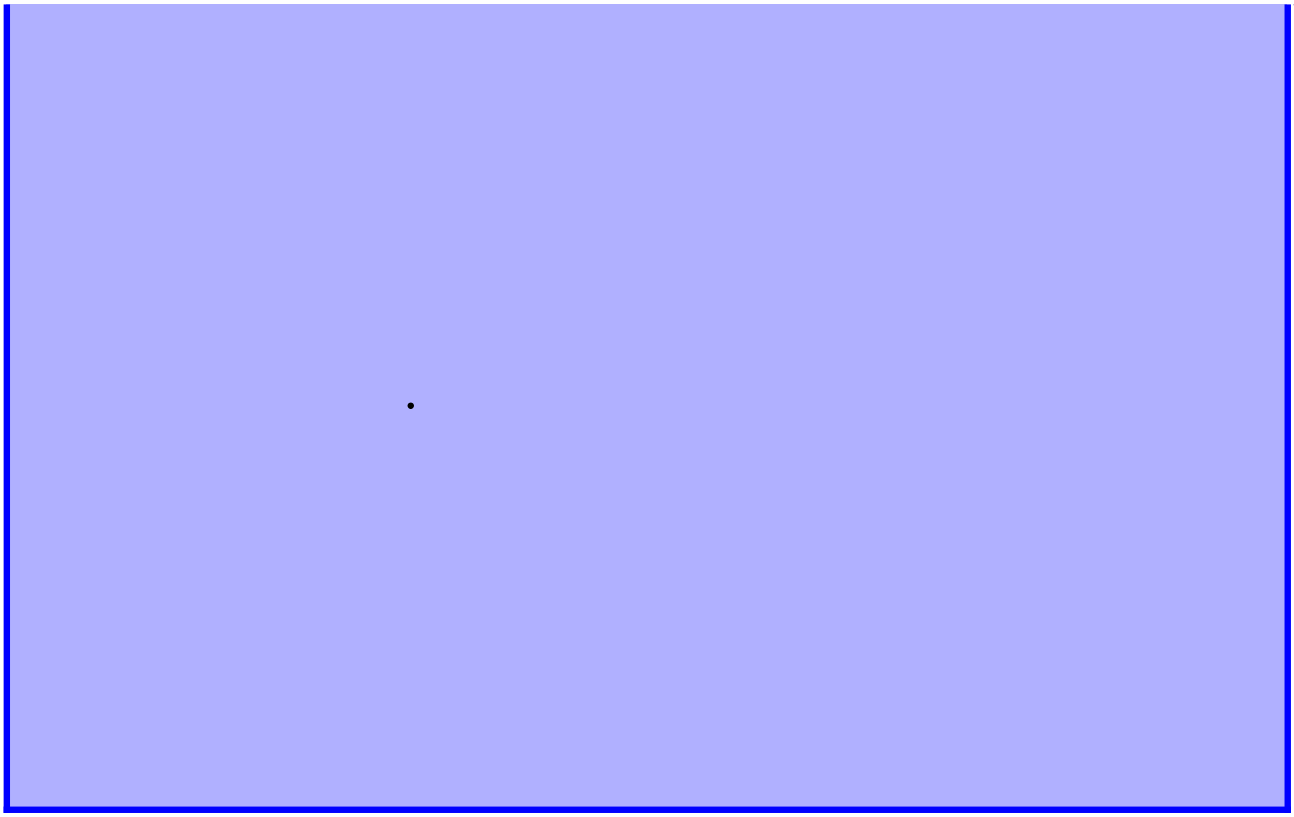
Obiekty graficzne

Graphics[lista_obiektow]
Graphics3D[lista_obiektow]

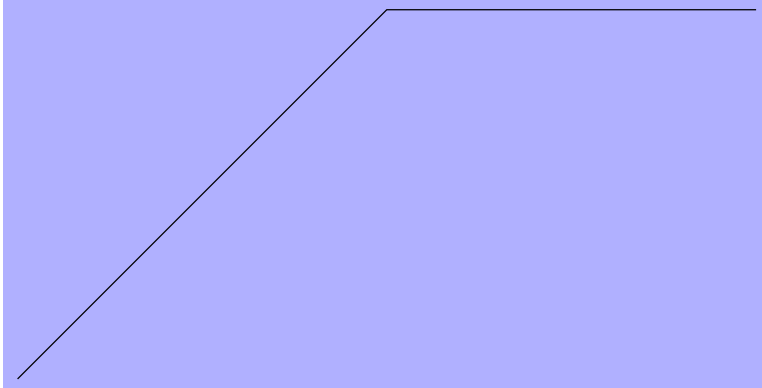
primitives (obiekty)

Point[{x,y}]
Line[{{x1,y1},...}]
Arrow[{{x1,y1},...}]
Polygon[{{x1,y1},...}]
Rectangle[{x1,y1},{x2,y2}]
Circle[{x,y},r]
Disk[{x,y},r]
BezierCurve[{{x1,y1},...}]
BSplineCurve
Text[wyrazenie,{x,y}]

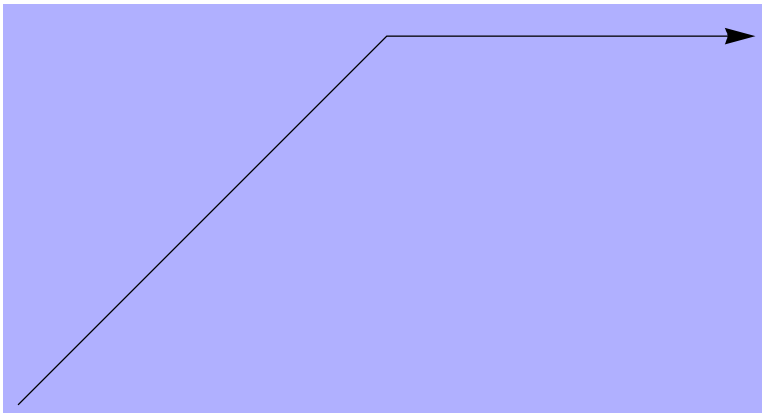
```
Graphics[Point[{0, 0}]]
```



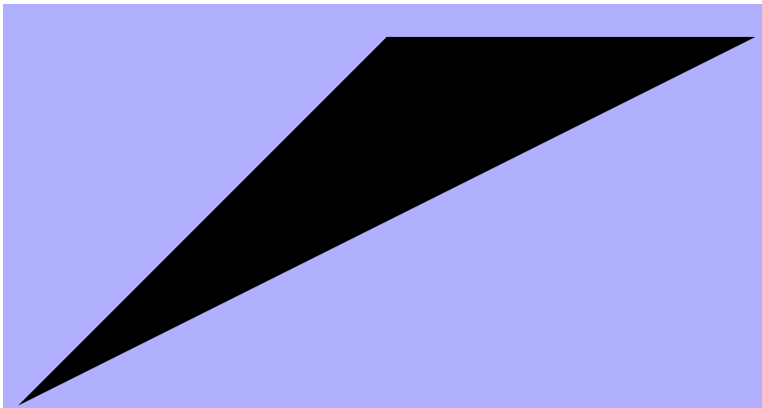
```
Graphics[Line[{{0, 0}, {1, 1}, {2, 1}}]]
```



```
Graphics[Arrow[{{0, 0}, {1, 1}, {2, 1}}]]
```

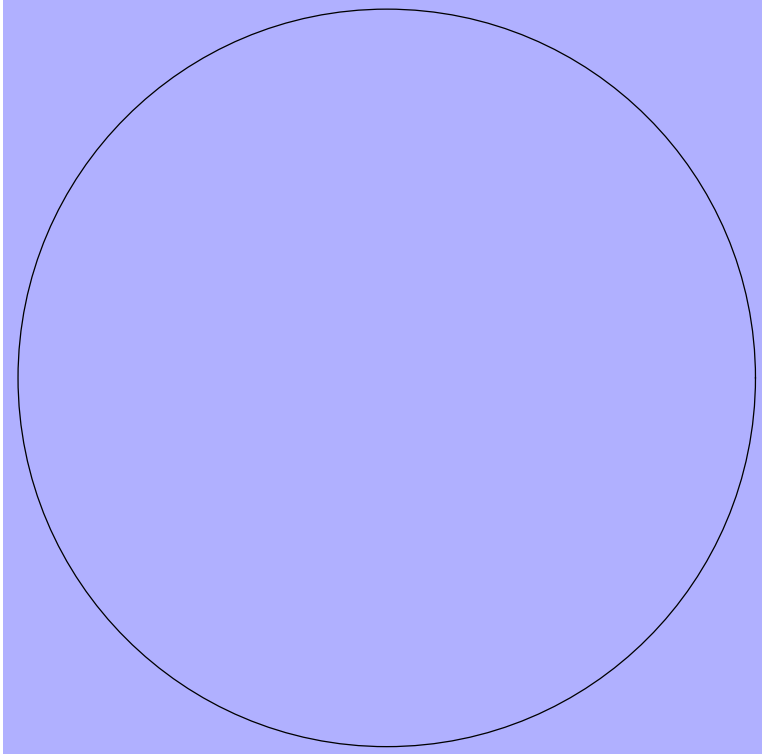


```
Graphics[Polygon[{{0, 0}, {1, 1}, {2, 1}}]]
```

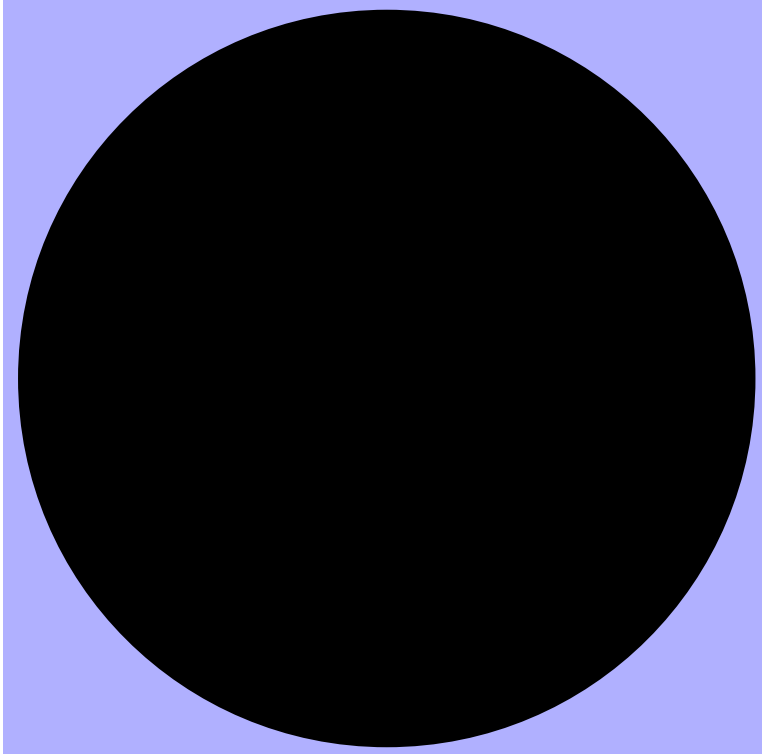


```
Graphics[Rectangle[{0, 0}, {2, 1}]]
```

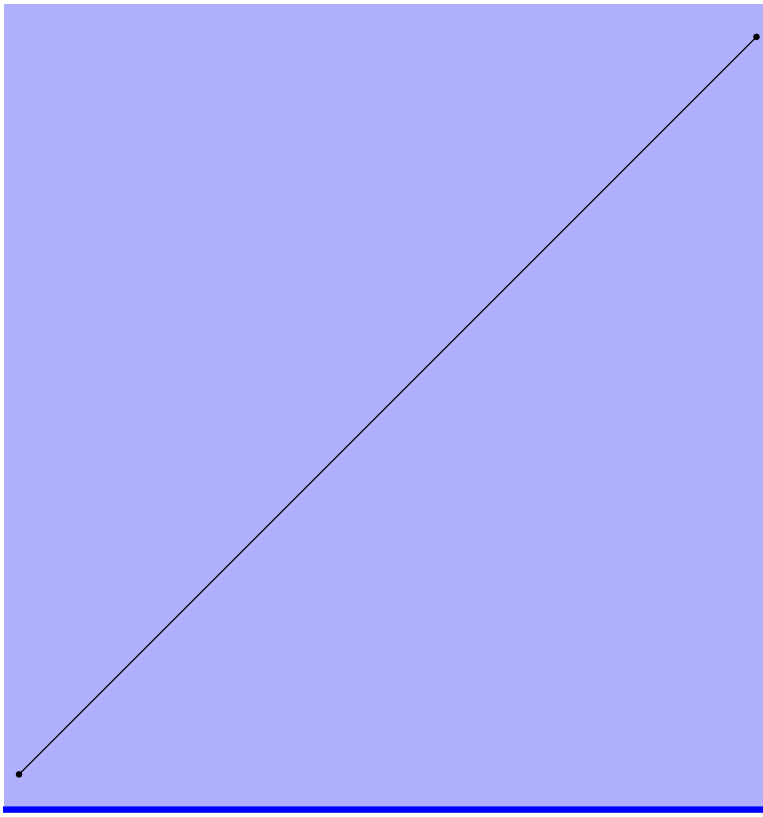
```
Graphics[Circle[{0, 0}, 1]]
```



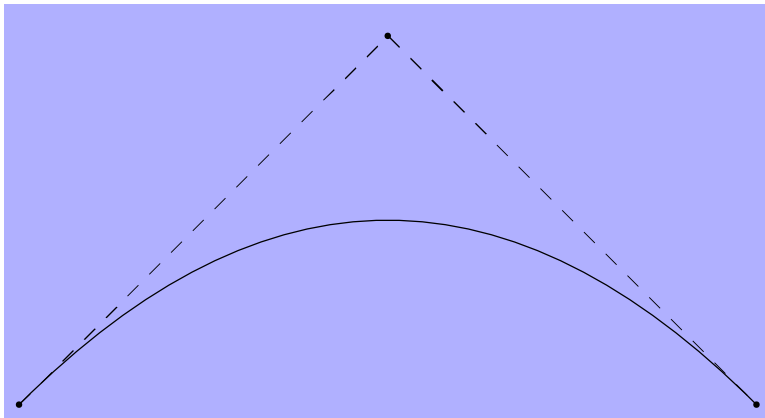
```
Graphics[Disk[{0, 0}, 1]]
```



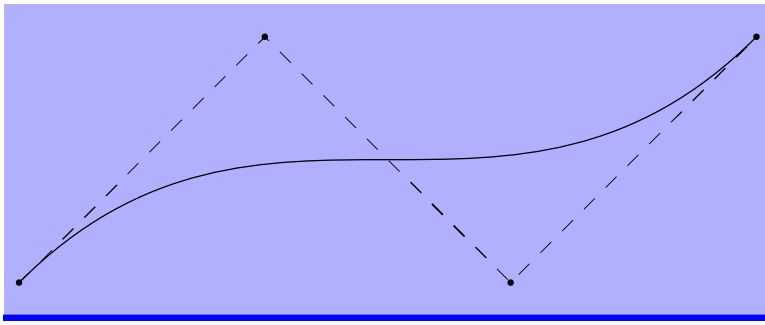
```
pt = {{0, 0}, {1, 1}}; Graphics[{BezierCurve[pt], Point[pt]}]
```



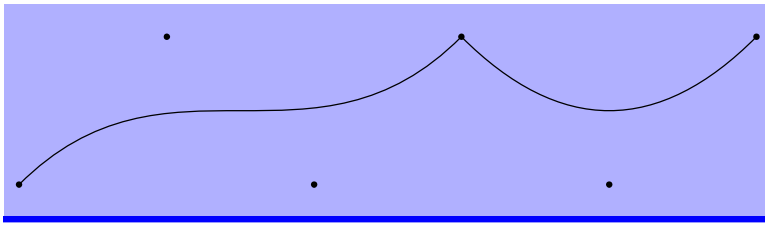
```
pt = {{0, 0}, {1, 1}, {2, 0}};
Graphics[{BezierCurve[pt], Point[pt], Dashing[{0.02}], Line[pt]}]
```



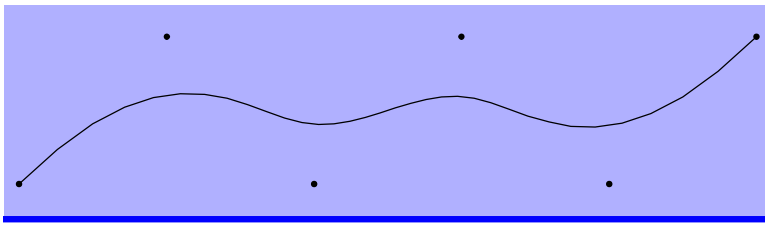
```
pt = {{0, 0}, {1, 1}, {2, 0}, {3, 1}};
Graphics[{BezierCurve[pt], Point[pt], Dashing[{0.02}], Line[pt]}]
```



```
pt = {{0, 0}, {1, 1}, {2, 0}, {3, 1}, {4, 0}, {5, 1}};
Graphics[{BezierCurve[pt], Point[pt], Dashing[{0.02}], Line[pt]}]
```



```
pt = {{0, 0}, {1, 1}, {2, 0}, {3, 1}, {4, 0}, {5, 1}};
Graphics[{BSplineCurve[pt], Point[pt], Dashing[{0.02}], Line[pt]}]
```



```
Graphics[{Text[2 + x^2 + 5 x, {0, 0}], Point[{0, 0}]}]
```

colors

White
Black
Gray - LightGray
Red - LightRed
Green - LightGreen
Blue - LightBlue
Cyan - LightCyan
Magenta - LightMagenta
Yellow - LightYellow
Brown - LightBrown
Orange - LightOrange
Pink - LightPink
Purple - LightPurple

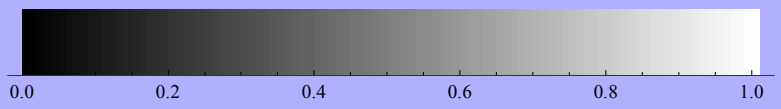
directives (parametry)

GrayLevel[n]

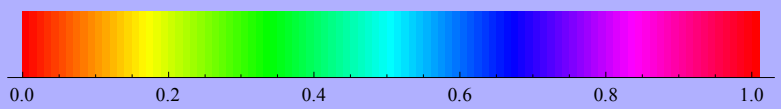
Hue[h]
RGBColor[r,g,b]
CMYKColor[c,m,y,k]
Opacity[a]
PointSize[d]
Thicknes[d]
Dashing[{d1,...}]
AbsolutePointSize[d]
AbsoluteThicknes[d]
AbsoluteDashing[{d1,...}]

Directive[g1,...]
Arrowheads[spec]
CapForm[spec]
EdgeForm[g]
FaceForm[g]
JoinForm[spec]

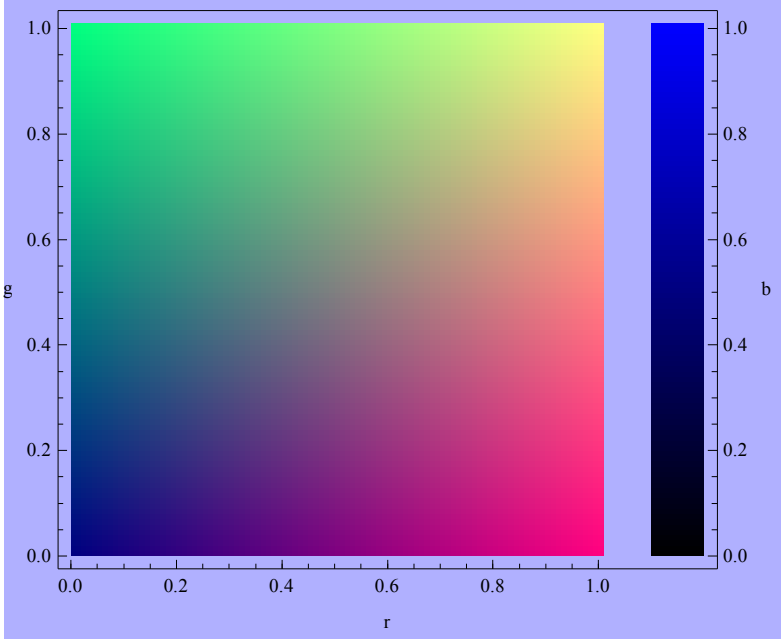
```
d = 0.01;
Graphics[Table[{GrayLevel[i], Polygon[{{i, 0}, {i + d, 0}, {i + d, 1}, {i, 1}}]},
  {i, 0, 1, d}], AspectRatio → 0.125, Axes → {True, False}]
```



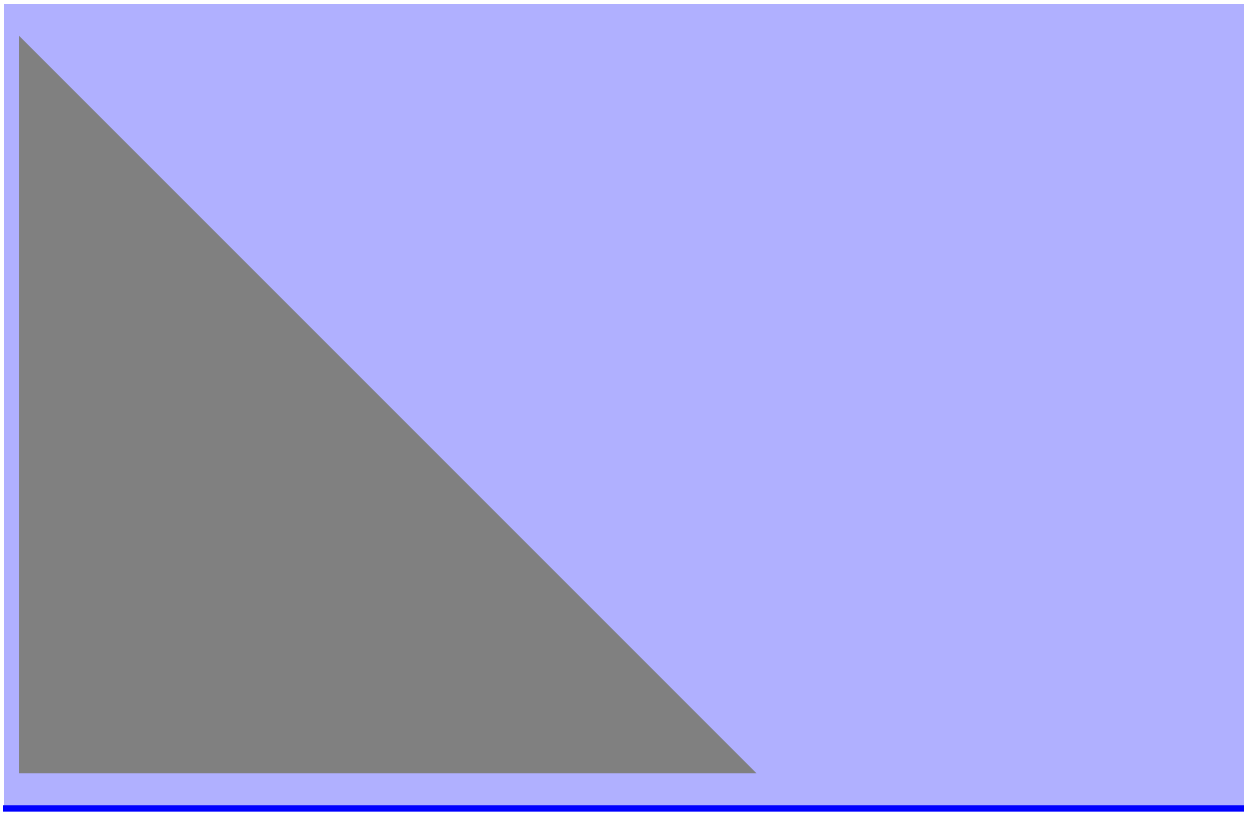

```
d = 0.01;
Graphics[Table[{Hue[i], Polygon[{{i, 0}, {i + d, 0}, {i + d, 1}, {i, 1}}]},
  {i, 0, 1, d}], AspectRatio → 0.125, Axes → {True, False}]
```



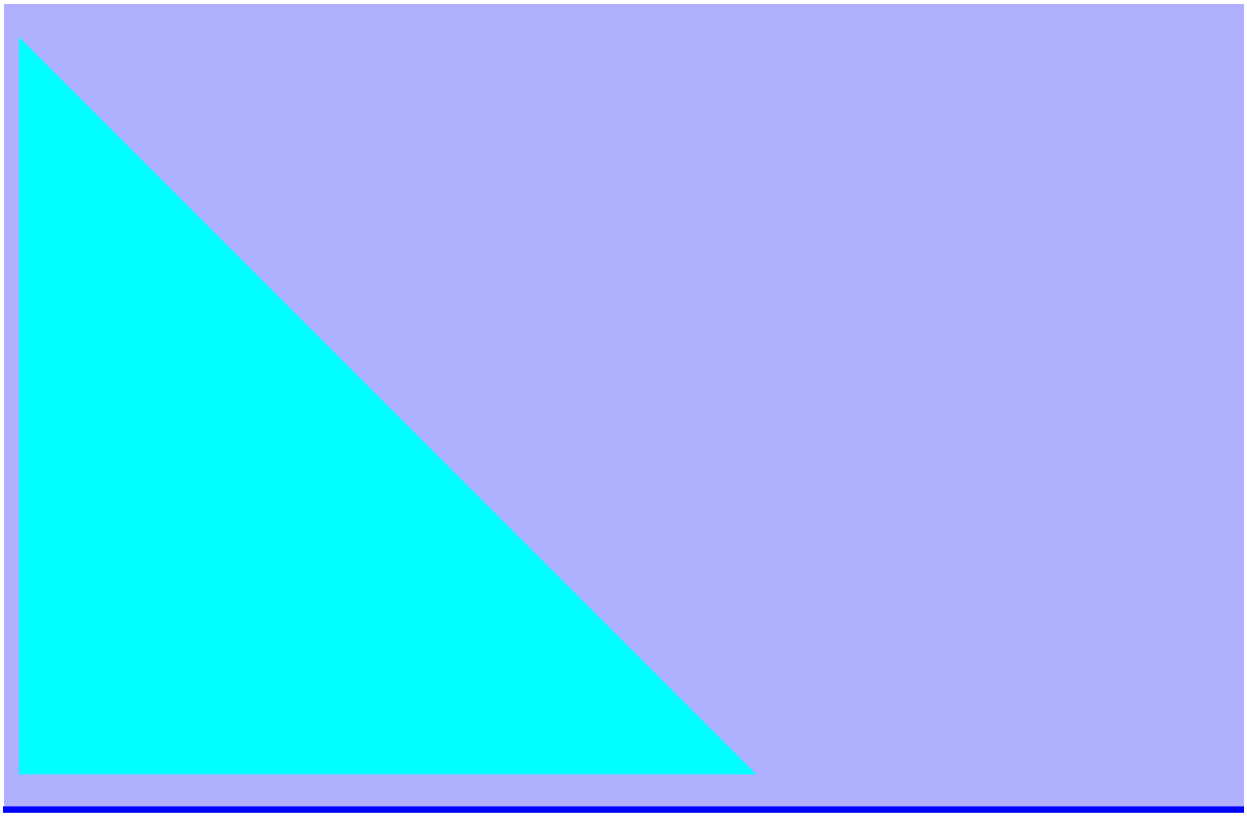
```
d = 0.01;
Graphics[{Table[{RGBColor[r, g, 0.5],
    Polygon[{{r, g}, {r + d, g}, {r + d, g + d}, {r, g + d}}]},
   {r, 0, 1, d}, {g, 0, 1, d}], Table[{RGBColor[0, 0, b],
    Polygon[{{1.1, b}, {1.2, b}, {1.2, b + d}, {1.1, b + d}}]},
   {b, 0, 1, d}]}, Frame → True, FrameLabel → {"r", "g", "", "b"},
 FrameTicks → {{All, All}, {Join[Table[{i, "", {0.008, 0}}, {i, 0, 1, 0.05}], Table[
      {i, NumberForm[i, {1, 1}]}, {i, 0, 1, 0.2}]], None}}, RotateLabel → False]
```



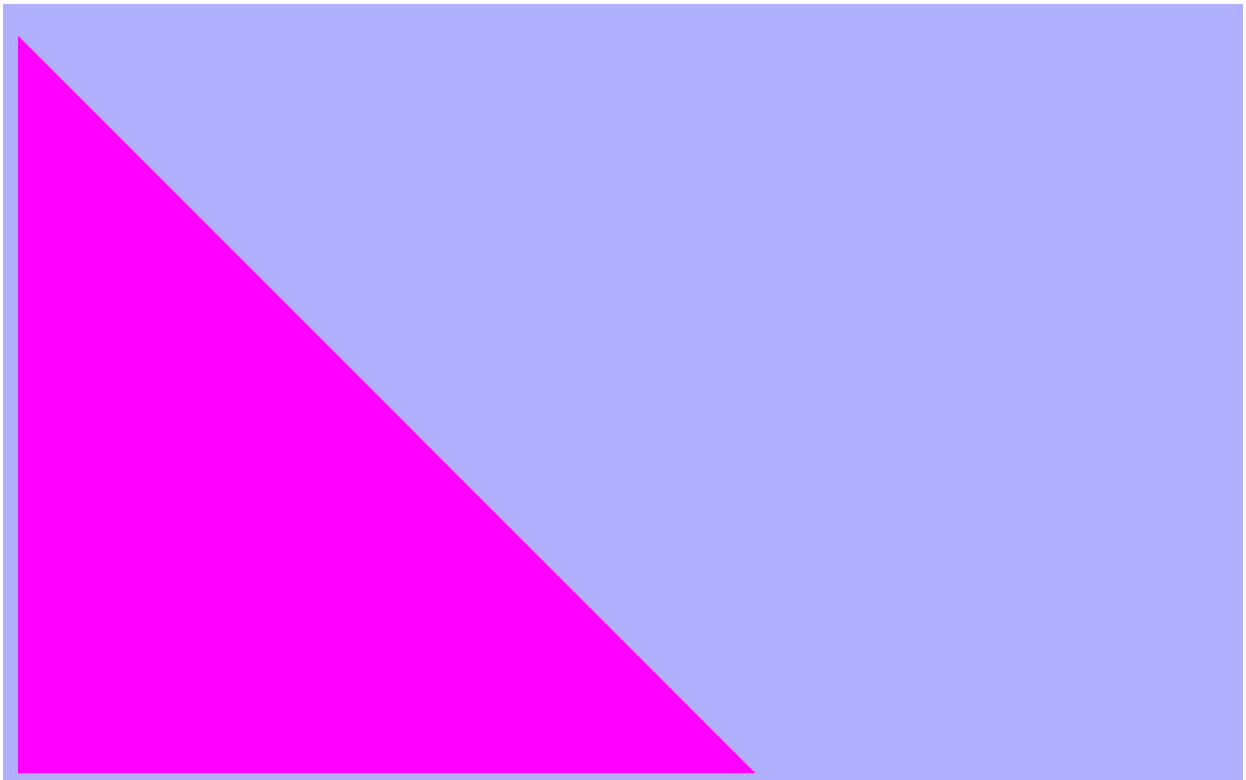
```
Graphics[{GrayLevel[0.5], Polygon[{{0, 0}, {1, 0}, {0, 1}}]}]
```



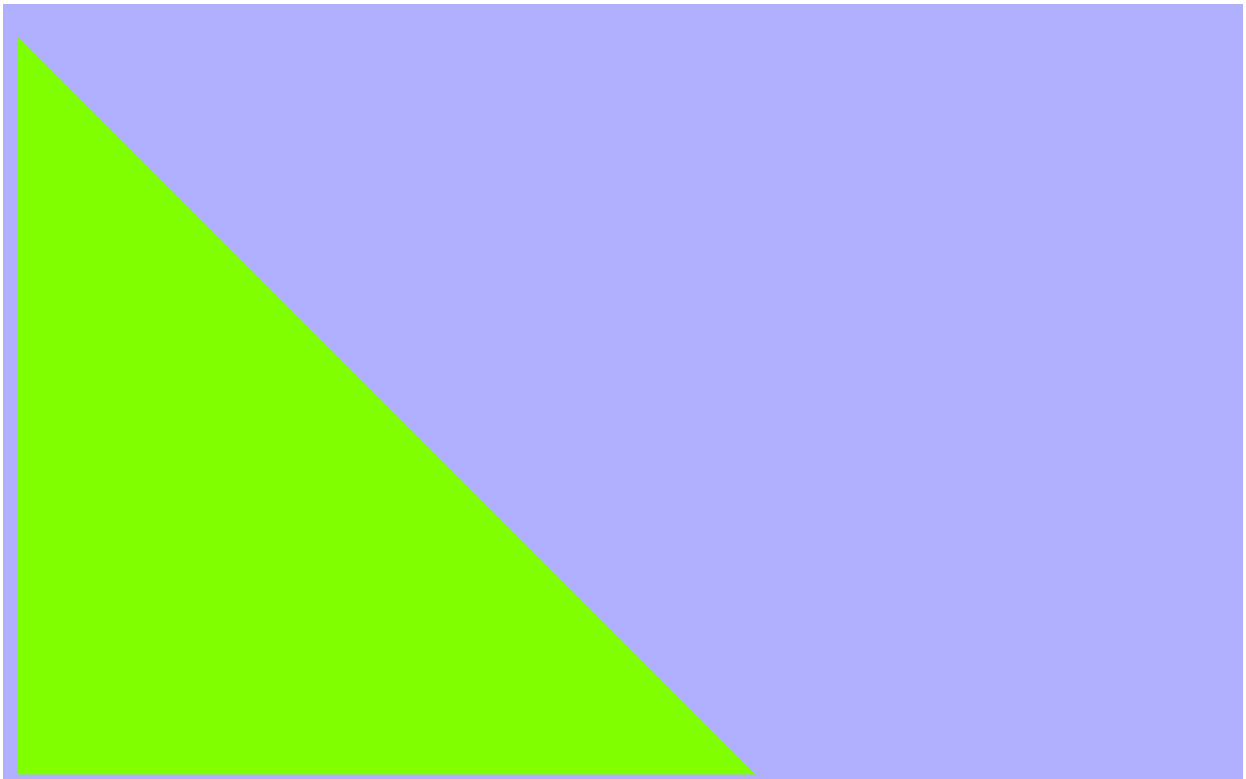
```
Graphics[{Hue[0.5], Polygon[{{0, 0}, {1, 0}, {0, 1}}]}]
```



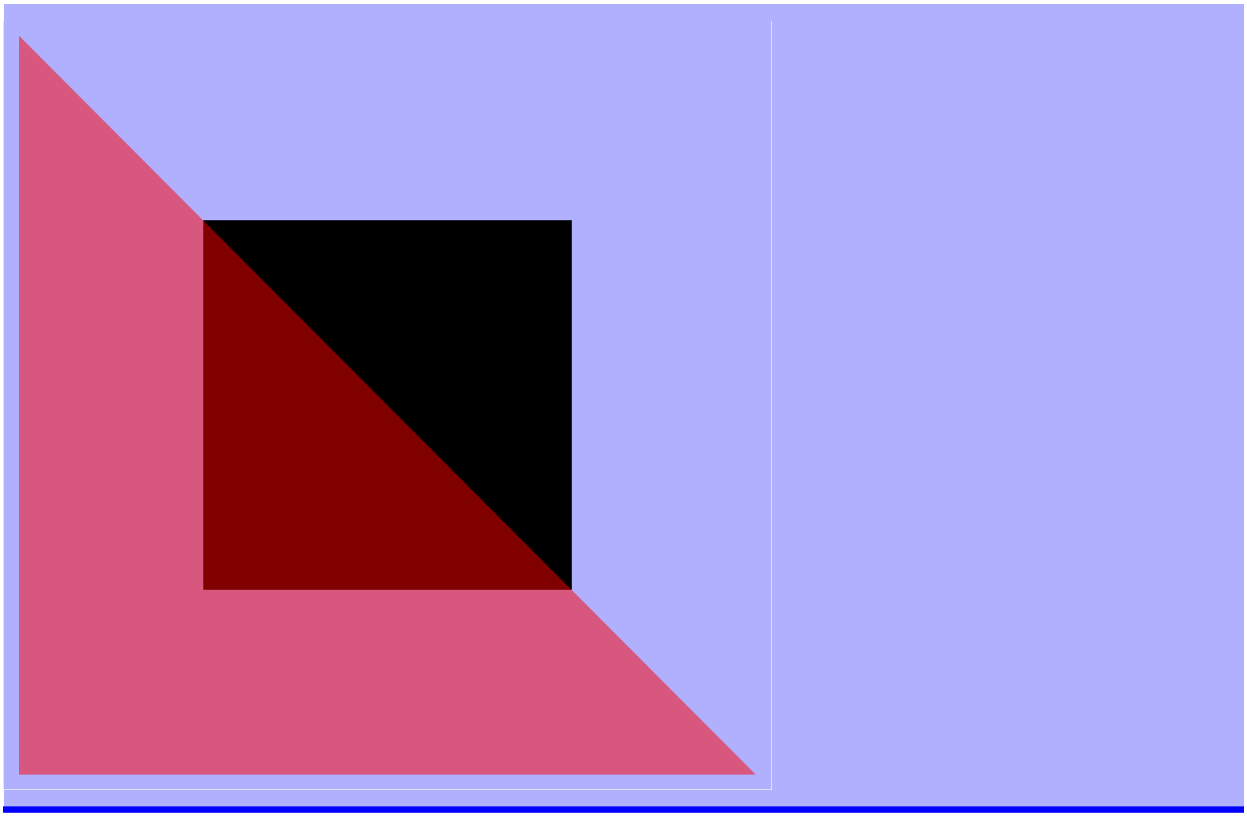
```
Graphics[{RGBColor[1, 0, 1], Polygon[{{0, 0}, {1, 0}, {0, 1}}]}]
```



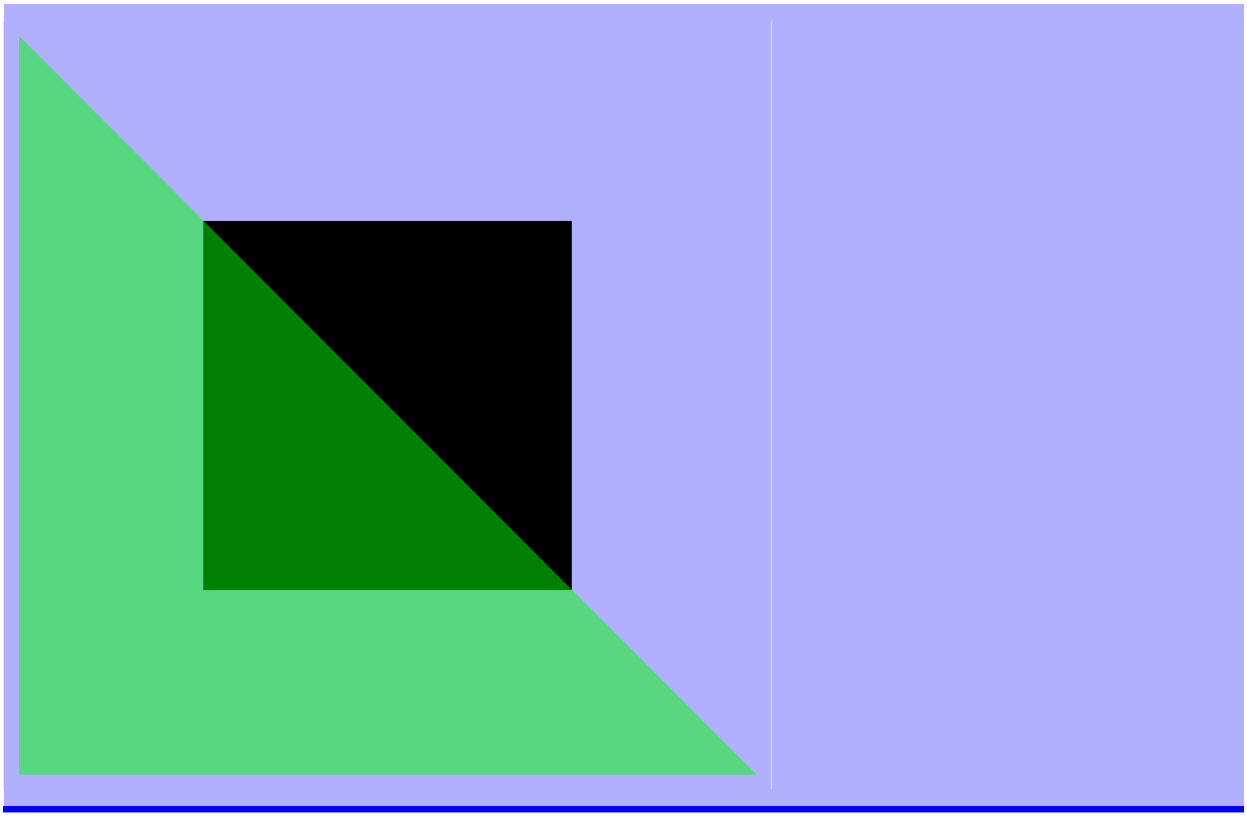
```
Graphics[{CMYKColor[0.5, 0, 1, 0], Polygon[{{0, 0}, {1, 0}, {0, 1}}]}]
```



```
Graphics[{Rectangle[{0.25, 0.25}, {0.75, 0.75}],
  RGBColor[1, 0, 0], Opacity[0.5], Polygon[{{0, 0}, {1, 0}, {0, 1}}]}]
```

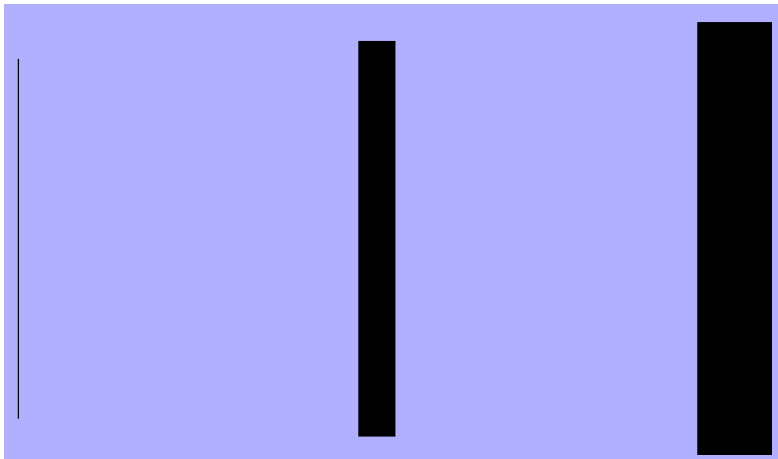


```
Graphics[{Rectangle[{0.25, 0.25}, {0.75, 0.75}],
  Opacity[0.5, RGBColor[0, 1, 0]], Polygon[{{0, 0}, {1, 0}, {0, 1}}]}]
```

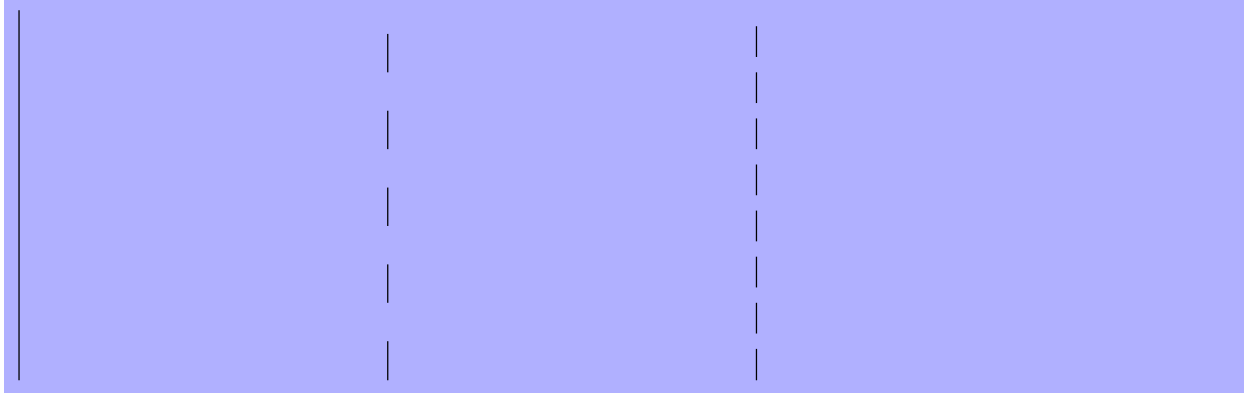


```
Graphics[
 {Point[{0, 0}], PointSize[0.05], Point[{1, 0}], PointSize[0.1], Point[{2, 0}]}]
```

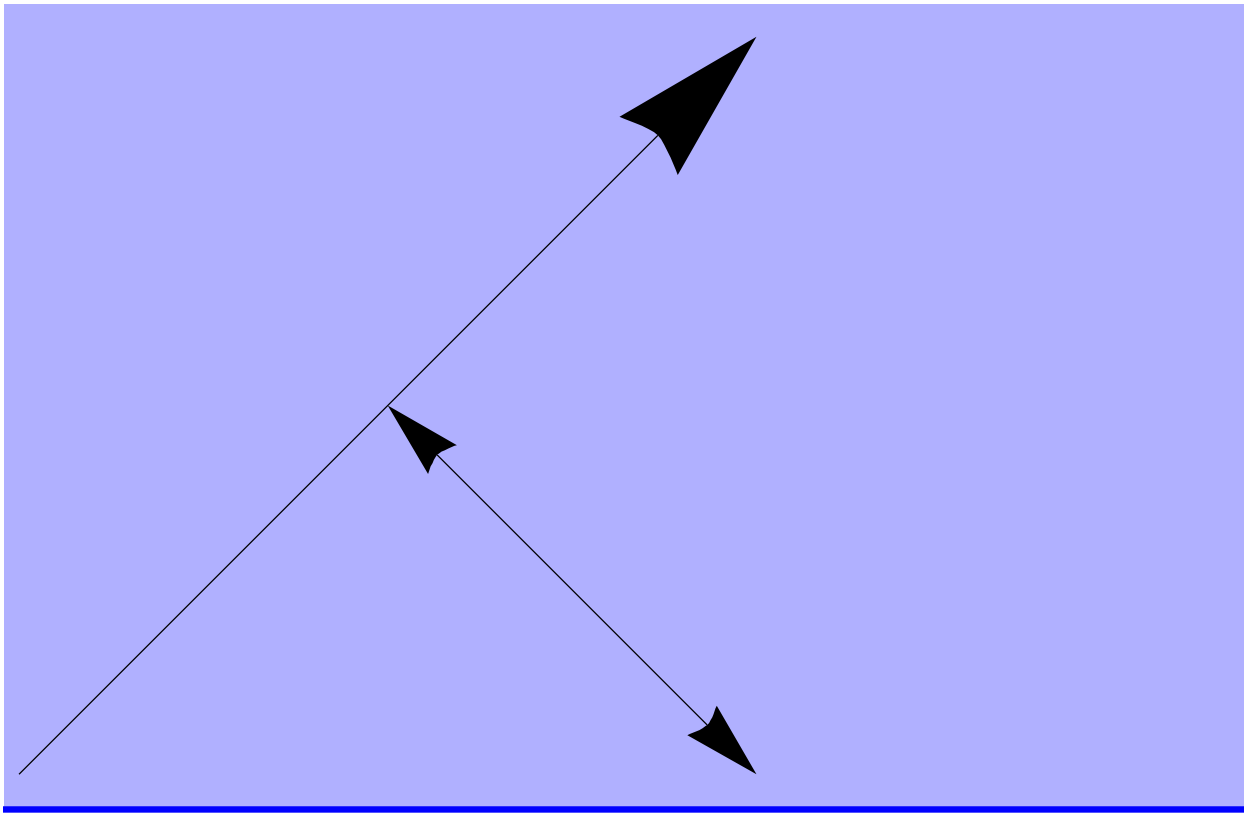
```
Graphics[{Line[{{0, 0}, {0, 1}}], Thickness[0.05],
  Line[{{1, 0}, {1, 1}}], Thickness[0.1], Line[{{2, 0}, {2, 1}}]}]
```



```
Graphics[{Line[{{0, 0}, {0, 1}}], Dashing[{0.05}],
  Line[{{1, 0}, {1, 1}}], Dashing[{0.04, 0.02}], Line[{{2, 0}, {2, 1}}]}]
```

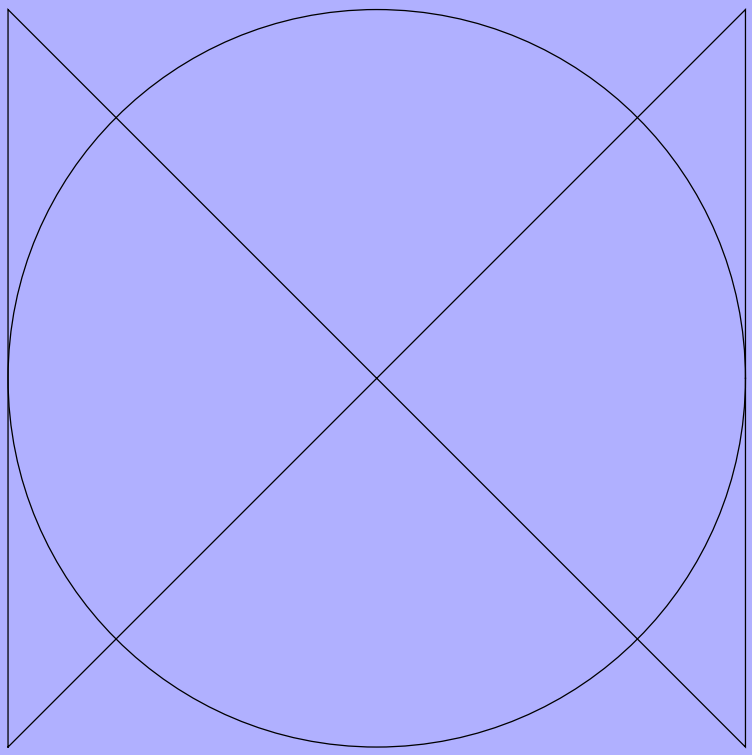


```
Graphics[{Arrowheads[.2], Arrow[{{0, 0}, {1, 1}}],
  Arrowheads[{-0.1, 0.1}], Arrow[{{1, 0}, {1 / 2, 1 / 2}}]}]
```

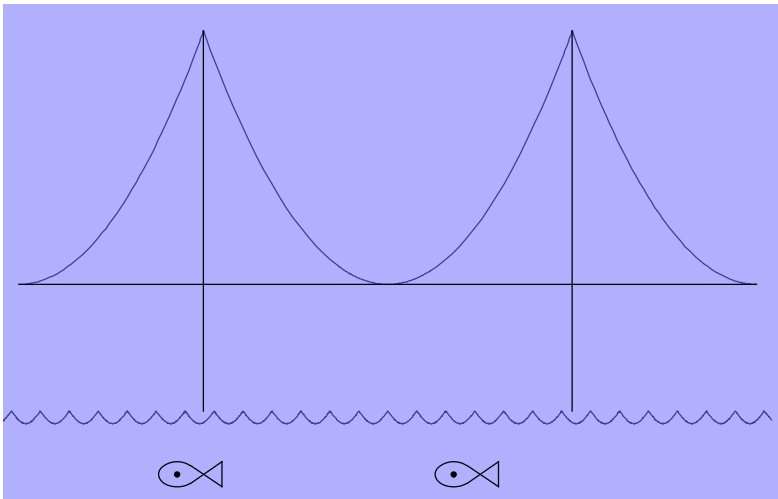


Show[obiekt]

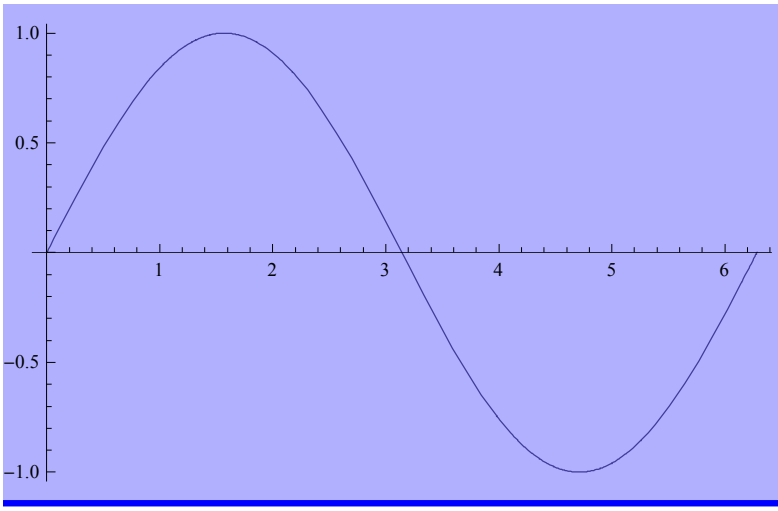
```
p = Graphics[Circle[{0, 0}, 1]];
q = Graphics[Line[{{-1, -1}, {1, 1}, {1, -1}, {-1, 1}, {-1, -1}}]];
Show[p, q]
```



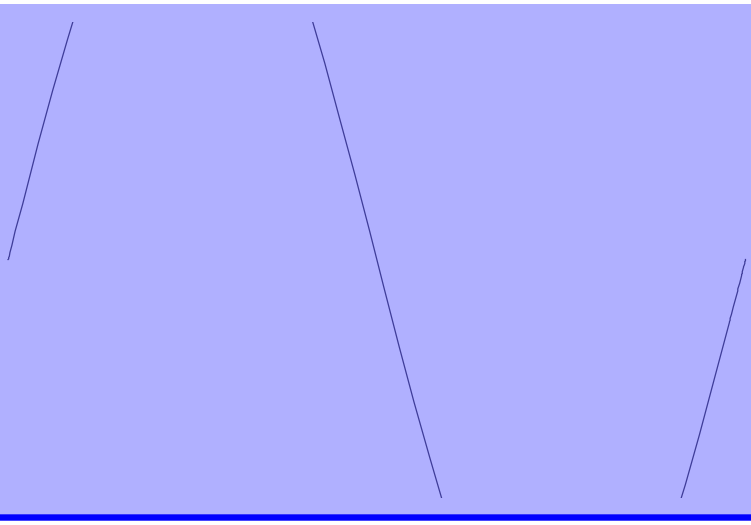
```
Clear[p];
p1 = Plot[x^2, {x, -2, 2}];
p2 = Plot[(x - 4)^2, {x, 2, 4}];
p3 = Plot[(x + 4)^2, {x, -4, -2}];
p4 = Plot[-2 - Abs[Sin[10 x] / 5], {x, -5, 5}];
p5 = Graphics[
   {Line[{{-2, -2}, {-2, 4}}], Line[{{2, -2}, {2, 4}}], Line[{{-4, 0}, {4, 0}}]}];
p[x_] := Graphics[{Line[{{x + 0.2, -3.2}, {x - 0.14, -2.86}}],
    Line[{{x + 0.2, -2.8}, {x - 0.14, -3.14}}], Point[{x - 0.286, -3}],
    Circle[{x - 0.286, -3}, 0.2, {Pi / 4, 7 Pi / 4}],
    Line[{{x + 0.2, -3.2}, {x + 0.2, -2.8}}]}];
Show[p1, p2, p3, p4, p5, p[-2], p[1], PlotRange → {{-4, 4}, All}, Axes → False]
```



```
w = Plot[Sin[x], {x, 0, 2 Pi}]
```

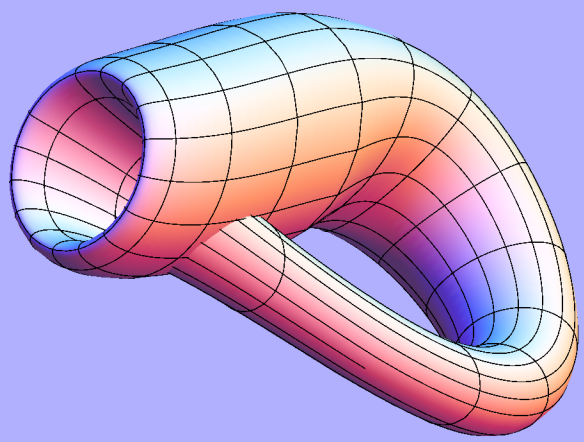


```
Show[w, PlotRange → {-0.5, 0.5}, Axes → False]
```

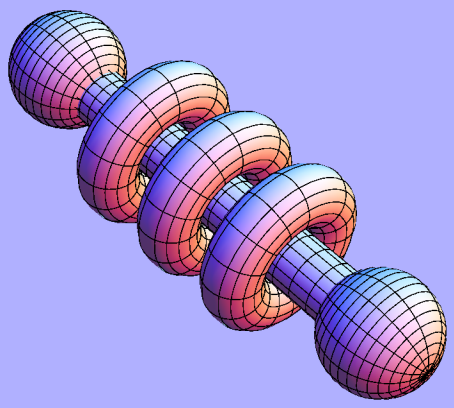


Przyklady

```
bx = 6 Cos[u] (1 + Sin[u]);
by = 16 Sin[u];
rad = 4 (1 - Cos[u] / 2);
X = If[Pi < u ≤ 2 Pi, bx + rad Cos[v + Pi], bx + rad Cos[u] Cos[v]];
Y = If[Pi < u ≤ 2 Pi, by, by + rad Sin[u] Cos[v]];
Z = rad Sin[v];
ParametricPlot3D[{X, Y, Z}, {u, 0, 2 Pi},
 {v, 0, 2 Pi}, PlotPoints → {48, 12}, Axes → False, Boxed → False]
```



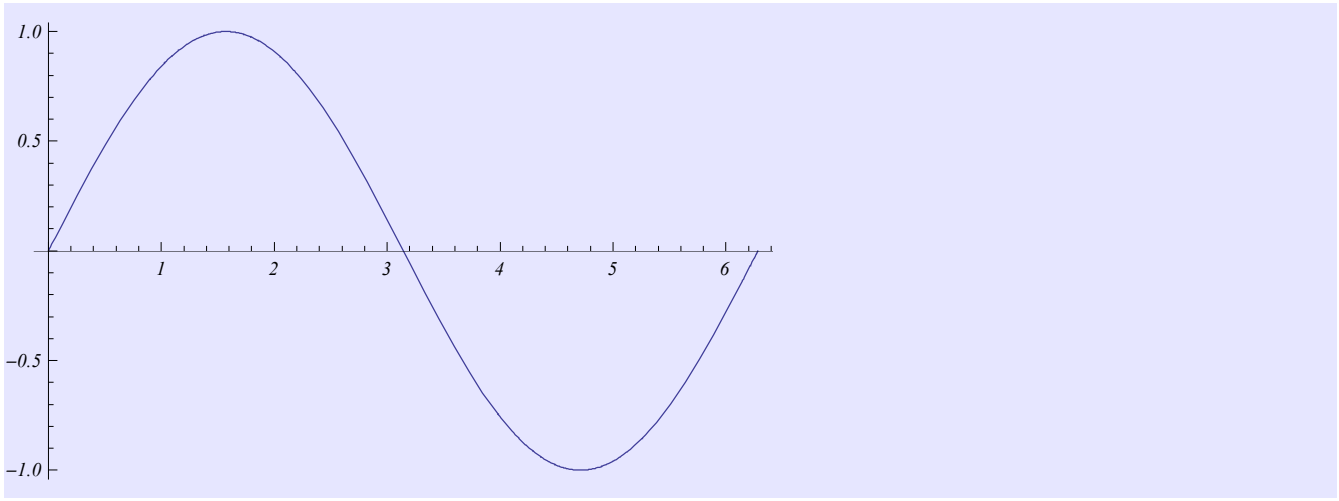
```
p1r = ParametricPlot3D[
    {-3 + Sin[p], Sin[t] (2 + Cos[p]), Cos[t] (2 + Cos[p])}, {t, 0, 2 Pi}, {p, 0, 2 Pi}];
p1g = ParametricPlot3D[{Sin[p], Sin[t] (2 + Cos[p]), Cos[t] (2 + Cos[p])},
    {t, 0, 2 Pi}, {p, 0, 2 Pi}];
p1b = ParametricPlot3D[{3 + Sin[p], Sin[t] (2 + Cos[p]), Cos[t] (2 + Cos[p])},
    {t, 0, 2 Pi}, {p, 0, 2 Pi}];
p2 = ParametricPlot3D[{u, Cos[t], Sin[t]}, {t, 0, 2 Pi}, {u, -6, 6}];
p5a = ParametricPlot3D[
    {7.5 + 2 Sin[p], 2 Sin[t] Cos[p], 2 Cos[t] Cos[p]}, {t, 0, 2 Pi}, {p, -Pi / 3, Pi / 2}];
p5b = ParametricPlot3D[{-7.5 + 2 Sin[p], 2 Sin[t] Cos[p], 2 Cos[t] Cos[p]},
    {t, 0, 2 Pi}, {p, Pi / 2, -Pi / 3}];
Show[p1r, p1g, p1b, p2, p5a, p5b, Axes → False, Boxed → False, PlotRange → {-6, 6}]
```

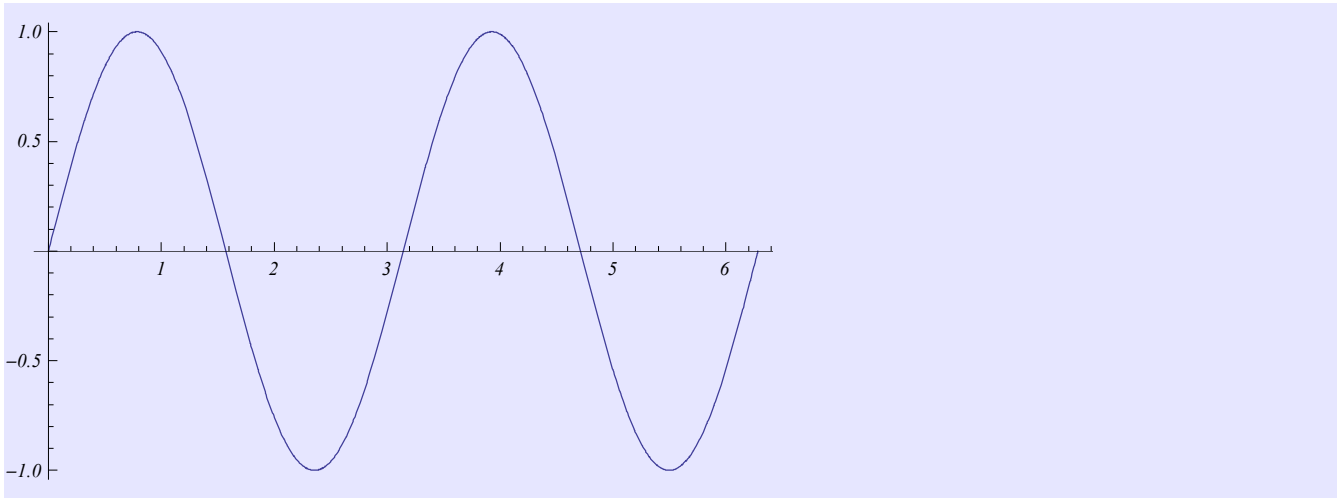


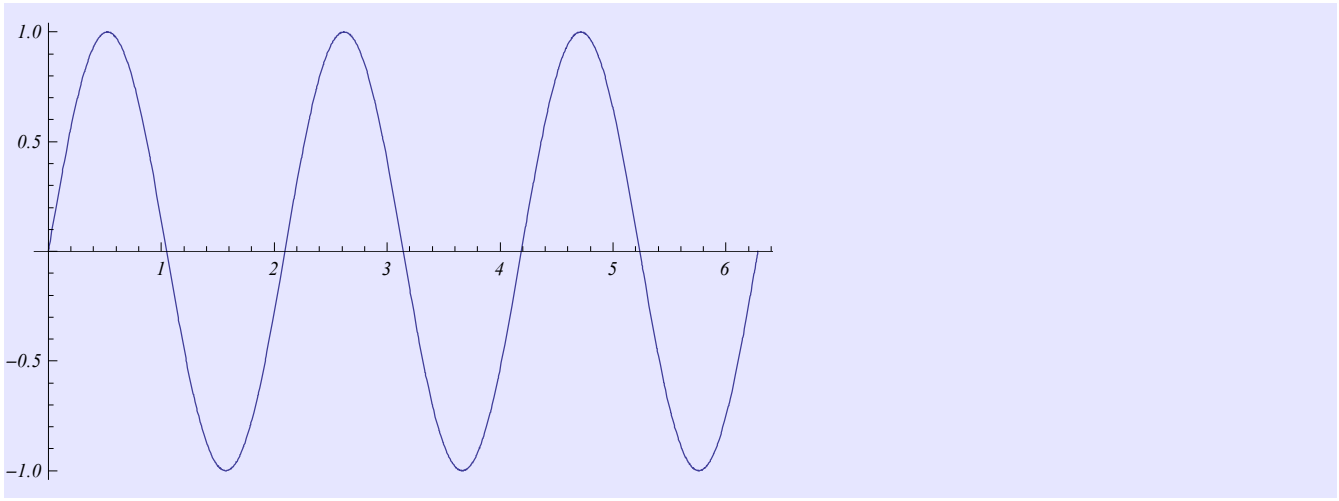
Animacje

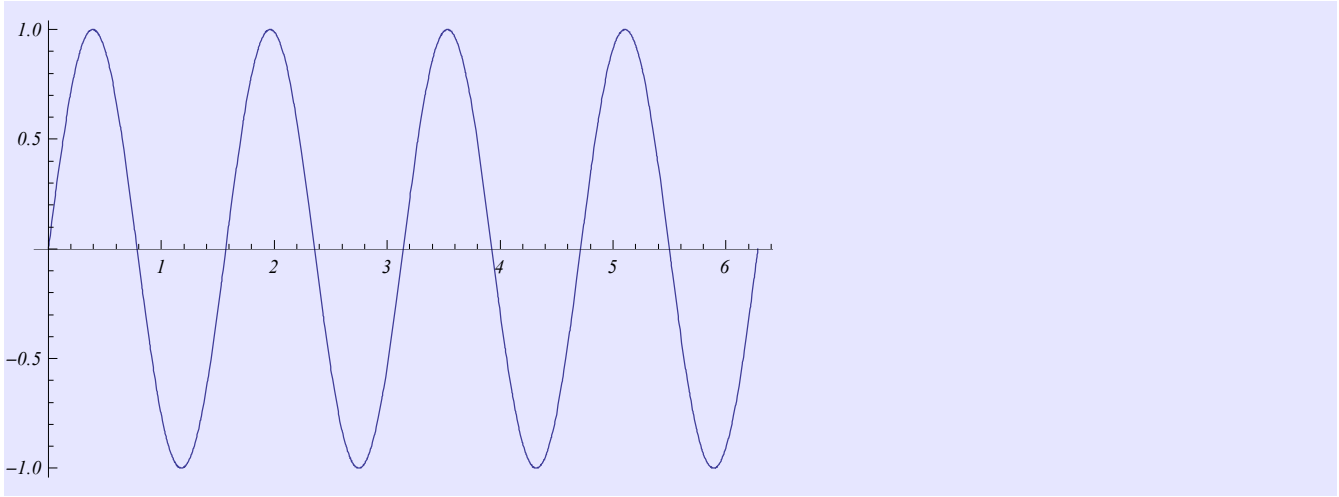
Animate[wyrazenie,iterator}
ListAnimate[{lista}]
Manipulate[wyrazenie,iterator]

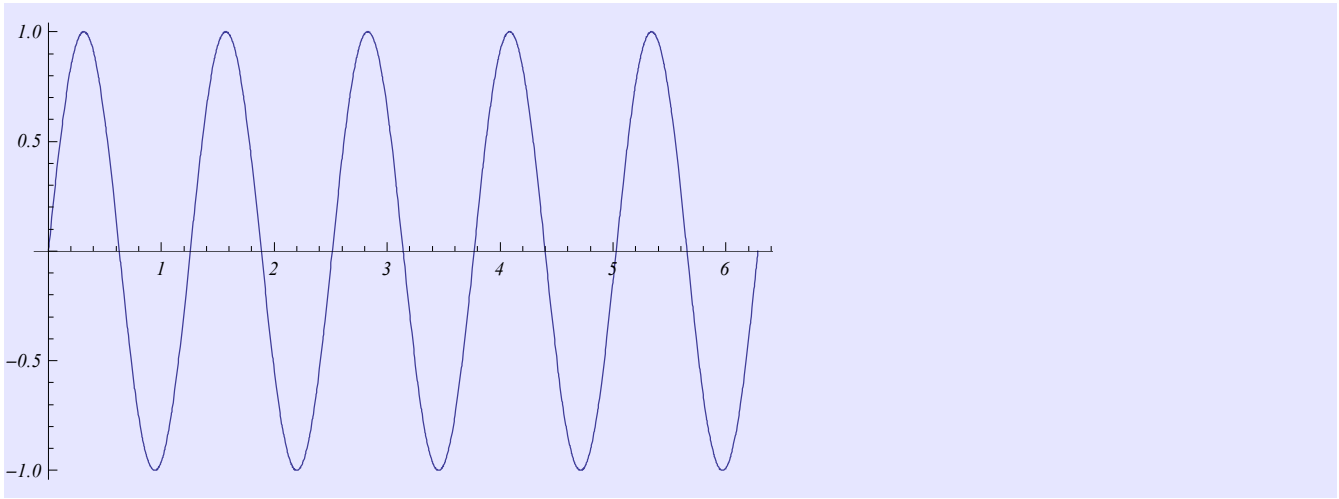
```
Do[Print[Plot[Sin[t x], {x, 0, 2 Pi}]], {t, 1, 20}]
```

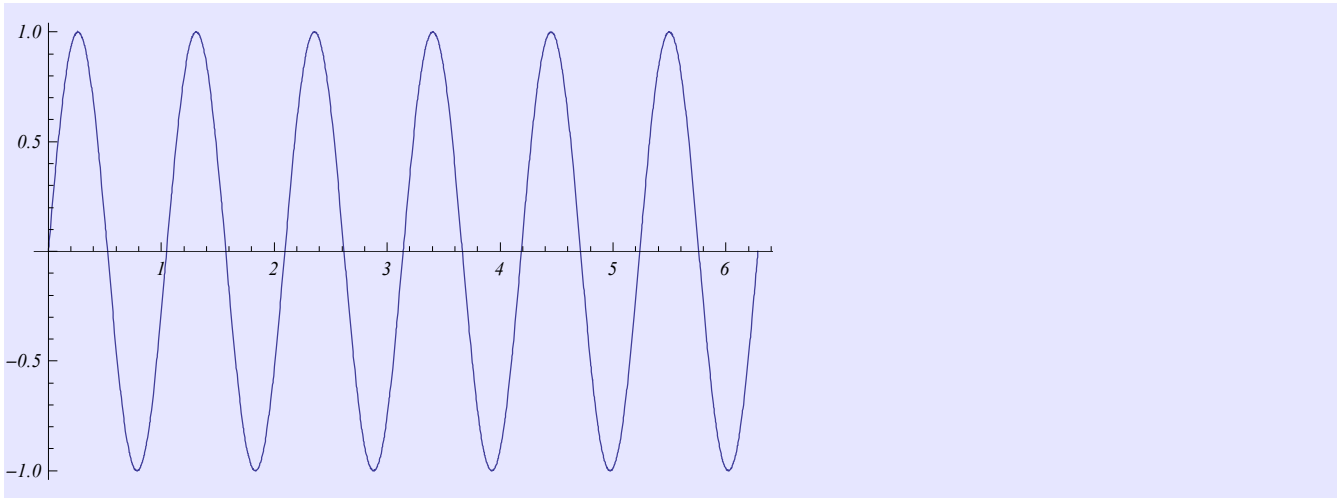

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

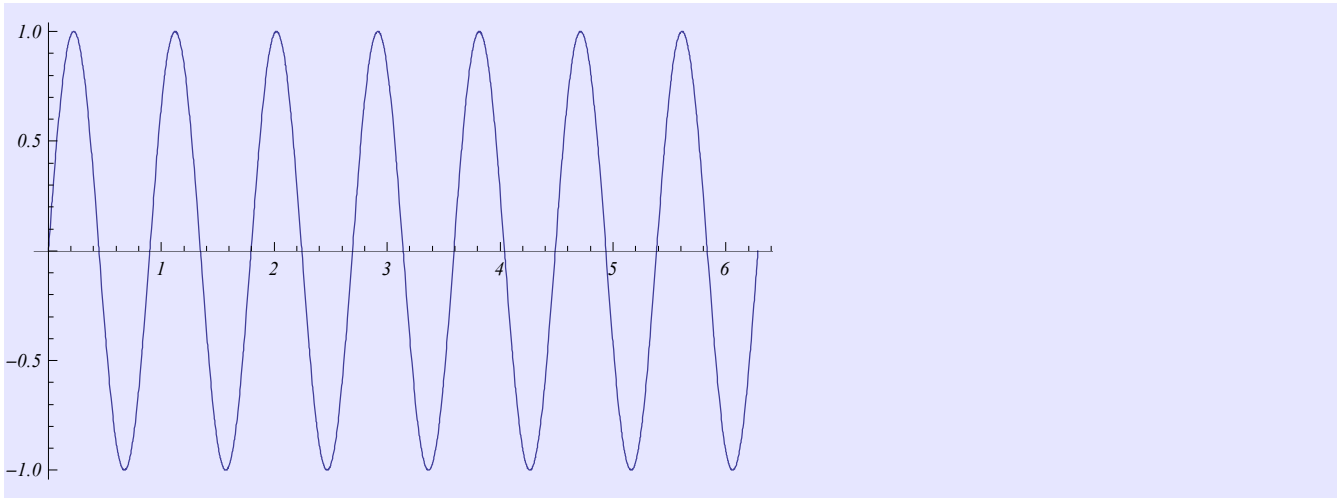

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

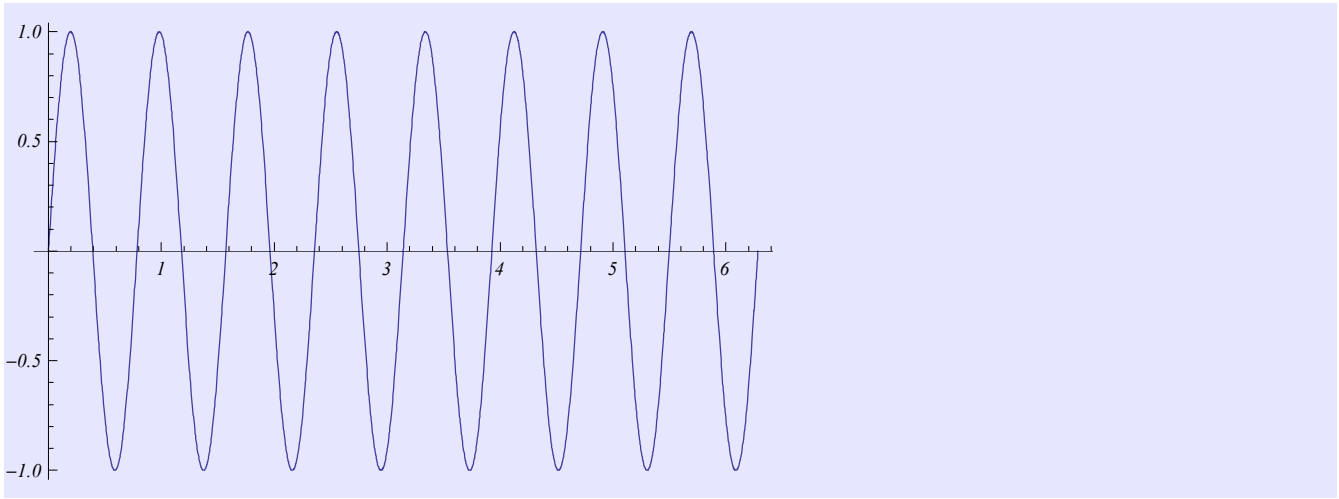

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

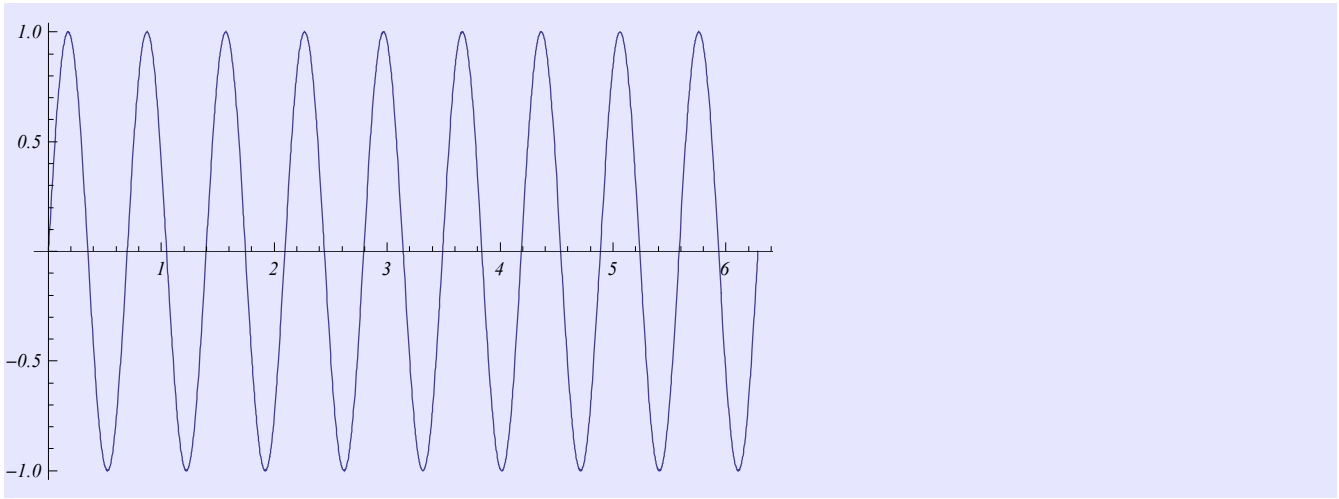

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

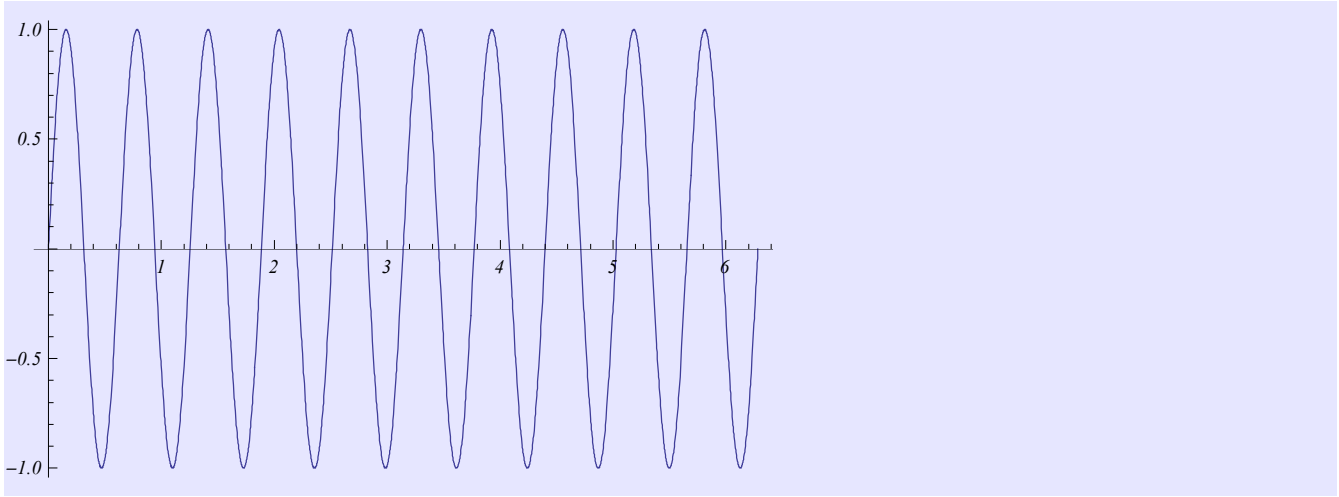

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

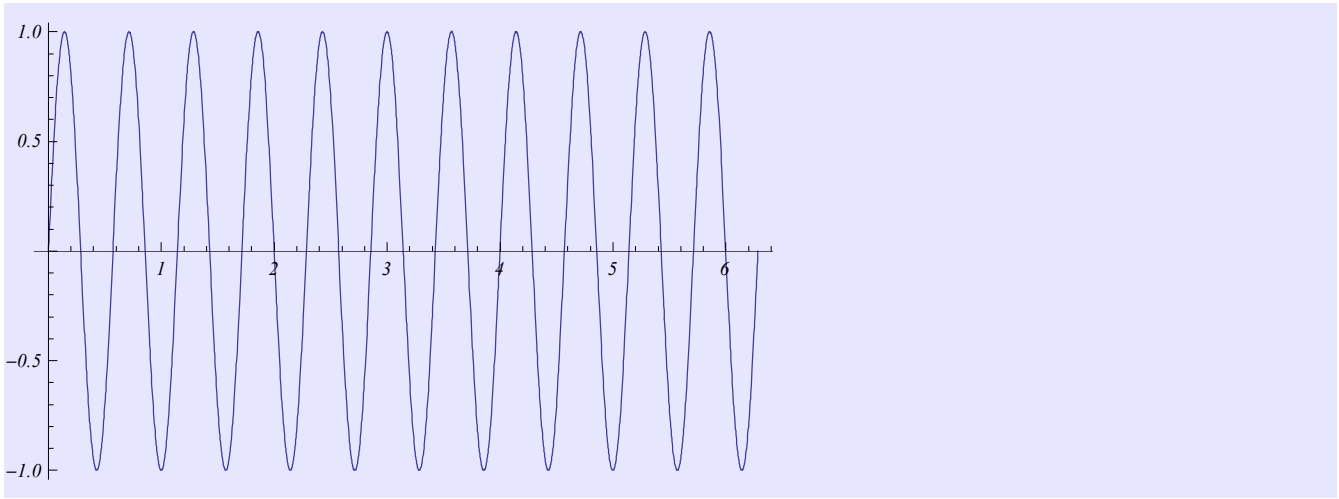

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

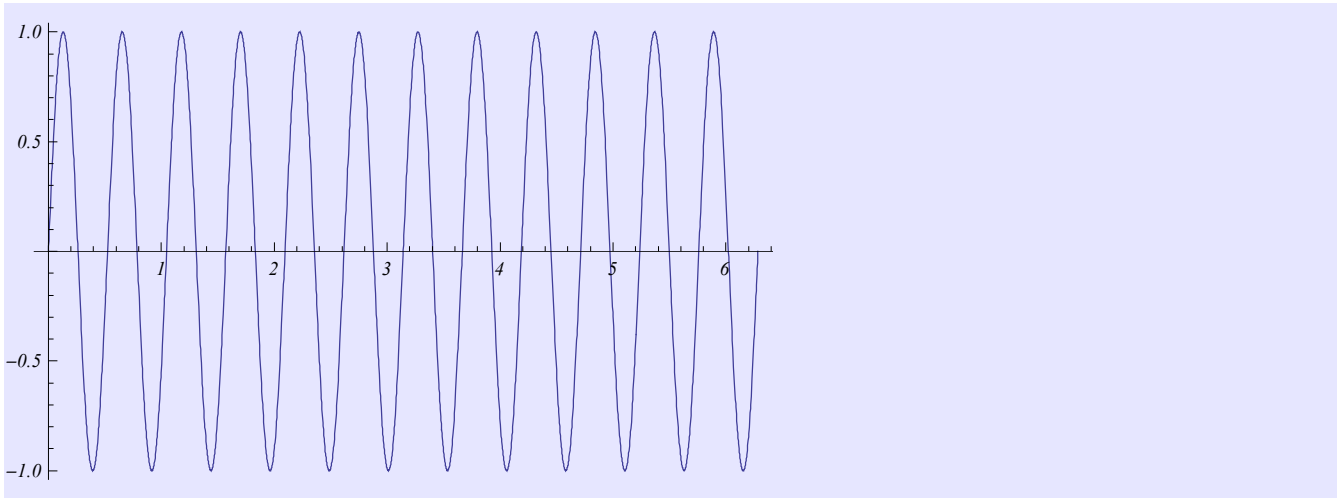

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

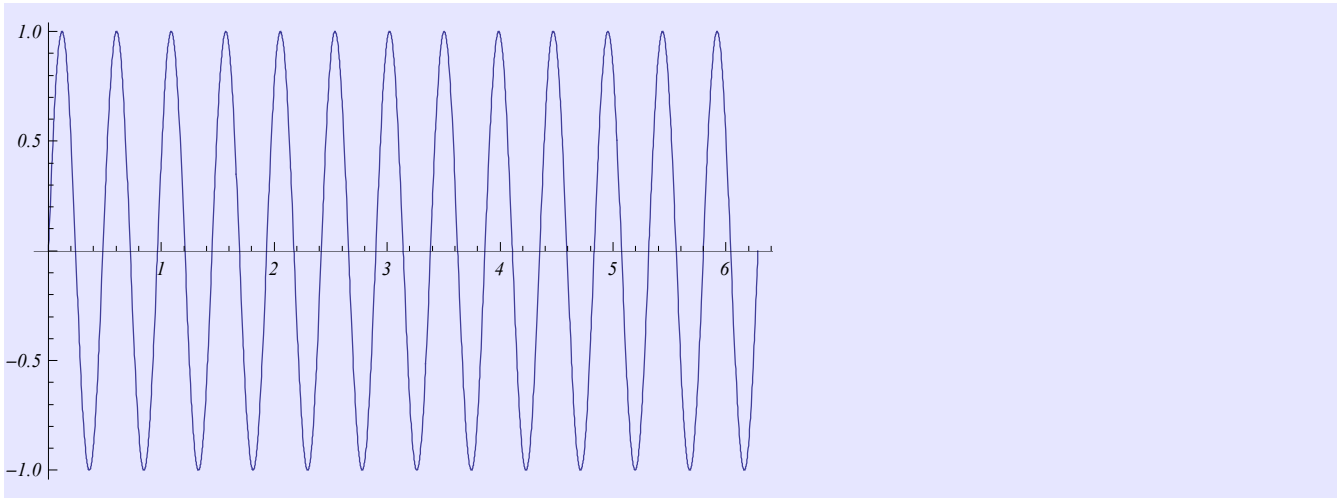

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

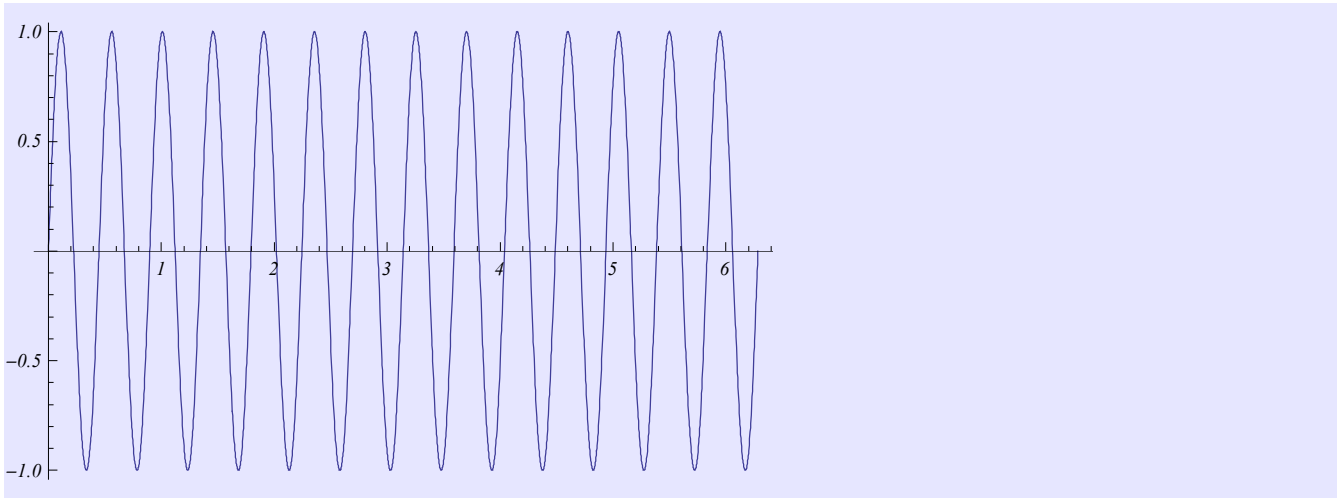

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

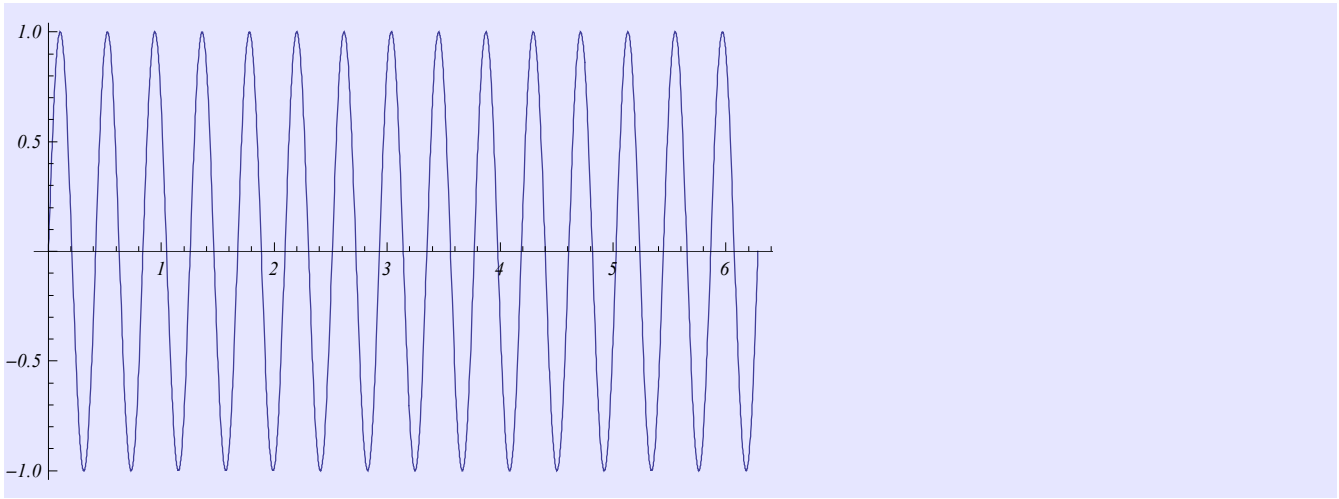

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

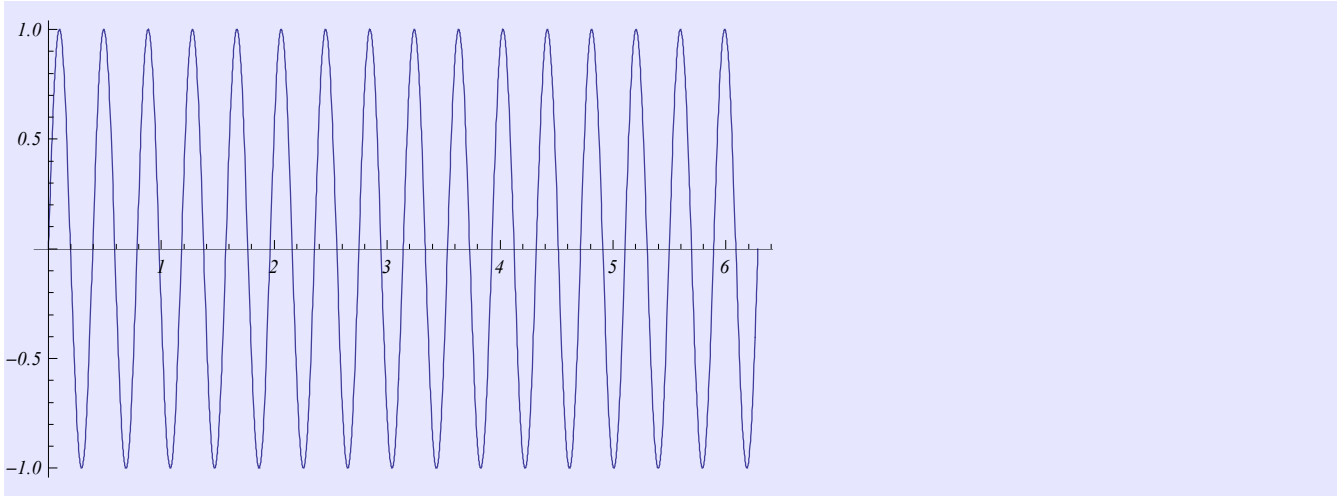

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

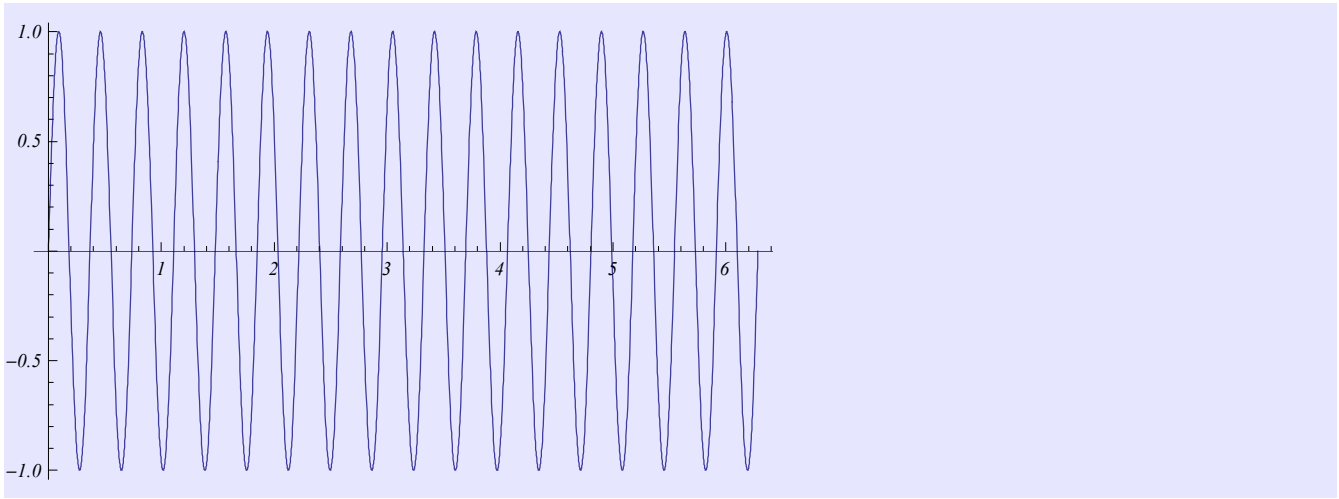

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

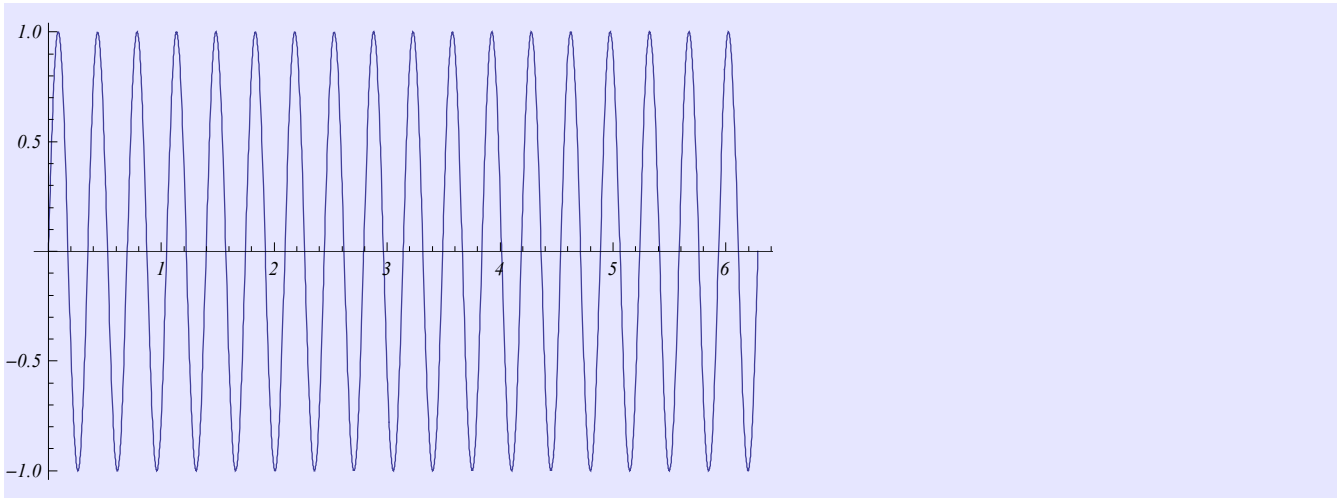

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

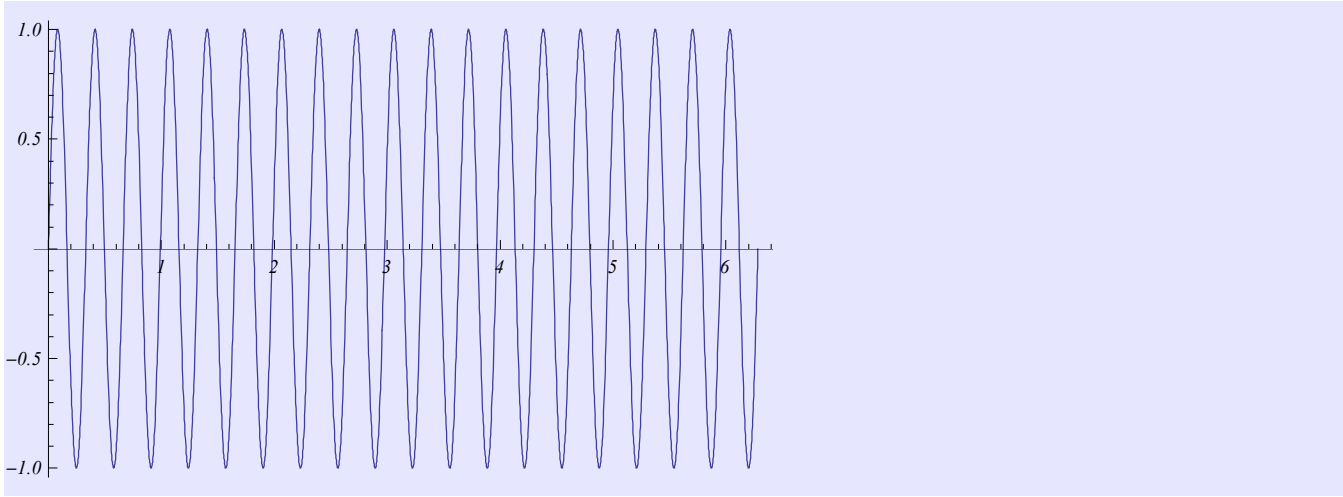

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

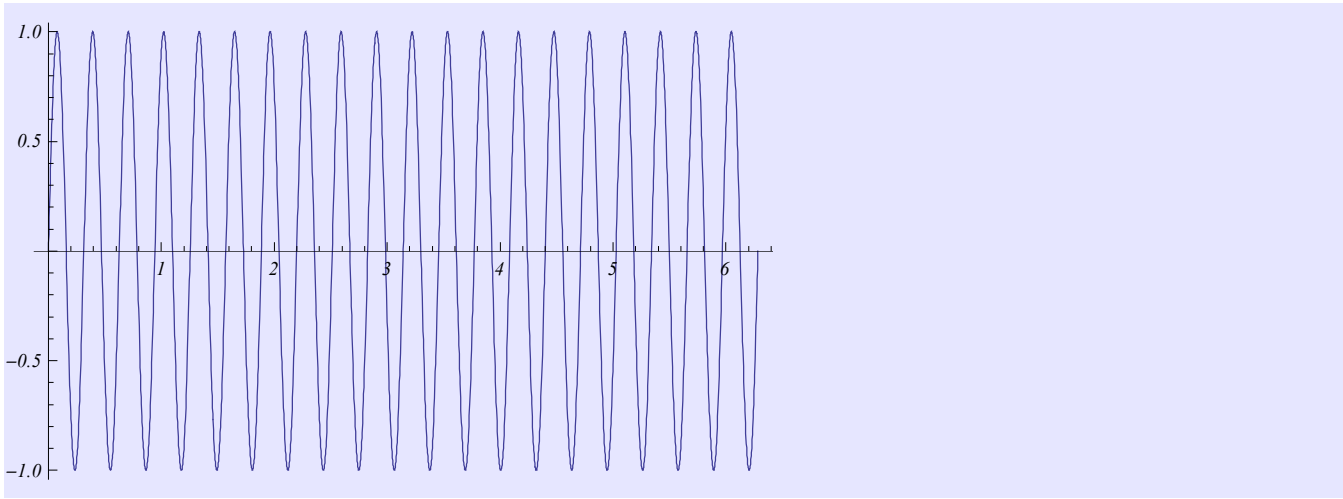

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6


1.0
0.5
−0.5
−1.0
1
2
3
4
5
6

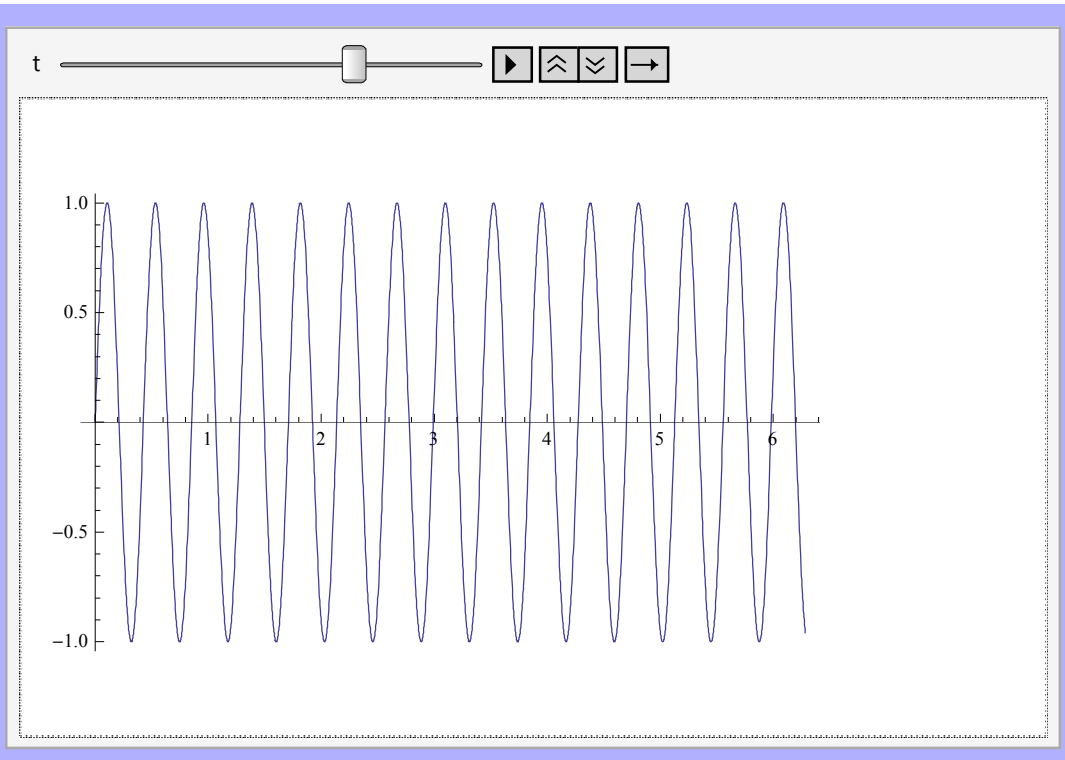

1.0
0.5
−0.5
−1.0
1
2
3
4
5
6


1.0
0.5
−0.5
−1.0
1
2
3
4
5
6



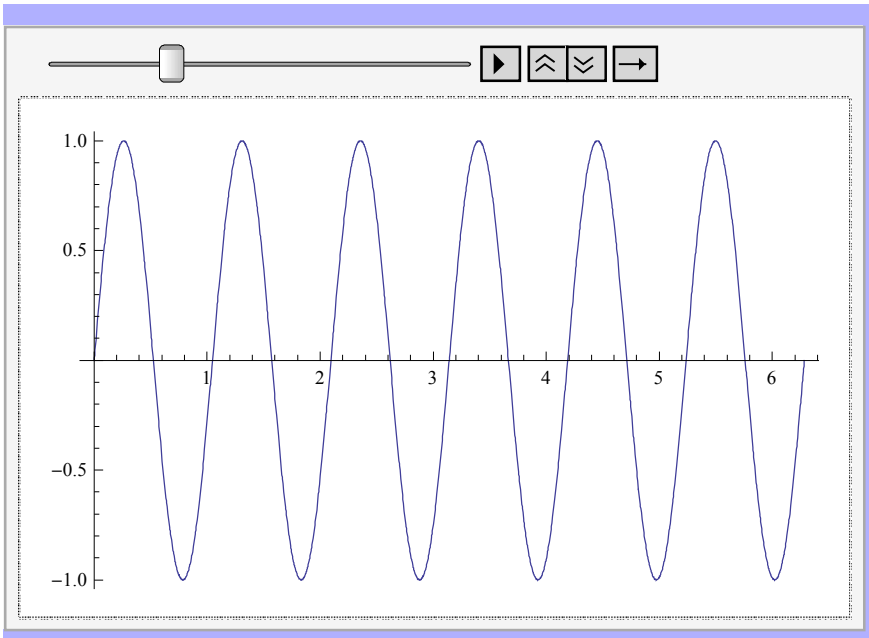



```
Animate[Plot[Sin[t x], {x, 0, 2 Pi}], {t, 1, 20}]
```

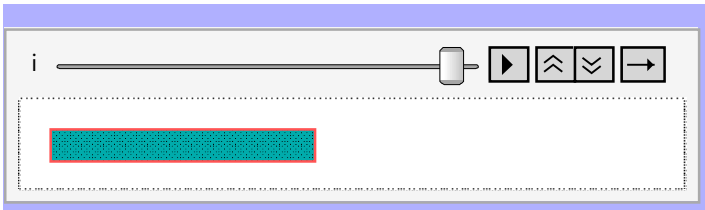


```
t1 = {};
Do[AppendTo[t1, Plot[Sin[t x], {x, 0, 2 Pi}]], {t, 1, 20}]
```

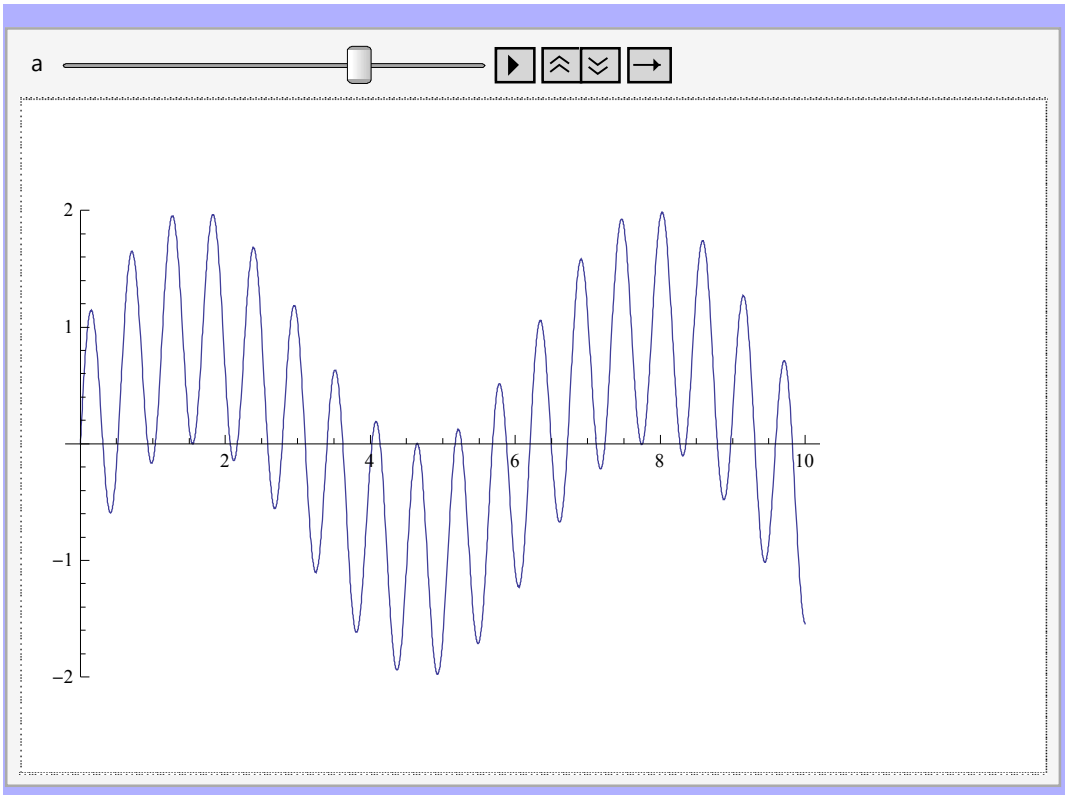
```
ListAnimate[t1]
```



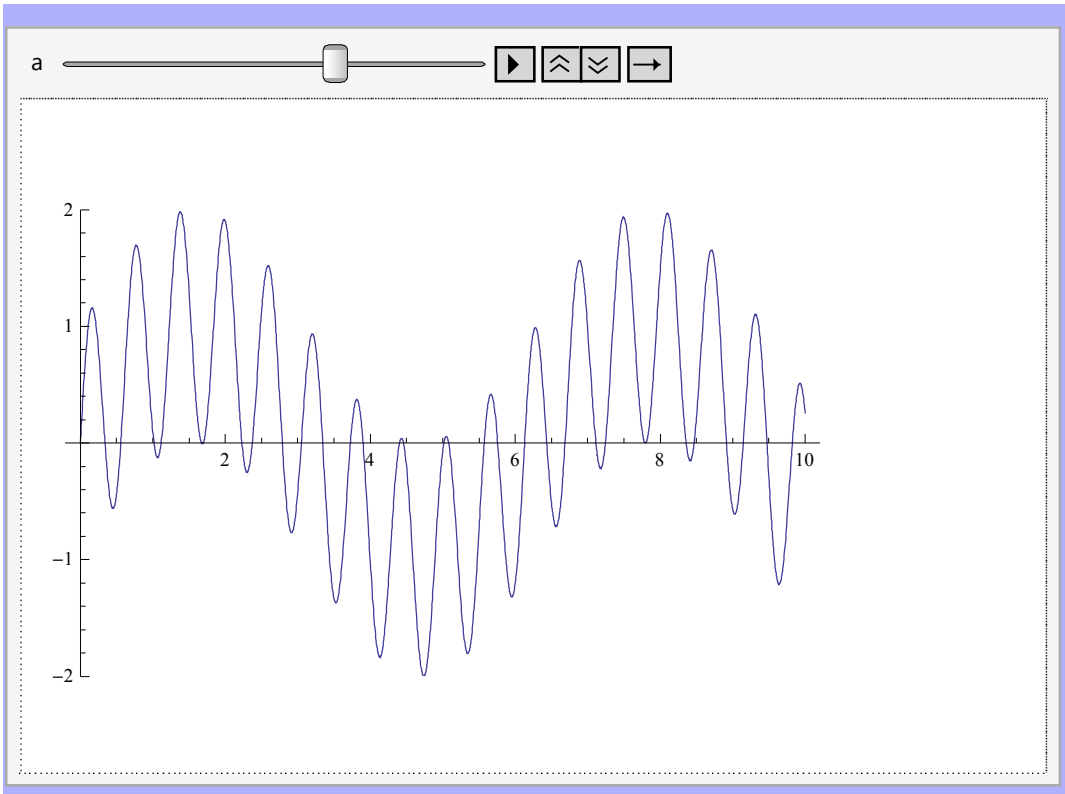

```
Animate[t1[[i]], {i, 1, Length[t1]}]
```



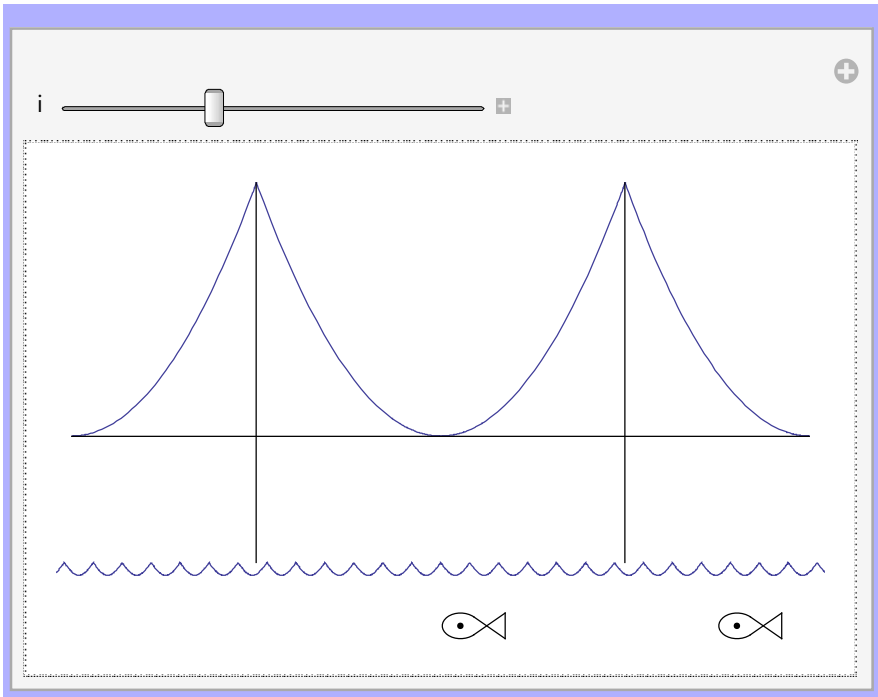
```
Animate[Plot[Sin[a x] + Sin[ x], {x, 0, 10}, PlotRange → 2], {a, 1, 15}]
```



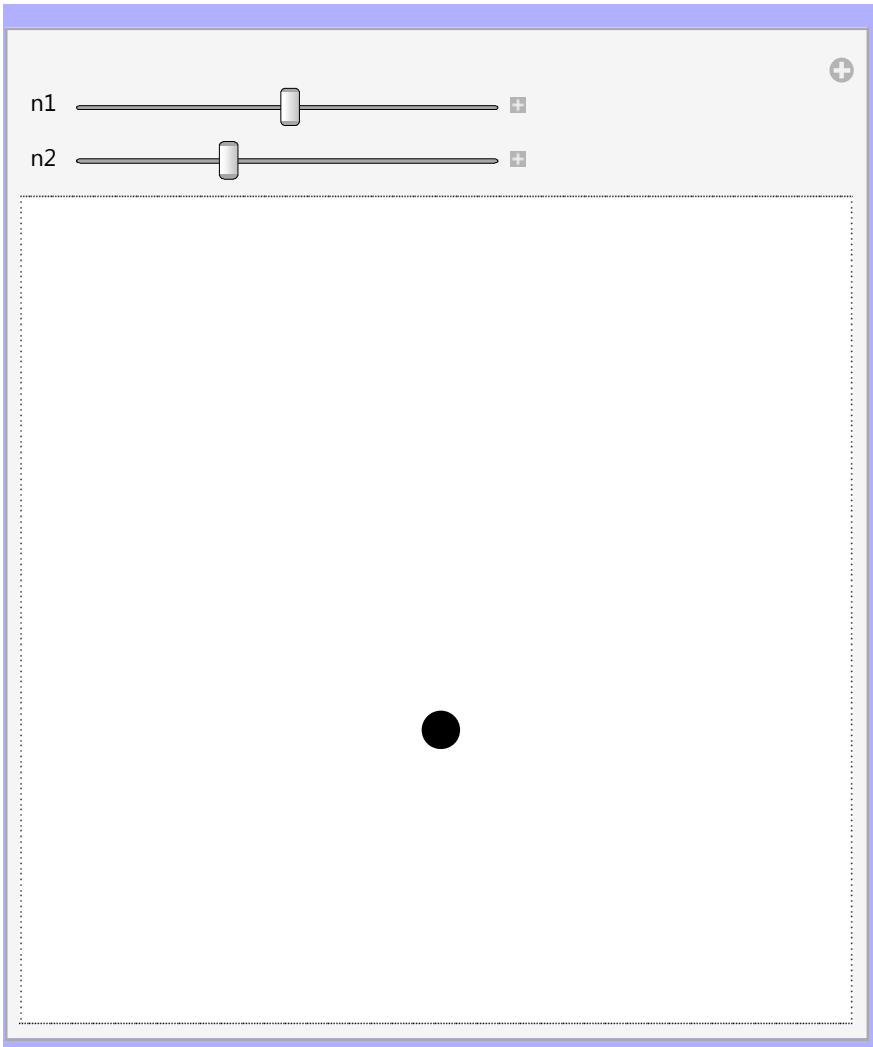

```
Animate[Plot[Sin[a x] + Sin[ x], {x, 0, 10}, PlotRange → 2],
 {a, 1, 15}, AnimationRunning → False]
```



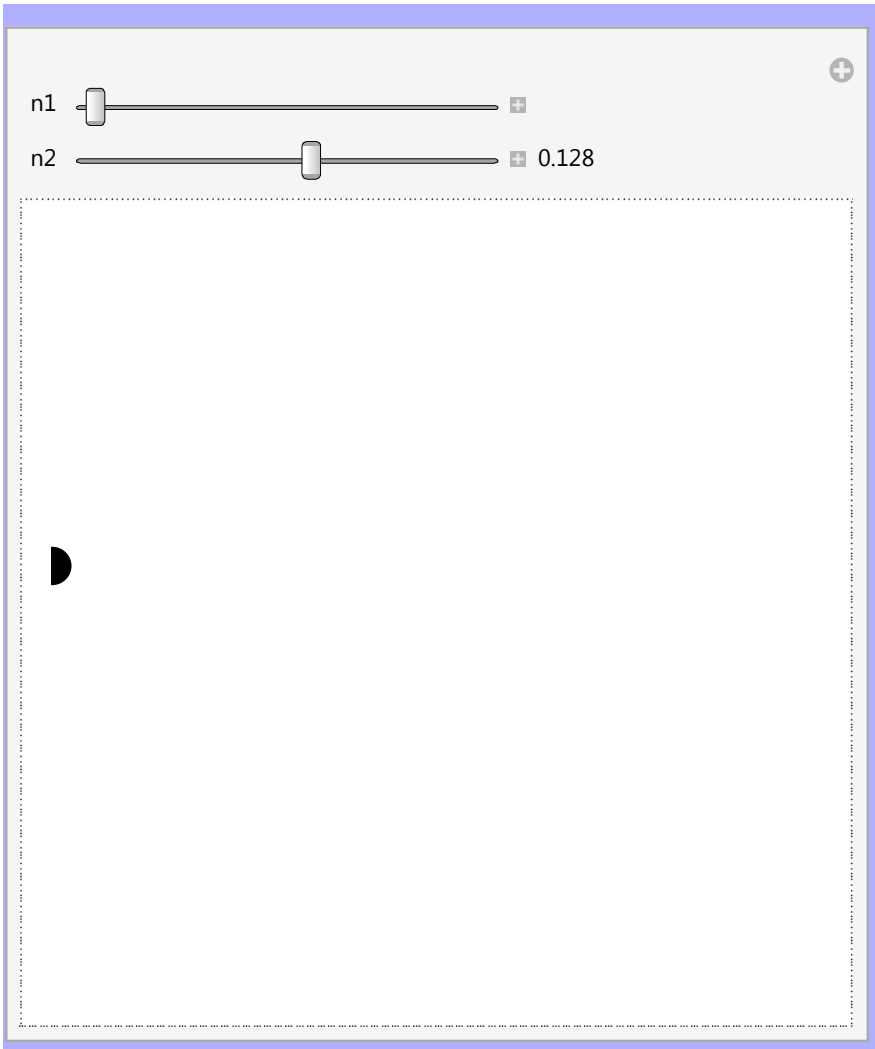
```
Manipulate[Show[p1, p2, p3, p4, p5, p[i], p[i + 3],
  PlotRange → {{-4, 4}, All}, Axes → False], {i, 5, -8, -0.5}]
```



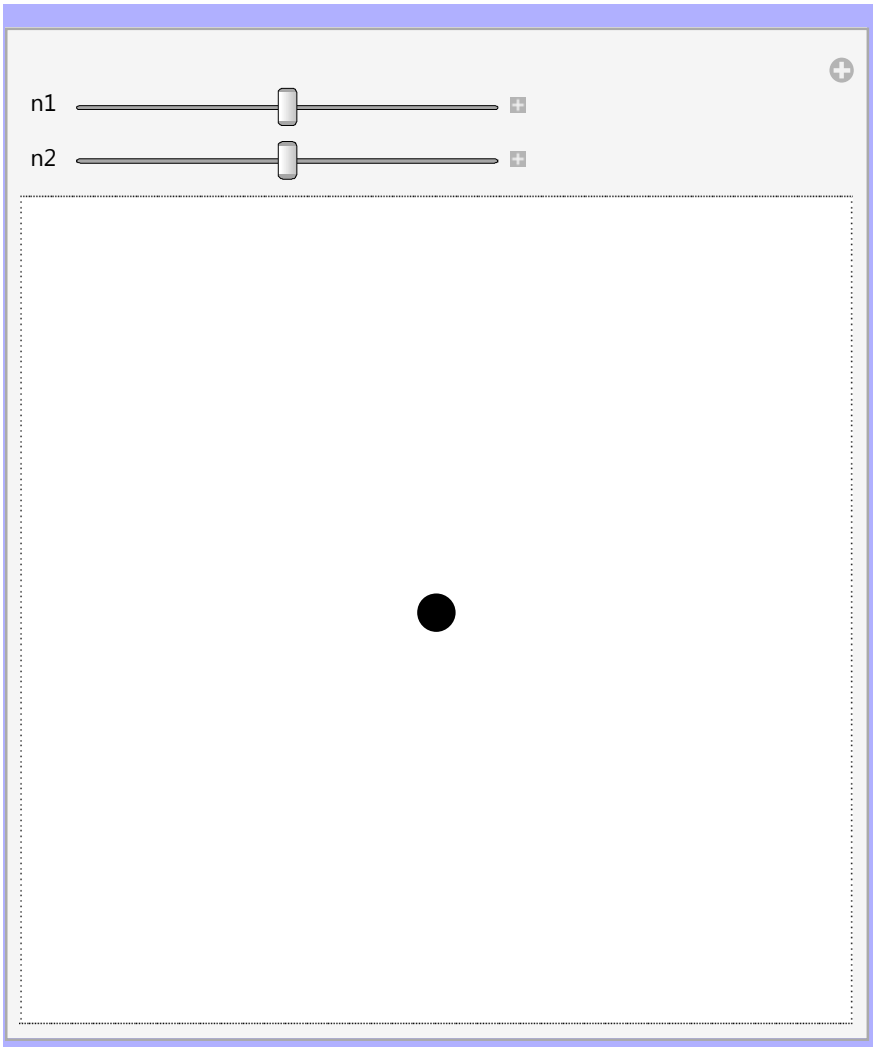
```
Manipulate[Graphics[{PointSize[0.05], Point[{n1, n2}]},
  PlotRange → {{-1, 1}, {-1, 1}}], {n1, -1, 1}, {n2, -1, 1}]
```



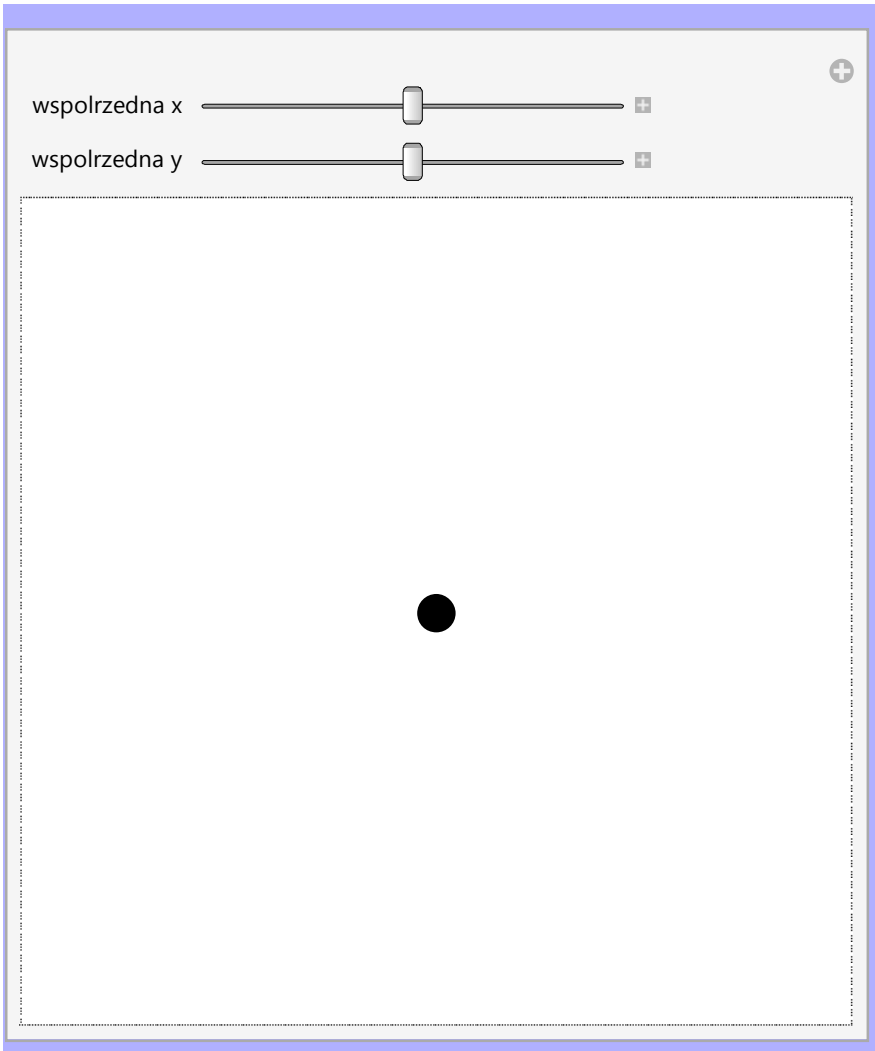
```
Manipulate[Graphics[{PointSize[0.05], Point[{n1, n2}]},
  PlotRange → {{-1, 1}, {-1, 1}}], {n1, -1, 1}, {n2, -1, 1, Appearance → "Labeled"}]
```



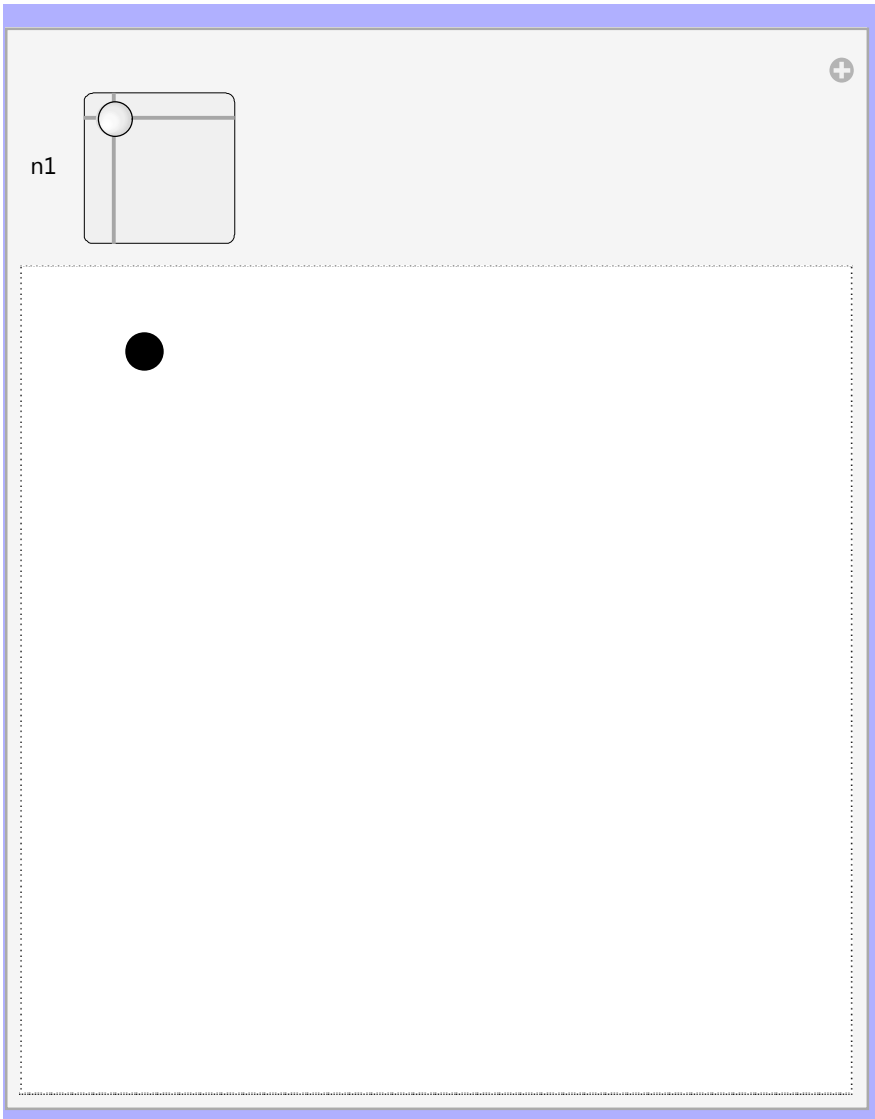
```
Manipulate[Graphics[{PointSize[0.05], Point[{n1, n2}]},
  PlotRange → {{-1, 1}, {-1, 1}}], {{n1, 0}, -1, 1}, {{n2, 0}, -1, 1}]
```



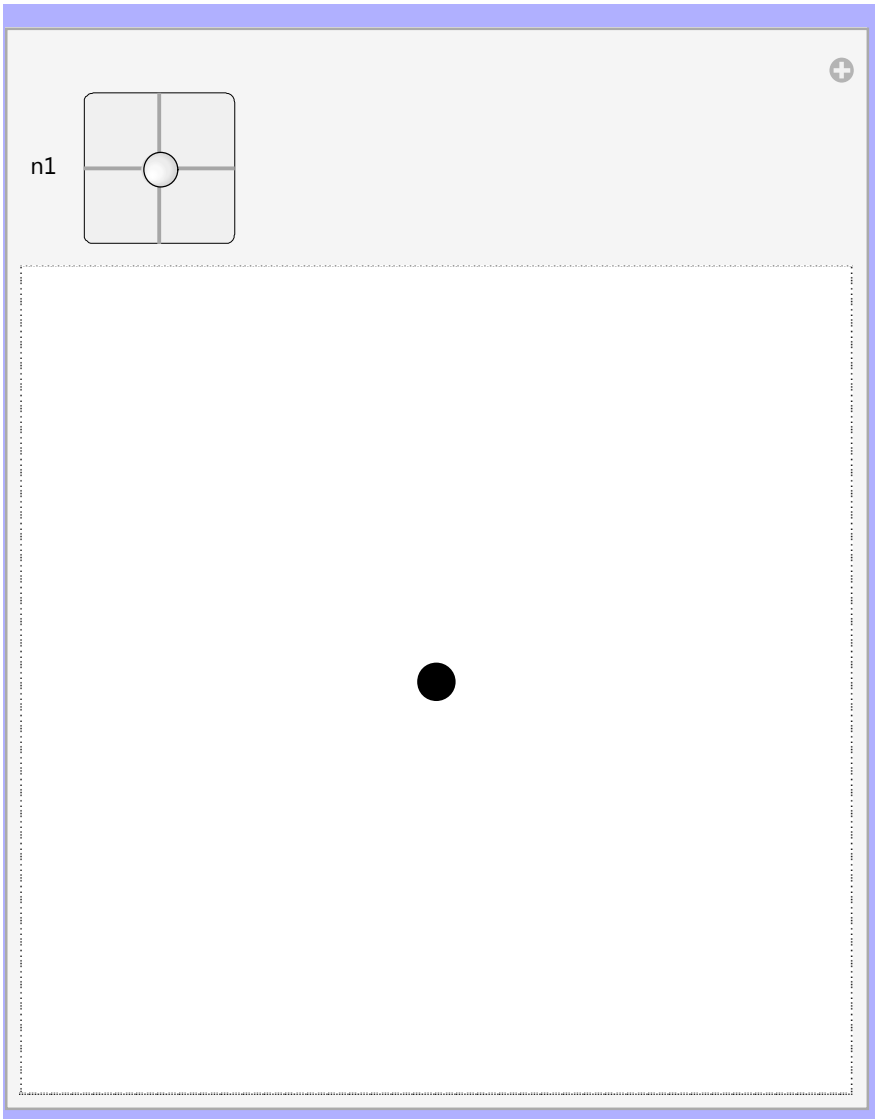
```
Manipulate[
 Graphics[{PointSize[0.05], Point[{n1, n2}]}, PlotRange → {{-1, 1}, {-1, 1}}],
 {{n1, 0, "wspolrzedna x"}, -1, 1}, {{n2, 0, "wspolrzedna y"}, -1, 1}]
```



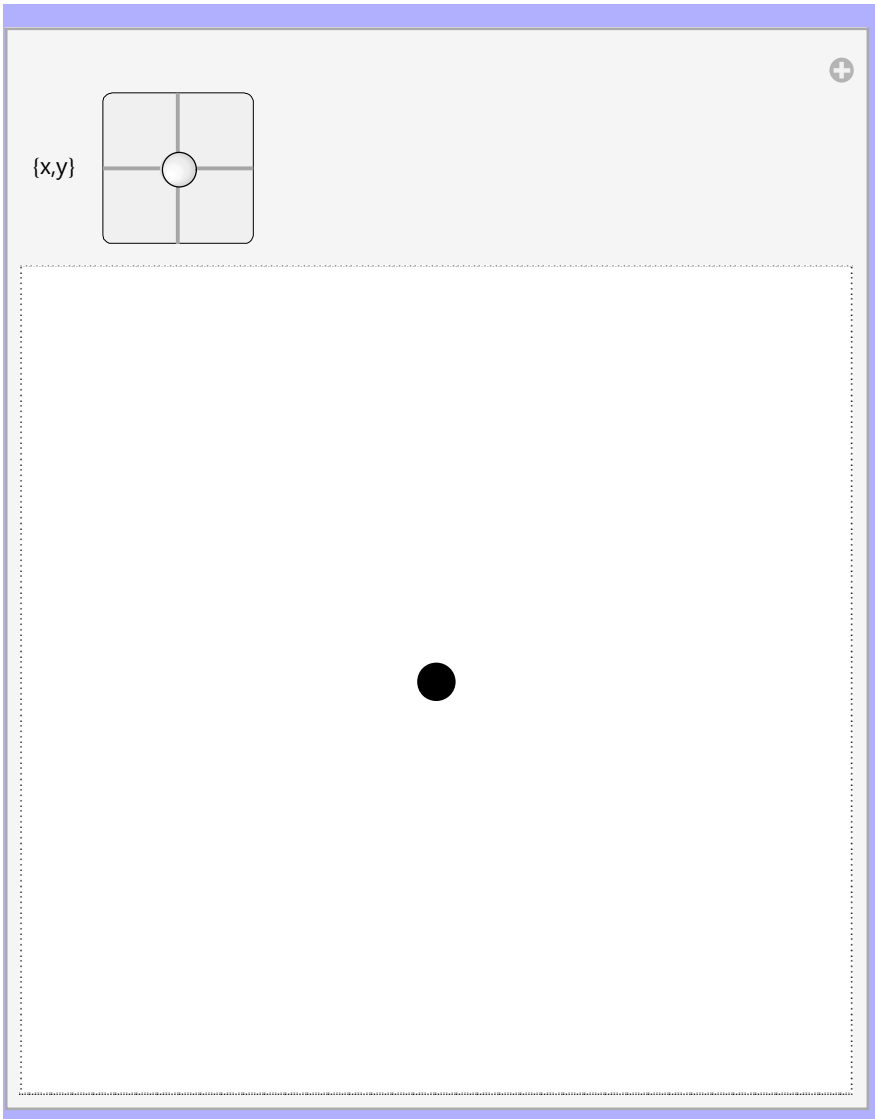
```
Manipulate[Graphics[{PointSize[0.05], Point[n1]}, PlotRange → {{-1, 1}, {-1, 1}}],
 {n1, {-1, -1}, {1, 1}}]
```



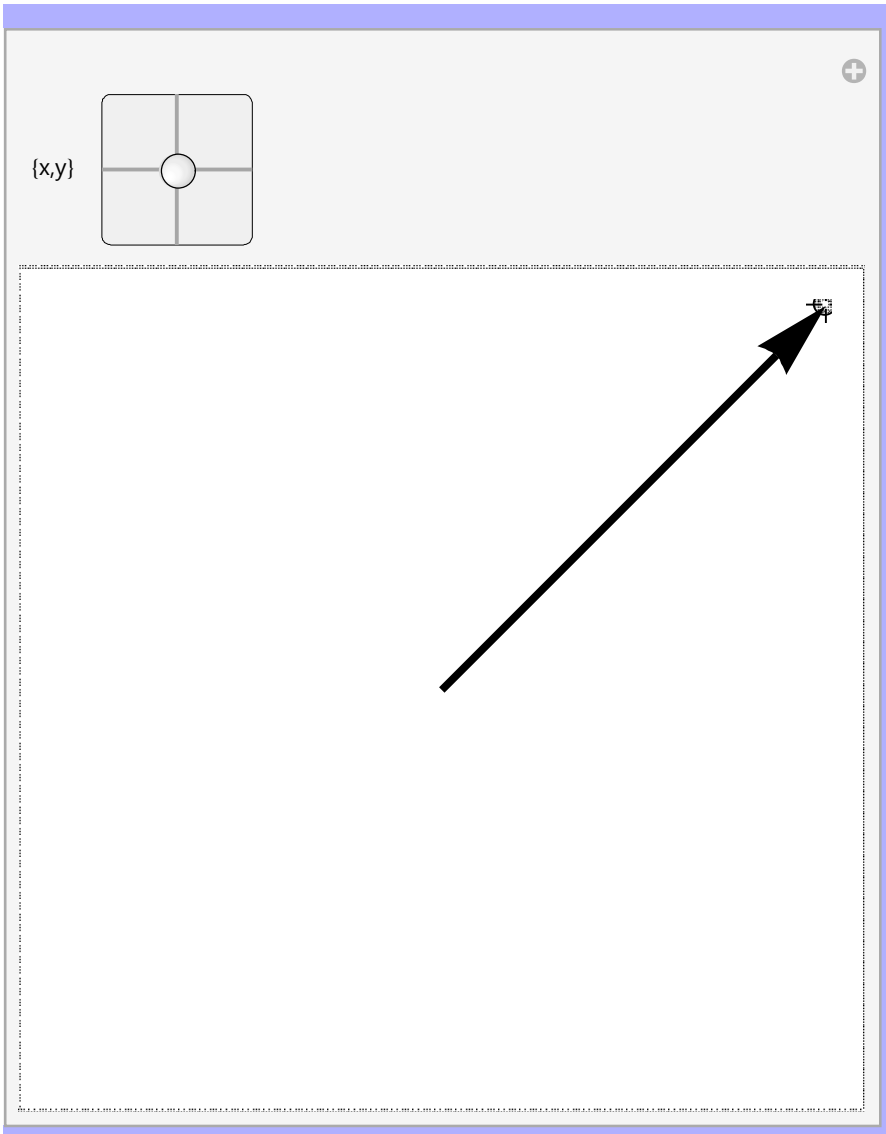
```
Manipulate[Graphics[{PointSize[0.05], Point[n1]}, PlotRange → {{-1, 1}, {-1, 1}}],
 {{n1, {0, 0}}, {-1, -1}, {1, 1}}]
```



```
Manipulate[Graphics[{PointSize[0.05], Point[n1]}, PlotRange → {{-1, 1}, {-1, 1}}],
 {{n1, {0, 0}, "{x,y}"}, {-1, -1}, {1, 1}}]
```

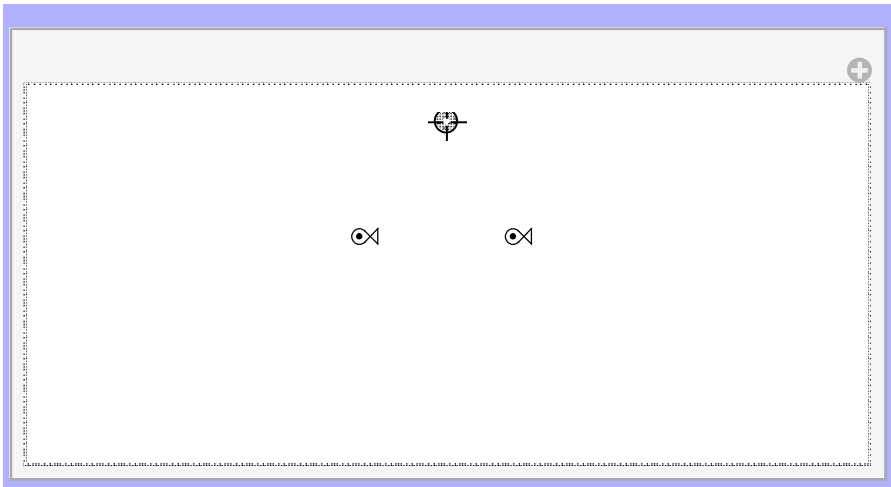


```
Manipulate[Graphics[{Thickness[0.01], Arrowheads[0.1], Arrow[{n1, n2}]},
  PlotRange → {{-1, 1}, {-1, 1}}],
 {{n1, {0, 0}, "{x,y}"}, {-1, -1}, {1, 1}}, {{n2, {1, 1}}, Locator}]
```

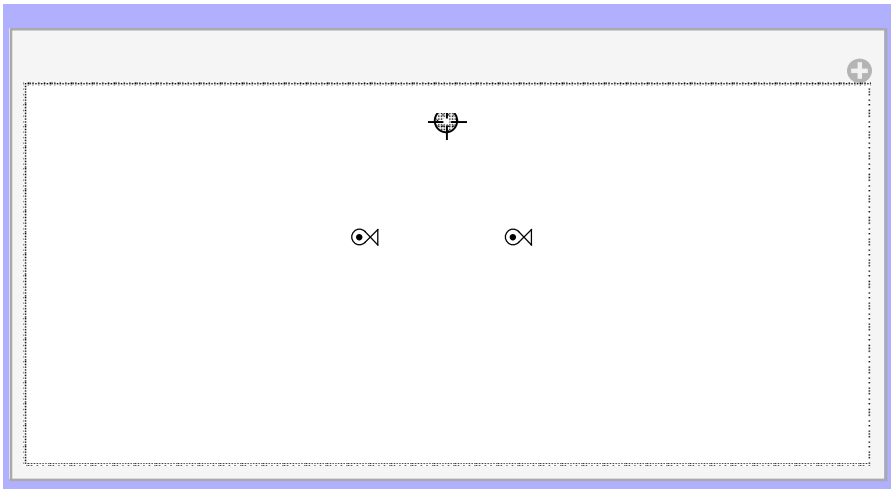



```
px[x_] := Graphics[{Line[{{x[[1]] + 0.2, x[[2]] - 3.2}, {x[[1]] - 0.14, x[[2]] - 2.86}}],
    Line[{{x[[1]] + 0.2, x[[2]] - 2.8}, {x[[1]] - 0.14, x[[2]] - 3.14}}],
    Point[{x[[1]] - 0.286, x[[2]] - 3}],
    Circle[{x[[1]] - 0.286, x[[2]] - 3}, 0.2, {Pi / 4, 7 Pi / 4}],
    Line[{{x[[1]] + 0.2, x[[2]] - 3.2}, {x[[1]] + 0.2, x[[2]] - 2.8}}]}];
```

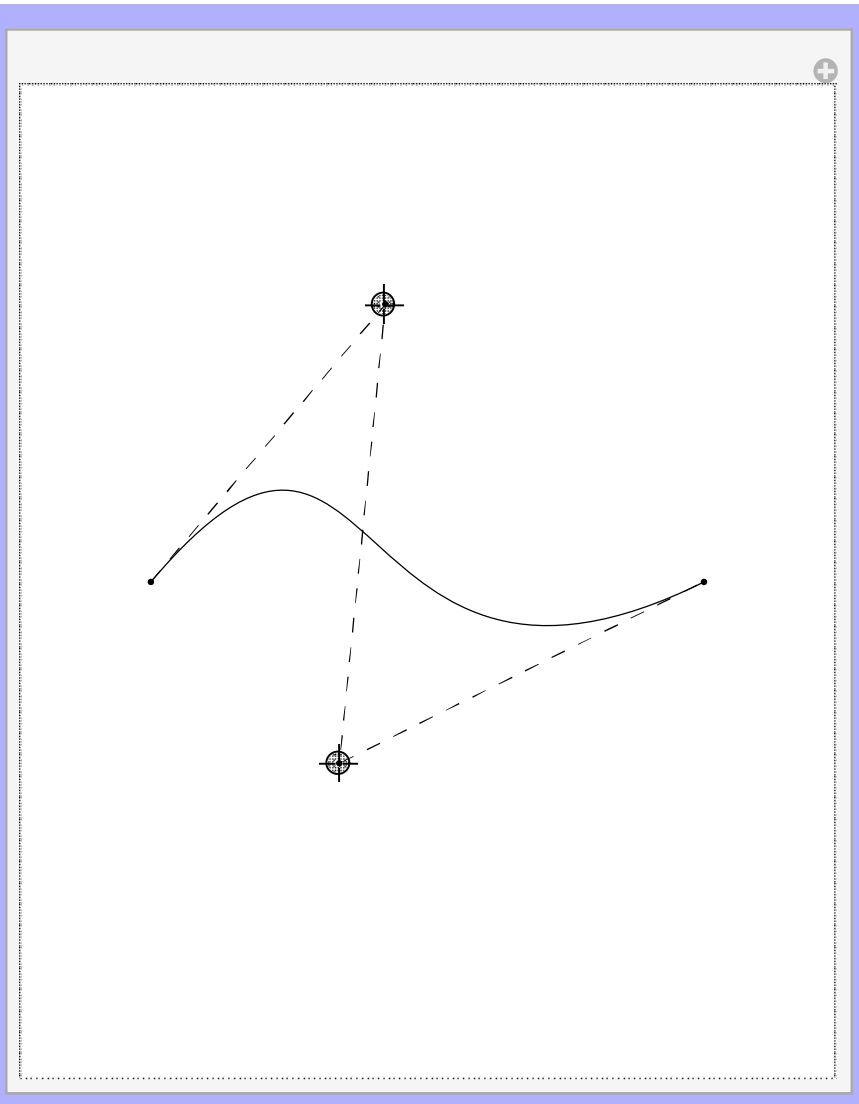
```
Manipulate[Show[px[n - {2, 0}], px[n + {2, 0}], PlotRange → {{-10, 10}, {-8, 0}}],
 {{n, {0, 0}}, Locator}]
```



```
Manipulate[Show[px[n - {2, 0}], px[n + {2, 0}], PlotRange → {{-10, 10}, {-8, 0}}],
 {{n, {0, 0}}, {-7, -4}, {7, 0}, Locator}]
```



```
Manipulate[
 Graphics[{Point[{{0, 0}, n1, n2, {6, 0}}], BezierCurve[{{0, 0}, n1, n2, {6, 0}}],
   Dashing[{0.02}], Line[{{0, 0}, n1, n2, {6, 0}}]}, PlotRange → {{-1, 7}, {-5, 5}}],
 {{n1, {2, 2}}, Locator}, {{n2, {4, -2}}, Locator}]
```



Ćwiczenia

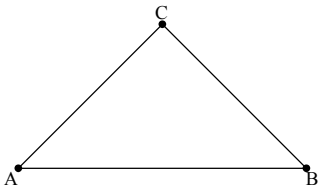
Wzory

Wyznaczanie pola powierzchni trójkąta

Przykład 1

pole1

Punkt C

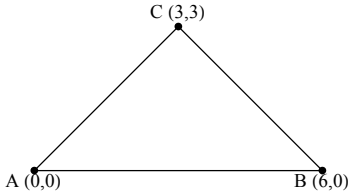


18

Przykład 2

pole2

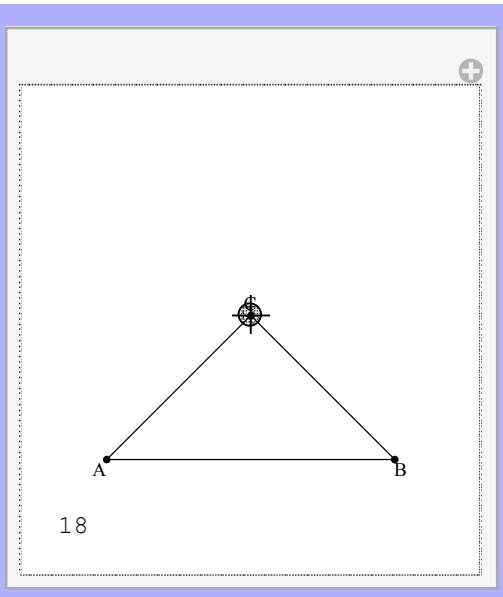
Punkt C



Pole: 18

Przykład 3

pole3



Wyznaczanie kąta między wektorami

Wyznaczanie okręgu opisanego na trójkącie

Wyznaczanie okręgu wpisanego w trójkąt

Obrazki

Import["nazwa"]
ImageData[obrazek]
Image[dane]
Export

Directory[]

```
C:\Users\OKR\Documents
```

SetDirectory["d:\\kks"]

```
d:\kks
```

```
p = Import["kotek.jpg"]
```

```
pp = ImageData[p];
pp[[1, 1]]
```

```
{0.941176, 1., 0.988235}
```

```
Dimensions[pp]
```

```
{640, 480, 3}
```

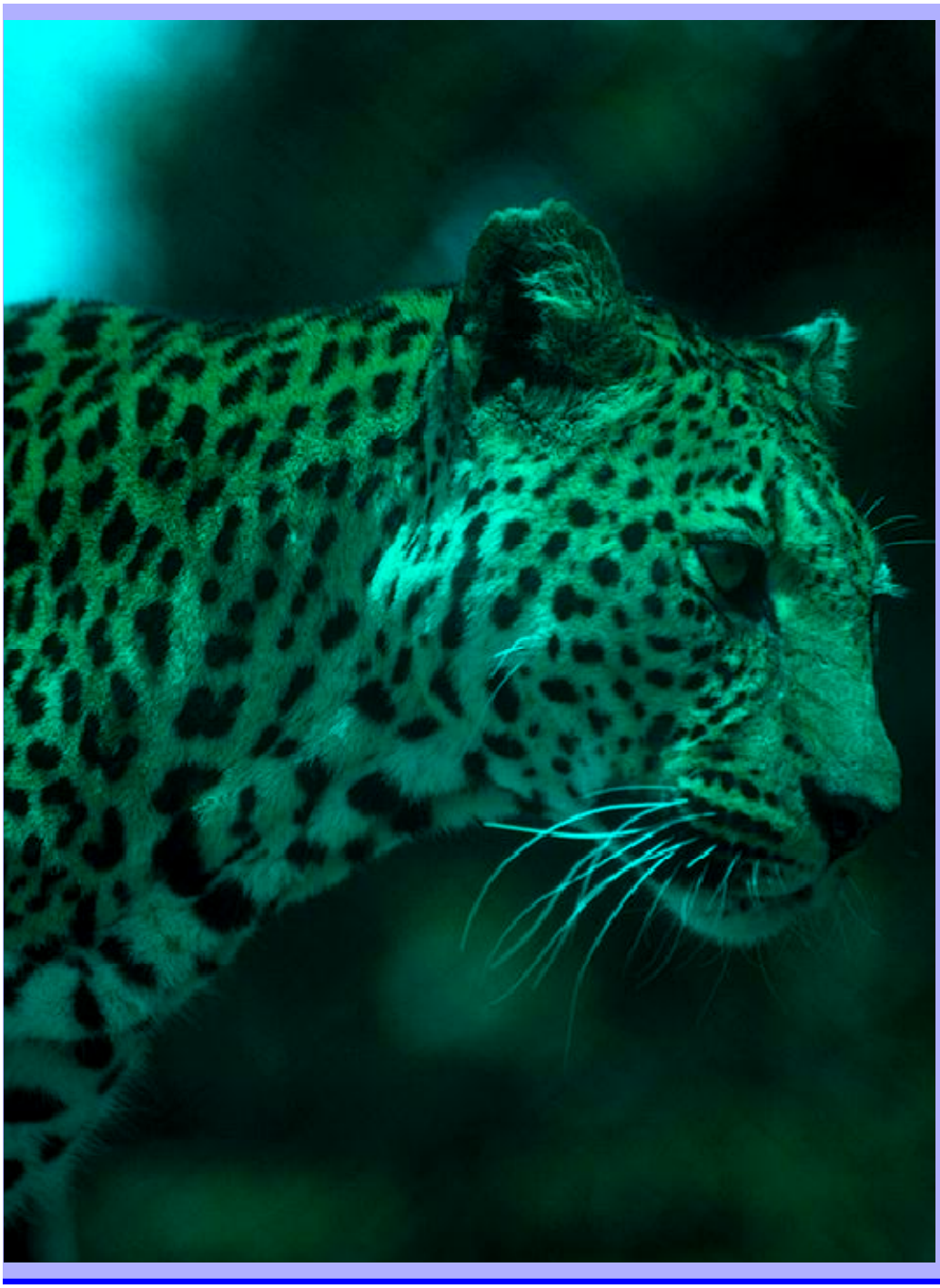
```
p2 = Import["kotek.jpg", "Data"] / 255 // N;
p2[[1, 1]]
```

```
{0.941176, 1., 0.988235}
```

```
Image[pp]
```

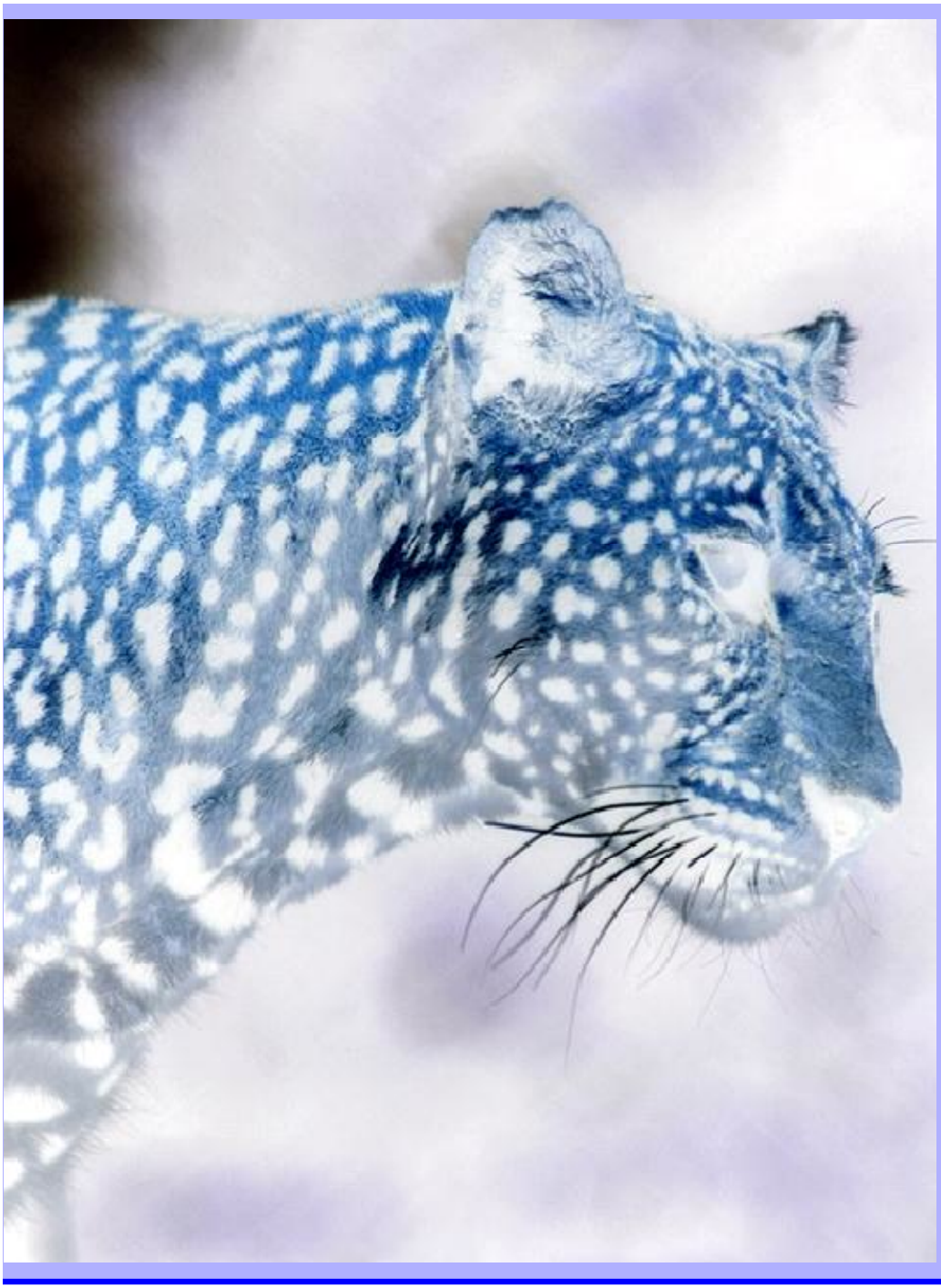
```
usuncolor[x_, c_] := Module[{col},
  If[c == "r", col = 1,
   If[c == "g", col = 2, If[c == "b", col = 3, Return[HoldForm[usuncolor[x, c]]]]]];
  Image[Map[Insert[#1, 0, col] &, Map[Drop[#1, {col}] &, x, {2}], {2}]]]
```

```
usuncolor[pp, "r"]
```



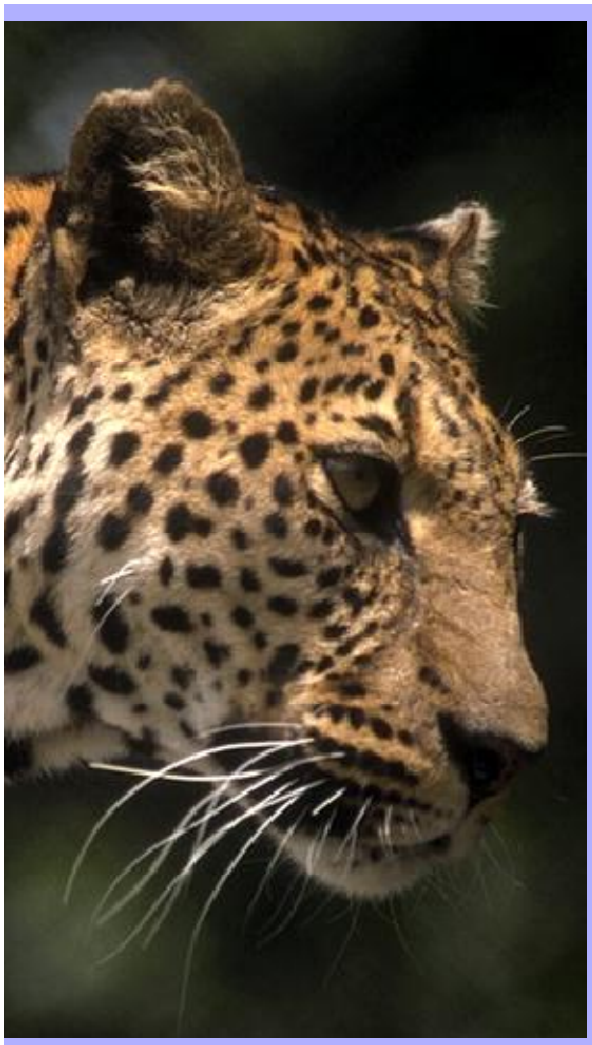
```
neg[x_] := Image[Map[Abs[1 - #1] &, x, {2}]]
```

```
neg[pp]
```



```
przytnij[x_, {{x1_, y1_}, {x2_, y2_}}] := Module[{p, d = Dimensions[x]},
  If[x1 < 1 || x1 > d[[2]] || x2 < 1 || x2 > d[[2]] || y1 < 1 || y1 > d[[1]] || y2 < 1 ||
    y2 > d[[1]], Return[HoldForm[przytnij[x, {{x1, y1}, {x2, y2}}]]]];
  p = Take[x, {y1, y2}];
  p = Transpose[Take[Transpose[p], {x1, x2}]];
  Image[p]]
```

```
przytnij[pp, {{208, 66}, {480, 542}}]
```



```
Image[pp]
```

```
jasnosc[x_, c_] := Image[Map[#1 * c &, x, {2}]]
```

jasnosc[pp, 1.6]