```
> restart;
> with(linalg):
> assume(t,real);
> r:=t->[exp(t)*sin(2*t),exp(t)*cos(2*t),2*exp(t)];
```

$$r := t \to \left[e^{t} \sin(2\,t),\ e^{t} \cos(2\,t),\ 2\,e^{t}\right]$$

```
> map(diff,r(t),t);
```

$$\left[e^{t\sim} \sin(2\,t\sim) + 2\,e^{t\sim} \cos(2\,t\sim),\ e^{t\sim} \cos(2\,t\sim) - 2\,e^{t\sim} \sin(2\,t\sim),\ 2\,e^{t\sim}\right]$$

```
> rp:=t->[exp(t)*sin(2*t)+2*exp(t)*cos(2*t), exp(t)*cos(2*t)-2*exp
  (t)*sin(2*t), 2*exp(t)];
```

$$rp := t \to \left[e^{t} \sin(2\,t) + 2\,e^{t} \cos(2\,t),\ e^{t} \cos(2\,t) - 2\,e^{t} \sin(2\,t),\ 2\,e^{t}\right]$$

```
> normalize(rp(0));
```

$$\left[\frac{2}{3}\quad \frac{1}{3}\quad \frac{2}{3}\right]$$

```
> normalize(rp(t));
```

$$\Bigg[\left(e^{t\sim} \sin(2\,t\sim) + 2\,e^{t\sim} \cos(2\,t\sim)\right) \Big/ \left(\left|2\,e^{t\sim} \sin(t\sim)\,\cos(t\sim) + 4\,e^{t\sim} \cos(t\sim)^2 - 2\,e^{t\sim}\right|^2 + \left|-2\,e^{t\sim} \cos(t\sim)^2 + e^{t\sim} + 4\,e^{t\sim} \sin(t\sim)\,\cos(t\sim)\right|^2 + 4\left(e^{t\sim}\right)^2\right)^{1/2},\ \left(e^{t\sim} \cos(2\,t\sim) - 2\,e^{t\sim} \sin(2\,t\sim)\right) \Big/ \left(\left|2\,e^{t\sim} \sin(t\sim)\,\cos(t\sim) + 4\,e^{t\sim} \cos(t\sim)^2 - 2\,e^{t\sim}\right|^2 + \left|-2\,e^{t\sim} \cos(t\sim)^2 + e^{t\sim} + 4\,e^{t\sim} \sin(t\sim)\,\cos(t\sim)\right|^2 + 4\left(e^{t\sim}\right)^2\right)^{1/2},\ \left(2\,e^{t\sim}\right) \Big/ \left(\left|2\,e^{t\sim} \sin(t\sim)\,\cos(t\sim) + 4\,e^{t\sim} \cos(t\sim)^2 - 2\,e^{t\sim}\right|^2 + \left|-2\,e^{t\sim} \cos(t\sim)^2 + e^{t\sim} + 4\,e^{t\sim} \sin(t\sim)\,\cos(t\sim)\right|^2 + 4\left(e^{t\sim}\right)^2\right)^{1/2}\Bigg]$$

```
> simplify(%);
```

$$\left[\frac{1}{3}\sin(2\,t\sim)+\frac{2}{3}\cos(2\,t\sim)\quad\frac{1}{3}\cos(2\,t\sim)-\frac{2}{3}\sin(2\,t\sim)\quad\frac{2}{3}\right]$$

```
> T:=t->vector([1/3*sin(2*t)+2/3*cos(2*t), 1/3*cos(2*t)-2/3*sin(2*
  t), 2/3]);
```

$$T:=t\rightarrow\left[\frac{1}{3}\sin(2\,t)+\frac{2}{3}\cos(2\,t)\quad\frac{1}{3}\cos(2\,t)-\frac{2}{3}\sin(2\,t)\quad\frac{2}{3}\right]$$

```
> map(diff,T(t),t);
```

$$\left[\frac{2}{3}\cos(2\,t\sim)-\frac{4}{3}\sin(2\,t\sim)\quad-\frac{2}{3}\sin(2\,t\sim)-\frac{4}{3}\cos(2\,t\sim)\quad0\right]$$

```
> Tp:=t->vector([2/3*cos(2*t)-4/3*sin(2*t), -2/3*sin(2*t)-4/3*cos
  (2*t), 0]);
```

$$Tp:=t\rightarrow\left[\frac{2}{3}\cos(2\,t)-\frac{4}{3}\sin(2\,t)\quad-\frac{2}{3}\sin(2\,t)-\frac{4}{3}\cos(2\,t)\quad0\right]$$

```
> normalize(Tp(t));
```

$$\left[\frac{\frac{2}{3}\cos(2\,t\sim)-\frac{4}{3}\sin(2\,t\sim)}{\sqrt{\left|-\frac{4}{3}\cos(t\sim)^2+\frac{2}{3}+\frac{8}{3}\sin(t\sim)\cos(t\sim)\right|^2+\left|\frac{4}{3}\sin(t\sim)\cos(t\sim)+\frac{8}{3}\cos(t\sim)^2-\frac{4}{3}\right|^2}},\right.$$

$$\left(-\frac{2}{3}\sin(2\,t\sim)-\frac{4}{3}\cos(2\,t\sim)\right)\Big/$$

$$\left(\left|-\frac{4}{3}\cos(t\sim)^2+\frac{2}{3}+\frac{8}{3}\sin(t\sim)\cos(t\sim)\right|^2+\left|\frac{4}{3}\sin(t\sim)\cos(t\sim)\right.\right.$$

$$\left.\left.+\frac{8}{3}\cos(t\sim)^2-\frac{4}{3}\right|^2\right)^{1/2},0\Bigg]$$

```
> simplify(%);
```

$$\left[\frac{1}{5}\left(\cos(2\,t\sim)-2\sin(2\,t\sim)\right)\sqrt{5}\quad-\frac{1}{5}\left(\sin(2\,t\sim)+2\cos(2\,t\sim)\right)\sqrt{5}\quad0\right]$$

```
> N:=t->vector([1/5*(cos(2*t)-2*sin(2*t))*5^(1/2), -1/5*(sin(2*t)
  +2*cos(2*t))*5^(1/2), 0]);
```

$$N:=t\rightarrow\left[\frac{1}{5}\left(\cos(2\,t)-2\sin(2\,t)\right)\sqrt{5}\quad-\frac{1}{5}\left(\sin(2\,t)+2\cos(2\,t)\right)\sqrt{5}\quad0\right]$$

```
> crossprod(T(t),N(t));
```

$$\left[\frac{2}{15}\left(\sin(2\,t\sim)+2\cos(2\,t\sim)\right)\sqrt{5},\frac{2}{15}\left(\cos(2\,t\sim)-2\sin(2\,t\sim)\right)\sqrt{5},-\frac{1}{5}\left(\frac{1}{3}\sin(2\,t\sim)\right.\right.$$

$$+\frac{2}{3}\cos(2\,t\sim)\Big)\,(\sin(2\,t\sim)+2\cos(2\,t\sim))\,\sqrt{5}-\frac{1}{5}\left(\frac{1}{3}\cos(2\,t\sim)\right.$$
$$\left.-\frac{2}{3}\sin(2\,t\sim)\Big)\,(\cos(2\,t\sim)-2\sin(2\,t\sim))\,\sqrt{5}\right]$$

```
> simplify(%);
```

$$\left[\frac{2}{15}\,(\sin(2\,t\sim)+2\cos(2\,t\sim))\,\sqrt{5}\quad -\frac{2}{15}\,(-\cos(2\,t\sim)+2\sin(2\,t\sim))\,\sqrt{5}\quad -\frac{1}{3}\sqrt{5}\right]$$

```
> B:=t->vector([2/15*(sin(2*t)+2*cos(2*t))*5^(1/2), 2/15*(cos(2*t)
  -2*sin(2*t))*5^(1/2), -1/3*5^(1/2)]);
```

$$B := t\rightarrow\left[\frac{2}{15}\,(\sin(2\,t)+2\cos(2\,t))\,\sqrt{5}\quad \frac{2}{15}\,(\cos(2\,t)-2\sin(2\,t))\,\sqrt{5}\quad -\frac{1}{3}\sqrt{5}\right]$$

```
> N1:=norm(Tp(t),2);
```

$$N1 := \sqrt{\left|\frac{2}{3}\cos(2\,t\sim)-\frac{4}{3}\sin(2\,t\sim)\right|^2+\left|\frac{2}{3}\sin(2\,t\sim)+\frac{4}{3}\cos(2\,t\sim)\right|^2}$$

```
> N2:=norm(rp(t),2);
```

$$N2 := \sqrt{\left|e^{t\sim}\sin(2\,t\sim)+2\,e^{t\sim}\cos(2\,t\sim)\right|^2+\left|-e^{t\sim}\cos(2\,t\sim)+2\,e^{t\sim}\sin(2\,t\sim)\right|^2+4\,\left(e^{t\sim}\right)^2}$$

```
> N1/N2;
```

$$\frac{\sqrt{\left|\frac{2}{3}\cos(2\,t\sim)-\frac{4}{3}\sin(2\,t\sim)\right|^2+\left|\frac{2}{3}\sin(2\,t\sim)+\frac{4}{3}\cos(2\,t\sim)\right|^2}}{\sqrt{\left|e^{t\sim}\sin(2\,t\sim)+2\,e^{t\sim}\cos(2\,t\sim)\right|^2+\left|-e^{t\sim}\cos(2\,t\sim)+2\,e^{t\sim}\sin(2\,t\sim)\right|^2+4\,\left(e^{t\sim}\right)^2}}$$

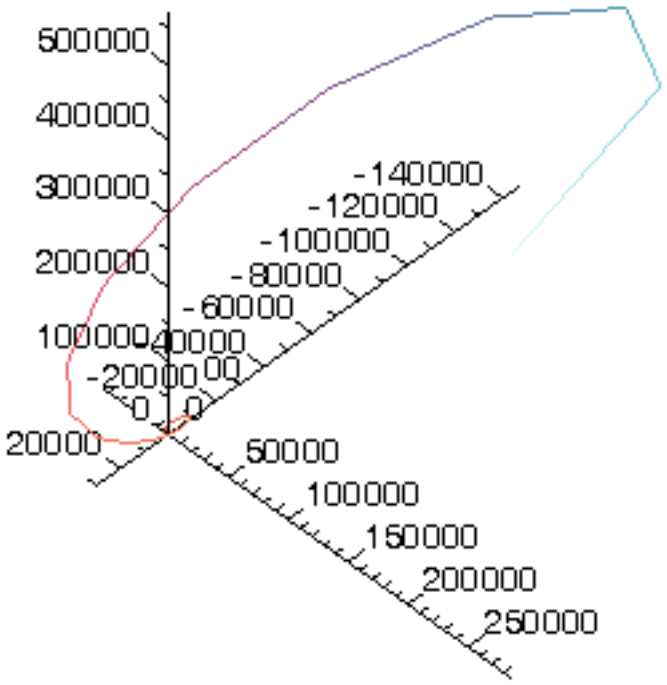
```
> simplify(%);
```

$$\frac{2}{9}\sqrt{5}\,e^{-t\sim}$$

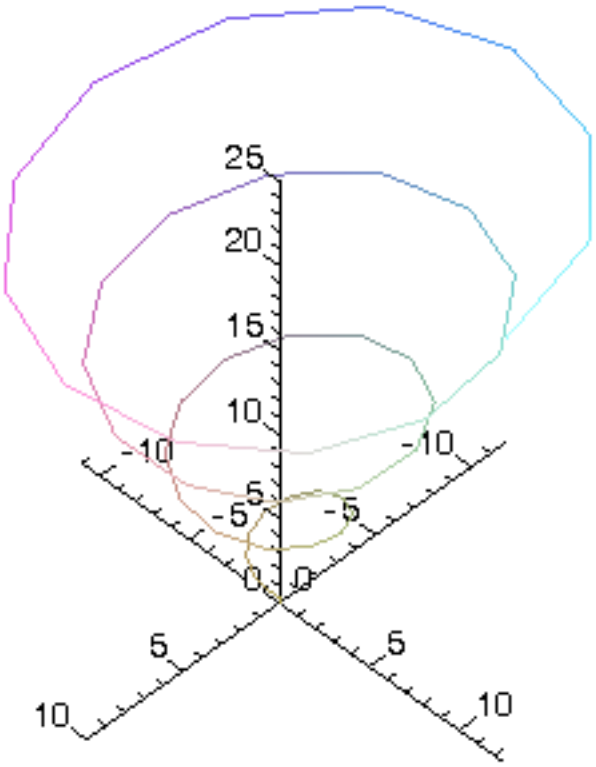
```
> kappa:=t->2/9*5^(1/2)*exp(-t);
```

$$\kappa := t\rightarrow\frac{2}{9}\sqrt{5}\,e^{-t}$$

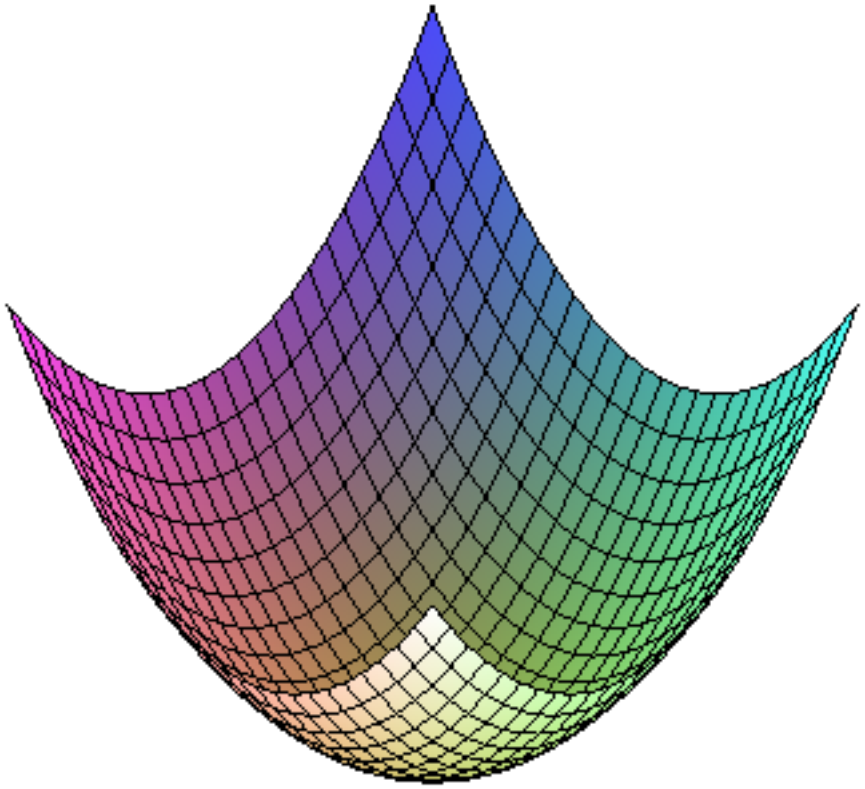
```
> with(plots):
> spacecurve({[exp(t)*sin(2*t),exp(t)*cos(2*t),2*exp(t)]},t=0..4*
  Pi);
```



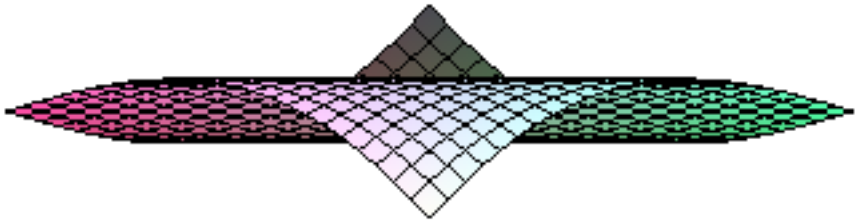

```
> spacecurve({[t*sin(2*t),t*cos(2*t),2*t]},t=0..4*Pi);
```

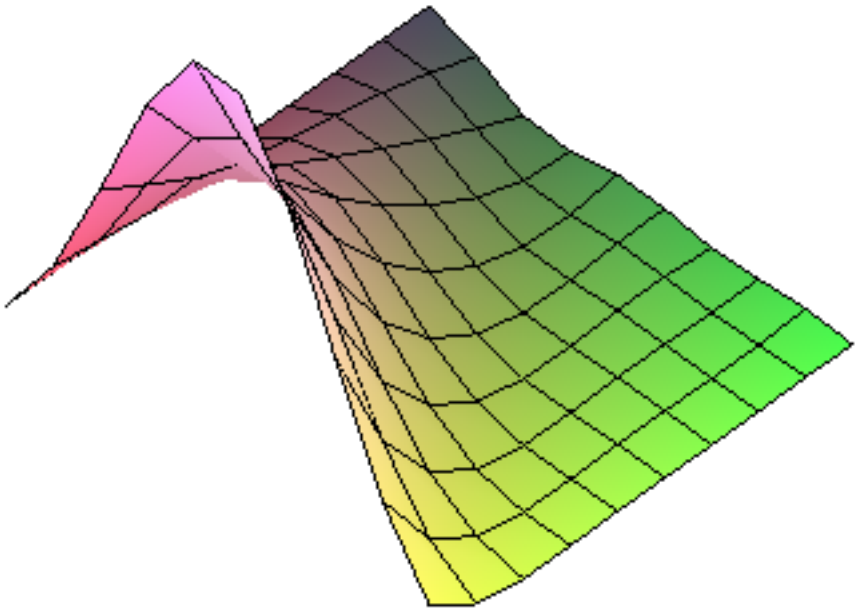



```
> plot3d(x^2+y^2,x=-2..2,y=-2..2);
```

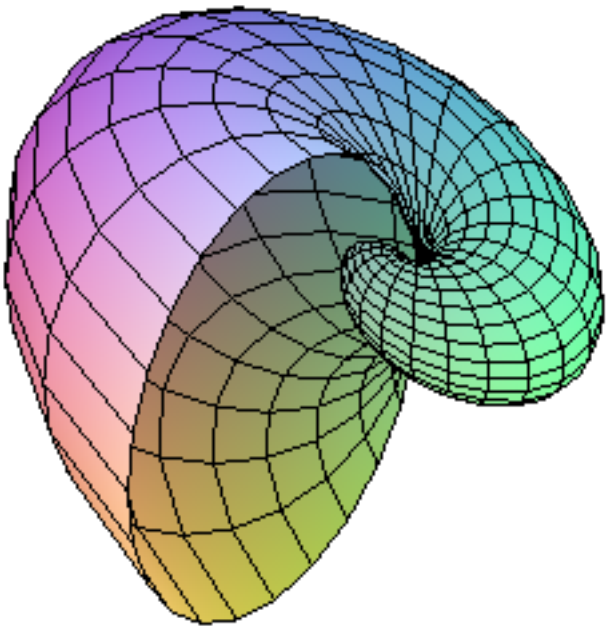


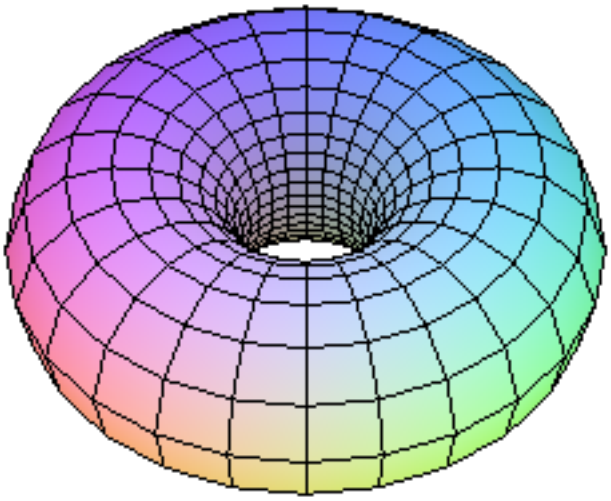
```
> plot3d(sin(x+y), x=-1..1, y=-1..1);
  plot3d(binomial, 0..5, 0..5, grid=[10,10]);
```



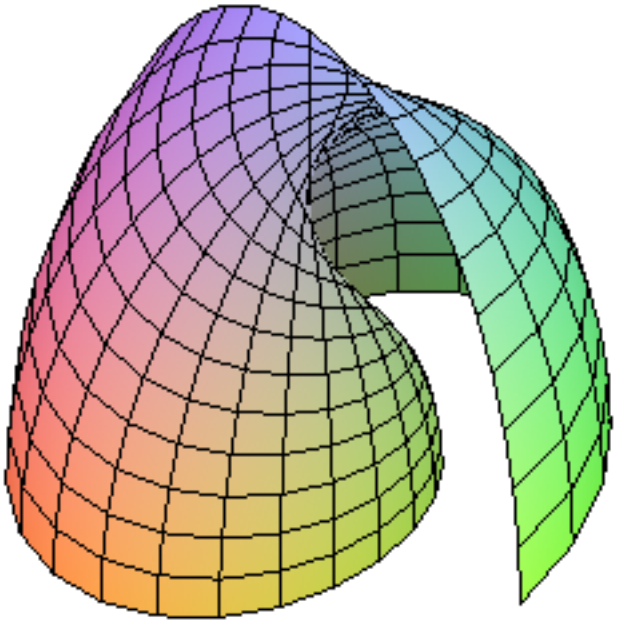


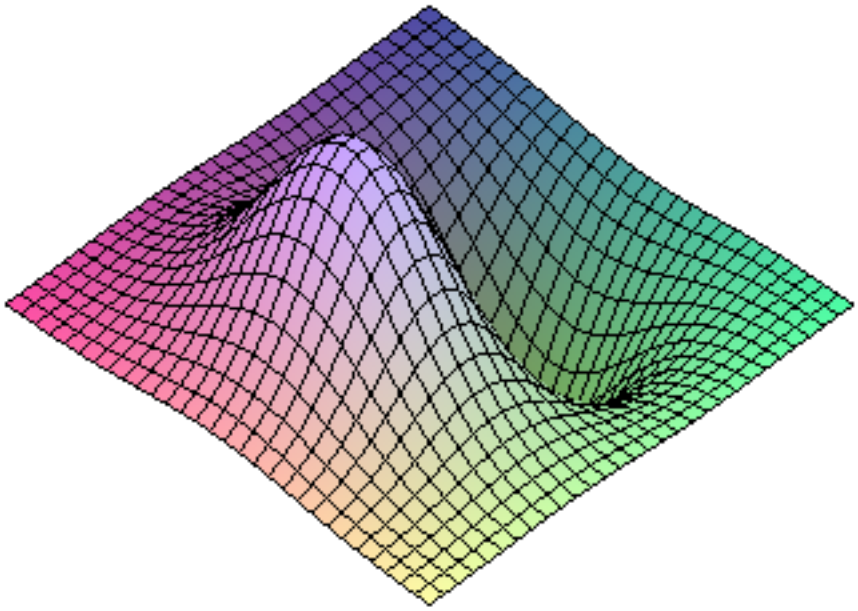
```
> plot3d((1.3)^x * sin(y), x=-1..2*Pi, y=0..Pi, coords=spherical,
  style=patch);
  plot3d([1,x,y], x=0..2*Pi, y=0..2*Pi, coords=toroidal(10),
  scaling=constrained);
```



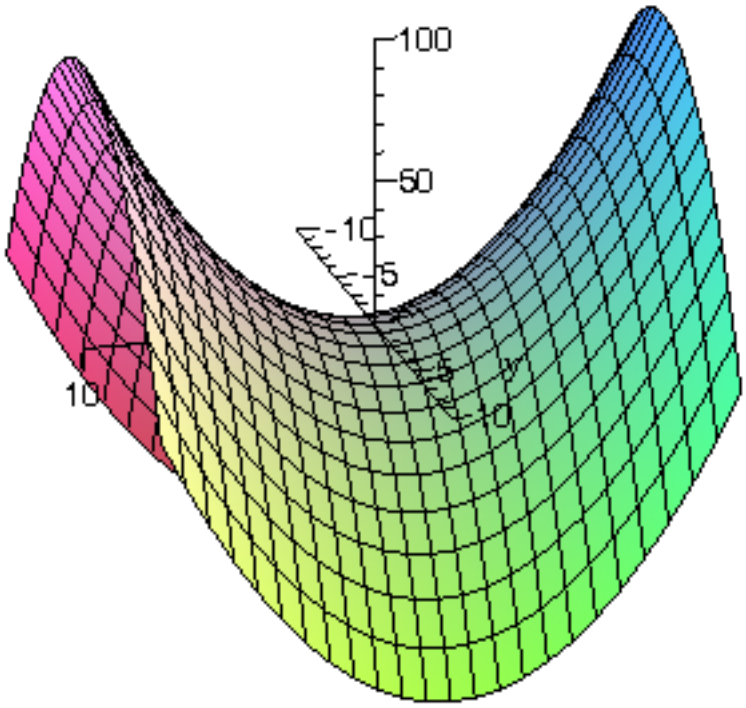


```
> plot3d([x*sin(x)*cos(y), x*cos(x)*cos(y), x*sin(y)], x=0..2*Pi,
  y=0..Pi);
  plot3d(x*exp(-x^2-y^2), x=-2..2, y=-2..2, grid=[30,30]);
```





```
> plot3d(x^2-y^2,x=-10..10,y=-10..10,orientation=[80,70]);
```


100
50
-10
5
10
5
y
-5
-10