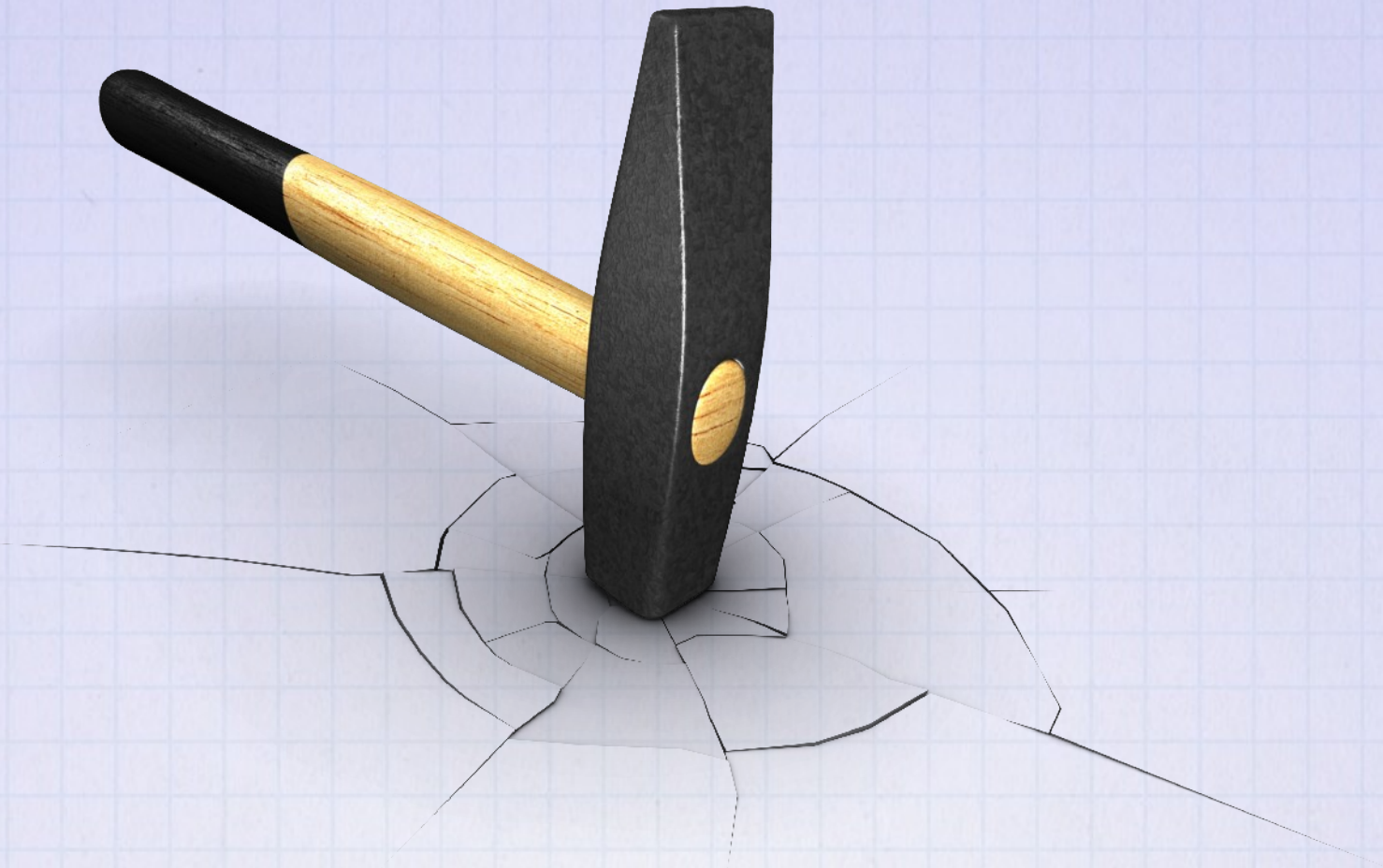

GrappaLug

Matematica di base e avanzata con Sage

Andrea Lazzarotto
andrealazzarotto.com/contatti

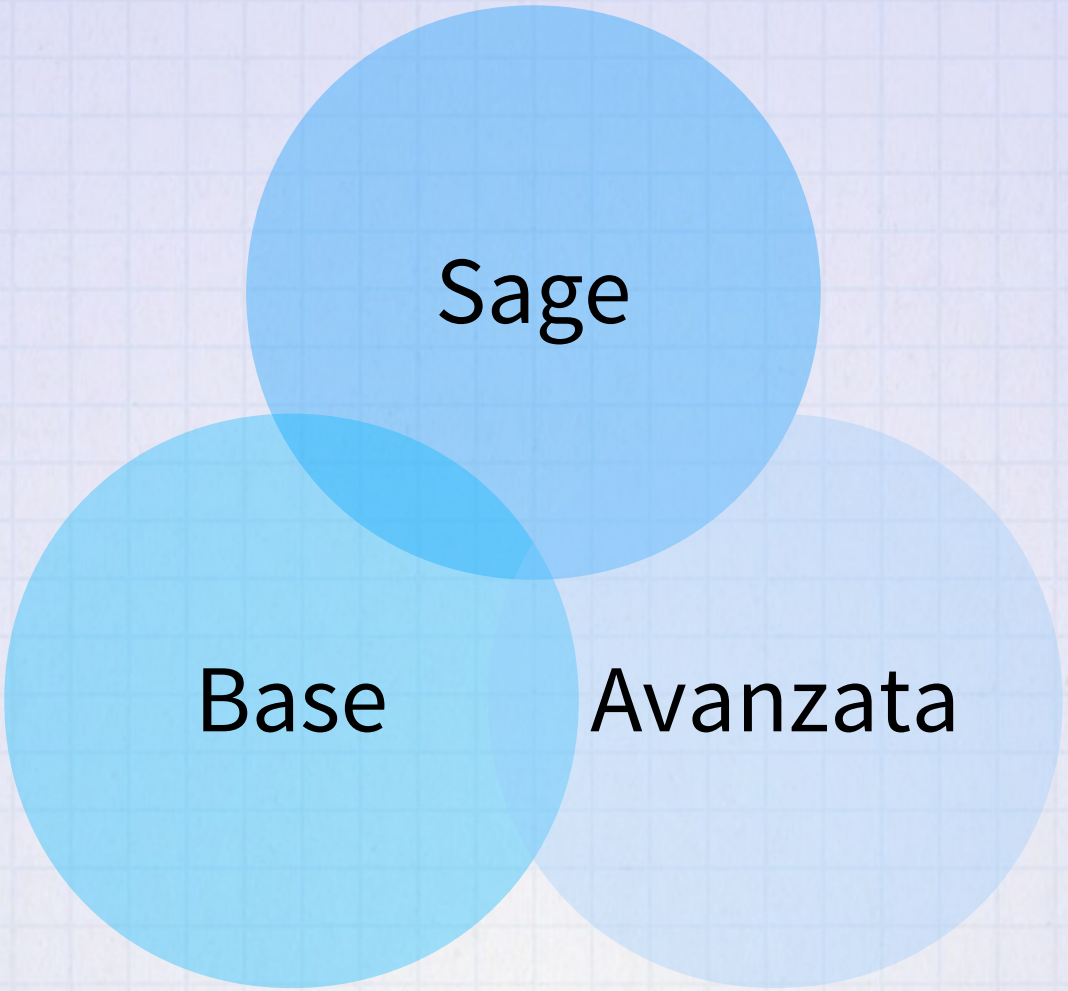
Problema

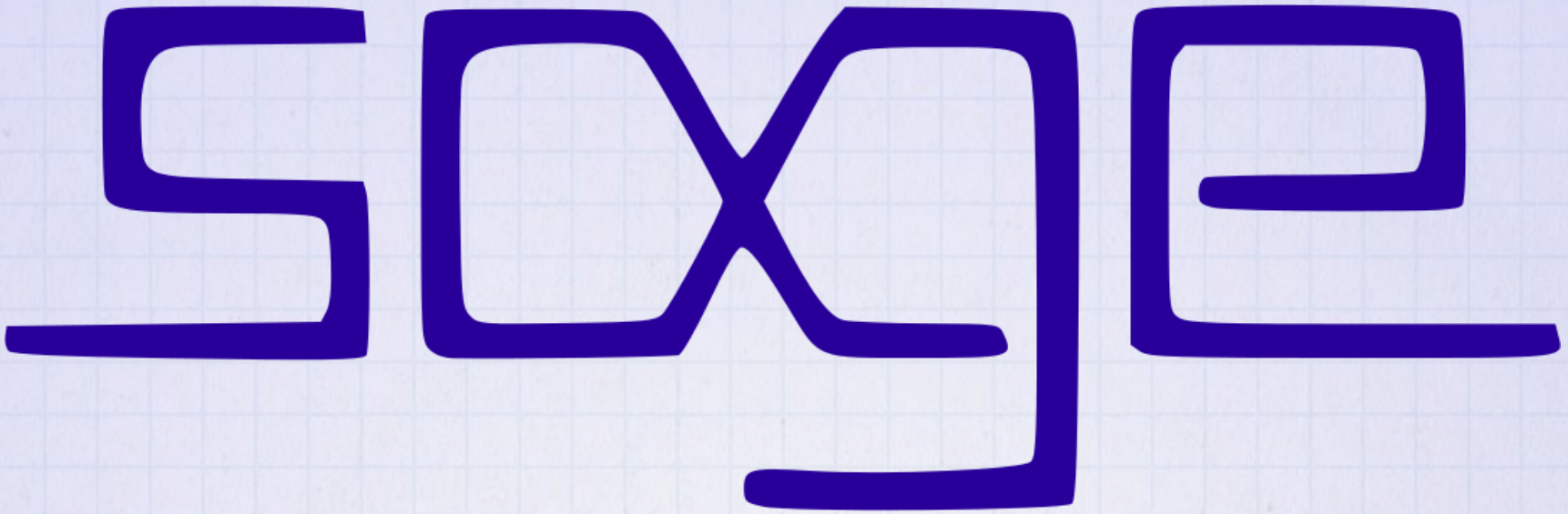
Software proprietario



Librerie open source

Percorso




sxge

> Creare una alternativa percorribile, libera e open source a Magma, Maple, Mathematica e Matlab.

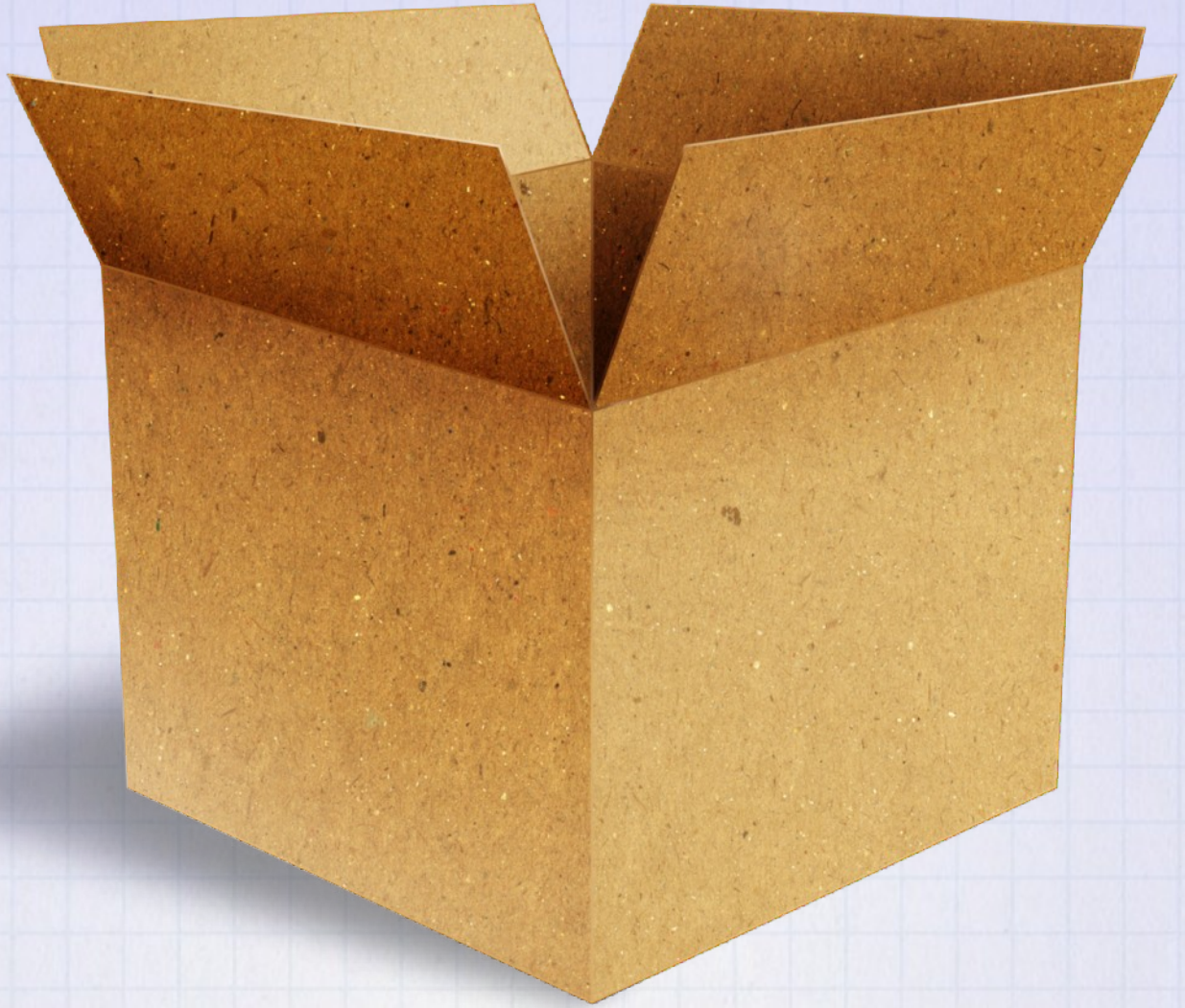
Caratteristiche chiave

Distribuzione auto-contenuta

Interfacce unificate

Nuova libreria

Distribuzione auto-contenuta



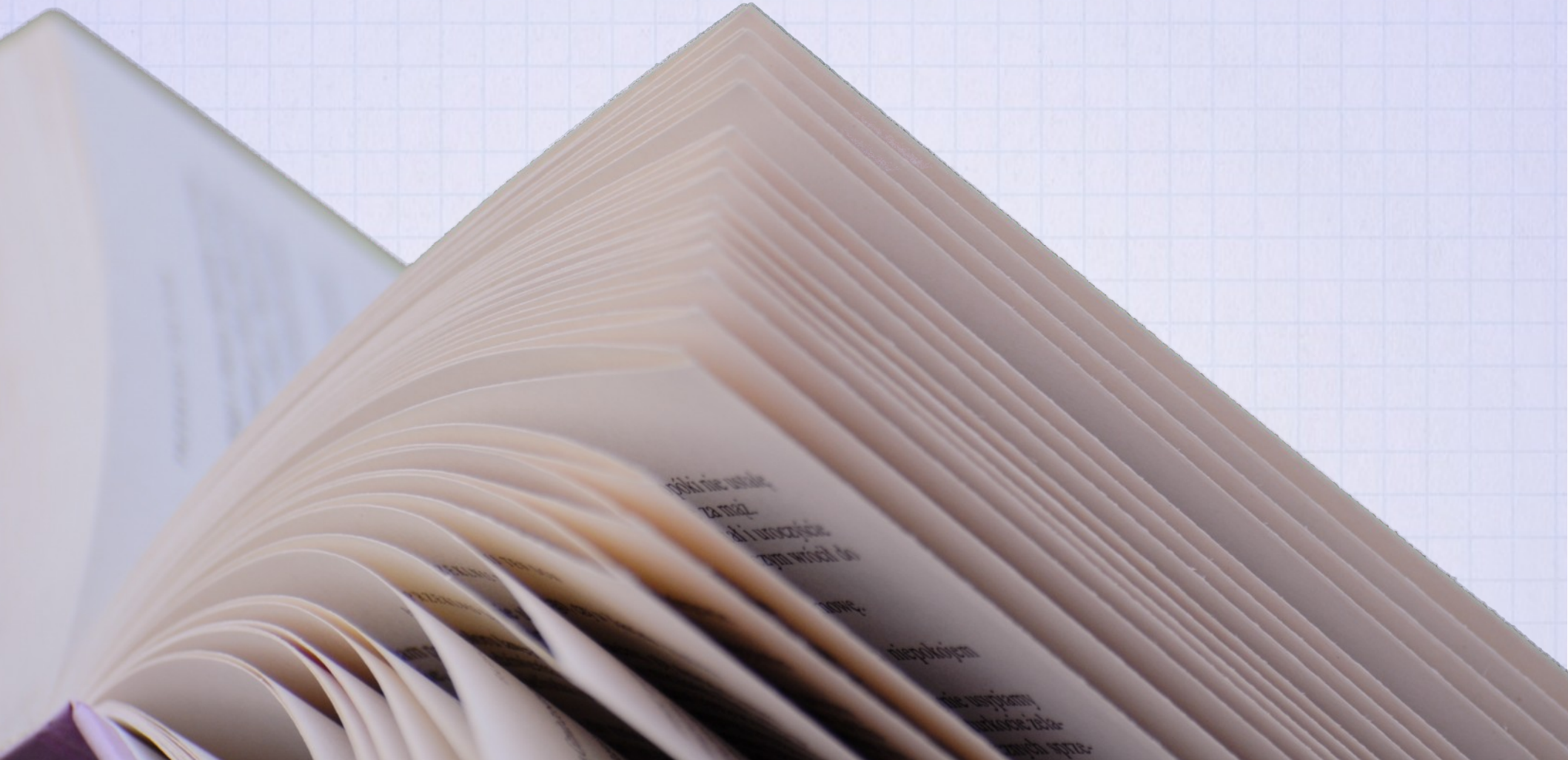
~ 100

software inclusi

Interfacce unificate

Approccio algebrico, simbolico e numerico

Nuova libreria



Python

Matematica di base

Il notebook

www.sagenb.org

Dimostrazione video del Sage Notebook:

https://www.youtube.com/watch?v=XmTo9ZqSNOg

Calcoli

```
1+1
```

$$2$$

```
1/2
```

$$\frac{1}{2}$$

```
(1/2+3/4)*7/3
```

$$\frac{35}{12}$$

```
252373613713462146373612+3242342342342
```

$$25237361371671 6 04488715954$$

```
factor(_)
```

$$2 \cdot 3^2 \cdot 13 \cdot 487 \cdot 26568989 \cdot 83353549567$$

```
N(pi, digits=20)
```

$$3.1415926535897932385$$

```
is_prime(435347)
```

$$\text{False}$$

```
next_prime(435347)
```

$$435349$$

```
pi+pi
```

$$2\pi$$

```

```

evaluate

Algebra

$$\begin{cases} 3x + y = 4 \\ x - y = 1 \end{cases}$$

```
solve(3*x+5 == 7, x)
```

$$\left[x = \left(\frac{2}{3}\right)\right]$$

```
solve(4*x^2-6*x+1 == 0, x)
```

$$\left[x = -\frac{1}{4}\sqrt{5} + \frac{3}{4}, x = \frac{1}{4}\sqrt{5} + \frac{3}{4}\right]$$

```
solve(4*x^4-6*x+1 == 0, x)
```

$$\left[x = -\frac{1}{2}\sqrt{\frac{3\left(\frac{1}{72}\sqrt{3}\sqrt{2123}+\frac{9}{8}\right)^{\left(\frac{2}{3}\right)}+1}{\left(\frac{1}{72}\sqrt{3}\sqrt{2123}+\frac{9}{8}\right)^{\frac{1}{3}}}}\sqrt{\frac{1}{3}} - \frac{1}{2}\sqrt{-\left(\frac{1}{72}\sqrt{3}\sqrt{2123}+\frac{9}{8}\right)^{\left(\frac{1}{3}\right)} - \frac{9\sqrt{\frac{1}{3}}}{\sqrt{\frac{3\left(\frac{1}{72}\sqrt{3}\sqrt{2123}+\frac{9}{8}\right)^{\left(\frac{2}{3}\right)}+1}{\left(\frac{1}{72}\sqrt{3}\sqrt{2123}+\frac{9}{8}\right)^{\frac{1}{3}}}}} - \frac{1}{3\left(\frac{1}{72}\sqrt{3}\sqrt{2123}+\right.}}\right]$$

```
solve(3*x^2-5*x <= 2, x)
```

$$\left[\left[x \geq \left(-\frac{1}{3}\right), x \leq 2\right]\right]$$

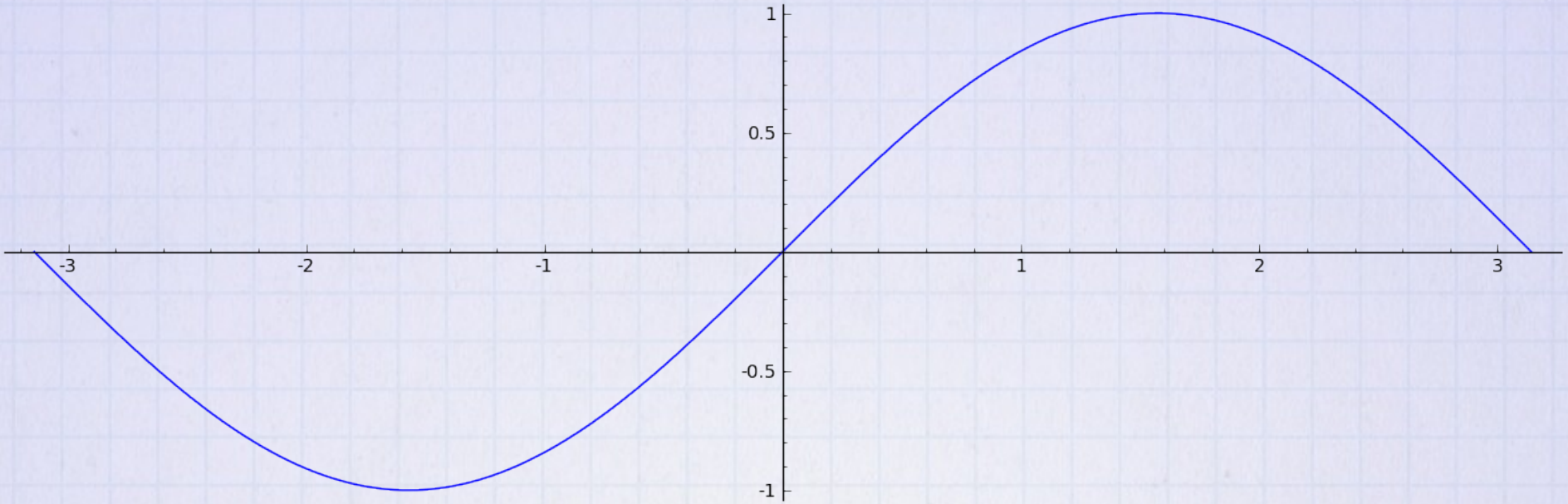
```
var("x y")
solve((3*x+y==4, x-y==1), (x, y))
```

$$\left[\left[x = \left(\frac{5}{4}\right), y = \left(\frac{1}{4}\right)\right]\right]$$

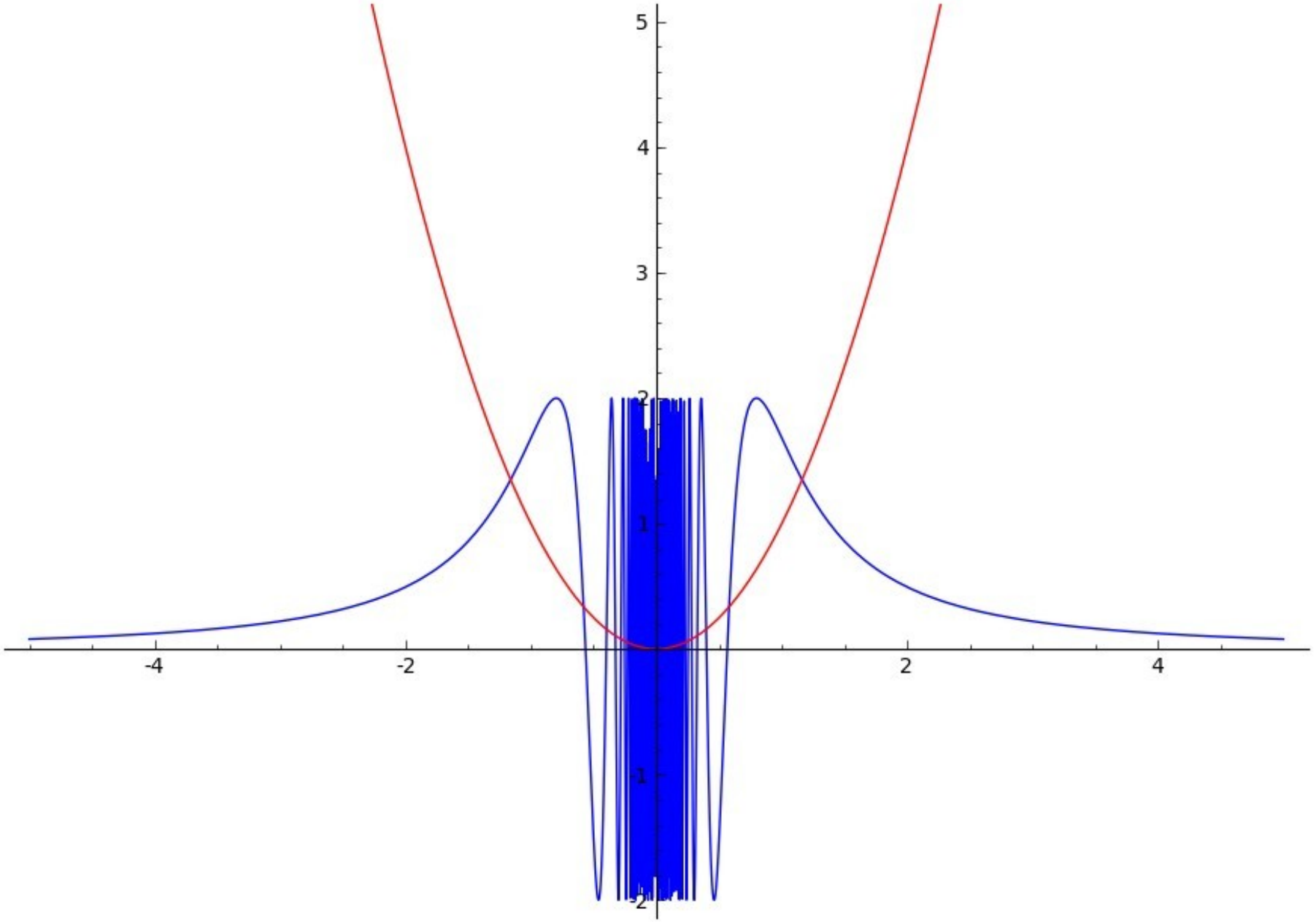
```

```

evaluate

Grafici



```
A = plot(2*sin(1/x^2), (x,-5,5), color='blue')
B = plot(x^2, (x,-5,5), color='red', ymax=5)
show(A + B, aspect_ratio=1, figsize=9)
```



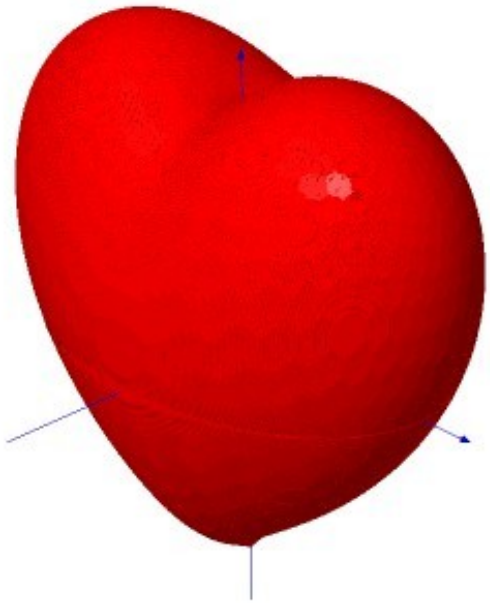
Dimostrazione video con grafici 3D:

http://www.youtube.com/watch?v=vPDJmaVwIXU&

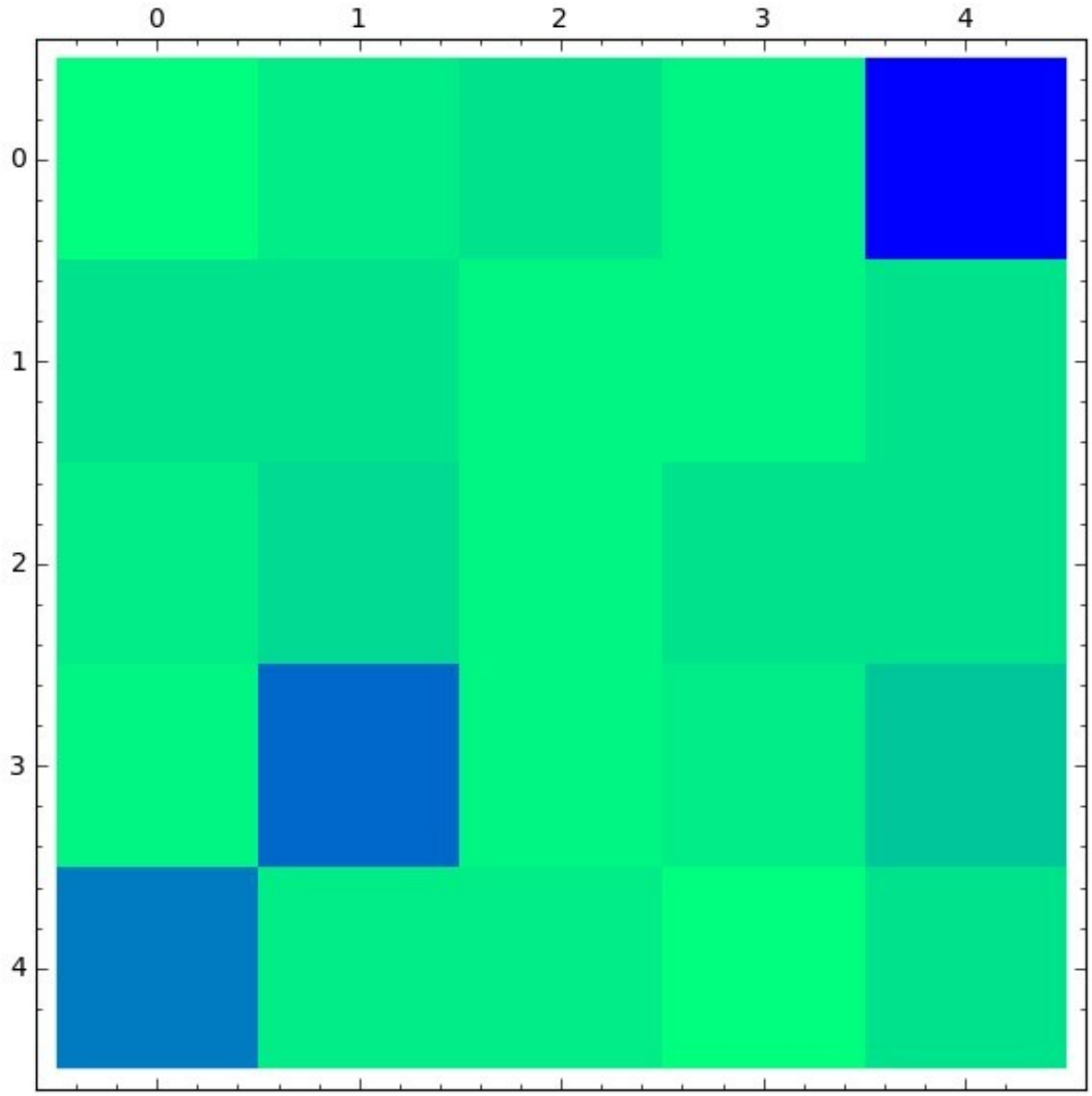
```
var("x y z")
f=(x^2+9/4*y^2+z^2-1)^3-x^2*z^3-9/80*y^2*z^3
show(latex(f) + "=0")
t = 1.25
implicit_plot3d(f, (x, -t, t), (y, -t, t), (z, -t, t), plot_points=300, axes=True,
color='red', frame=False)
```

$$-x^2z^3-\frac{9}{80}\,y^2z^3+\frac{1}{64}\left(4\,x^2+9\,y^2+4\,z^2-4\right)^3=0$$

Sleeping... Make Interactive



```
M = random_matrix(ZZ, 5, 5)
matrix_plot(M, cmap='winter')
```



evaluate

Matematica avanzata

```
f(x) = e^(-x^2)
lim(f, x = +oo)
```

$$x \mapsto 0$$

```
lim(1/x, x = 0, dir='left')
```

$$-\infty$$

```
diff(f, x)
```

$$x \mapsto -2xe^{(-x^2)}$$

```
g(y) = sin(y)+3*y^3
integrate(g, y)
```

$$y \mapsto \frac{3}{4}\,y^4 - \cos(y)$$

```
h(x, y) = f*g
show(h)
```

$$(x, y) \mapsto \left(3y^3 + \sin(y)\right)e^{(-x^2)}$$

```
[diff(h, x), diff(h, y)]
```

$$\left[(x, y) \mapsto -2\left(3y^3 + \sin(y)\right)xe^{(-x^2)}, (x, y) \mapsto \left(9y^2 + \cos(y)\right)e^{(-x^2)}\right]$$

```
solve(diff(y) == h, y)
```

$$\left[y = \frac{1}{2}\left(i\sqrt{3} - 1\right)\left(\frac{1}{3}\,e^{(x^2)} - \frac{1}{3}\sin(y)\right)^{\left(\frac{1}{3}\right)}, y = \frac{1}{2}\left(-i\sqrt{3} - 1\right)\left(\frac{1}{3}\,e^{(x^2)} - \frac{1}{3}\sin(y)\right)^{\left(\frac{1}{3}\right)}, y = \left(\frac{1}{3}\,e^{(x^2)} - \frac{1}{3}\sin\right.$$

Interazione

Dimostrazione video dei controlli interattivi:

http://www.youtube.com/watch?v=yijxi1Un-Gw

Altro software?

Formule $L^{A}T_{E}X$ e stampa

Immagini copiabili

Integrazione Python

Esempio

```
def triangolo(a, b):
    x0 = a[0]
    y0 = a[1]
    x1 = b[0]
    y1 = b[1]
    x2 = (x0+x1)/2
    l=abs(x1-x0)
    y2=y0+l*sqrt(3)/2
    c = (x2, y2)
    return polygon([a,b,c])
```

```
def frattale(a, c, volte):
    if (volte <= 0):
        graph = triangolo(a, c)
        return graph
    else:
        x0, y0 = a[0], a[1]
        x2, y2 = c[0], c[1]
        x1, y1 = (x2+x0)/2, y0
        l = abs(x1-x0)
        x3, y3 = (x0+x1)/2, y0 + l*sqrt(3)/2
        x4, y4 = (x1+x2)/2, y3
        b = (x1, y1)
        d = (x3, y3)
        e = (x4, y4)

        graph1 = frattale(a, b, volte-1)
        graph2 = frattale(b, c, volte-1)
        graph3 = frattale(d, e, volte-1)

        return graph1 + graph2 + graph3
```

Dimostrazione video del codice Python:

http://www.youtube.com/watch?v=pH4ftfeiEL8

Conclusione