

test5

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```
f(x)=x^3+1
f(2)
```

9

```
show(f)
```

$x^3 + 1$

```
f.limit(x=1)
```

$x \rightarrow 2$

```
f.lim(x=1)
```

Traceback (click to the left of this block for traceback)

```
...
AttributeError: 'sage.symbolic.expression.Expression' object has no
attribute 'lim'
```

```
lim(f, x=1, dir='- '); lim(f, x=1, dir='+ '); f(1)
```

$x \rightarrow 2$
 $x \rightarrow 2$
 2

```
limit(sin(x)/abs(x), x=0)
```

und

```
limit(sin(x)/abs(x), x=0, dir='- '); limit(sin(x)/abs(x), x=0, dir='+')
```

-1
 1

```
limit(exp(x), x=oo)
```

+Infinity

```
limit(exp(x), x=-oo)
```

0

```
limit(sqrt(x^2+x+1)+x, taylor=true, x=-oo)
```

-1/2

```
limit(sqrt(x^2+x+1)+x, x=-oo)
```

-1/2

```
limit((tan(sin(x))-sin(tan(x)))/x^7, x=0)
```

1/30

```
limit((tan(sin(x))-sin(tan(x)))/x^7, taylor=true, x=0)
```

1/30

```
var('a')
```

a

```
limit(x^a, x=0)
```

Traceback (click to the left of this block for traceback)

```
...
Is a positive, negative or zero?
```

```
assume(a>0)
limit(x^a, x=0)
```

Traceback (click to the left of this block for traceback)

```
...
Is a an integer?
```

```
assume(a, 'integer')
limit(x^a, x=0)
```

Traceback (click to the left of this block for traceback)

```
...
Is a an even number?
```

```
assume(a, 'even')
limit(x^a, x=0)
```

0

```
forget()
```

```
limit(exp(-1/x), x=0, dir='right')
```

0

```
limit(exp(-1/x), x=0, dir='left')
+Infinity
```

```
var('x', domain='positive')
```

```
f(x)=log(log(x))/log(x)
assume(x>0)
```

```
Traceback (click to the left of this block for traceback)
...
ValueError: Assumption is inconsistent
```

```
show(log(i))
```

$$\frac{1}{2}i\pi$$

```
forget()
f=log(log(x))/log(x)
assume(x<-2); limit(f, x=0)
```

$$0$$

```
lim(sin(1/x), x=0)
```

$$\text{ind}$$

```
var('xx')
limit(floor(xx), xx=0, dir='-')
```

$$-1$$

```
limit(floor(xx), xx=0, dir='plus')
```

$$0$$

```
limit(floor(xx), xx=0)
```

$$\text{und}$$

```
limit(xx*floor(sin(xx)/xx), taylor=true, xx=0)
```

$$\text{limit}(xx \cdot \text{floor}(\sin(xx)/xx), xx, 0)$$

```
limit(exp(x^2)*(1-erf(x)), x=infinity)
```

$$-\text{limit}((\text{erf}(x) - 1) \cdot e^{x^2}, x, +\text{Infinity})$$

```
a=sage.calculus.calculus.dummy_limit(sin(x)/x, x, 0); a
```

$$\text{limit}(\sin(x)/x, x, 0)$$

```
f=sin(x); f.derivative()
```

`cos(x)`

`derivative(f,x)`

`cos(x)`

`derivative(f,x,x)`

`-sin(x)`

`derivative(f,x,3)`

`-cos(x)`

`f(x,y)=x^2*y+y^2+y;y`
`f.diff()`

`(x, y) |--> (2*x*y, x^2 + 2*y + 1)`

`derivative(f)`

`(x, y) |--> (2*x*y, x^2 + 2*y + 1)`

`f.diff(x)`

`(x, y) |--> 2*x*y`

`diff(f,x)`

`(x, y) |--> 2*x*y`

`f(x,y)=3*x^4*y^3+9*y*x^2-4*x+8*y`
`show(f)`

`(x,y) 3x4y3 + 9x2y - 4x + 8y`

`dfdx(x,y)=diff(f,x)`
`dfdx.show()`

`(x,y) 12x3y3 + 18xy - 4`

`dfdy(x,y)=diff(f,y)`
`dfdy.show()`

`(x,y) 9x4y2 + 9x2 + 8`

`show(dfdx())`

`12x3y3 + 18xy - 4`

dfdx?

<div class="docstring">

<p>File:
/home/sage/sage-6.8/local/lib/python2.7/site-packages/sage/symbolic
ession.pyx</p>

<p>Type: <type
‘sage.symbolic.expression.Expression’></p&\n
>

<p>Definition: dfdx(SR,
x=0)</p>

<p>Docstring:</p>

<blockquote>

<div><p>Nearly all expressions are created by calling
new_Expression_from_*,
but we need to make sure this at least does not leave dfdx._gobj
uninitialized and segfault.</p>

<p>TESTS:</p>

<div class="highlight-python"><div class="highlight"><pre

class="literal-block">sage:

sage<span

class="o">.<span

class="n">symbolic<span

class="o">.<span

class="n">expression<span

class="o">.<span

class="n">Expression<span

class="p">(SR<span

class="p">)

0

sage: <span

class="n">sage<span

class="o">.<span

class="n">symbolic<span

class="o">.<span

class="n">expression<span

class="o">.<span

class="n">Expression<span

class="p">(SR<span

class="p">, <span

class="mi">5)

5

</pre></div>

</div>

<p>We test subclassing <tt class="docutils literal"><span
class="pre">Expression</tt>:</p>

<div class="highlight-python"><div class="highlight"><pre

class="literal-block">sage:

from <span

class="nn">sage.symbolic.expression <span

class="kn">import <span

class="n">Expression

sage: <span

class="k">class <span

```

class="nc">exp_sub</span><span
class="p">(</span><span
class="n">Expression</span><span
class="p">):</span> <span class="k">pass</span>
<span class="gp">sage: </span><span
class="n">f</span> <span class="o">=</span>
<span class="n">function</span><span
class="p">(</span><span
class="s">f</span><span
class="p">)</span>
<span class="gp">sage: </span><span
class="n">t</span> <span class="o">=</span>
<span class="n">f</span><span
class="p">(</span><span class="n">x</span><span
class="p">)</span>
<span class="gp">sage: </span><span
class="n">u</span> <span class="o">=</span>
<span class="n">exp_sub</span><span
class="p">(</span><span class="n">SR</span><span
class="p">,</span> <span class="n">t</span><span
class="p">)</span>
<span class="gp">sage: </span><span
class="n">u</span><span class="o">.</span><span
class="n">operator</span><span class="p">(</span>
<span class="go">f</span>
</pre>

```

</div>

show(f)

$$(x, y) \quad 3x^4y^3 + 9x^2y - 4x + 8y$$

show(f.diff(x,y))

$$(x, y) \quad 36x^3y^2 + 18x$$

f(x,y)=3*x^3*y+x^2-4*y^3
show(f)

$$(x, y) \quad 3x^3y - 4y^3 + x^2$$

f.diff(x)

$$(x, y) \quad | \rightarrow 9x^2y + 2x$$

show(f.diff(y))

$$(x,y) \quad 3x^3 - 12y^2$$

```
f.diff(x,y)
```

$$(x, y) \quad | \rightarrow 9x^2$$

```
F_x=f.diff(x)
show(F_x)
```

$$(x,y) \quad 9x^2y + 2x$$

```
F_x=f.diff(y)
```

```
d2fdx2(x,y)=derivative(f,x,2)
d2fdx2.show()
```

$$(x,y) \quad 18xy + 2$$

```
y(x)=function('y',x)
expr=5*y^2+sin(y)==x^2
expr.show()
```

$$x \quad 5y(x)^2 + \sin(y(x)) = x^2$$

```
dydx=solve(diff(expr),diff(y))
dydx[0].show()
```

$$D[0](y)(x) = \frac{2x}{\cos(y(x)) + 10y(x)}$$

```
integral(sin(x),x)
-cos(x)
```

```
integral(sin(x),x,0,pi/2)
1
```

```
integrate(1/sqrt(1+x^2),x,0,pi/2)
arcsinh(1/2*pi)
```

```
var('k,w')
f=x^3*e^(k*x)*sin(w*x);
show(f.integral(x,0,1))
```

$$-\frac{24(k^3w - kw^3)}{k^8 + 4k^6w^2 + 6k^4w^4 + 4k^2w^6 + w^8} - \frac{(w^7e^k + 3(k^2 - 2k - 2)w^5e^k + 3(k^4 - 4k^3 + 4k^2 - 2k - 2)w^3e^k + 3(k^6 - 6k^4w^2 + 6k^2w^4 - w^6)e^k)}{k^8 + 4k^6w^2 + 6k^4w^4 + 4k^2w^6 + w^8}$$

```
forget()
assume(x>1)
var('t')
f(x)=integral(1/t,1,x)
f.show()
```

$$x \log(x)$$

```
f.derivative()
```

$$x \mapsto 1/x$$

```
var(r,t)
u=solve(5/6*x+1/2*integral(x*t*u(t),t,0,1),x)
u[0].show()
```

Traceback (click to the left of this block for traceback)

```
...
AttributeError: 'sage.symbolic.expression.Expression' object has no
attribute 'strip'
```

```
forget()
var('h,n,k')
h(k)=(-1)^(k+1)*1/k
show(h)
h.sum(k,1,infinity)
```

$$k \frac{(-1)^{k+1}}{k}$$

$$\log(2)$$

```
h(x)=binomial(n,k)
show(h)
h.sum(k,1,infinity)
```

$$x \binom{n}{k}$$

$$2^n - 1$$

```
f(x)=sin(x)/x^2
show(f)
```

$$x \rightarrow \frac{\sin(x)}{x^2}$$

```
s(x)=f.series(x==1,3)
s.show()
```

$$x \rightarrow (\sin(1)) + (\cos(1) - 2 \sin(1))(x - 1) + (-2 \cos(1) + \frac{5}{2} \sin(1))(x - 1)^2 + O((x - 1)^3)$$

```
forget()
f(x)=(-1)^k/factorial(2*k+1)
show(f)
```

$$x \rightarrow \frac{(-1)^k}{(2k + 1)!}$$

```
g(x)=f.sum(k,0,oo)
g.show()
```

$$x \rightarrow \frac{1}{2} \sqrt{2} \sqrt{\pi} J_{\frac{1}{2}}(1)$$

```
(g(pi/2)==1)
```

$$1/2*\sqrt{2}*\sqrt{\pi}*bessel_J(1/2, 1) == 1$$