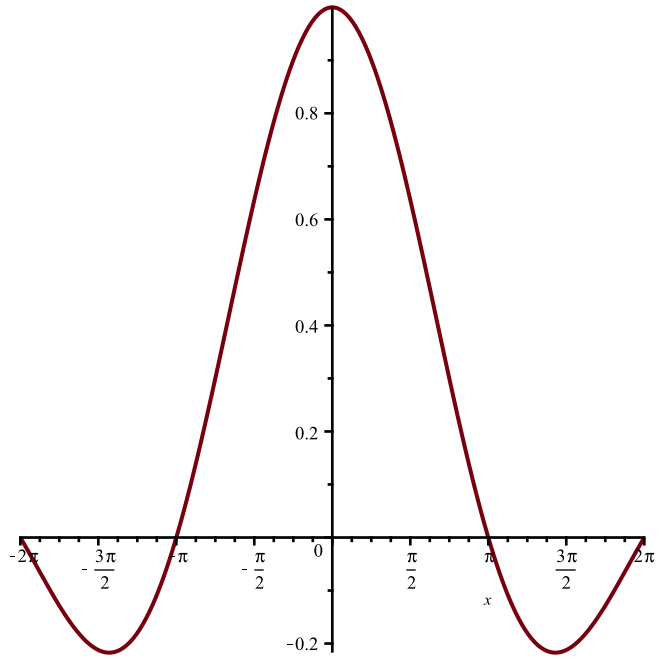
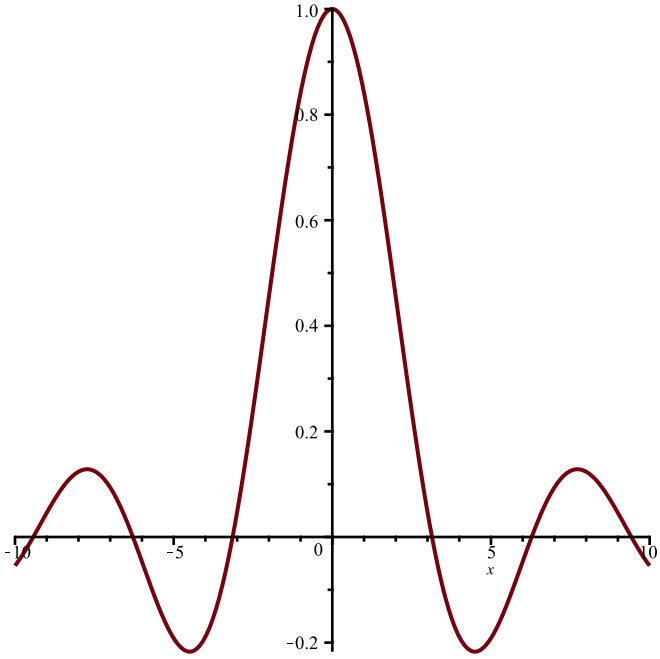
```
> restart :
> #Графики в Maple
> # График по умолчанию
> plot(sin(x)/x);
```

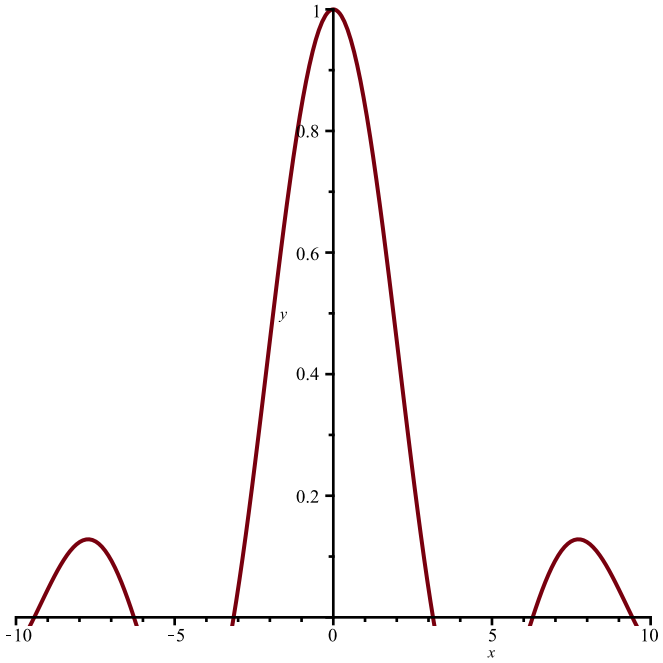



```
> # x=−10..10
> plot(sin(x)/x, x=-10..10);
```




```
> # y=−0..1
```

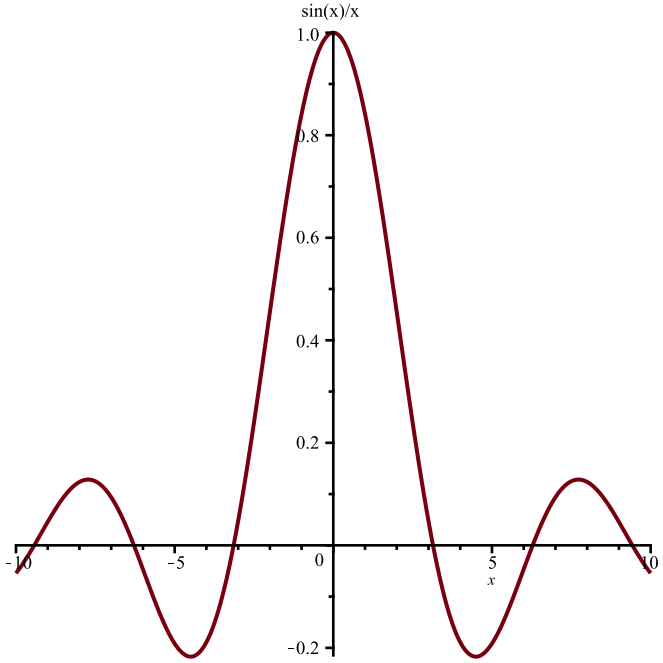
```
> plot(sin(x)/x, x=-10..10, y=-0..1);
```




```
> # Зададим функцию с помощью →
> f1 := x→sin(x)/x;
```

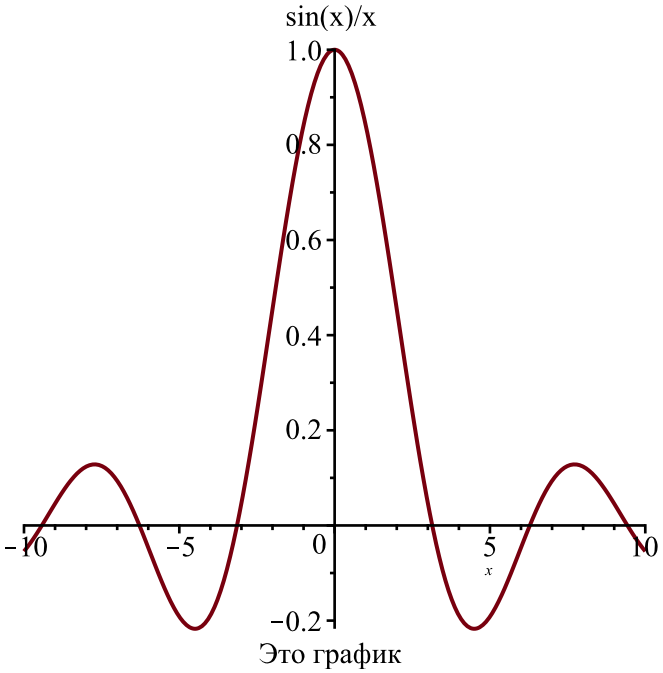
$$f1 := x \mapsto \frac{\sin(x)}{x} \qquad (1)$$

```
> # title="sin(x)/x"
> plot(f1(x), x=-10..10, title="sin(x)/x");
```



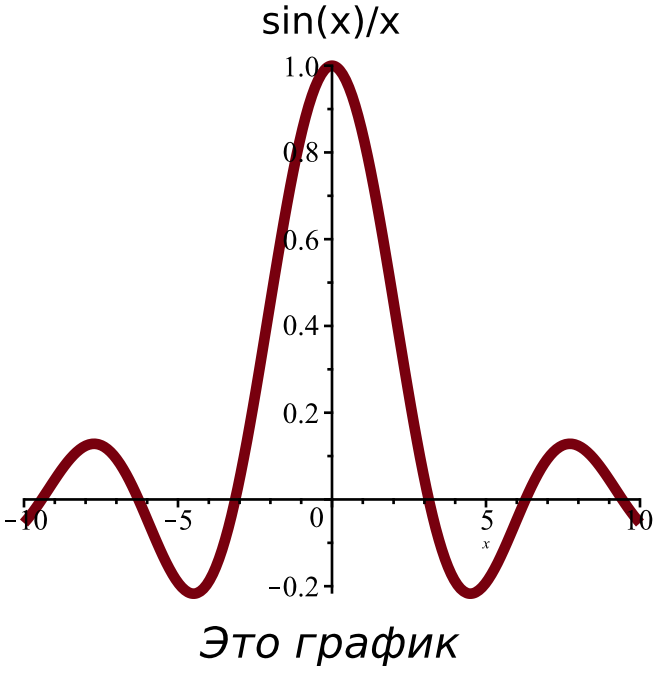

```
> # caption="Это график"
  #font=["ROMAN", 18]
```

```
> plot(f1(x), x=-10..10, title="sin(x)/x", caption="Это график", font=["ROMAN", 18]);
```



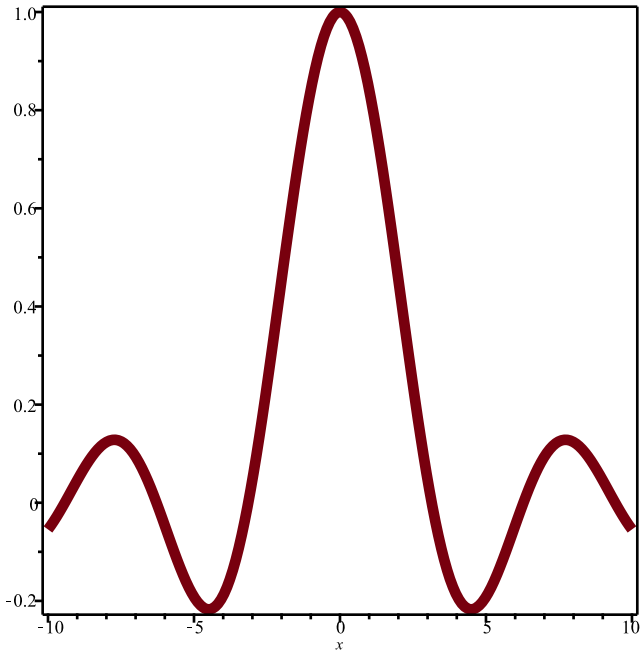

```
> # axesfont=["ROMAN", 18]
  # titlefont=["HELVETICA", "ARIAL", 22]
  # captionfont=["HELVETICA", "ITALIC", 25]
```

```
> plot(f1(x), x=-10..10, title="sin(x)/x", caption="Это график", axesfont=["ROMAN", 18],
      titlefont=["HELVETICA", "ARIAL", 22], captionfont=["HELVETICA", "ITALIC", 25],
      thickness=4)
```




```
> # axes="box"
```

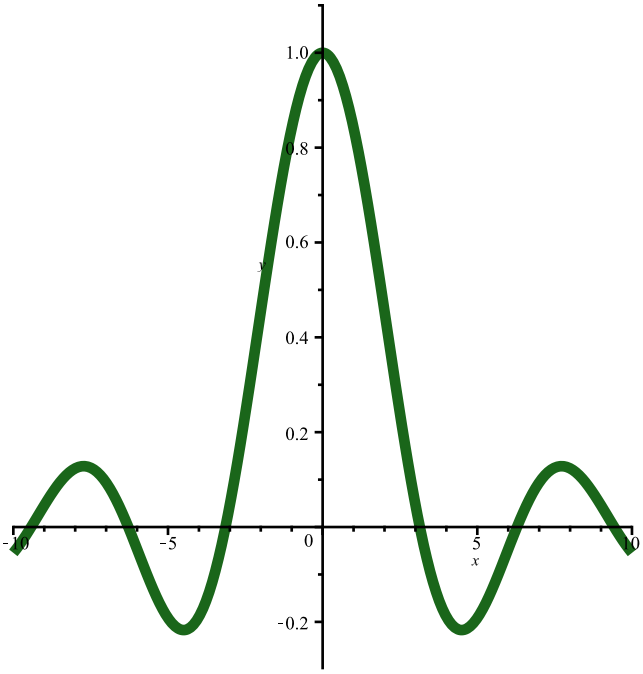
```
> plot(f1(x), x=-10..10, axes="box", thickness=4);
```



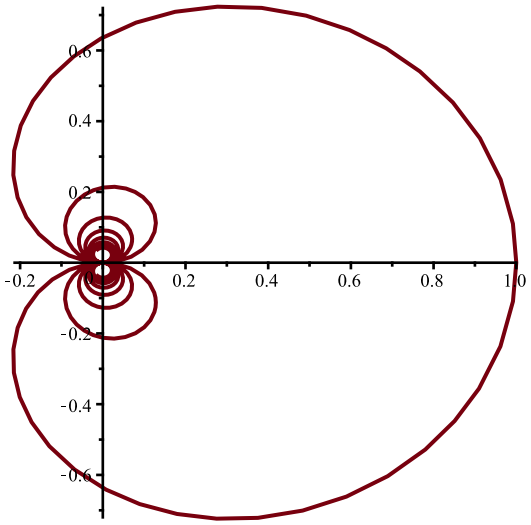

```
> # Error
> plot(f1(x), x=-10..10, axes="bx");
```

Error, (in plot) expecting option axes to be of type identical ("boxed", "frame", "normal", "none") but received bx

```
> # color=COLOR(RGB, 0.1, 0.4, 0.1)
> plot(f1(x), x=-10..10, y=-0.3..1.1, color=COLOR(RGB, 0.1, 0.4, 0.1), thickness=4);
```

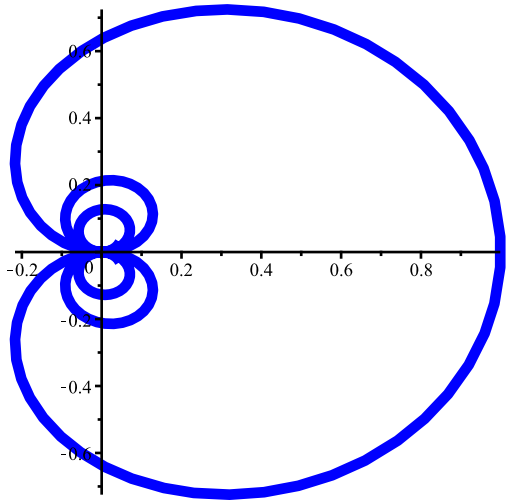



```
> # coords=polar
> ?#coords;
> plot(f1(x), x=-24..24, coords=polar);
```



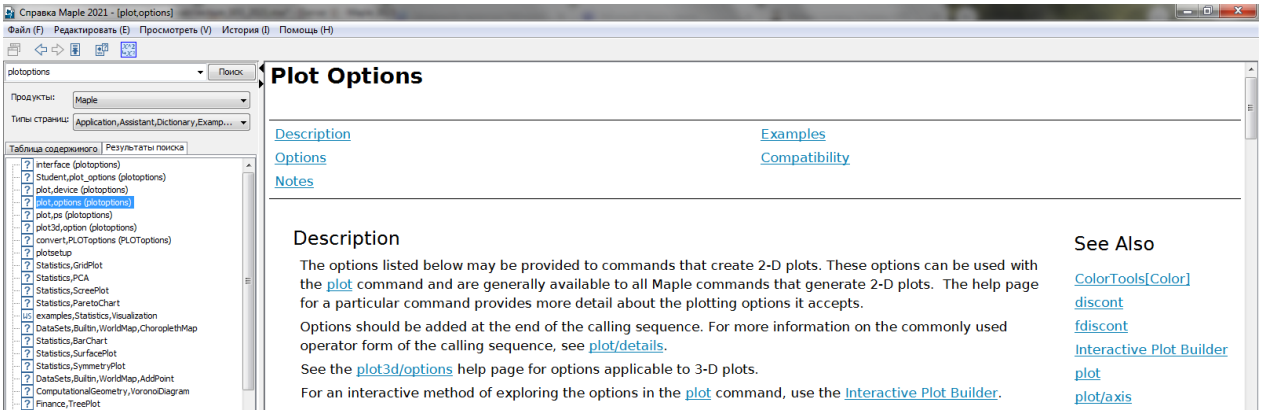

```
> # coords=polar, thickness=4,color="Blue"
```

```
> plot(f1(x), x = -10..10, coords = polar, thickness = 4, color = "Blue");
```




```
> #?plotoptions
```

```
>
```




# Options

▶ ***adaptive***

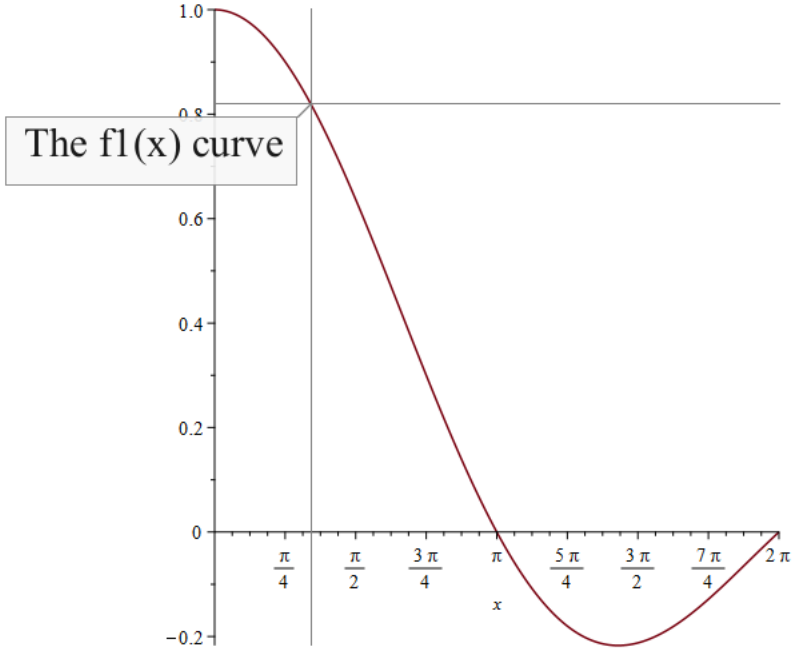
- ***annotation***
- ***axes***
- ***axesfont***
- ***axis***
- ***axiscoordinates***
- ***background***
- ***caption***
- ***captionfont***
- ***color***
- ***colorscheme***
- ***coordinateview***
- ***coords***
- ***discont***
- ***filled***
- ***filledregions***
- ***font***
- ***gridlines***
- ***labels***
- ***labeldirections***
- ***labelfont***
- ***legend***
- ***legendstyle***
- ***linestyle***
- ***numpoints***
- ***resolution***
- ***sample***
- ***scaling***
- ***size***
- ***smartview***
- ***style***
- ***symbol***

- ***symbolsize***
- ***thickness***
- ***tickmarks***
- ***title***
- ***titlefont***
- ***transparency***
- ***useunits***
- ***view***

```
> # annotation="a sine curve"
```

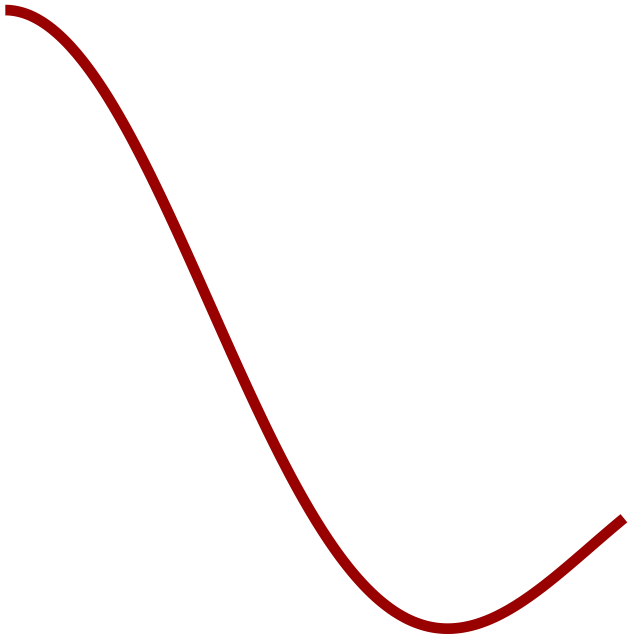
```
> plot( f1(x), x = 0 ..2 * Pi, annotation = "The f1(x) curve" ) :
```

$$plot(f1(x), x = 0..2 * \mathrm{Pi}, annotation = \text{"The f1(x) curve"});$$

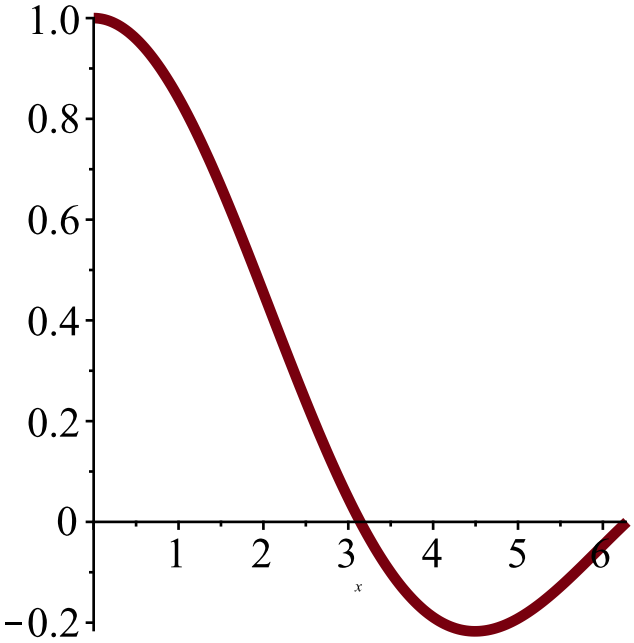



```
> #axes = boxed, frame, none, or normal.
```

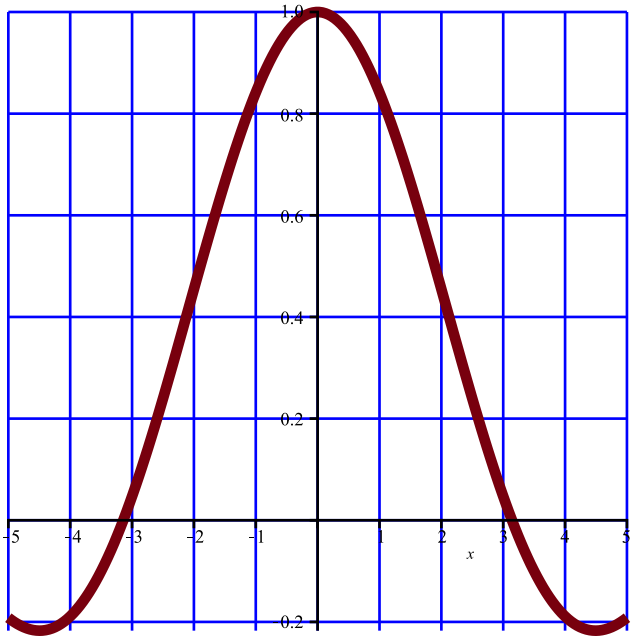
```
> plot(f1(x), x = 0 ..2 * Pi, annotation = "The f1(x) curve", axes ='none', thickness = 4, color
      = RGB(0.6, 0, 0) );
```



```
> # axesfont
> plot(fl(x), x = 0..2 * Pi, axesfont = ["Roman", "Normal", 26], thickness = 4);
```

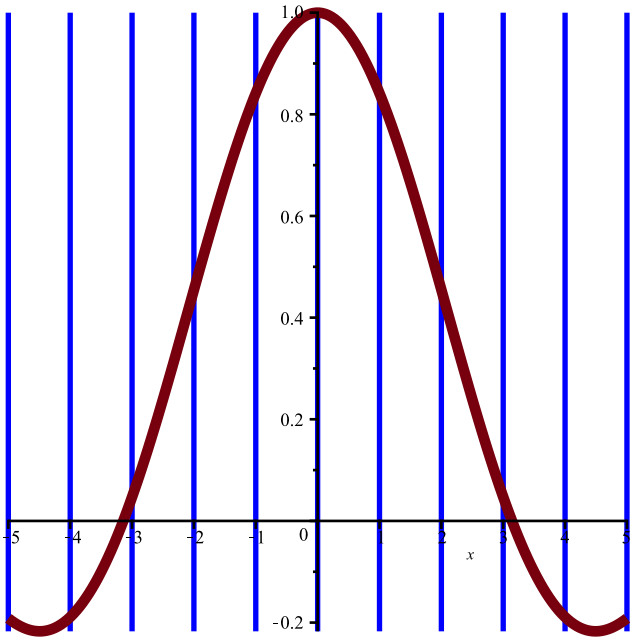



```
> #Error
> plot(fl(x), x = 0..2 * Pi, axesfont = 26, thickness = 4);
Error, (in plot) expecting option [axesfont, axes_font] to be of type list but received 26
> # axis
> plot(fl(x), x = -5..5, thickness = 4, axis = [gridlines = [10, color = blue]]);
```



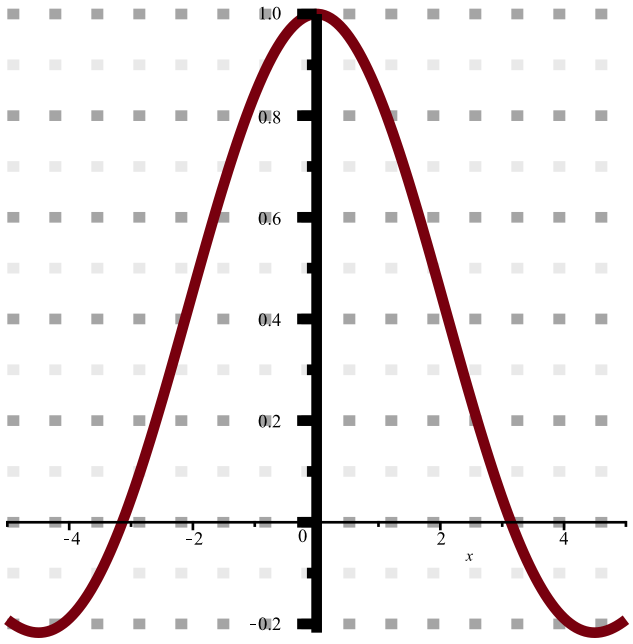

```
> #` `axis[1]
```

```
> plot(f1(x), x=-5..5, thickness=4, axis[1]=[gridlines=[10, thickness=2, subticks=false,
      color=blue]])
```

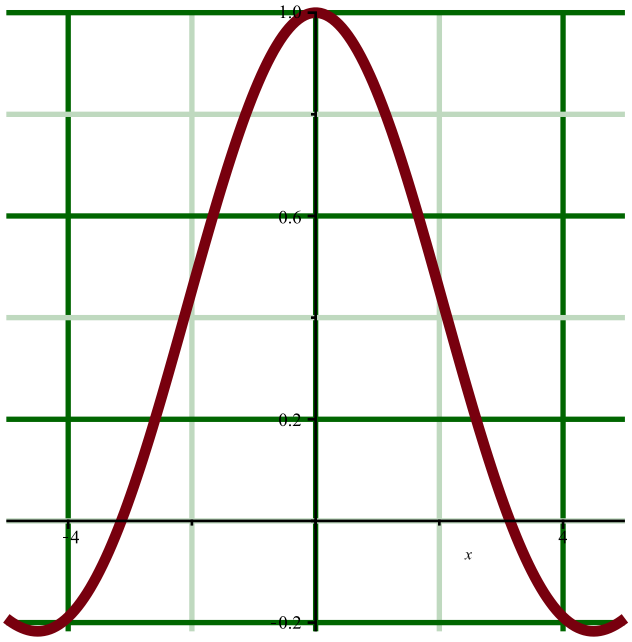



```
> #` `axis[2]=[gridlines=[linestyle=dot], thickness=4]
```

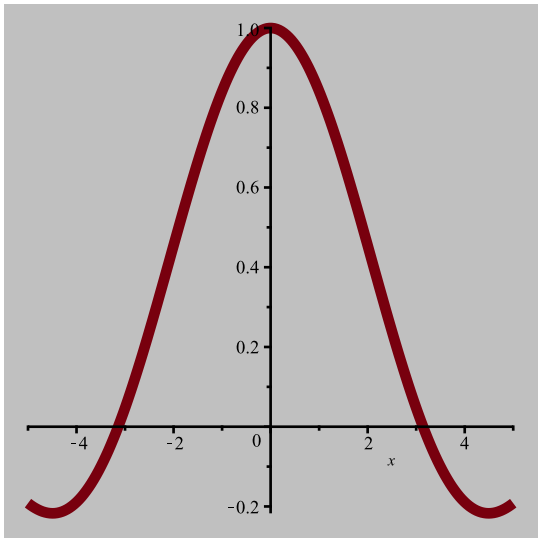
```
> plot(f1(x), x=-5..5, thickness=4, axis[2]=[gridlines=[linestyle=dot], thickness=4]);
```




```
> #axis = [gridlines = [colour = RGB(0, 0.4, 0), majorlines = 2, thickness = 2]]
> plot(f1(x), x = -5..5, thickness = 4, axis = [gridlines = [colour = RGB(0, 0.4, 0), majorlines
      = 2, thickness = 2]]);
```

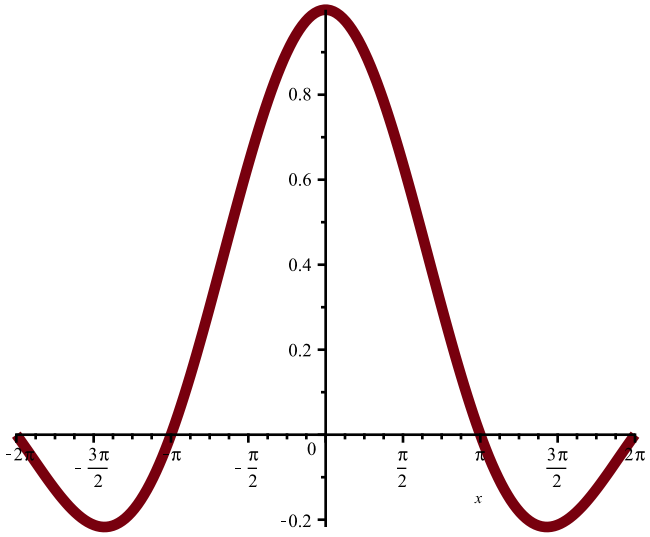



```
> #background="gray"
> plot(f1(x), x = -5..5, thickness = 4, background = "gray");
```




```
> # caption, typeset, captionfont
```

```
> plot(f1(x), caption = typeset("Это график ", sin(x)/x, "."), captionfont = ["HELVETICA",
      "ITALIC", 25], thickness = 4);
```

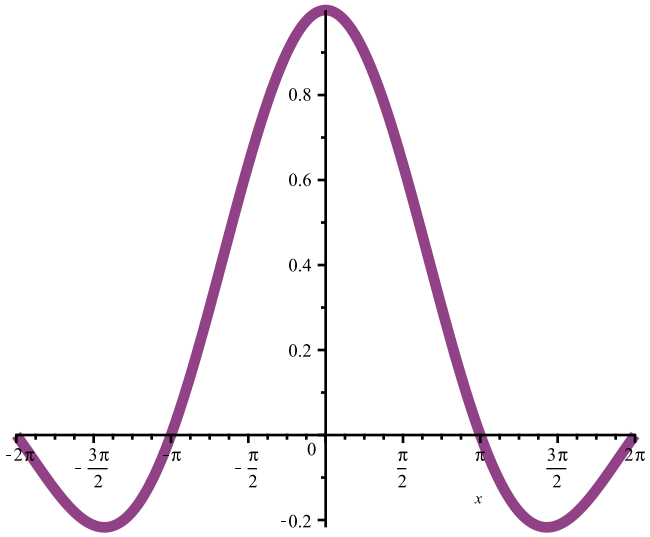



Это график $\frac{sin(x)}{x}$.

```
> # color=n or colour=n
```

```
> # color="Niagara DarkOrchid"
```

```
> plot(f1(x), caption = typeset("Это график ", sin(x)/x, "."), captionfont = ["HELVETICA",
      "ITALIC", 25], thickness = 4, color = "Niagara DarkOrchid")
```

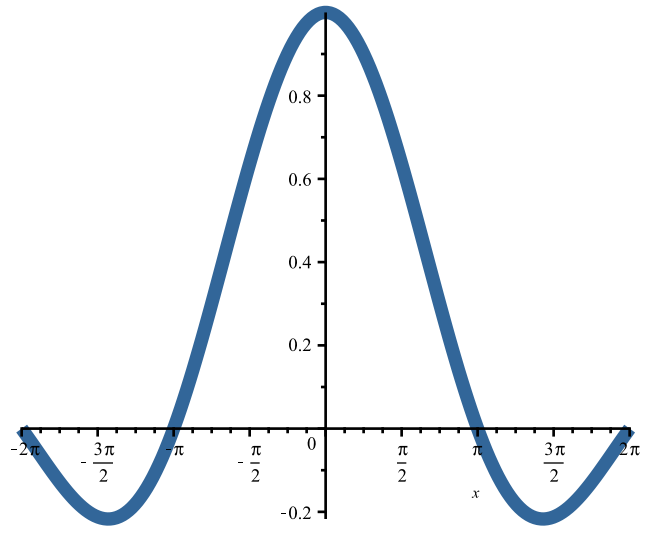



Это график $\frac{sin(x)}{x}$.

```
> #` `myColor := ColorTools:-Color([0.196, 0.4, 0.6])
```

```
> myColor := ColorTools:-Color([0.196, 0.4, 0.6]) :
```

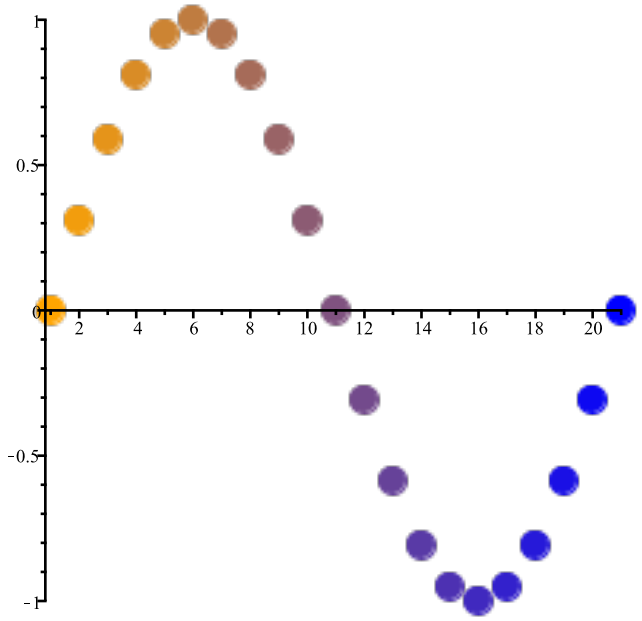
```
> plot(f1(x), caption = typeset("Это график ", sin(x)/x, "."), captionfont = ["HELVETICA",
      "ITALIC", 25], thickness = 5, color = myColor)
```




Это график $\frac{sin(x)}{x}$.

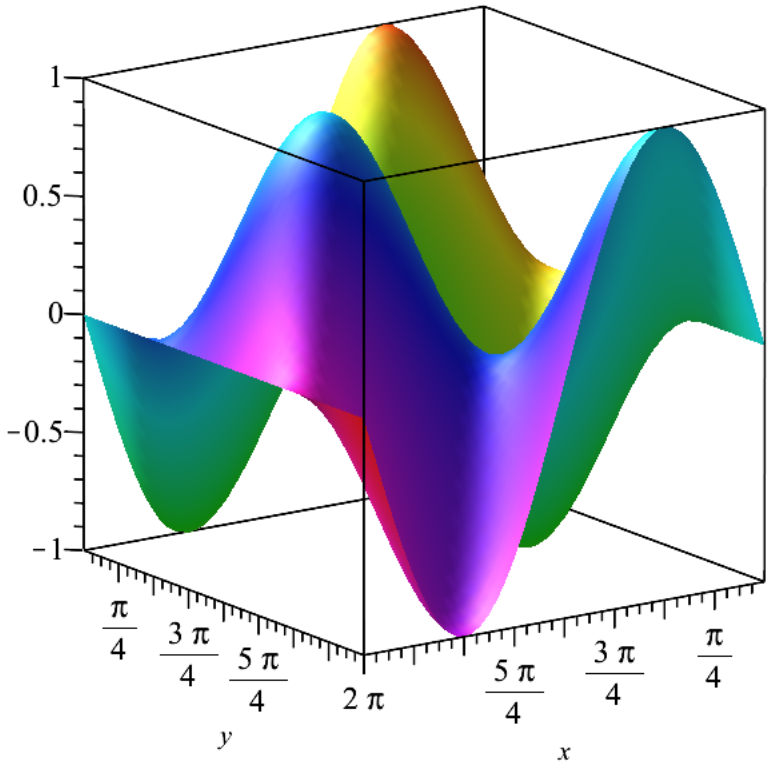
```
> #` `colorscheme = ["Orange", "Blue"]
```

```
> dataplot([seq(sin(i*π/10), i = 0..20)], colorscheme = ["Orange", "Blue"], style = point,
      symbolsize = 30)
```




> #` `colorscheme`=["xyzcoloring", (x, y, z) ↦ x + y − z^2]

> plot3d(sin(x) cos(y), x = 0 ..2 π, y = 0 ..2 π, colorscheme = ["xyzcoloring", (x, y, z) ↦ x + y − z^2], style = surface);




> # discont

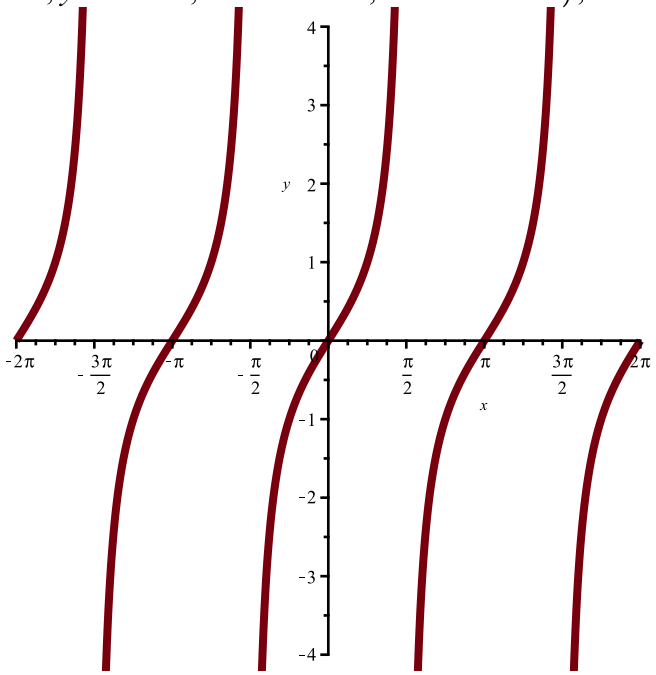
> *# Если строится функция с разрывом, могут возникнуть проблемы. Во-первых, оценка в точке разрыва или очень близко к ней может привести к неопределенным значениям или к чрезвычайно большим или малым значениям, создавая тем самым искаженное представление о графике. Также может произойти некорректное соединение соседних точек по разрыву.*

> *#Команда построения графика использует команды discont и fdiscont для обнаружения разрывов и делит диапазон построения на поддиапазоны, в которых график является непрерывным.*

*Опция discont принимает значения true* и *false, причем значение по умолчанию — false.*

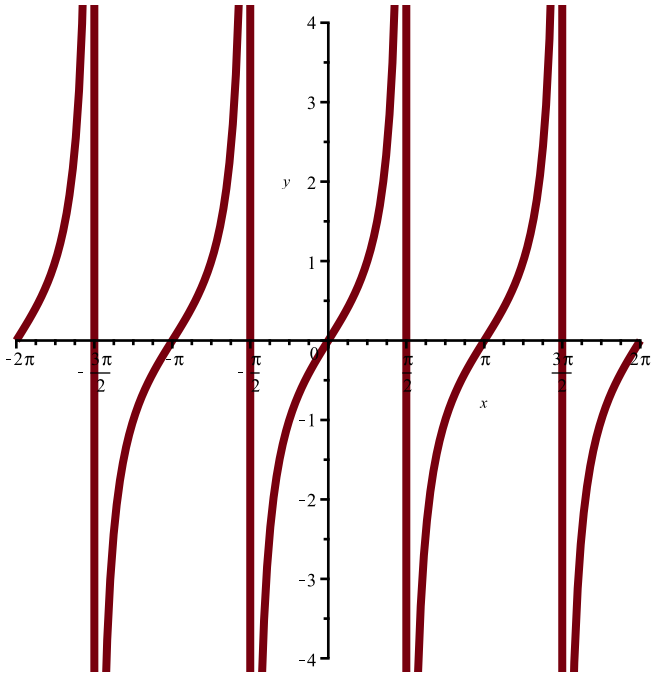
> ***# discont=true***

> $plot(\tan(x), x = -2\pi..2\pi, y = -4..4, thickness = 3, discont = true);$



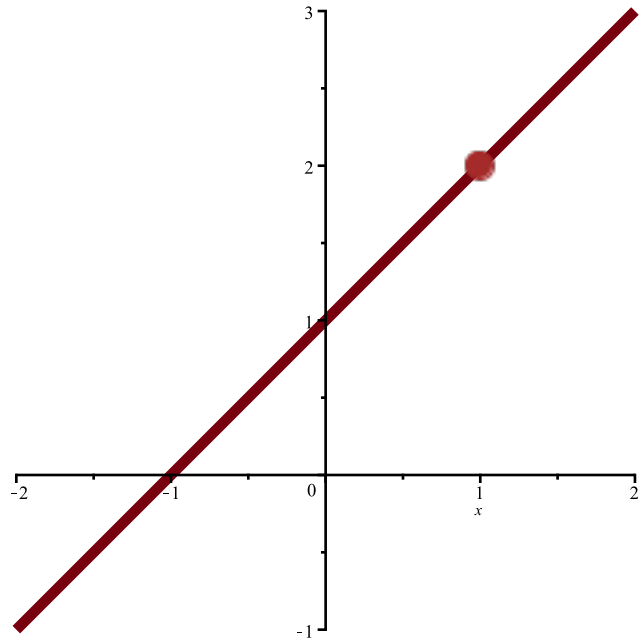

> ***# discont=false***

> $plot(\tan(x), x = -2\pi..2\pi, y = -4..4, thickness = 3, discont = false);$



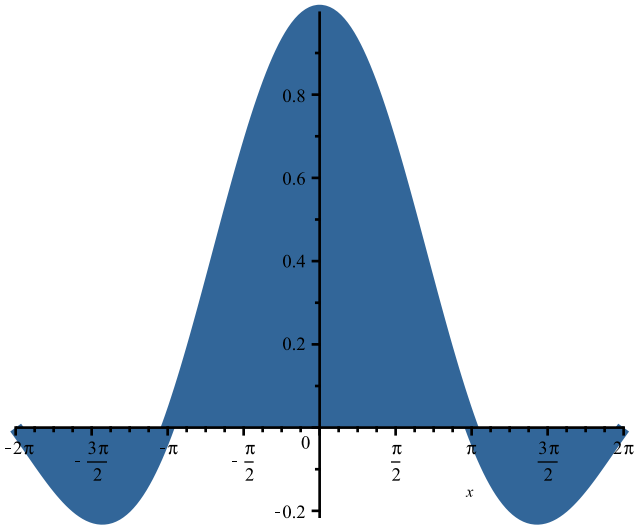

```
> #discont = [showremovable = [color = "Brown", symbol = "solidcircle", symbolsize = 30 ]]
```

```
> plot( (x^2 - 1)/(x - 1), x = -2 ..2, thickness = 4, discont = [showremovable = [color = "Brown", symbol
      = "solidcircle", symbolsize = 30 ]] );
```




```
> # filled Эта опция работает с декартовой системой координат.
```

```
> plot( f1(x), caption = typeset( "Это график ", sin(x)/x, "." ), captionfont = ["HELVETICA",
      "ITALIC", 25 ], thickness = 5, color = myColor, filled = true ) ;
```




Это график $\frac{sin(x)}{x}$.

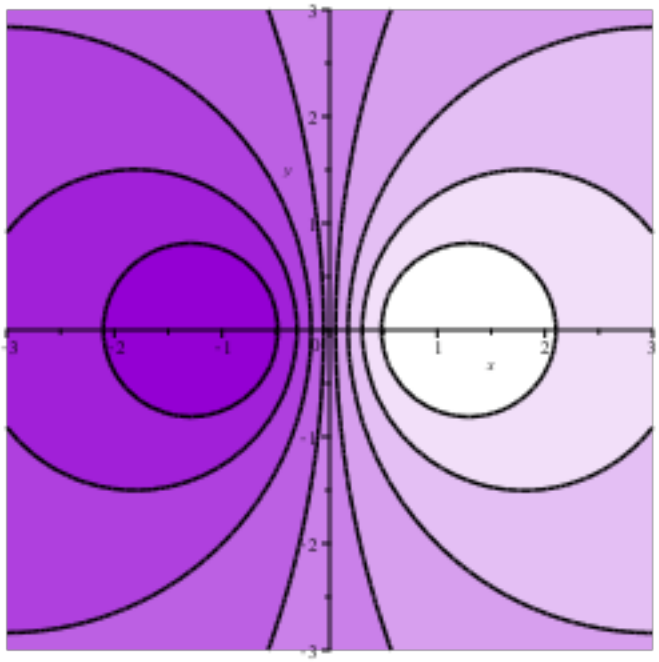
```
> # filledregions
```

```
> #Эта опция действительна только со следующими командами:
  contourplot, implicitplot и listcontplot. Эта опция не работает с недекартовыми системами
```

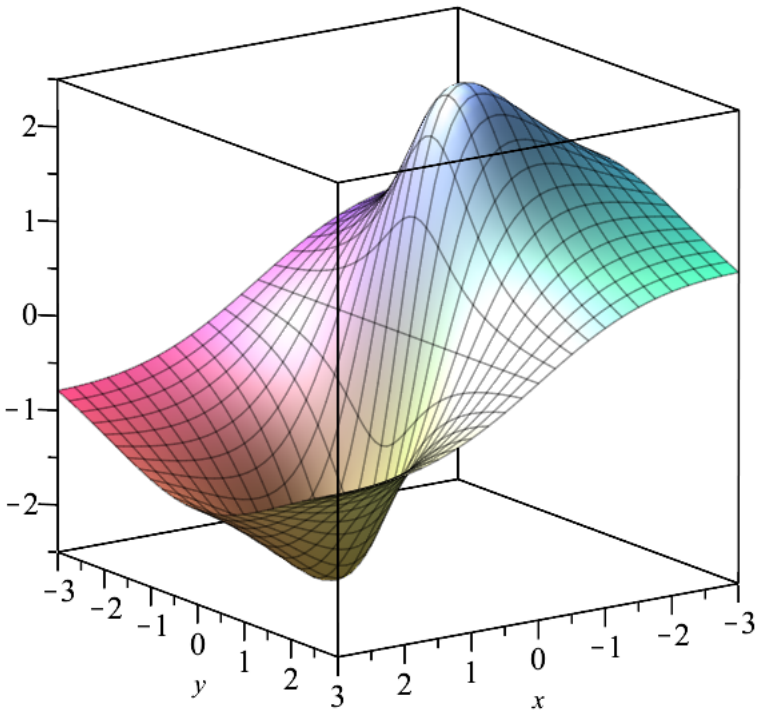
```
> with(plots);
```

[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot] **(2)**

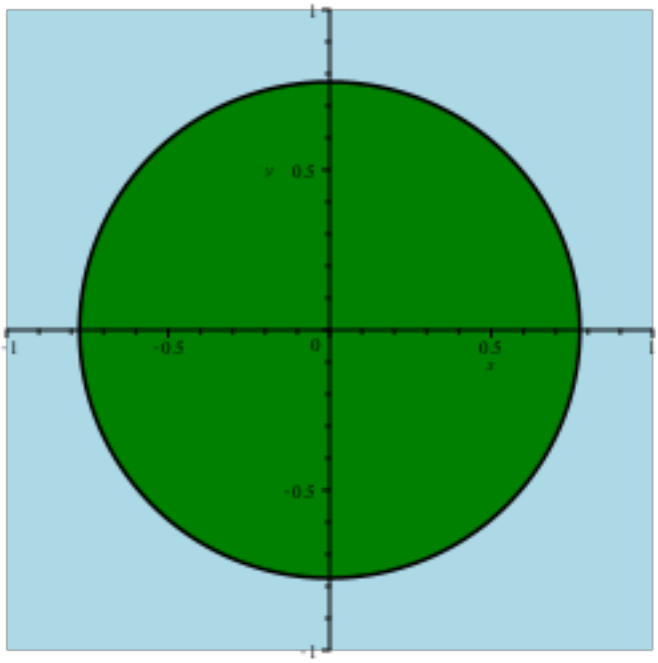
```
> contourplot( -5*x/(x^2+y^2+1), x=-3..3, y=-3..3, filledregions=true, coloring=["White", "DarkViolet"] )
```



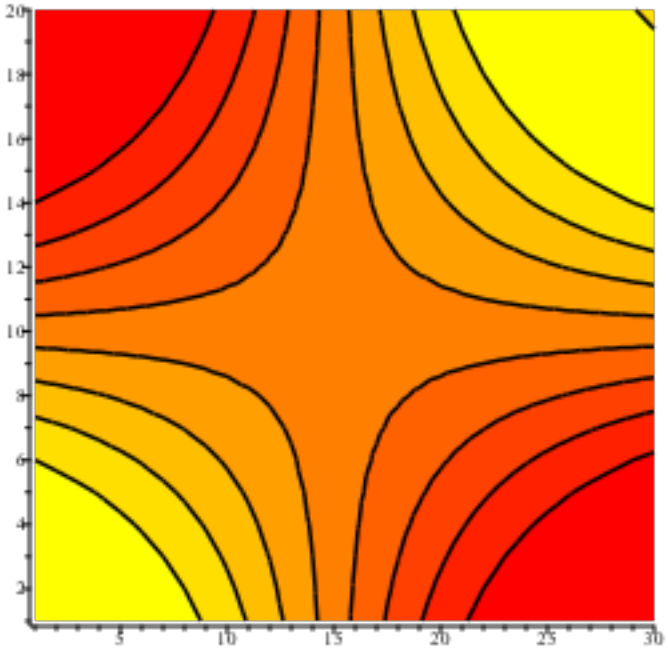
> $plot3d\left(-\frac{5x}{x^2+y^2+1}, x=-3..3, y=-3..3\right)$




> $implicitplot\left(x^2+y^2-0.6, x=-1..1, y=-1..1, coloring=["Green", "LightBlue"], filledregions=true\right);$

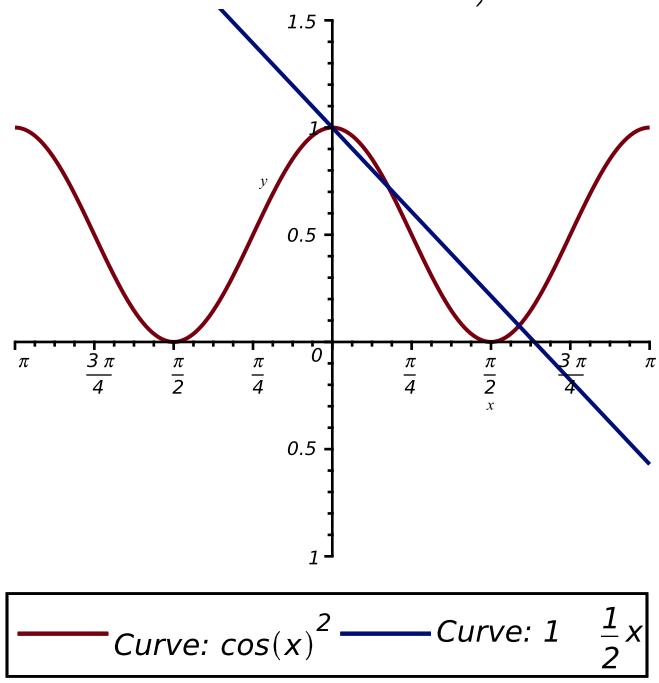


```
> listcontplot([[seq([seq(sin((i-15)*(j-10)/(20*Pi)), i=1..30)], j=1..20)], filledregions=true);
```



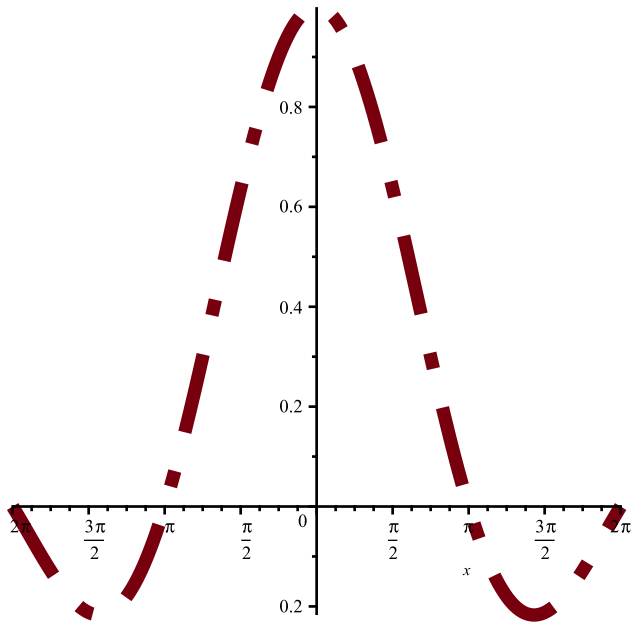
```
> # legend legendstyle
> #`legendstyle=[font=["HELVETICA","ITALIC",18],location=bottom]
> plot([[cos(x)^2, 1-1/2*x]], x=-Pi..Pi, y=-1..1.5, legend=[typeset("Curve: ", cos(x)^2), typeset("Curve: ", 1-1/2*x)], font=["HELVETICA","ITALIC",12], legendstyle=[font
```

$= [\text{"HELVETICA"}, \text{"ITALIC"}, 18], location = bottom]\Big);$




```
> # linestyle
```

```
> plot(f1(x), thickness = 5, linestyle = dashdot);
```



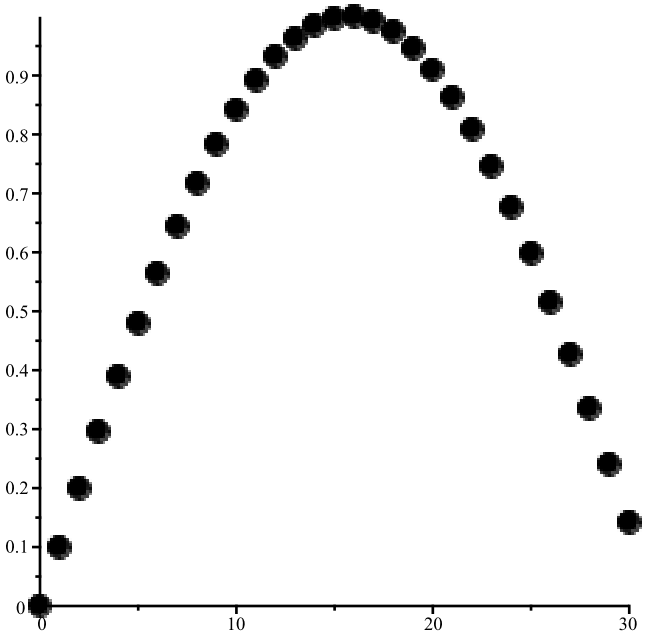

```
> #Error
```

```
> plot(f1(x), thickness = 5, linestyle = dshdot);
```

```
Error, (in plot) expecting option [linestyle, line style] to be of
type {nonnegint, identical("dash", "dashdot", "dot", "longdash",
"solid", "spacedash", "spacedot", "ticks")} but received dshdot
```

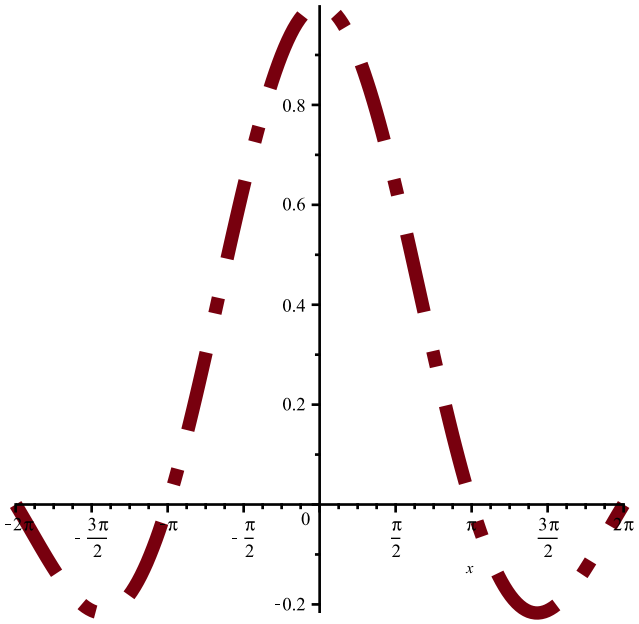
```
> # numpoints
```

```
> pointplot({seq([n, sin(n/10)], n = 0..30)}, symbol = "solidcircle", symbolsize = 24, numpoints = 30);
```

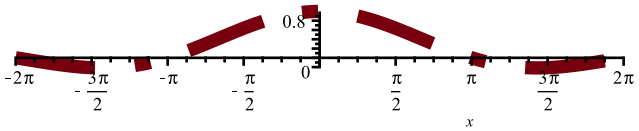



```
> #scaling=constrained unconstrained
```

```
> plot(f1(x), thickness = 5, linestyle = dashdot, scaling = unconstrained);
```

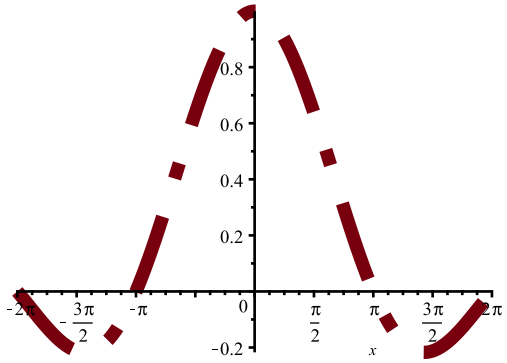



```
> plot(f1(x), thickness = 5, linestyle = dashdot, scaling = constrained);
```

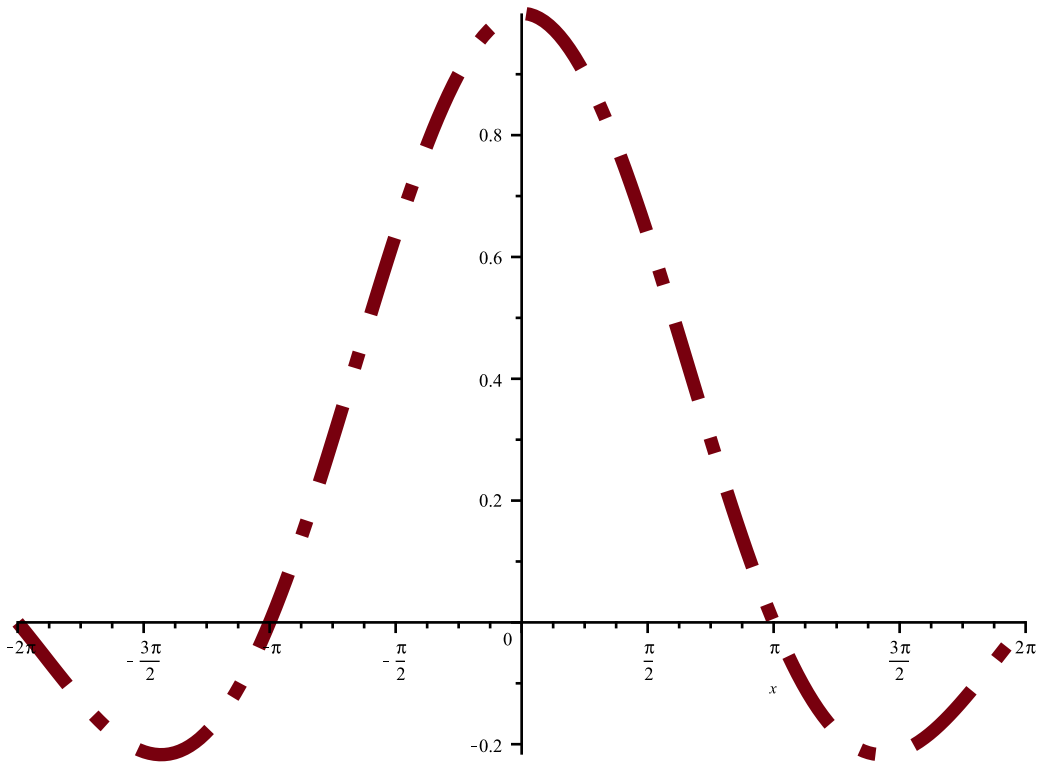



> # ***size***=[**800, 600**] - ***размер графического окна***

> *plot*(*f1*(*x*), *thickness* = 5, ***linestyle*** = *dashdot*, *size* = [400, 300]) ;



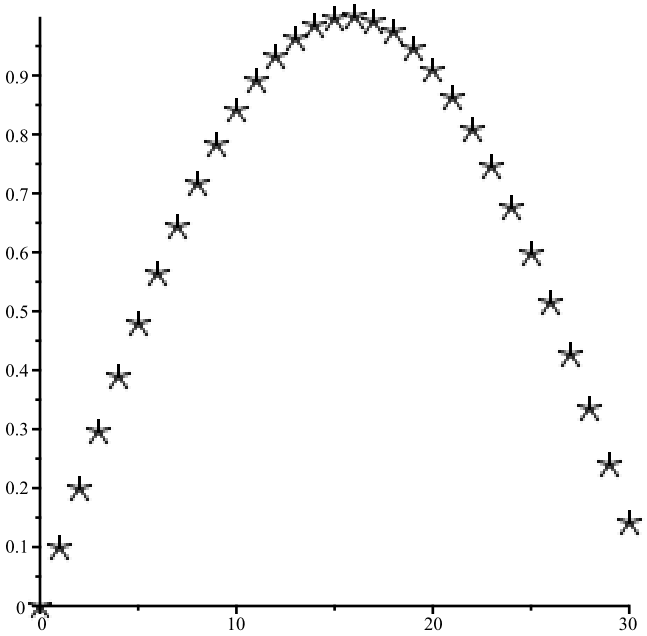

> *plot*(*f1*(*x*), *thickness* = 5, ***linestyle*** = *dashdot*, *size* = [800, 600]) ;




```
> # symbol symbolsize
> #Error
> pointplot( {seq( [n, sin( n/10 )], n = 0..30 )}, symbol = "slidcircle", symbolsize = 24, numpoints
      = 30 );
```

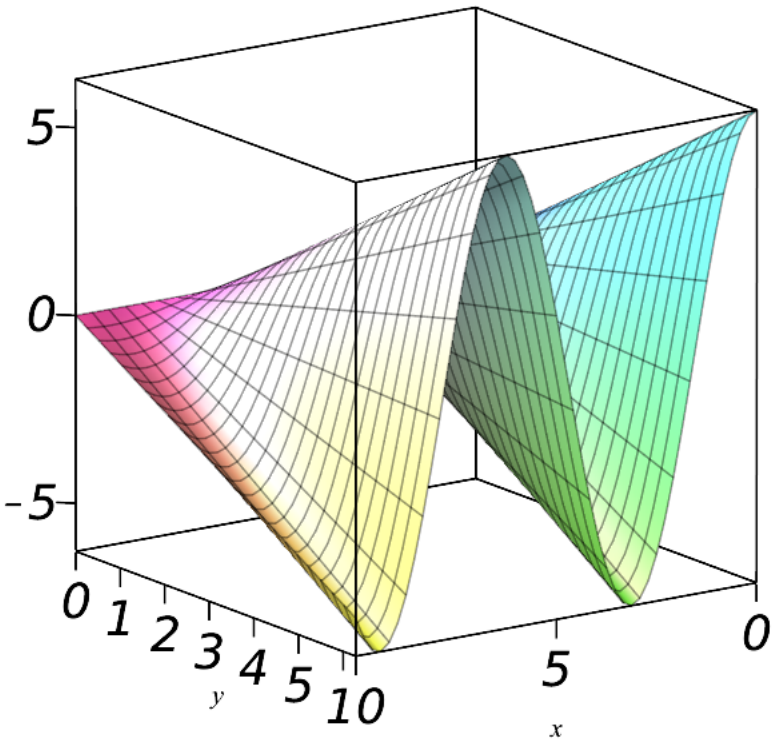
Error, (in plots:-pointplot) expecting option symbol to be of type identical("asterisk", "box", "cross", "circle", "diagonalcross", "diamond", "point", "solidcircle", "solidbox", "soliddiamond") but received slidcircle

```
> pointplot( {seq( [n, sin( n/10 )], n = 0..30 )}, symbol = "asterisk", symbolsize = 24, numpoints
      = 40 );
```



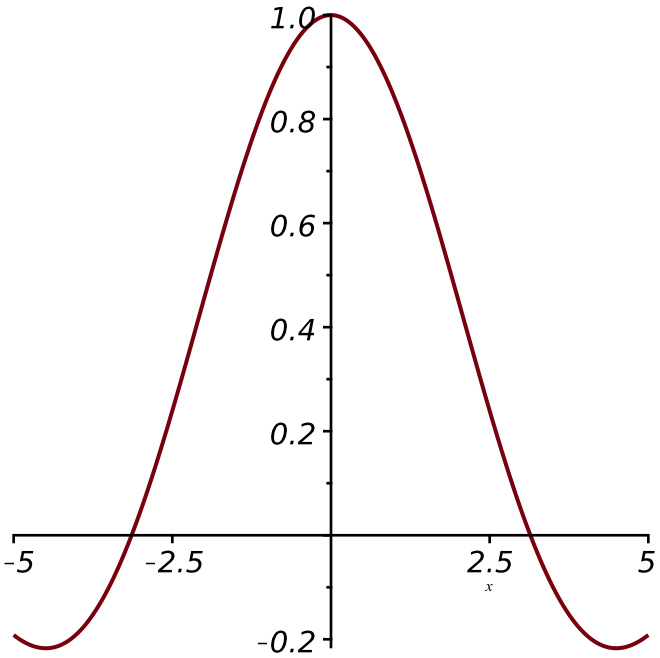

```
> #tickmarks
```

```
> plot3d(y cos(x), x = 0 ..10, y = 0 ..2 π, tickmarks = [4, 6, 3], axes = boxed, font
      = ["HELVETICA", "ITALIC", 18]);
```



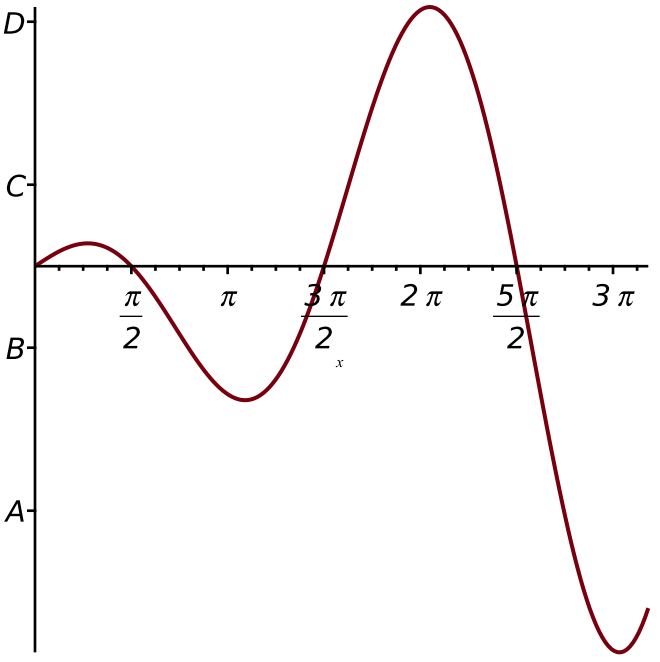

```
> #`tickmarks = [[-5, -2.5, 2.5, 5], default]
```

```
> plot(f1(x), x = -5..5, tickmarks = [[-5, -2.5, 2.5, 5], default], font = ["HELVETICA",
      "ITALIC", 18])
```



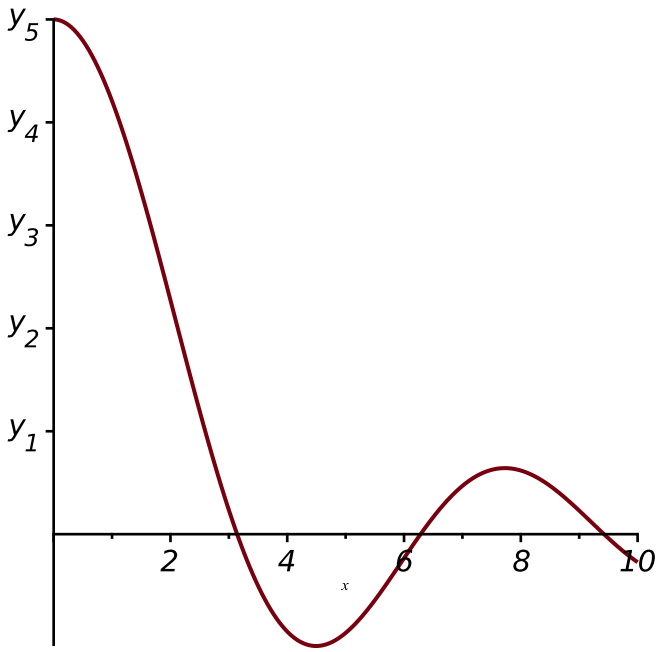

```
> # tickmarks=[piticks, [ — 6 = "A", — 2 = "B", 2 = "C", 6 = "D"]]
```

```
> plot(x cos(x), x = 0..10, tickmarks = [piticks, [ — 6 = "A", — 2 = "B", 2 = "C", 6 = "D"]], font
      = ["HELVETICA", "ITALIC", 18]);
```

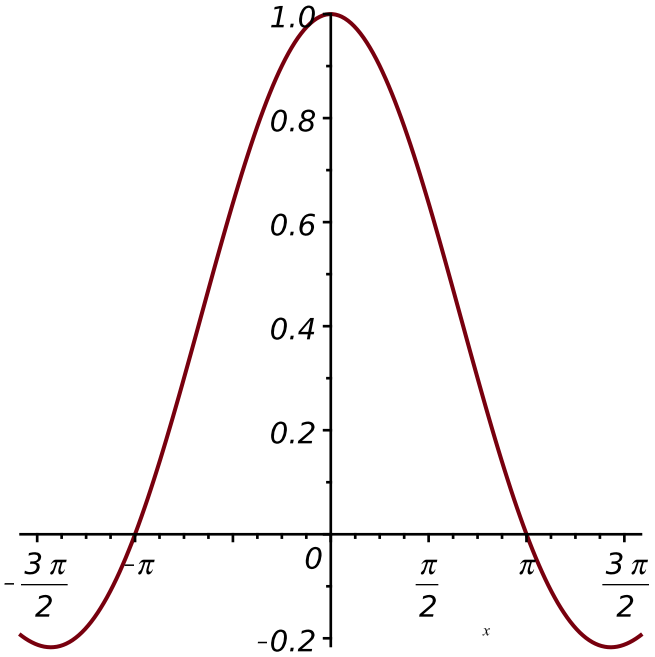



```
> #`tickmarks = [default, [seq(i/5 = y[i], i = 1..5)]]
```

```
> plot(f1(x), x = 0..10, tickmarks = [default, [seq(i/5 = y[i], i = 1..5)]], font
      = ["HELVETICA", "ITALIC", 18])
```




```
> # tickmarks = [piticks, decimalticks]
> plot(f1(x), x = -5..5, tickmarks = [piticks, decimalticks], font = ["HELVETICA", "ITALIC",
      18]) ;
```



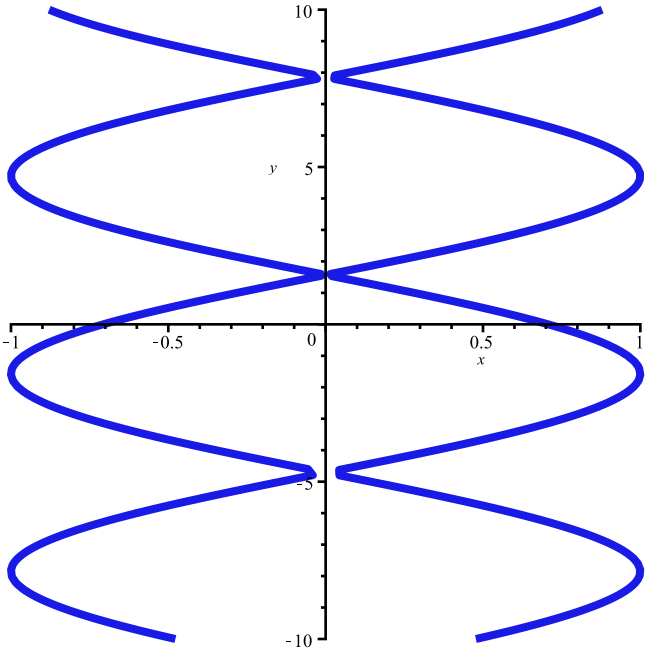

```
> # Библиотека plots
> with(plots);
```

[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal, conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display, dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal, interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot, listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot, **(3)**

*pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot, rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween, spacecurve, sparsematrixplot, surfdata, textplot, textplot3d, tubeplot* ]

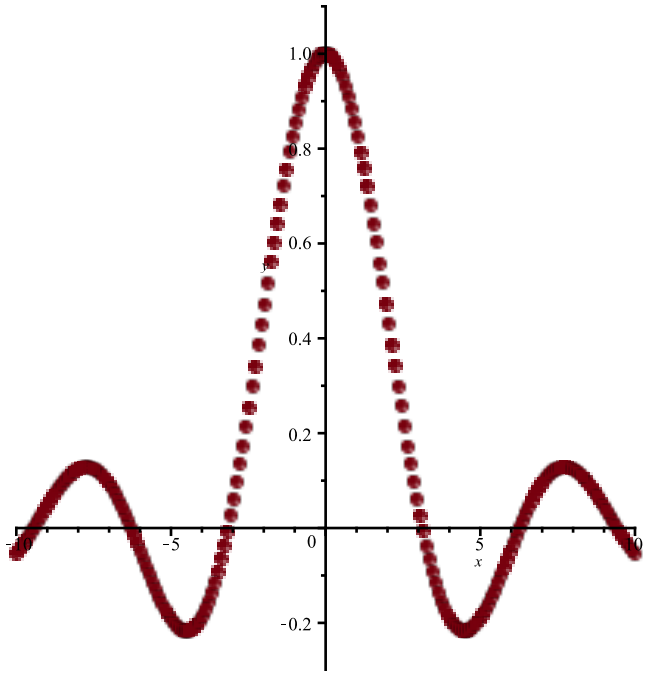
```
> #?implicitplot;
```

```
> implicitplot(2·x^2 + sin(y) = 1, x = -1..1, y = -10..10, color = COLOR(RGB, 0.1, 0.1, 0.9),
      scaling = UNCONSTRAINED, thickness = 3);
```




```
> #` `style = point
```

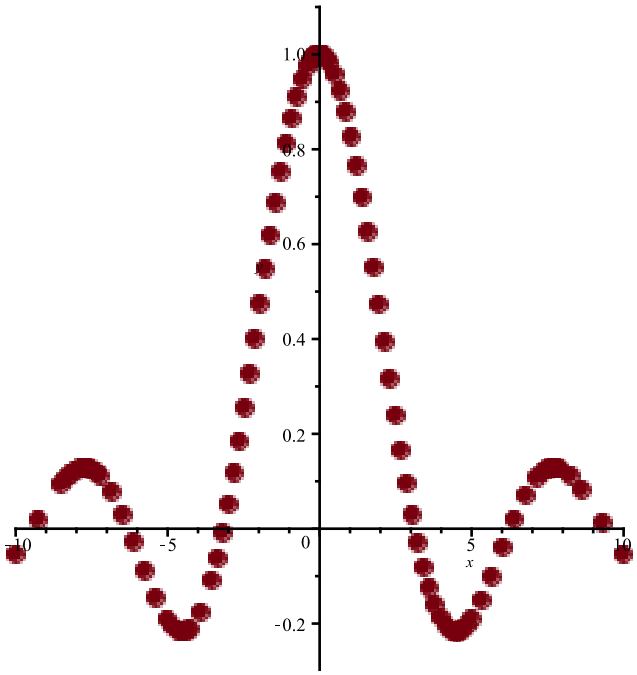
```
> plot(f1(x), x = -10..10, y = -0.3..1.1, style = point, symbol = solidcircle, symbolsize = 15);
```



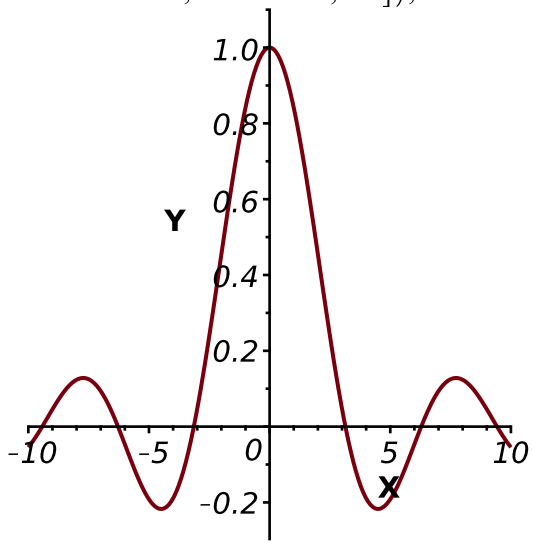

```
> #` `style = point, symbol = solidcircle, symbolsize = 20, numpoints = 15
```

```
> plot(f1(x), x = -10..10, y = -0.3..1.1, style = point, symbol = solidcircle, symbolsize = 20,
```

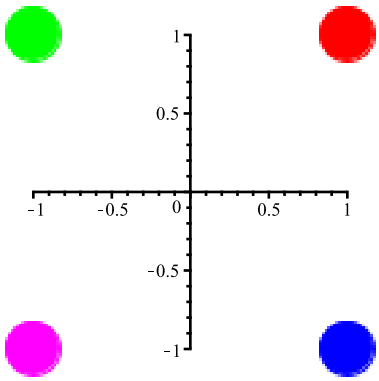
**numpoints = 15**);




> *plot*(*f1*(*x*), *x* = −10 ..10, y = −0.3 ..1.1, labels = ["X", "Y"], *labelfont* = ["HELVETICA", "BOLD", 18], *font* = ["HELVETICA", "ITALIC", 18]);

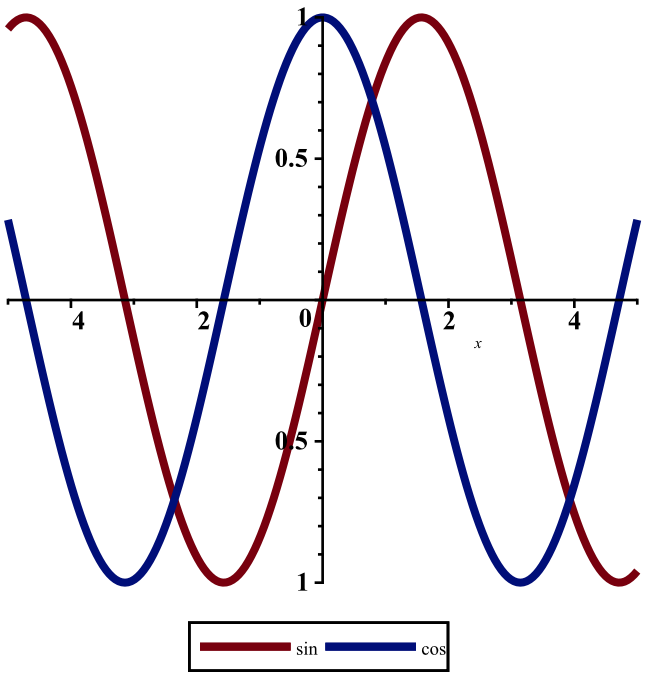



> *pointplot*([[1, 1], [−1, 1], [1, −1], [−1, −1]], *color* = ["red", "green", "blue", "magenta"], *symbolsize* = 80, *symbol* = "solidcircle");



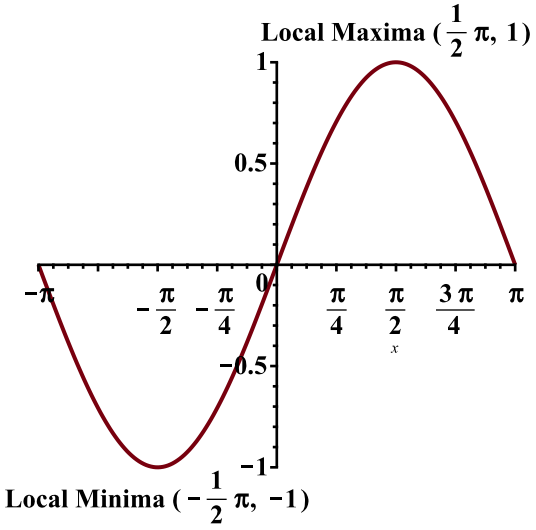

```
> # list [sin(x), cos(x)]
```

```
> plot([sin(x), cos(x)], x=-5..5, thickness=3, legend=["sin", "cos"], font=[ARIAL, BOLD,
      16]);
```




```
> #?textplot; display
```

```
> p := plot(sin(x), x = Pi..Pi, font=[ARIAL, BOLD, 16]) :
  t1 := textplot([Pi/2, 1, typeset("Local Maxima (", Pi/2, ", ", 1, ")")], align=above) :
  t2 := textplot([ Pi/2, 1, typeset("Local Minima (", Pi/2, ", ", 1, ")")], align=below) :
  display({p, t1, t2});
```



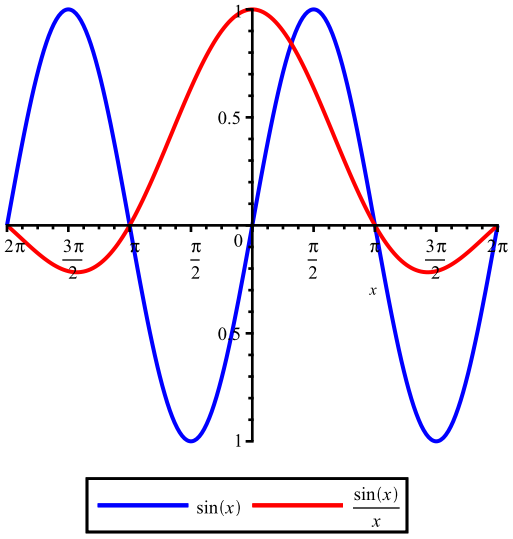

```
> #display
```

```
> p1 := x→sin(x) : p2 := x→sin(x)/x :
```

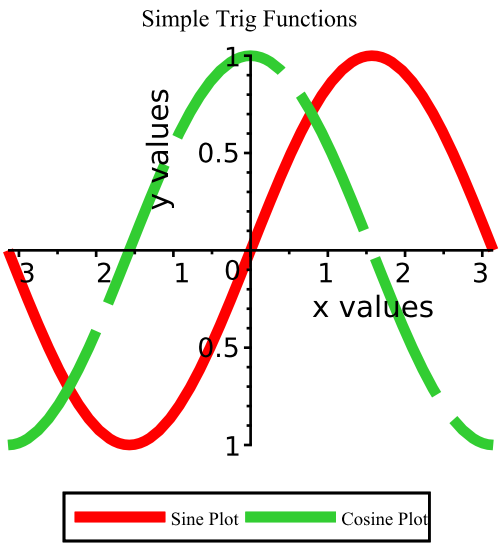
```
> y1 := plot(p1(x), color = "blue", legend = "sin(x)") :
```

```
> y2 := plot(p2(x), color = "red", legend = "sin(x)/x") :
```

```
> display(y1, y2);
```

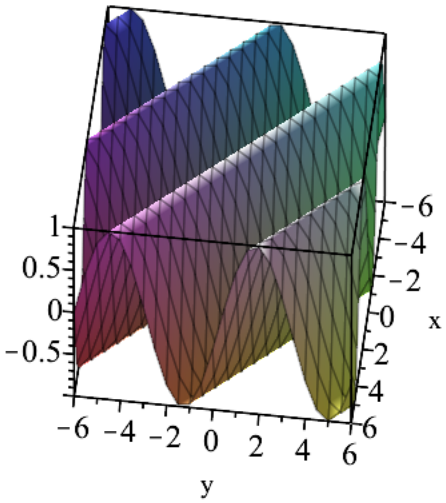



```
> plot( [sin, cos], π..π, thickness = 4, title = "Simple Trig Functions", legend = ["Sine Plot",
      "Cosine Plot"], titlefont = ["ARIAL", 15], labels = ["x values", "y values"], labeldirections
      = ["horizontal", "vertical"], labelfont = ["HELVETICA", 18], linestyle = [solid, longdash],
      axesfont = ["HELVETICA", "ROMAN", 16], legendstyle = [font = ["HELVETICA", 16],
      location = bottom]);
```



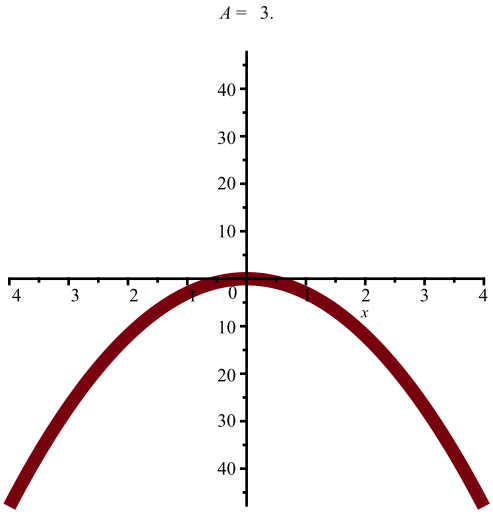

> ***#plot3d***

> $plot3d(\sin(x+y), x=-6..6, y=-6..6);$

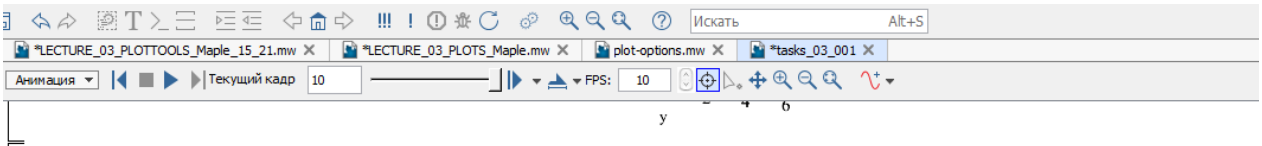



> ***#animate***

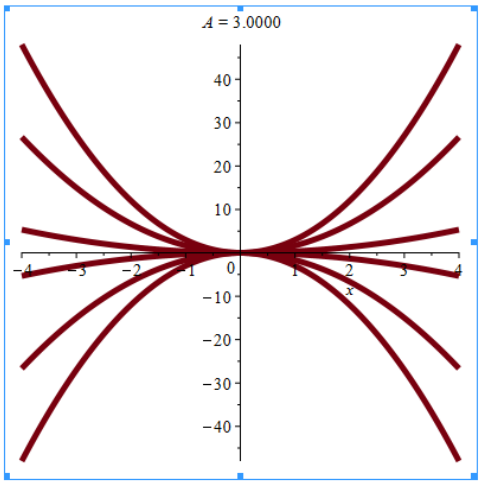
> animate( plot, [A*x^2, x=-4..4], A=-3..3, frames=10, trace=5 , thickness=5);



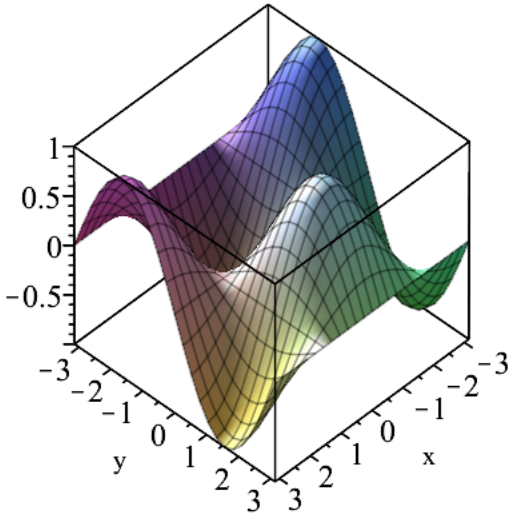
```
>
```



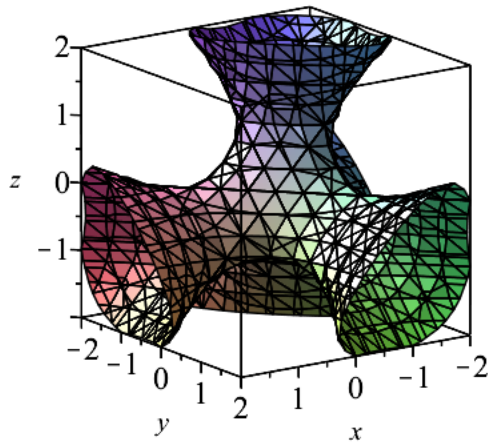

```
> #animate
> animate( plot, [A*x^2, x=-4..4], A=-3..3, frames = 10, trace = 5 , thickness
      = 5);
```




```
> #animate3d
> animate3d(cos(t*x)*sin(t*y), x=-Pi..Pi, y=-Pi..Pi, t=1..2);
```

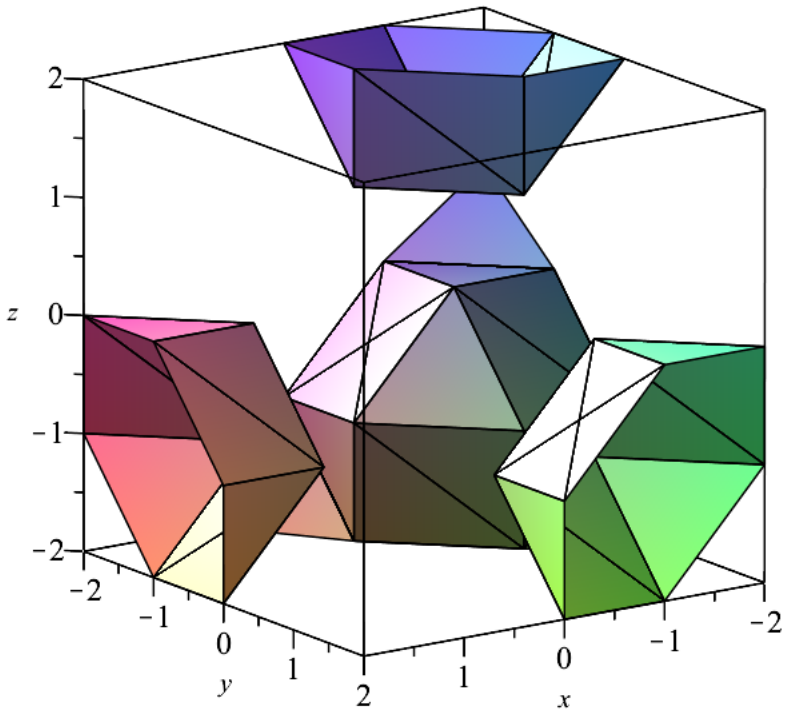



```
> #implicitplot3d
> #grid = [15, 15, 15]
> implicitplot3d(x^3 + y^3 + z^3 + 1 = (x + y + z + 1)^3, x=-2..2, y=-2..2, z=-2..2, grid
      = [15, 15, 15]);
```

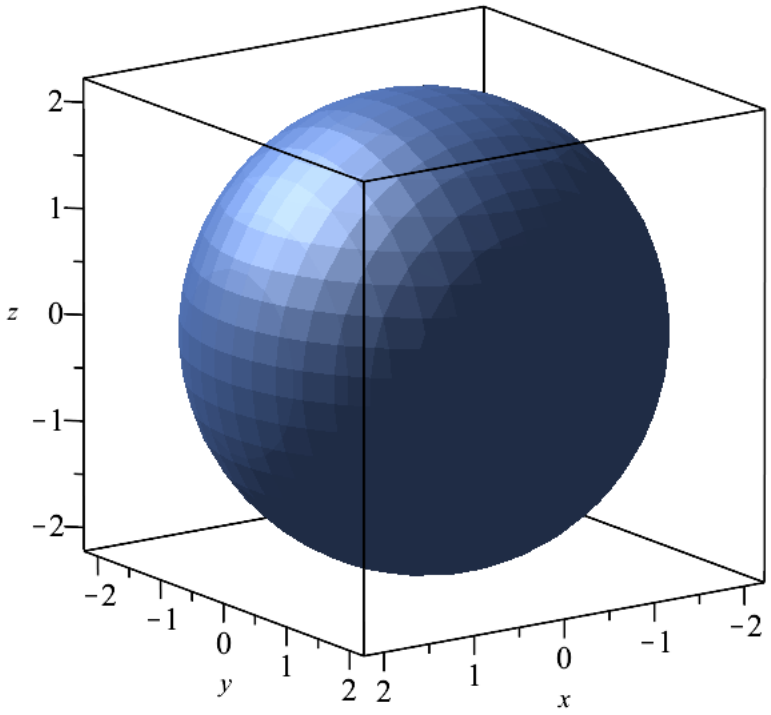



> **#grid** = [**5, 5, 5**]

> *implicitplot3d*(x^3 + y^3 + z^3 + 1 = (x + y + z + 1)^3, x = -2 ..2, y = -2 ..2, z = -2 ..2, **grid** = [**5, 5, 5**]);

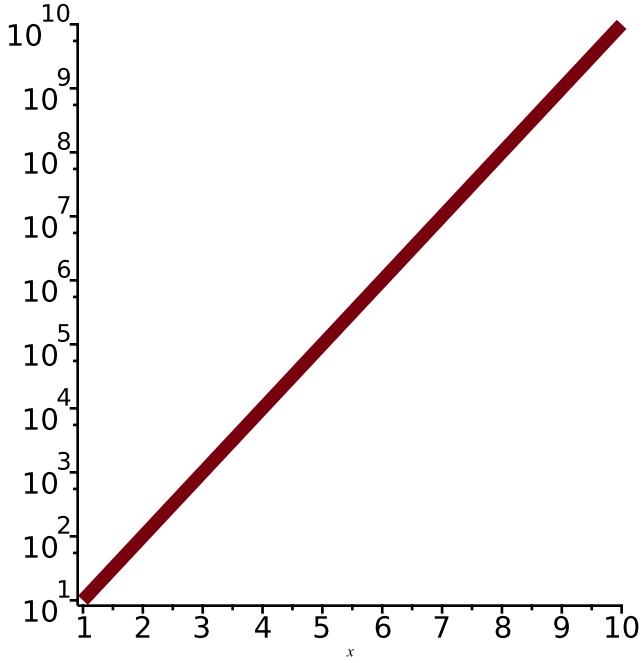



> *implicitplot3d*($x^2 + y^2 + z^2 = 5$, x = -2.6 ..2.6, y = -2.6 ..2.6, z = -2.6 ..2.6, *style* = *surface*, *color* = "Niagara Azure", *grid* = [20, 20, 20])

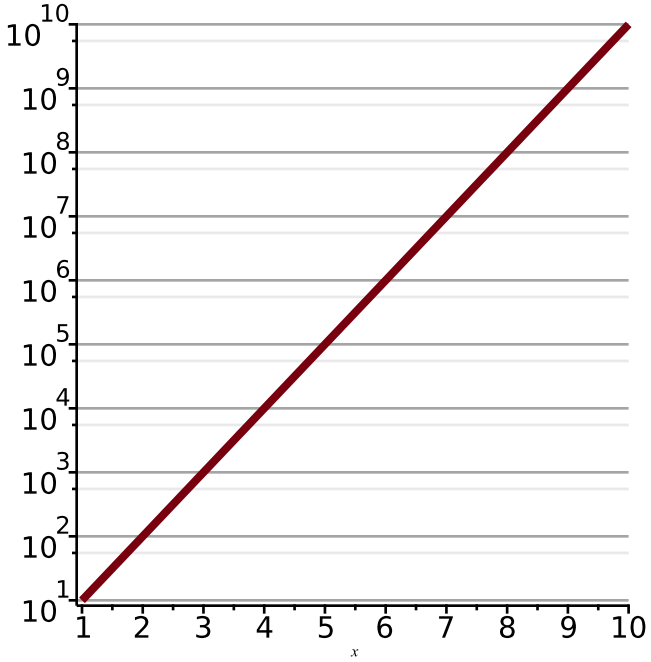



> **# *logplot***

> $logplot\left(10^{x}, x = 1..10, thickness = 5, \text{font} = [\text{"Helvetica"}, \text{"roman"}, 18]\right);$

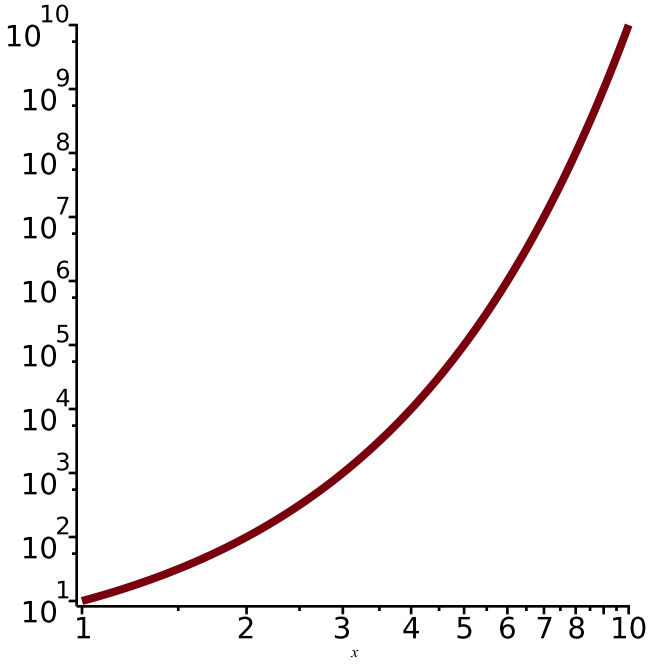



> $logplot\left(10^{x}, x = 1..10, \text{thickness} = 3, axis[2] = [gridlines], \text{font} = [\text{"Helvetica"}, \text{"roman"}, 18]\right);$



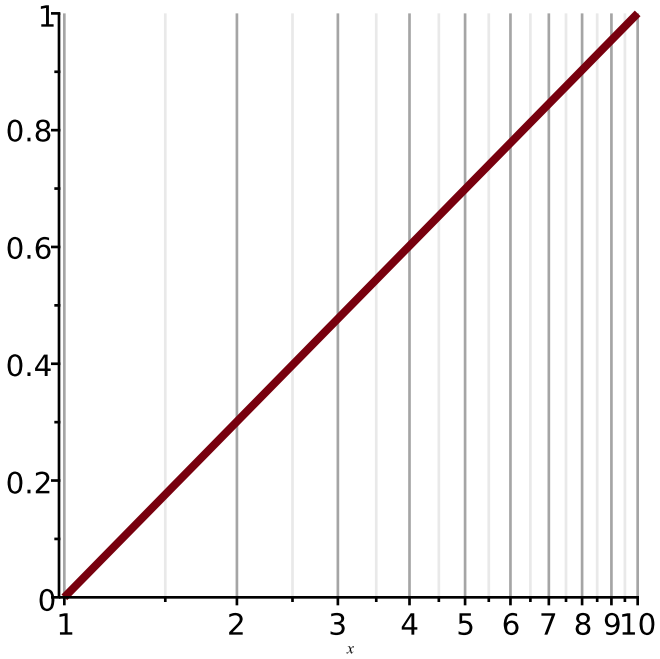

> **# *loglogplot***
> **# *doubly logarithmic plot of functions***

> $loglogplot(10^x, x = 1..10, \text{thickness} = 3, font = [\text{"Helvetica"}, \text{"roman"}, 18])$

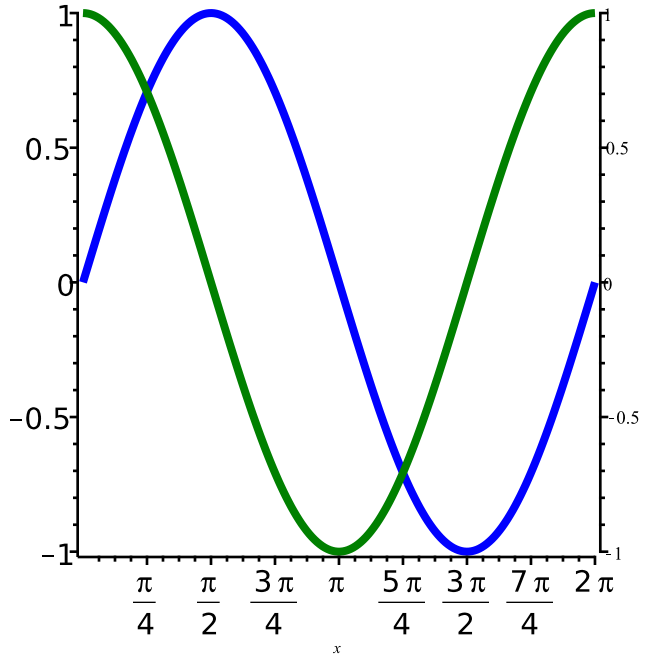



> **#` `*semilogplot***

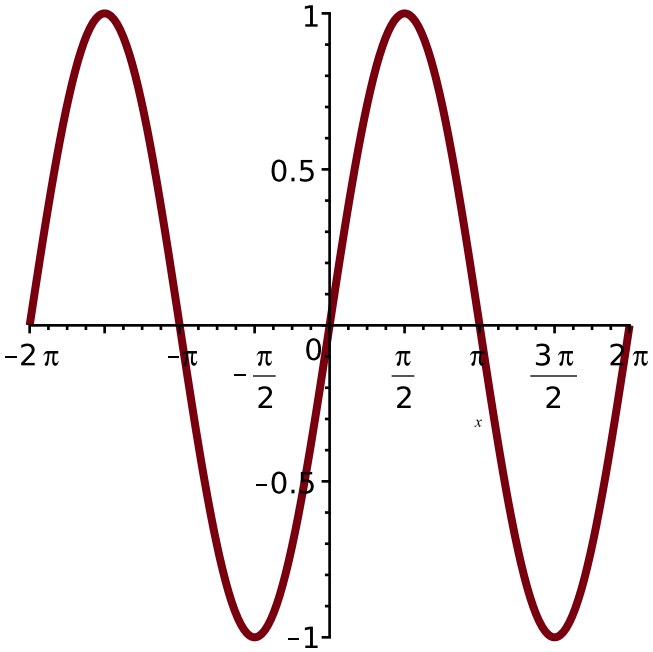
> $\mathbf{semilogplot}(\log[10](x), x = 1..10, \text{thickness} = 3, font = [\text{"Helvetica"}, \text{"roman"}, 18], axis[1] = [gridlines])$



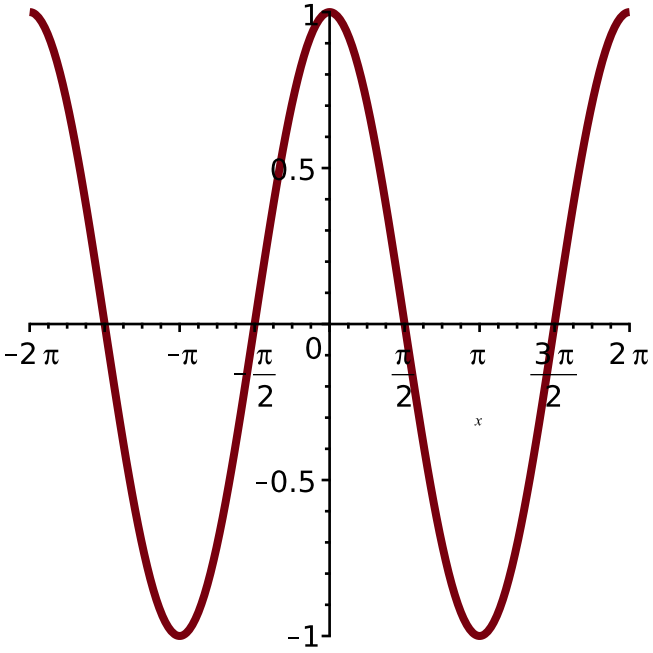

```
> #setoptions
> setoptions(thickness = 3, font = ["Helvetica", "roman", 18]) :
> dualaxisplot(sin(x), cos(x), x = 0 ..2 π, color = ["Blue", "Green"]);
```




```
> #setoptions
> with(plots) :
> setoptions(thickness = 3, font = ["Helvetica", "roman", 18]) :
> plot(sin(x));
```

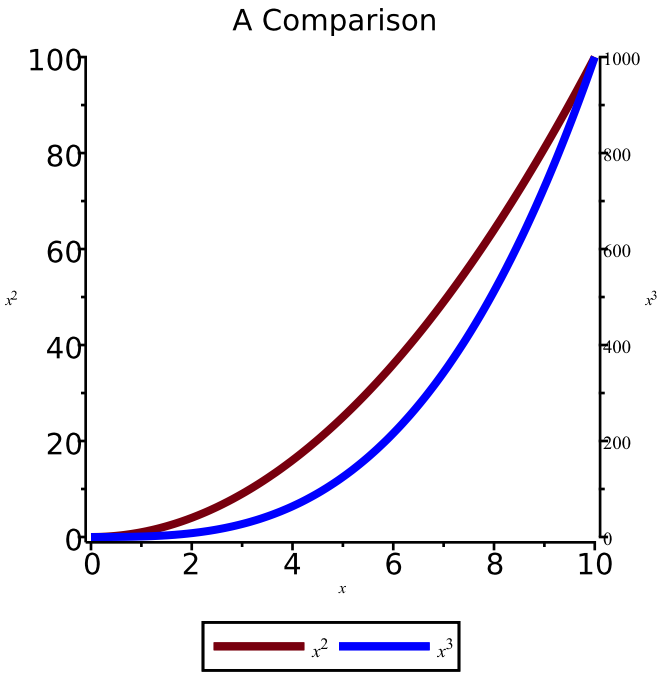



```
> plot(cos(x));
```

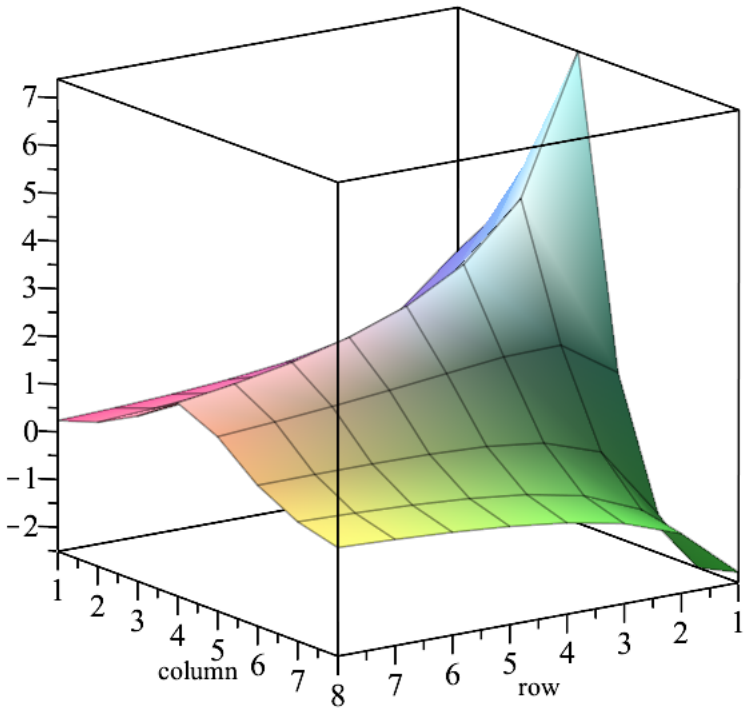



```
> #dualaxisplot
```

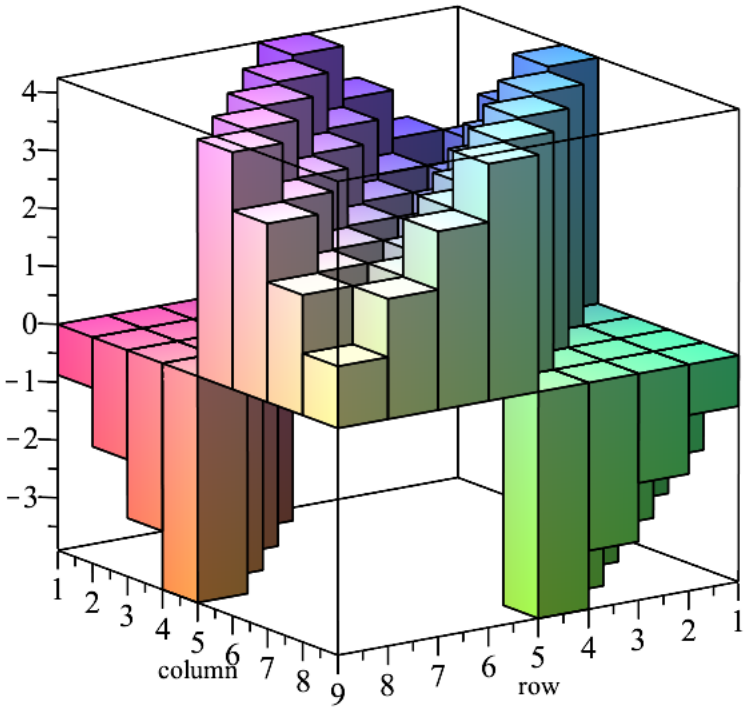
```
> dualaxisplot(plot(x^2, x = 0..10, labels = [x, x^2], legend = x^2), plot(x^3, x = 0..10, color = blue,
      labels = [x, x^3], legend = x^3), title = "A Comparison", thickness = 3, font = ["Helvetica",
      "roman", 18])
```



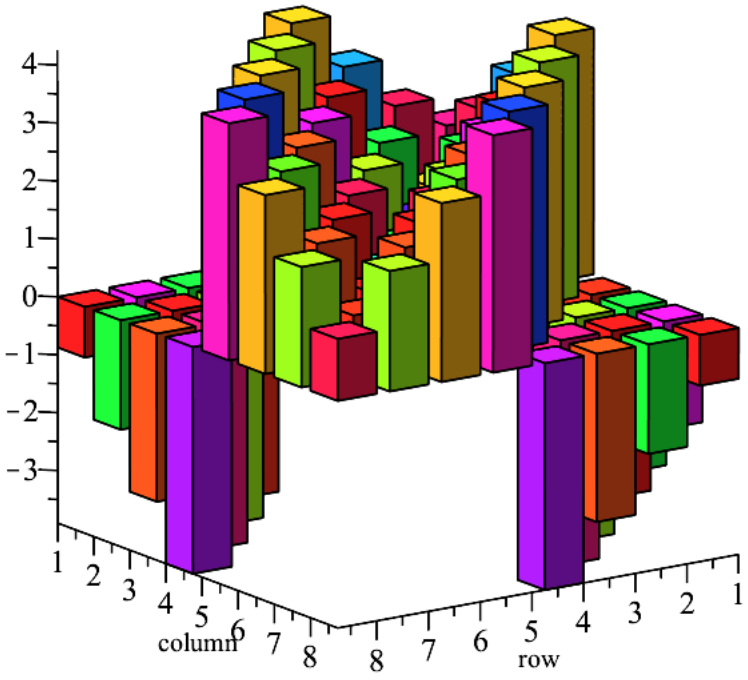

```
> #matrixplot
> with(LinearAlgebra) :
> A := HilbertMatrix(8) : B := ToeplitzMatrix([1, 2, 3, 4,  4,  3,  2,  1], symmetric) :
> matrixplot(A • B)
```



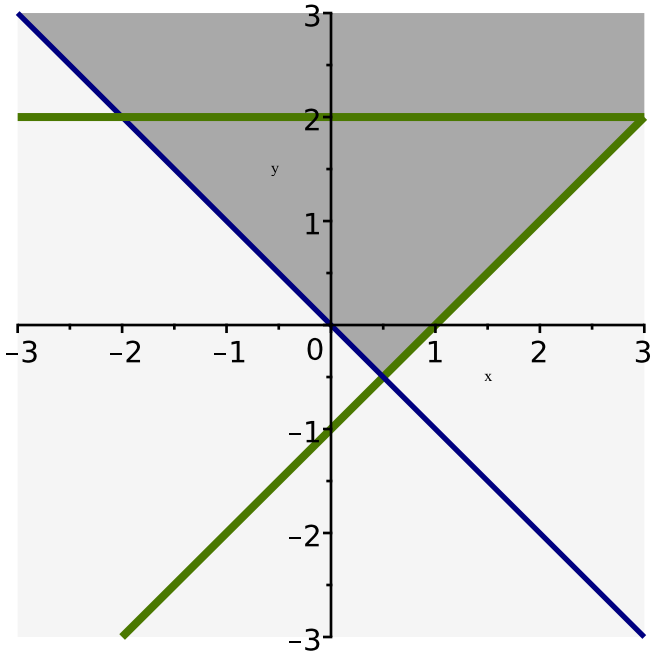
```
> # heights=histogram
> matrixplot(A + B, heights = histogram, axes = boxed) ;
```




```
> # color=F
> F := (x, y) ↦ sin(y·x) :
> matrixplot(A + B, heights = histogram, axes = frame, gap = 0.25, color = F);
```



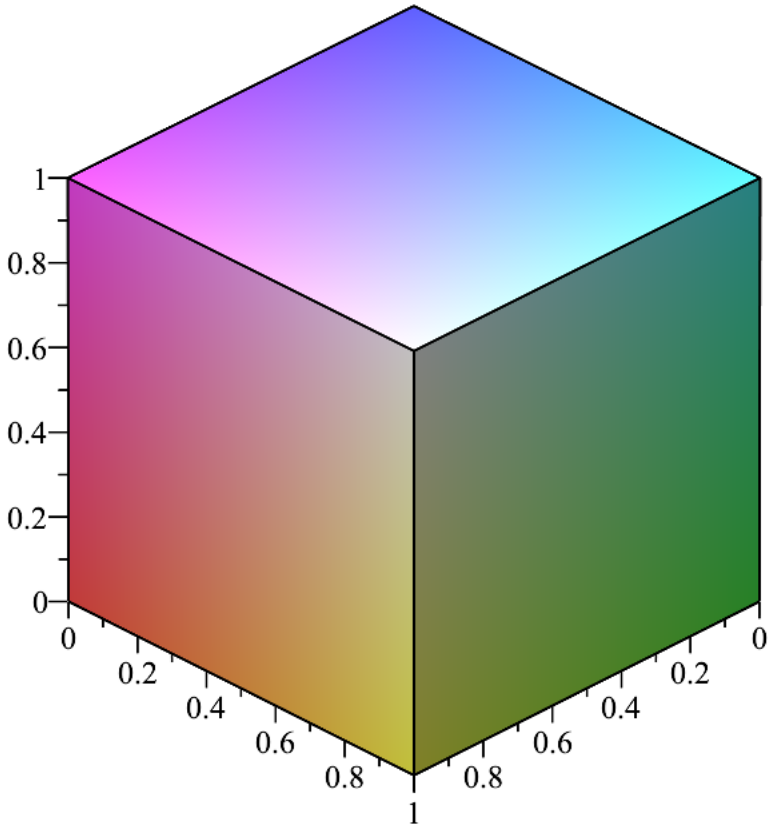

```
> # inequal
> inequal([{0 < x + y, x - y ≤ 1}, {y = 2}], x = -3..3, y = -3..3, optionsfeasible = [color
      = "DarkGrey"], optionsopen = [color = "Navy", thickness = 2], optionsclosed = [color
      = "Niagara Green", thickness = 3], optionsexcluded = [color = "WhiteSmoke"])
```



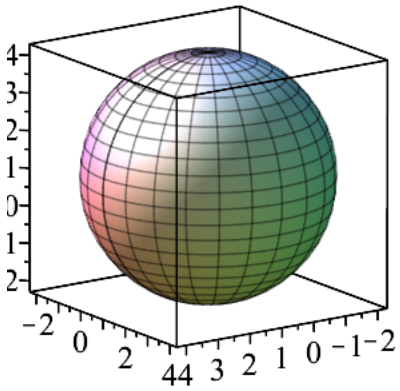

```
>
```

# #plottools Package

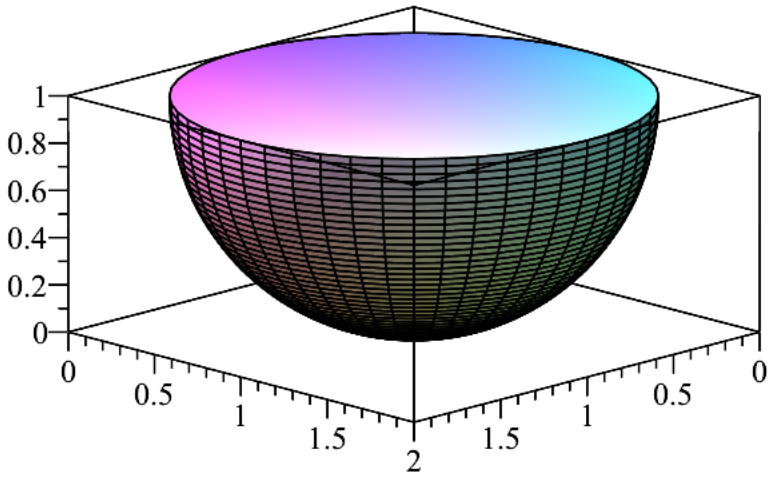
```
> #` plottools Package
> #The commands to generate plot structures are
> with(plottools) :
> with(plots) :
> display(parallelepiped([1, 0, 0], [0, 1, 0], [0, 0, 1]), orientation = [45, 60])
```



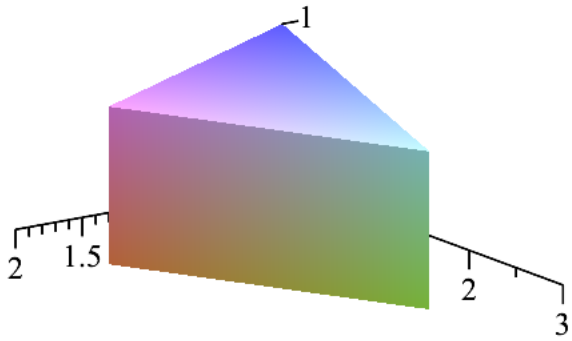

```
> c := sphere([1, 1, 1], 3.3) :
> display(c, scaling = constrained, axes = boxed)
```



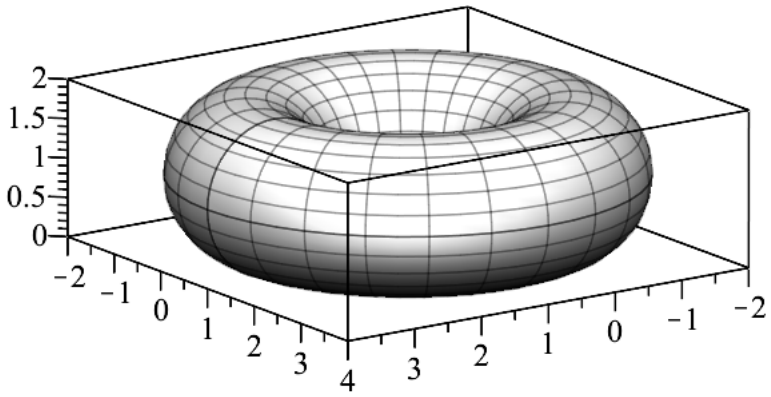

```
> display(hemisphere([1, 1, 1]), scaling = constrained, axes = boxed, orientation = [45, 75])
```



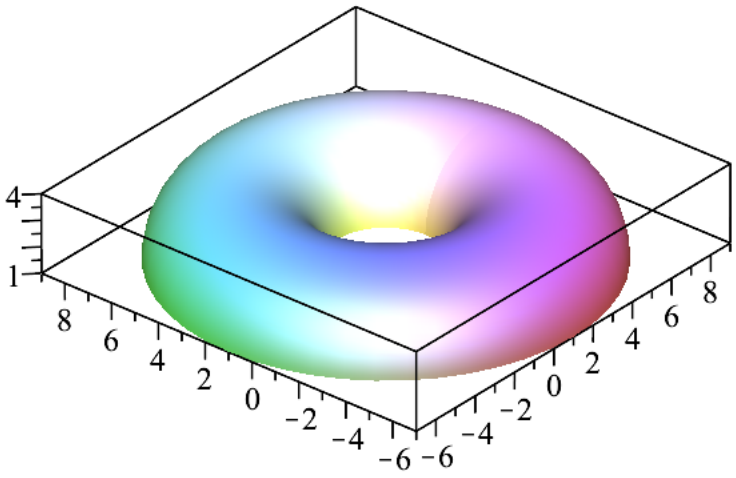

```
> T := polygon([[0, 0], [2, 1], [1, 3]]) :
> display(prism(T), axes = normal, scaling = constrained)
```



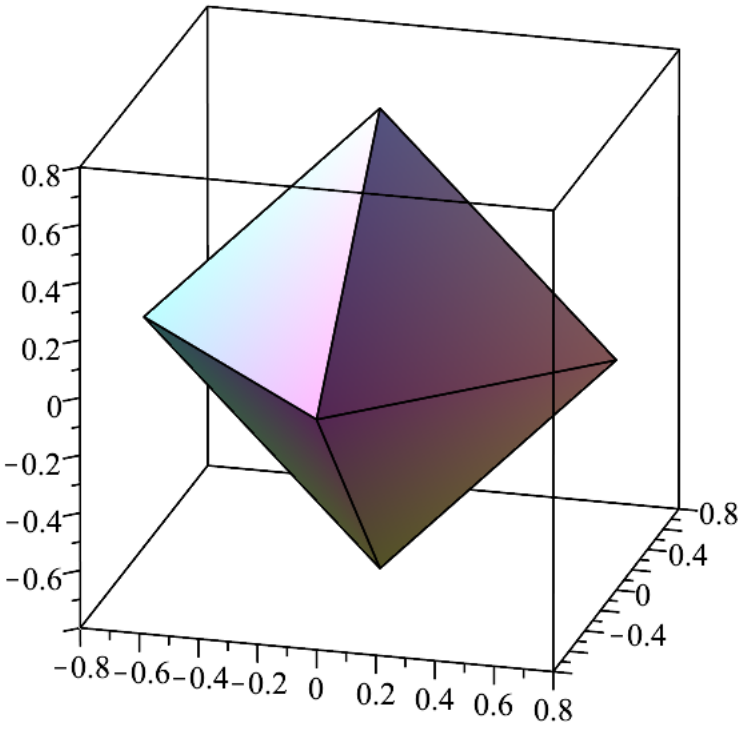

```
> display(torus([1, 1, 1], 1, 2), scaling = constrained, lightmodel = light1, shading
      = zgrayscale)
```



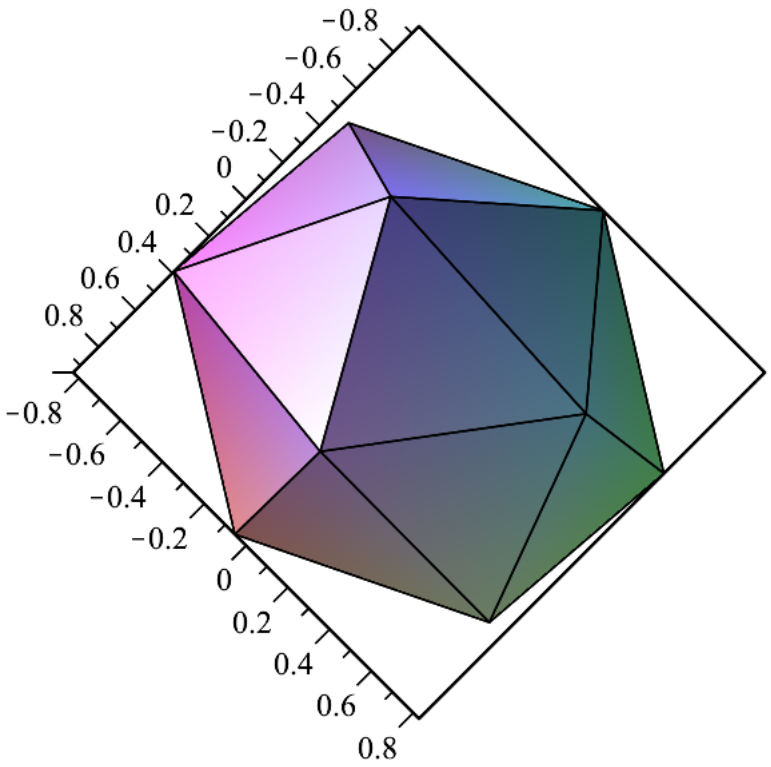

```
> display(semitorus([1, 1, 1], 0..Pi, 3, 5), lightmodel = light1, orientation = [ − 140, 60 ],
      scaling = constrained, style = surface)
```



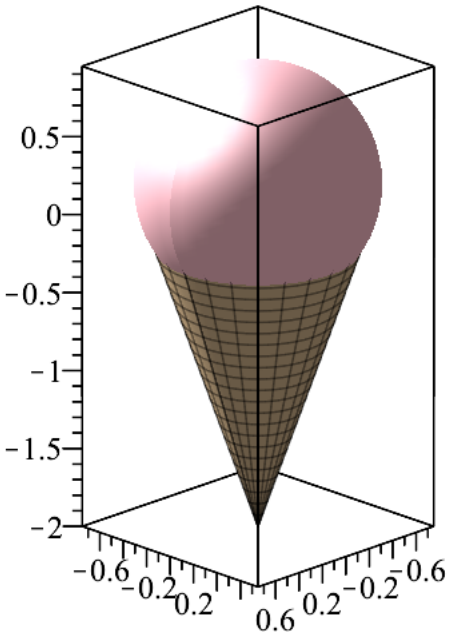

```
> display(octahedron([0, 0, 0], 0.8), orientation = [ − 75, 70])
```




```
> display(icosahedron([0, 0, 0], 0.8), orientation = [45, 0])
```



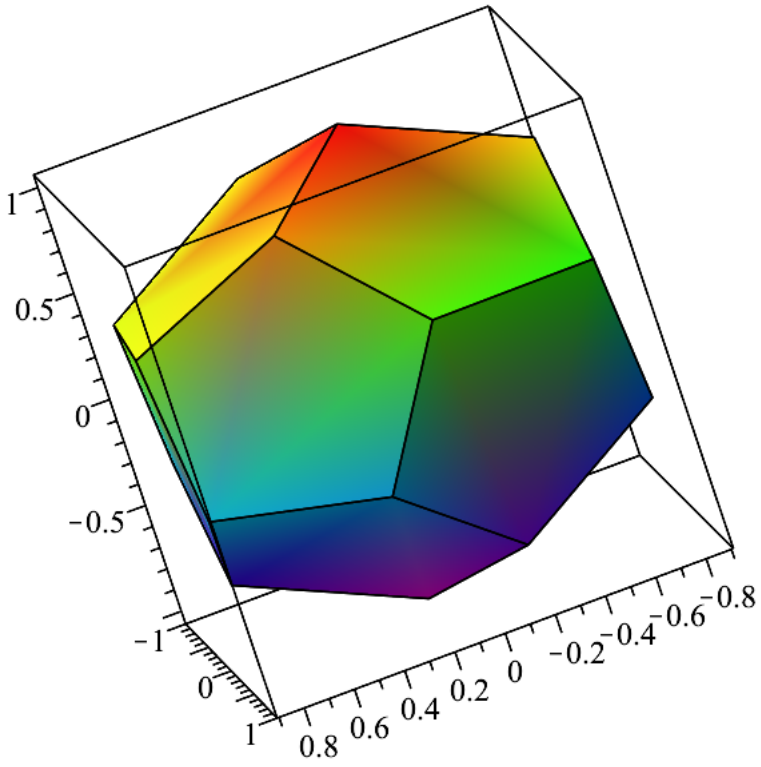

```
> icecream := cone([0, 0, −2], 0.7, 2, color = "Tan"), sphere([0, 0, 0.2], 0.75, color
      = "Pink", style = patchnogrid) :
> display(icecream, scaling = constrained, orientation = [45, 70])
```



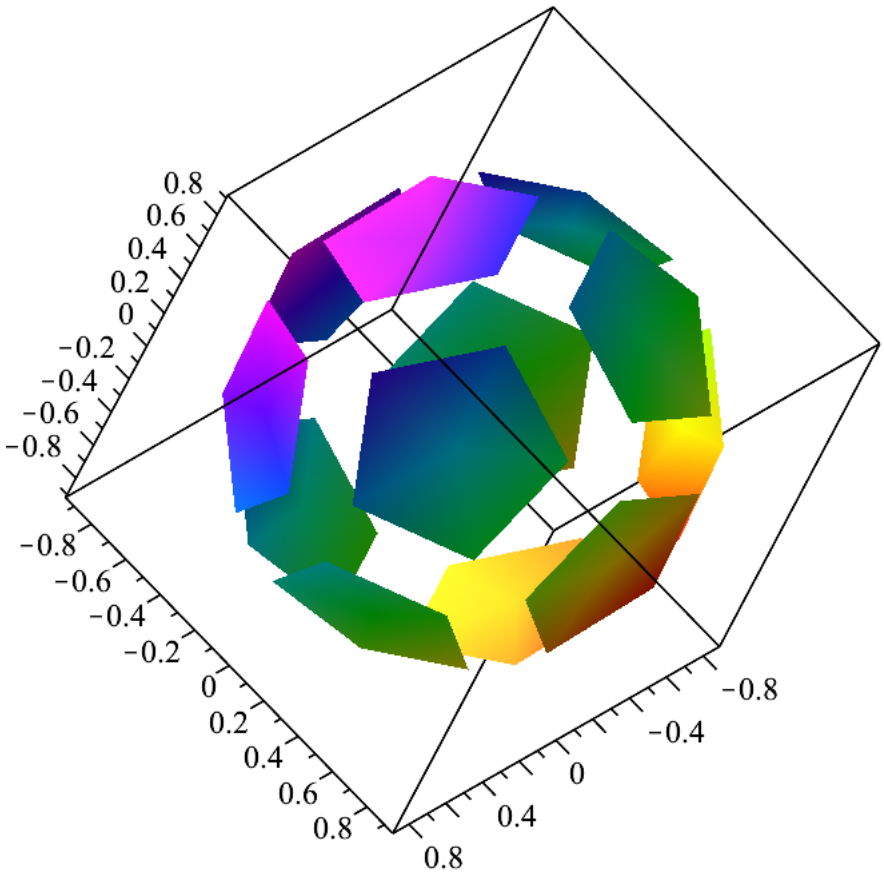

## cutin

perform contraction on polygon faces

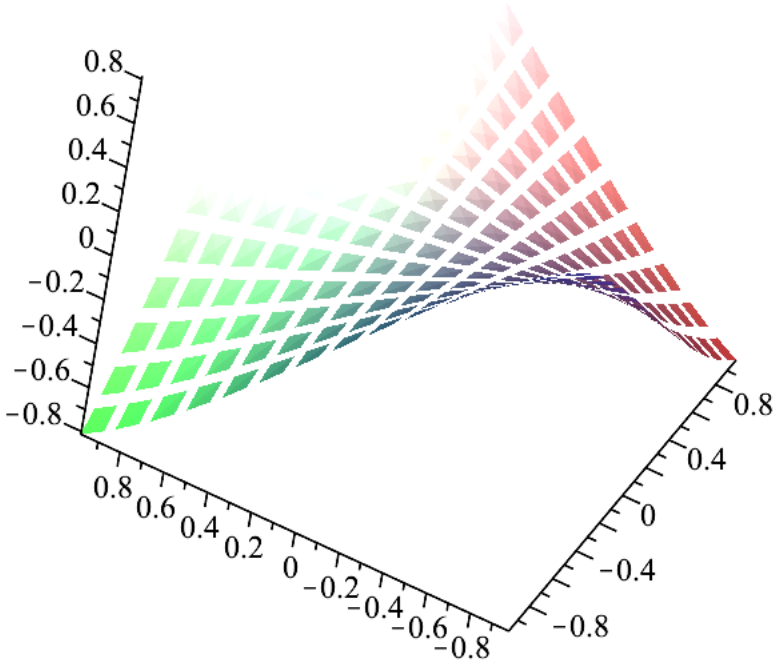
```
> display(dodecahedron( ), shading = zhue);
```




> $display\left( cutin\left( dodecahedron(\ ), \frac{2}{3} \right), shading = zhue \right)$




```
> p := convert(plot3d(sin(x*y), x = -1..1, y = -1..1, grid = [15, 15]), POLYGONS):
> display(cutin(p, 2/3), axes = frame, lightmodel = light1, orientation = [150, 85])
```

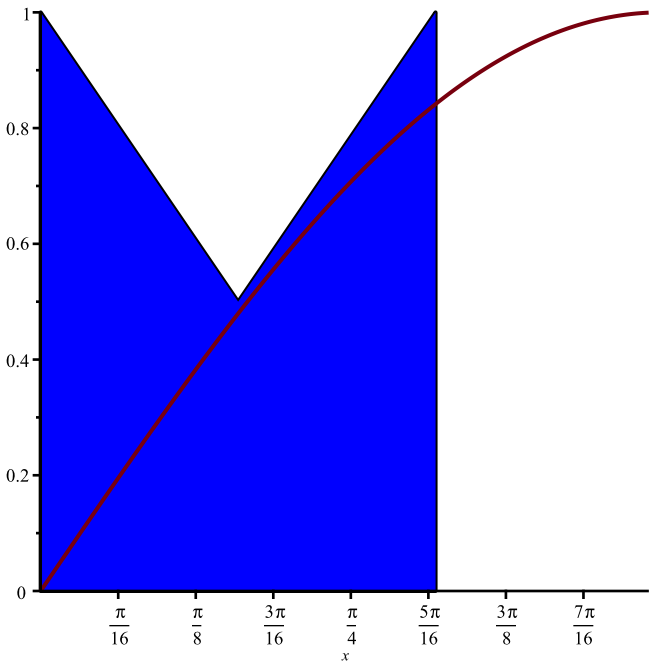



```
> with(plottools);
```

[*annulus*, *arc*, *arrow*, *circle*, *cone*, *cuboid*, *curve*, *cutin*, *cutout*, *cylinder*, *disk*, *dodecahedron*, *ellipse*, *ellipticArc*, *exportplot*, *extrude*, *getdata*, *hemisphere*, *hexahedron*, *homothety*, *hyperbola*, *icosahedron*, *importplot*, *line*, *octahedron*, *parallelepiped*, *pieslice*, *point*, *polygon*, *polygonbyname*, *prism*, *project*, *rectangle*, *reflect*, *rotate*, *scale*, *sector*, *semitorus*, *sphere*, *stellate*, *tetrahedron*, *torus*, *transform*, *translate*, *triangulate*] **(2.1)**

## *The commands* **to** *alter* **or** *examine plot structures are* : ***plottools***. The plottools[getdata] command was introduced in Maple 15.

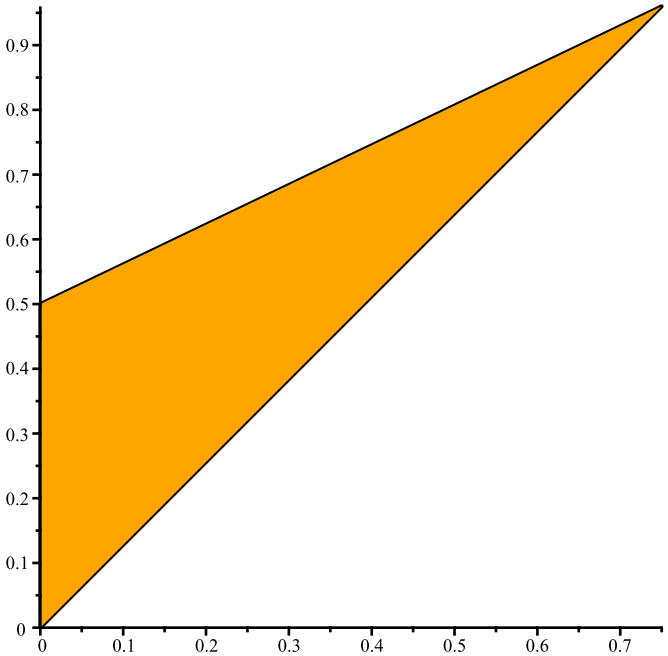
```
> with(plottools) :
> p1 := plot(sin(x), x = 0 .. π/2) :
> p2 := plots:-polygonplot(Matrix([[0, 0], [0, 1], [0.5, 0.5], [1, 1], [1, 0]], 'datatype'
      = 'float'), 'color' = "Blue") :
> p := plots:-display(p1, p2) : p
```




```
> getdata(p, 'includecolor') :
> getdata(p, 'element' = "curve") :
> getdata(p, 'rangesonly')
```

$$[0..1.53950000000000009, 0..1.] \quad \textbf{(2.2)}$$

```
> getdata(plot3d(sin(x + y), x = -1..1, y = -1..1)) :
> p3 := plots:-polygonplot(Matrix([[0, 0], [0, 0.5], [0.75, 0.96]], 'datatype' = 'float'), 'color'
      = "Orange");
```




```
> g3 := getdata(p3, 'includecolor');
```

**(2.3)**

$$g3 := \left[\text{"polygon"}, [0..0.750000000000000000, 0..0.959999999999999964], \left[\begin{matrix} 0. & 0. \\ 0. & 0.500000000000000 \\ 0.750000000000000 & 0.960000000000000 \end{matrix}\right], [\,], \left[\text{"RGB"}, \begin{bmatrix} 1. & 0.647058820000000 & 0. \end{bmatrix}\right]\right] \tag{2.3}$$

```
> g3[1];
```

$$\left[\text{"polygon"}, [0..0.750000000000000000, 0..0.959999999999999964], \left[\begin{matrix} 0. & 0. \\ 0. & 0.500000000000000 \\ 0.750000000000000 & 0.960000000000000 \end{matrix}\right], [\,]\right] \tag{2.4}$$

```
> g3[1][3];
```

$$\begin{bmatrix} 0. & 0. \\ 0. & 0.500000000000000 \\ 0.750000000000000 & 0.960000000000000 \end{bmatrix} \tag{2.5}$$

```
> g3[1][3][2];
```

$$\begin{bmatrix} 0. & 0.500000000000000 \end{bmatrix} \tag{2.6}$$

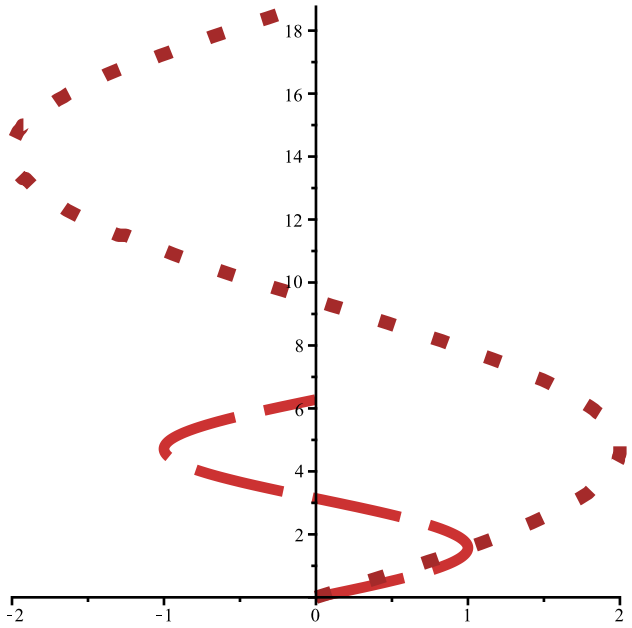
```
> g3[2];
```

$$\left[\text{"RGB"}, \begin{bmatrix} 1. & 0.647058820000000 & 0. \end{bmatrix}\right] \tag{2.7}$$

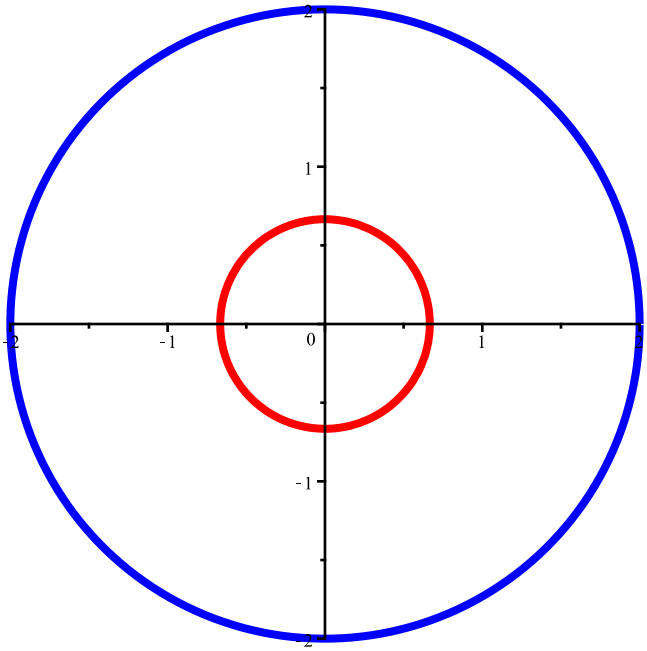
## scale

$$scale \tag{2.8}$$

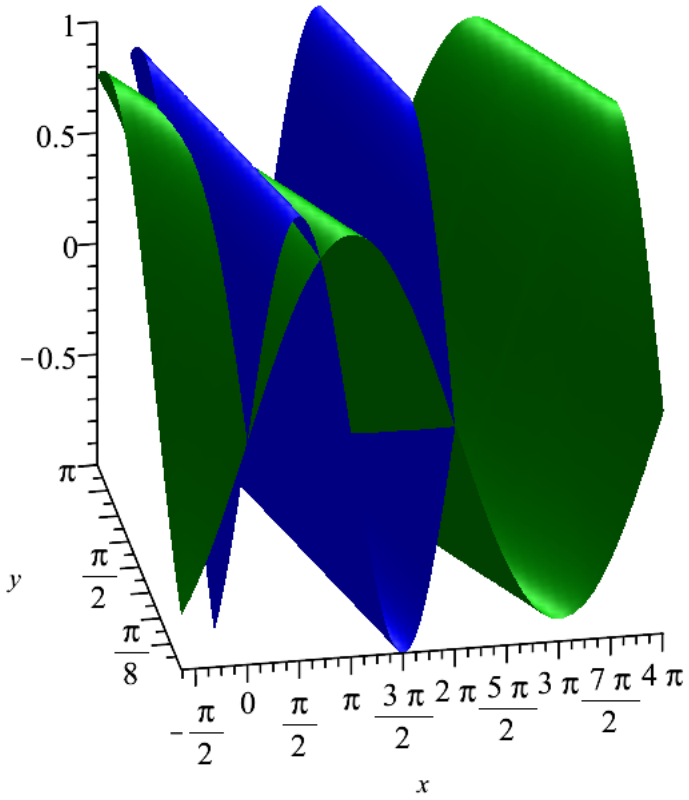
```
> with(plots):

> p := plot([sin(x), x, x = 0..2π]):
> s := scale(p, 2, 3):
> display(p, s, thickness = [4, 5], color = [orange, brown], linestyle = [dash, dot]);
```




```
> c := circle([0, 0], 2):
> display(c, scale(c, 1/3, 1/3), thickness = [3, 3], color = [blue, red], scaling = constrained)
```




```
> q := plot3d(sin(x + y), x = -1..2π, y = 0..π):
> s := scale(q, 2, 1, 0.9):
> display(q, s, axes = frame, lightmodel = light2, orientation = [-100, 65], shading
      = zgrayscale, style = patchnogrid, color = ["Blue", "Green"])
```

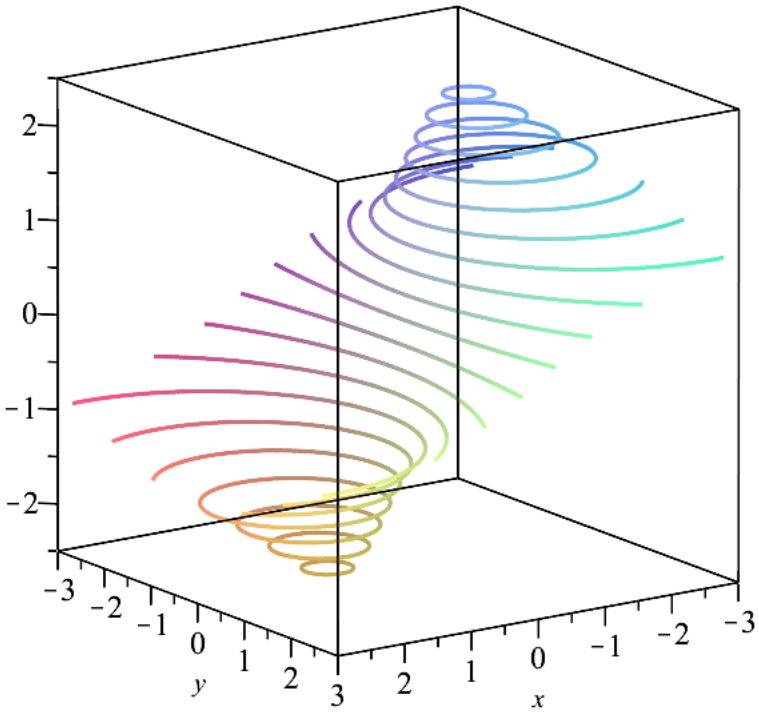



# *transform*

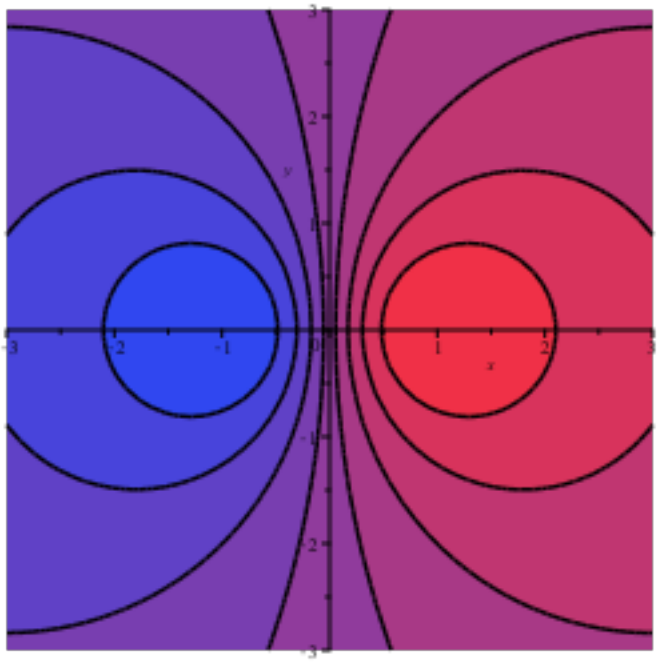
*transform* **(2.9)**

**Draw contour plots onto axes of 3-D plots.**

> $p := plot3d\left( -\frac{5x}{x^2+y^2+1}, x = -3..3, y = -3..3, thickness = 3, style = contour, contours = 20 \right) : p$

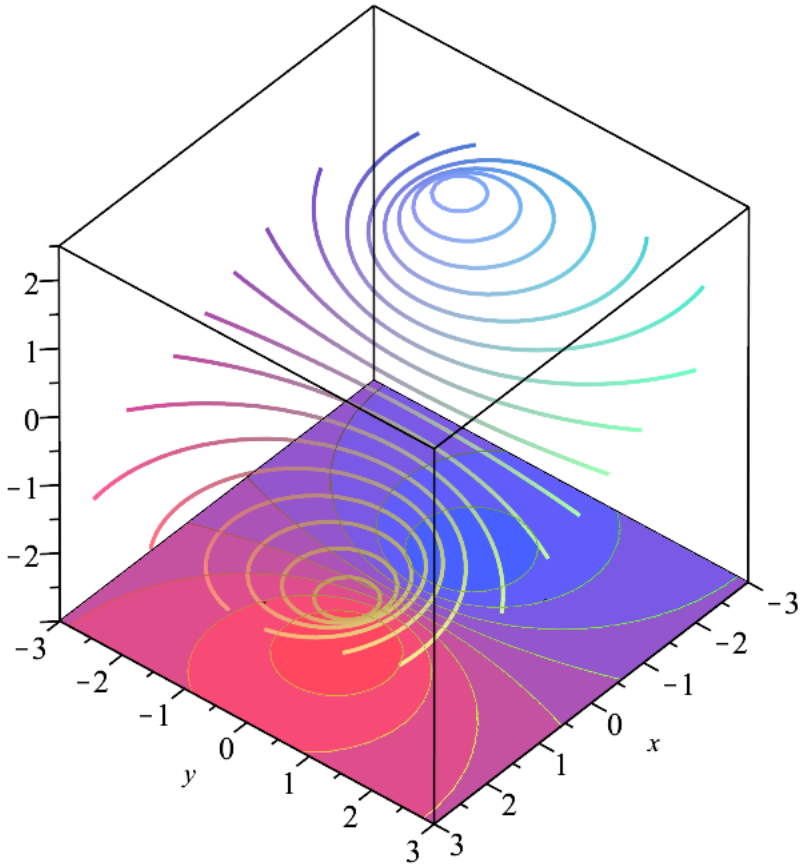



> $q := contourplot\left( -\frac{5x}{x^2+y^2+1}, x = -3..3, y = -3..3, filled = true \right) : q$



> $f := transform\left( (x, y) \mapsto [x, y, -3] \right) :$

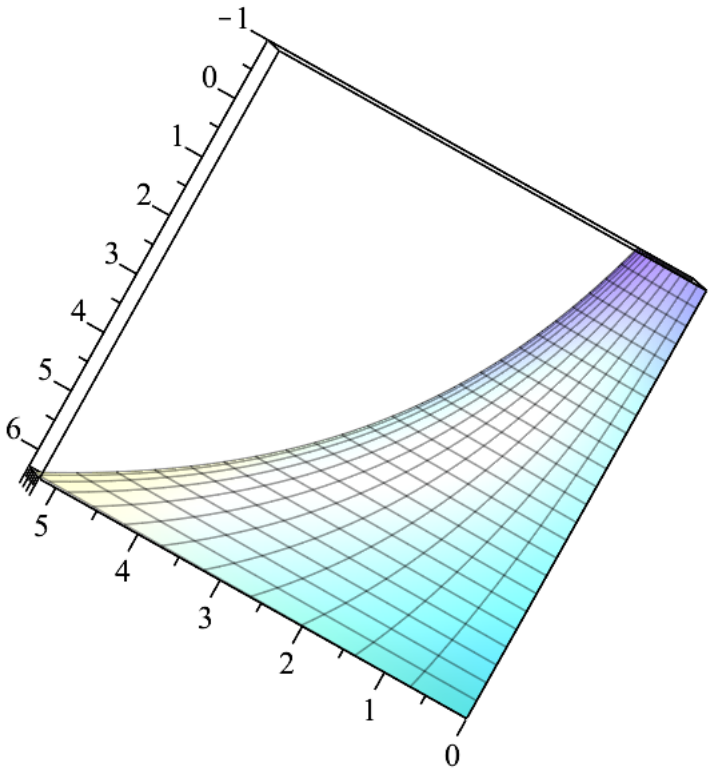
> $display(\{p, f(q)\}, orientation = [40, 50])$




>

# Change coordinate systems.

> $p := plot3d([1.3^x \sin(y), x, y], x = -1..2\pi, y = 0..\pi) : p$

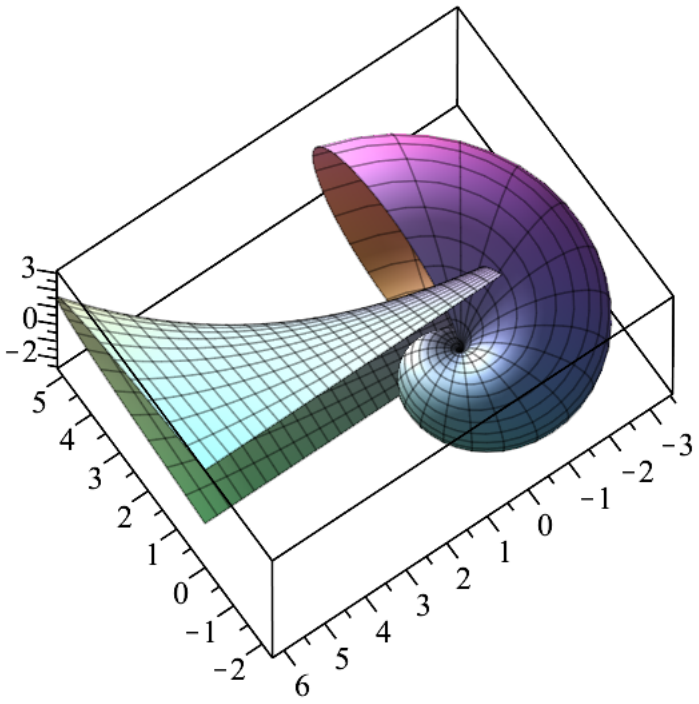



,

:

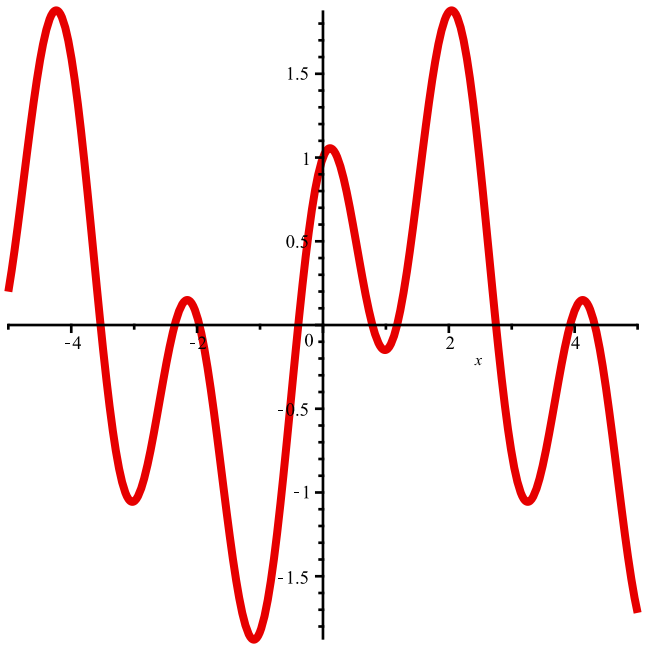
$$\begin{cases} x = r\sin\theta\cos\varphi, \\ y = r\sin\theta\sin\varphi, \\ z = r\cos\theta. \end{cases}$$

```
> f := transform( (r, th, ph) ↦ [r·sin(ph)·cos(th), r·sin(ph)·sin(th), r·cos(ph) ]) :
> display( {p, f(p)}, orientation = [145, 20], scaling = constrained)
```

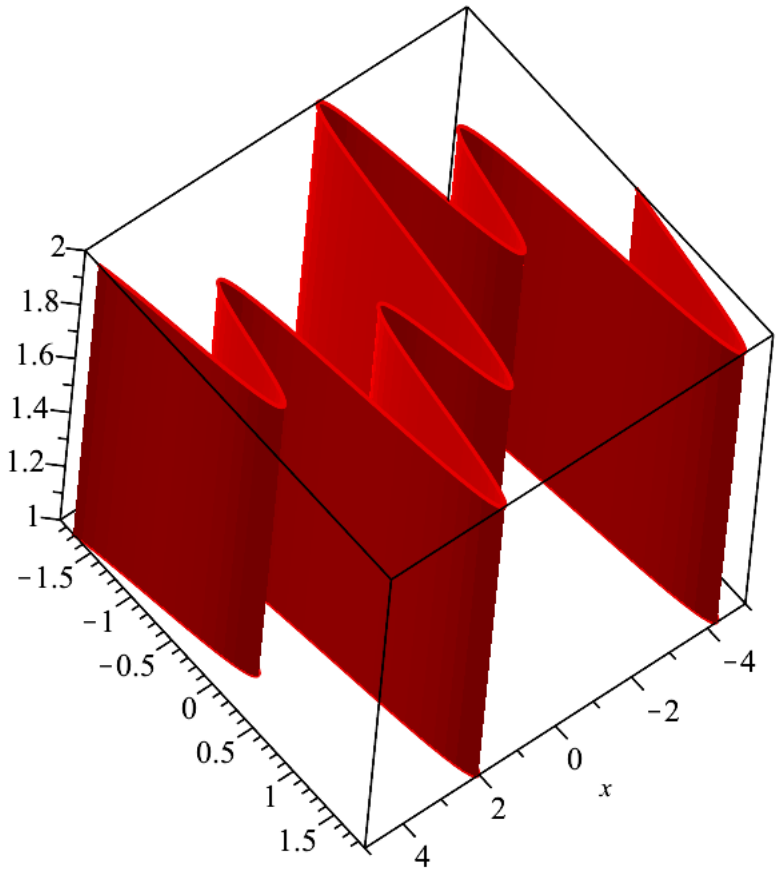



**extrude**(p, erange, transform, opts)

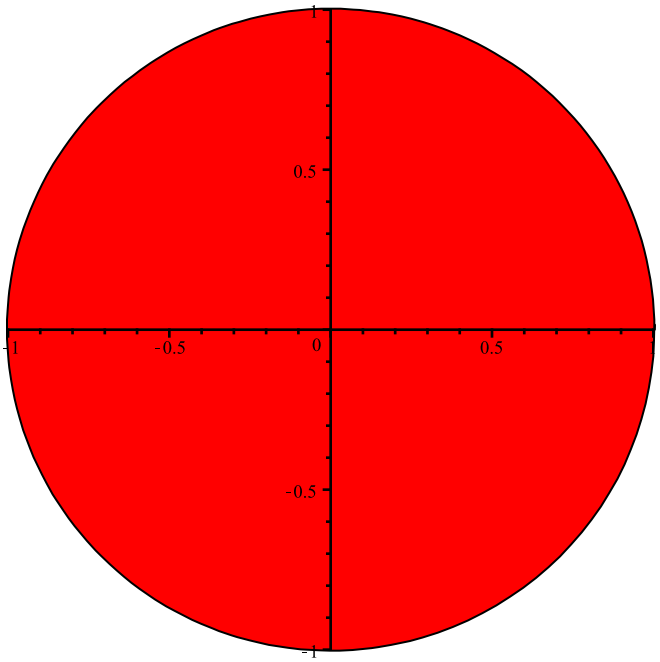
```
> y := x→sin(x) + cos(3 x) :
> p := plot(y(x), x = — 5 ..5, thickness = 3, color = RGB(0.9, 0, 0) )
```



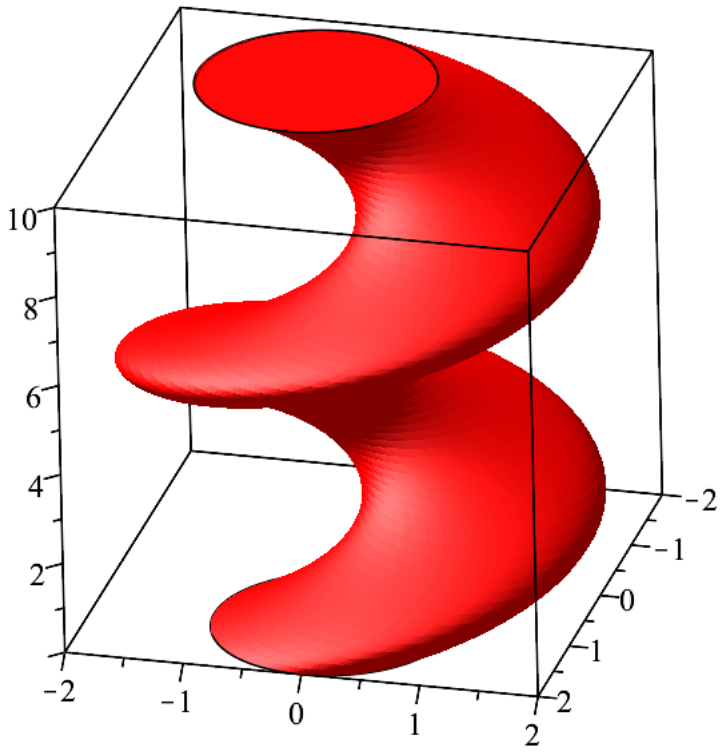

```
> extrude( p, 1 ..2 )
```




> $Disk := plots:\text{-}display(disk(1, color = red)) : Disk$




> $extrude(Disk, 0..10, (x, y, t) \mapsto [x + \cos(t), y + \sin(t), t], numsegments = 80)$




# *reflect*

,

.

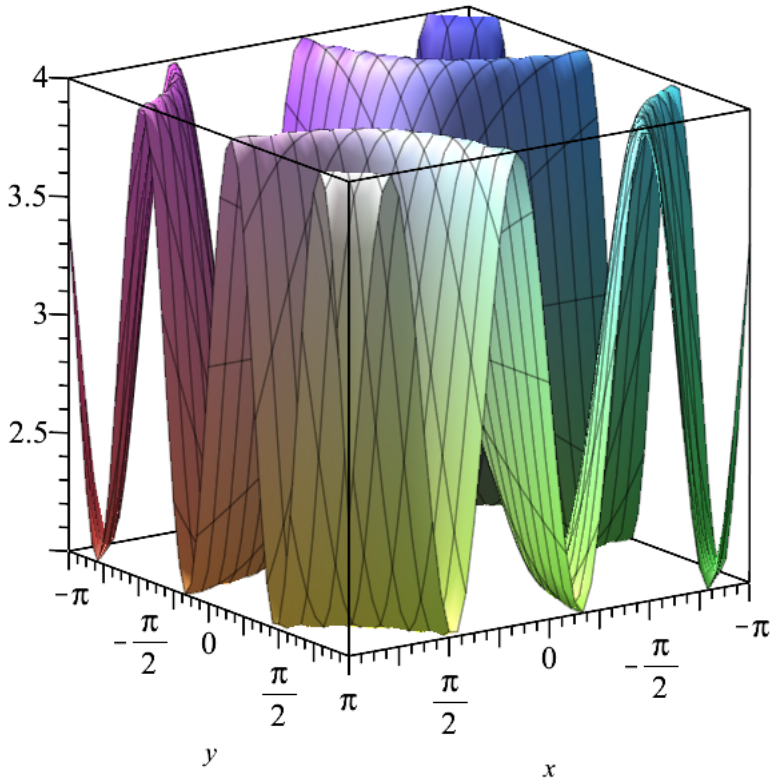
• В трехмерном случае объект может отражаться относительно точки, линии или плоскости Точка представлена в виде списка либо из двух действительных чисел (2-D), либо из трех ( 3 - D ) .

.

.

*reflect* **(2.10)**

> $p := plot3d(\sin(xy) + 3, x = -\pi..\pi, y = -\pi..\pi) : p$

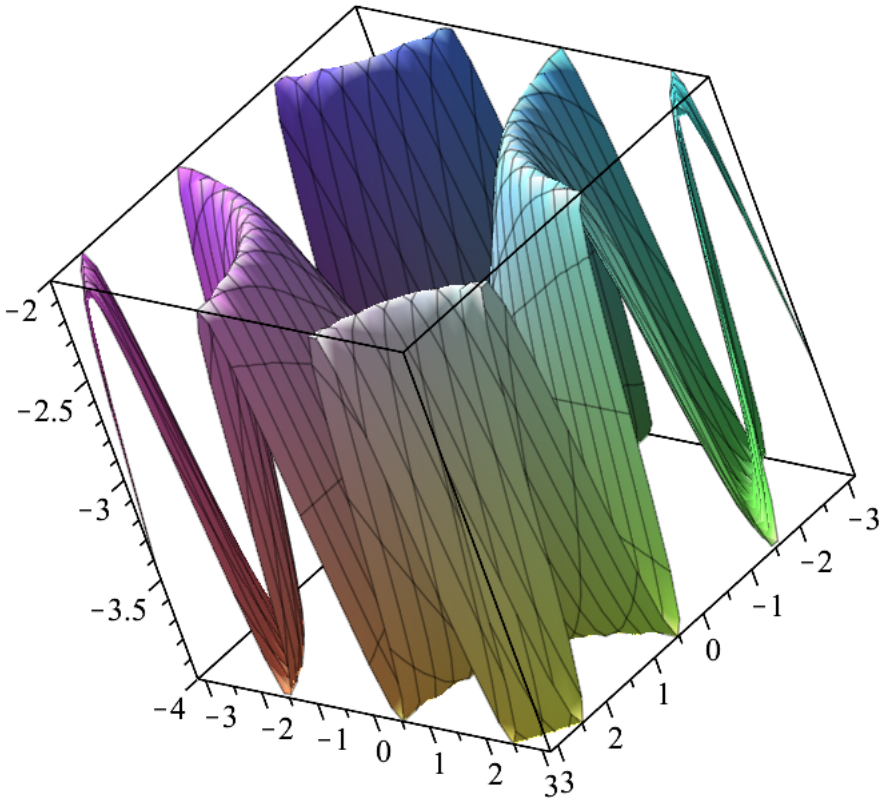



```
> m := [[0, 0, 0], [1, 0, 0], [0, 1, 0]]; whattype(m);
```

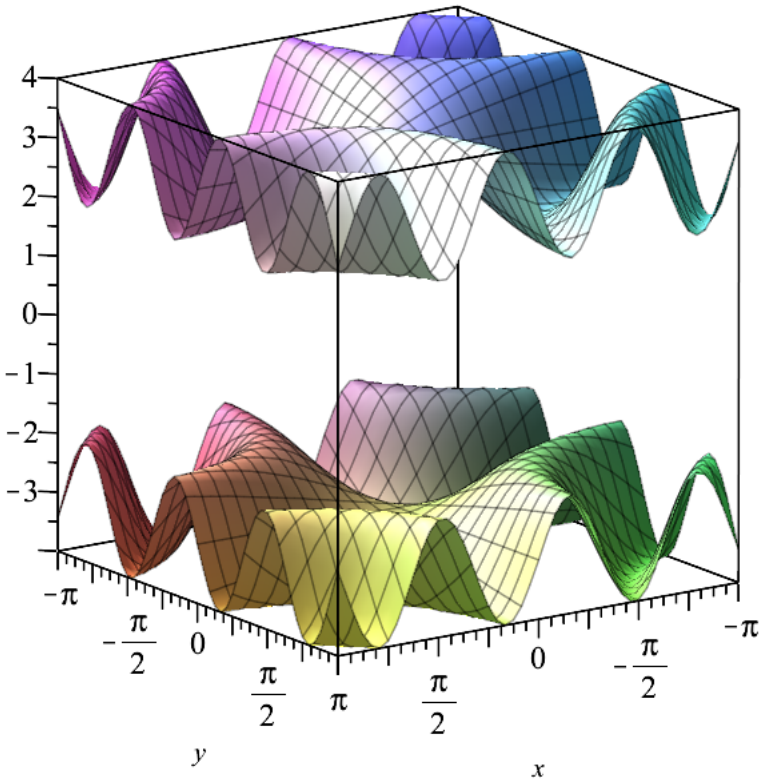
$$m := [[0, 0, 0], [1, 0, 0], [0, 1, 0]]$$

$$list \qquad (2.11)$$

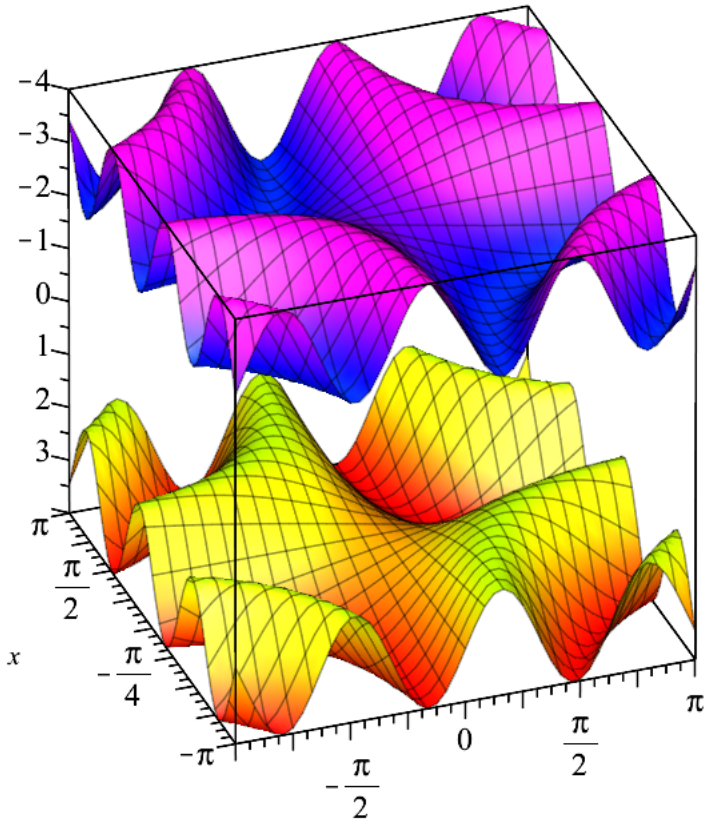
```
> q := reflect(p, m) : q
```




```
> display([p, q])
```



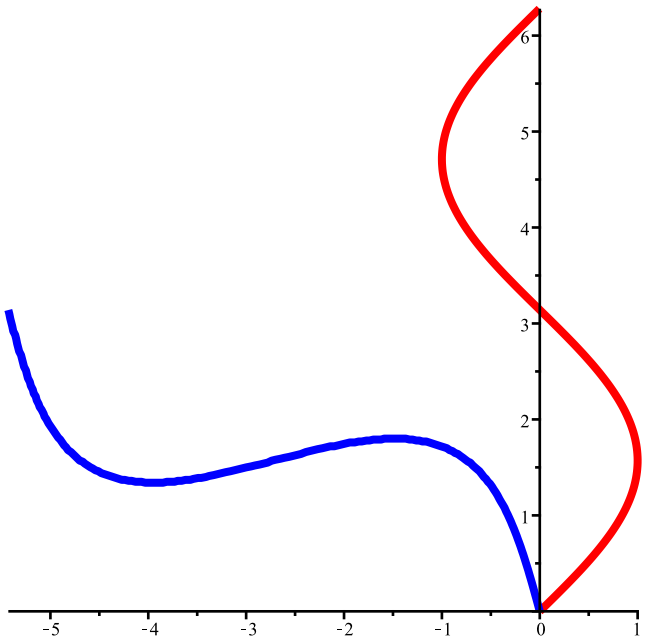

```
> display( [ p, q ], lightmodel = light1, orientation = [ 20,  — 120 ], shading = zhue)
```



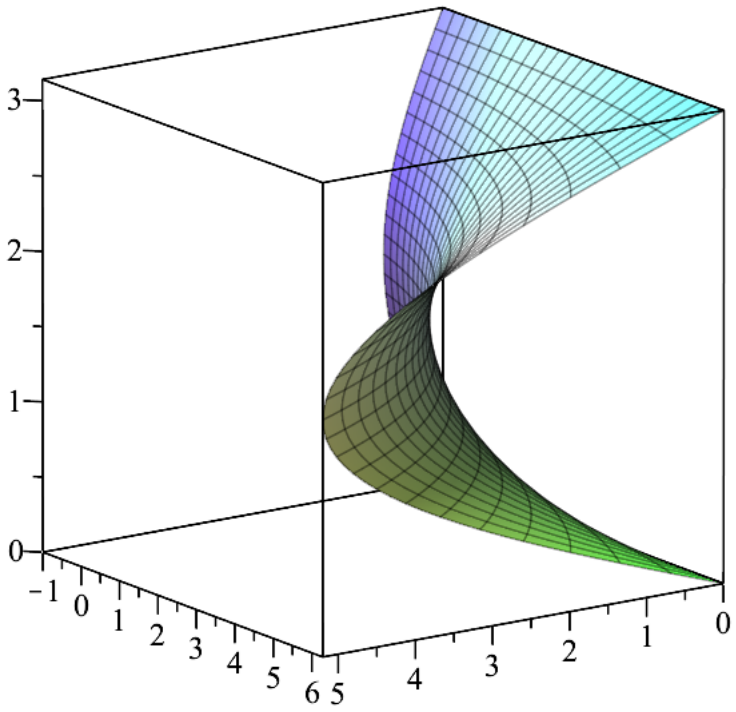

## rotate

*rotate* **(2.12)**

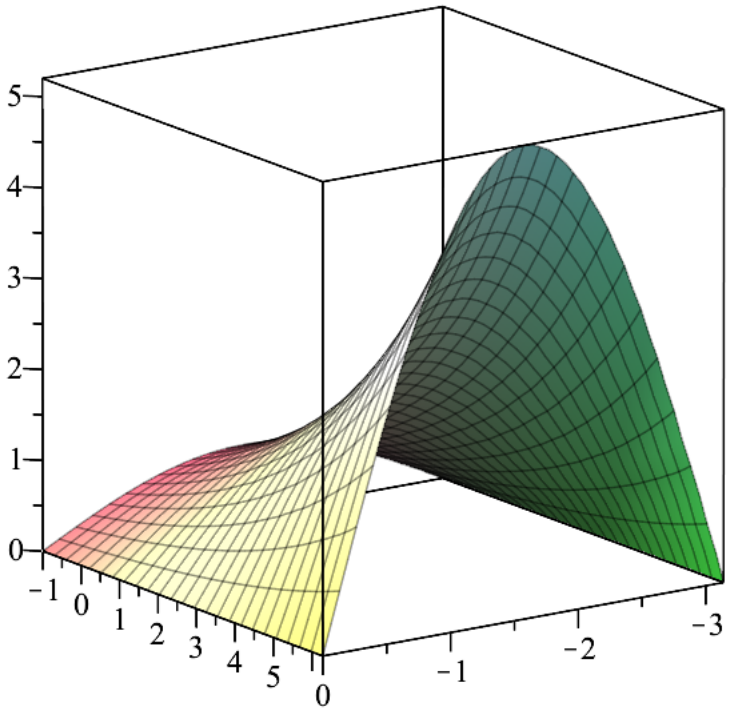
```
> p := plot([sin(x), x, x = 0 ..2 π]) :
> r := rotate(p, π/3) :
> display(p, r, color = [red, blue], thickness = 3);
```



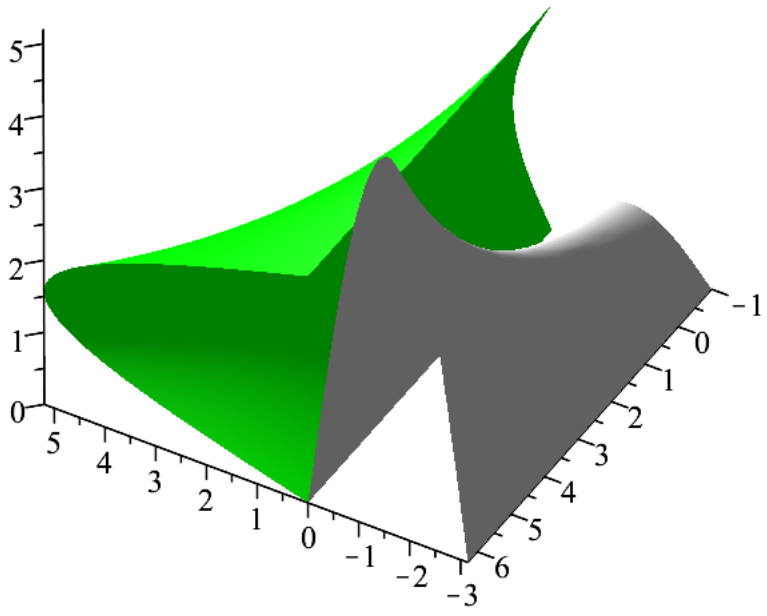

> $p := plot3d([1.3^x \sin(y), x, y], x = -1..2\pi, y = 0..\pi);$




> $r := rotate\left(p, \pi, \frac{\pi}{2}, \pi\right);$



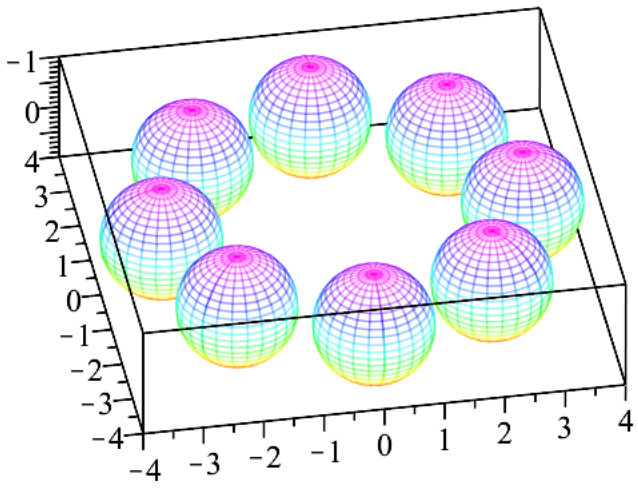

```
> display(p, r, axes = frame, orientation = [120, 50], color = [green, gray], style = patchnogrid)
```




```
> r[0] := sphere([3, 0, 0], 1, grid = [25, 25]) :
```

```
> a := π/4 : c := 1 :
```

```
> while evalf(a - 2π) < 0 do
      r[c] := rotate(r[0], a, [[0, 0, 0], [0, 0, 1]]);
      a := a + π/4;
      c := c + 1
  end do :
  display([seq(r[i], i = 0 ..c - 1)], scaling = constrained, style = hidden, lightmodel = light4,
      orientation = [10, -125], shading = zhue)
```




The plottools[**exportplot**, **importplot**] command was introduced in Maple 18.
The format option was updated in Maple 2021.

```
> with(plottools):
> stl := FileTools:-JoinPath([FileTools:-TemporaryDirectory(), "seashell.stl"])
```

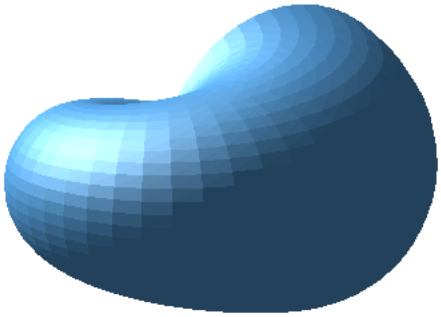
$$stl := \text{"C:\Users\Oleandr\AppData\Local\Temp\seashell.stl"} \quad \textbf{(2.13)}$$

```
> p := plot3d(-1.2^x*sin(y), x = -1..2*Pi, y = 0..Pi, coords = spherical):
> exportplot(stl, p)
```

$$230484 \quad \textbf{(2.14)}$$

```
> importplot(stl)
```

seashell.stl

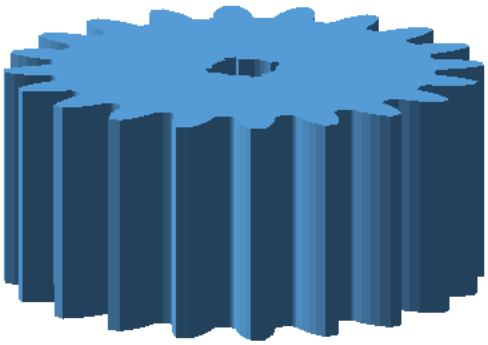


```
> gear := FileTools:-JoinPath( ["example/gear.ply"], base = datadir )
```

$$gear := \text{"C:\Program Files\Maple 2021\data\example/gear.ply"} \quad \textbf{(2.15)}$$

```
> plottools:-importplot(gear)
```

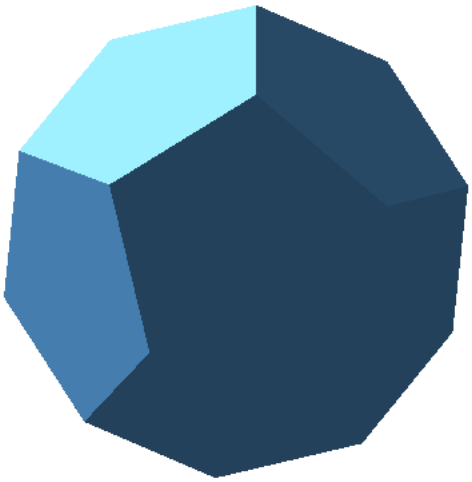
gear.ply



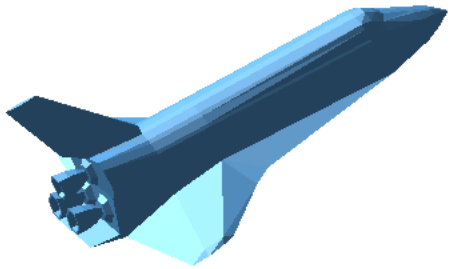
```
> stl := FileTools:-JoinPath( ["example/dodecahedron.stl"], base = datadir )
```

$$stl := \text{"C:\Program Files\Maple 2021\data\example/dodecahedron.stl"} \quad \textbf{(2.16)}$$

```
> plottools:-importplot(stl)
```



```
> byu := FileTools:-JoinPath( ["example/shuttle.byu"], base = datadir) :
> plottools:-importplot(byu, format = "BYU")
```



```
> stellated := FileTools:-JoinPath( ["example/stellated.ply"], base = datadir) :
> plottools:-importplot(stellated, format = "PLY")
```