Introduction à Sage

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```
%hide
```

Calculatrice

```
1+1
```

```
2
```

```
factorial(50)
```

```
30414093201713378043612608166064768844377641568960512000000000000
```

```
s = add(1/n for n in (1..30))
```

```
s
```

```
9304682830147/2329089562800
```

```
s.n()
```

```
3.99498713092039
```

```
%hide
```

Python

```
def myfact(n):
    res = 1
    for k in (1..n):
        res = res * k
    return res
```

```
myfact(50)
```

```
30414093201713378043612608166064768844377641568960512000000000000
```

```
%hide
```

Calculatrice 2 : aide, calcul symbolique

```
x, y = var('x, y')
u = cos(x)*sin(y)
u
```

```
    sin(y)*cos(x)
```

```
diff(u, x)
```
```
    -sin(x)*sin(y)
```

```
u.derivative(y)
```
```
    cos(x)*cos(y)
```

```
u.i
```

```

```

```
u.integral(x)
```
```
    sin(x)*sin(y)
```

```
u.series(x, 5)
```
```
    (sin(y)) + (-1/2*sin(y))*x^2 + (1/24*sin(y))*x^4 + Order(x^5)
```

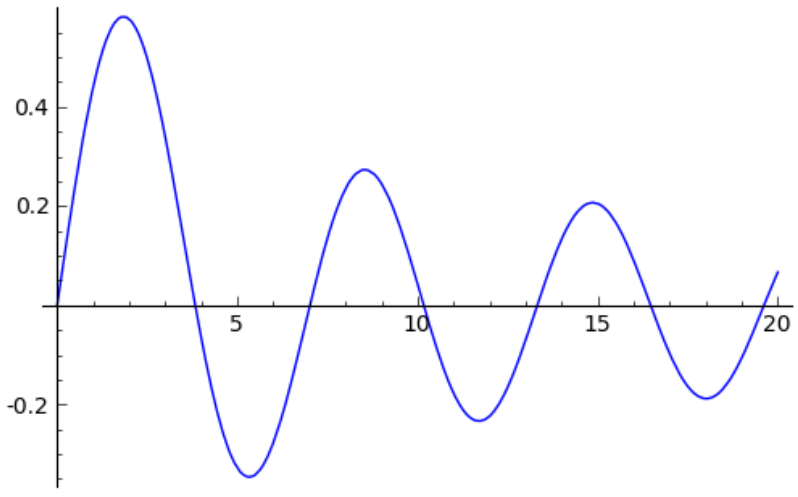
```
u(x=1)
```
```
    sin(y)*cos(1)
```

```
u(x=pi, y=1).n(prec=200)
```
```
    -0.84147098480789650665250232163029899962256306079837106567275
```

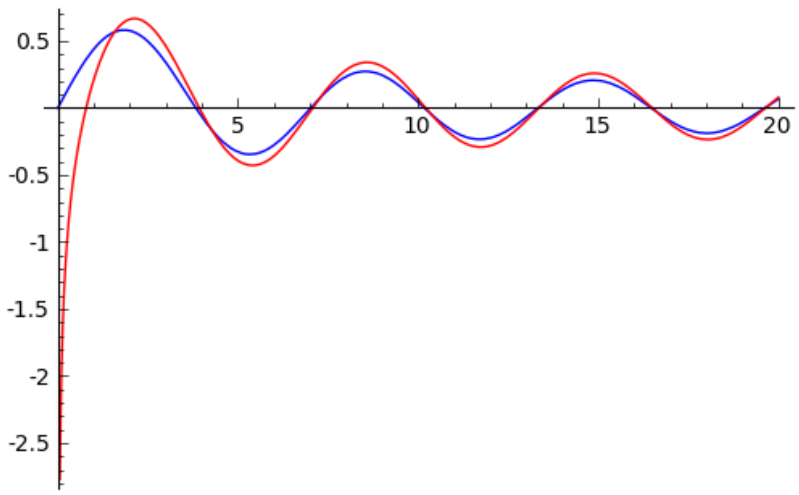
```
%hide
```

Graphiques

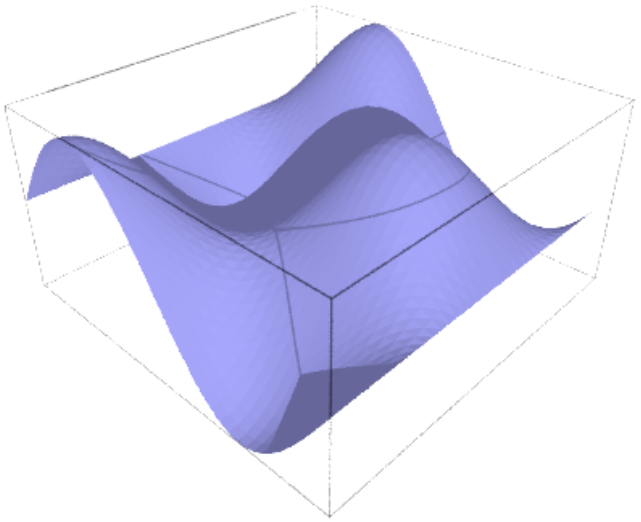
```
p = plot(Bessel(1, 'J'), 0, 20)
p
```



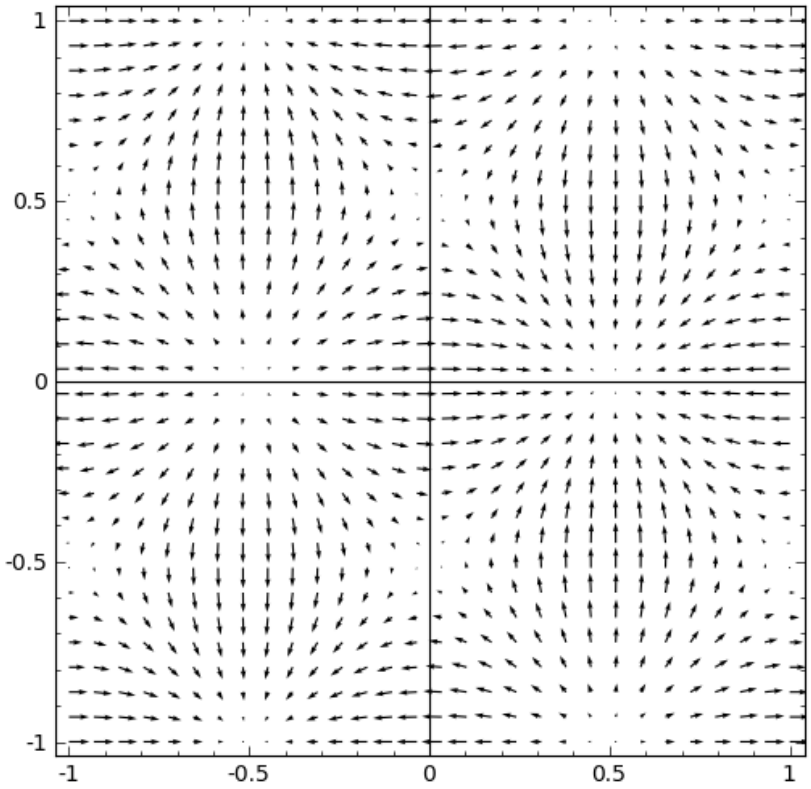

```
p + plot(cos(x-3*pi/4)/sqrt(x), (x,0,20), color='red')
```



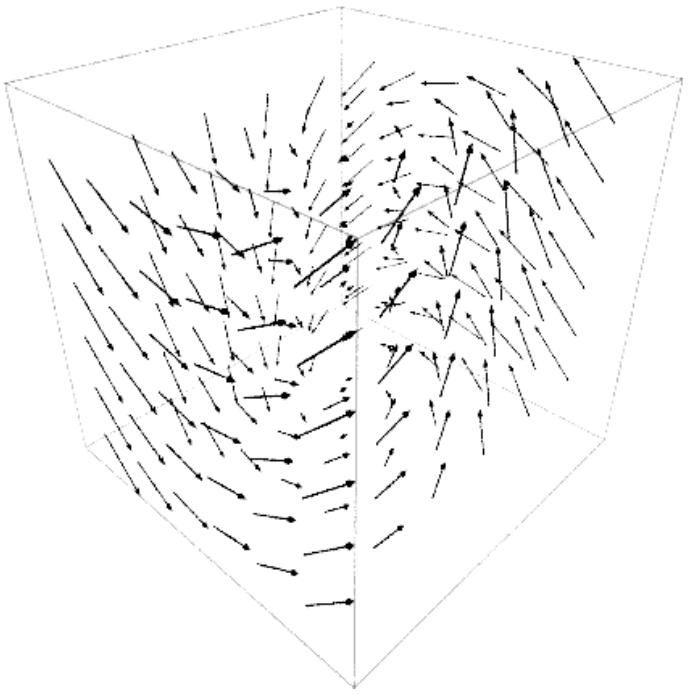

```
u, v = var('u, v')
f = sin(pi*u)*cos(pi*v)
plot3d(f, (u,-1,1), (v,-1,1), viewer="tachyon")
```



```
plot_vector_field(f.gradient(), (u,-1,1), (v,-1,1), aspect_ratio=1,
plot_points=30)
```




```
x,y,z=var('x y z')
myplot = plot_vector_field3d(
    (-y, 0, x), (x,-2,2), (y,-2,2), (z,-2,2),
    colors='black', plot_points=6)
show(myplot, viewer="tachyon")
```



```
@interact
def _(b = range_slider(-20, 20, 1, default=(-19,3), label='Range')):
    plot(sin(x)/x, b[0], b[1]).show(xmin=b[0],xmax=b[1])
```

```
%hide
```

Éléments et parents

```
2.parent()
```

```
    Integer Ring
```

```
R = IntegerModRing(10); R
```

```
    Ring of integers modulo 10
```

```
a = R(2)
a.parent()
```

```
    Ring of integers modulo 10
```

```
a^10
```

```
    4
```

```
x.parent()
```

```
    Symbolic Ring
```

```
(x+1)^10
```

```
    (x + 1)^10
```

```
R.<z> = QQ[]
z.parent()
```

```
    Univariate Polynomial Ring in z over Rational Field
```

```
(z+1)^10
```

```
    z^10 + 10*z^9 + 45*z^8 + 120*z^7 + 210*z^6 + 252*z^5 + 210*z^4 + 120*z^3
    + 45*z^2 + 10*z + 1
```

```
%hide
```

Quelques domaines de calcul

```
E = MatrixSpace(RealField(12), 4); E
```

```
    Full MatrixSpace of 4 by 4 dense matrices over Real Field with 12 bits
    of precision
```

```
M = E.random_element(); M
```

```
    [ -0.531   0.306  -0.852  -0.458]
    [  0.377  0.0303   0.491   0.788]
    [ -0.829   0.880   0.328 -0.0947]
    [  0.448  -0.965   0.687   0.233]
```

```
M.inverse()
```

```
[  -2.44   -1.02   -1.07   -1.78]
[  -1.58  -0.452 -0.0618   -1.61]
[  -1.33  -0.723   0.555  0.0641]
[   2.05    2.22   0.169   0.874]
```

```
MatrixSpace(QQ, 4)(M).inverse()
```

```
[-362649323357793480145300800/1489876517027922182161521 7
-151779126743592139149540000/1489876517027922182161521 7
-159705971409354345887984800/1489876517027922182161521 7
-265294430004267783278523000/1489876517027922182161521 7]
[-234946935763712817595696000/1489876517027922182161521 7
-670901194558810607123355000/1489876517027922182161521 7
-915827987471453367643850/1489876517027922182161521 7
-478451620351597837231958250/2979753034055844364323043 4]
[-197447320135738403707387200/1489876517027922182161521 7
-107754832156979961177601650/1489876517027922182161521 7
827458395415095327421639500/1489876517027922182161521 7
382546107360330767117468100/5959506068111688728646086 8]
[ 305524168876233856152273600/1489876517027922182161521 7
331363973046219264513121500/1489876517027922182161521 7
251568522614051208592740000/1489876517027922182161521 7
130103359127124080646335100/1489876517027922182161521 7]
```

```
GF(49, 'a')['x,y,z']
```

```
Multivariate Polynomial Ring in x, y, z over Finite Field in a of size
7^2
```

```
PowerSeriesRing(CDF, 'x')
```

```
Power Series Ring in x over Complex Double Field
```

```
PermutationGroup([(1,2), ((3,4,5), (1,6))])
```

```
Permutation Group with generators [(1,2), (1,6)(3,4,5)]
```