

2016-04-25 - Calculus (1 of 3)

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1 Math 480: Open Source Mathematical Software

1.0.1 2016-04-25

1.0.2 William Stein

1.1 Lectures 13: Symbolic Calculus (part 1 of 3)

Today:

1. (John Jeng) Update on peer grading (due Friday at 6pm)
2. Turn on screen cast
3. New homework assignment (due Friday at 6pm)
4. Today: symbolic calculus (part 1 of 3)

1.2 Some Resources for Symbolic Calculus in Sage

- Basic Sage Calculus Tutorial (written by a UW undergrad): <http://www.sagemath.org/calctut/>
- Sage for Undergraduates has a TON: <http://www.gregorybard.com/Sage.html>
- Sage reference manual: <http://doc.sagemath.org/html/en/reference/calculus/index.html>
- Sage Calculus "thematic tutorial": <http://doc.sagemath.org/html/en/prep/Calculus.html>

1.3 Short crash course

- defining symbolic variables
- defining symbolic functions
- plot
- differentiate
- integrate
- finding zeros

```
# x is predefined; can define other variables...
```

```
%var y, theta
```

```
show(x+y+theta)
```

```
θ + x + y
```

```
var('y, theta')
```

```
(y, theta)
```

```
f(z) = z*(z+1)
```

```
f(10)
```

```
110
```

```
type(f)
```

```
<type 'sage.symbolic.expression.Expression'>
```

```
f.parent()
```

```
Callable function ring with argument z
```

```
f * f
```

```
z |--> (z + 1)^2*z^2
```

```
show(f)
```

```
z ↦ (z + 1)z
```

```
# GOTCHA!
```

```
z = .5
```

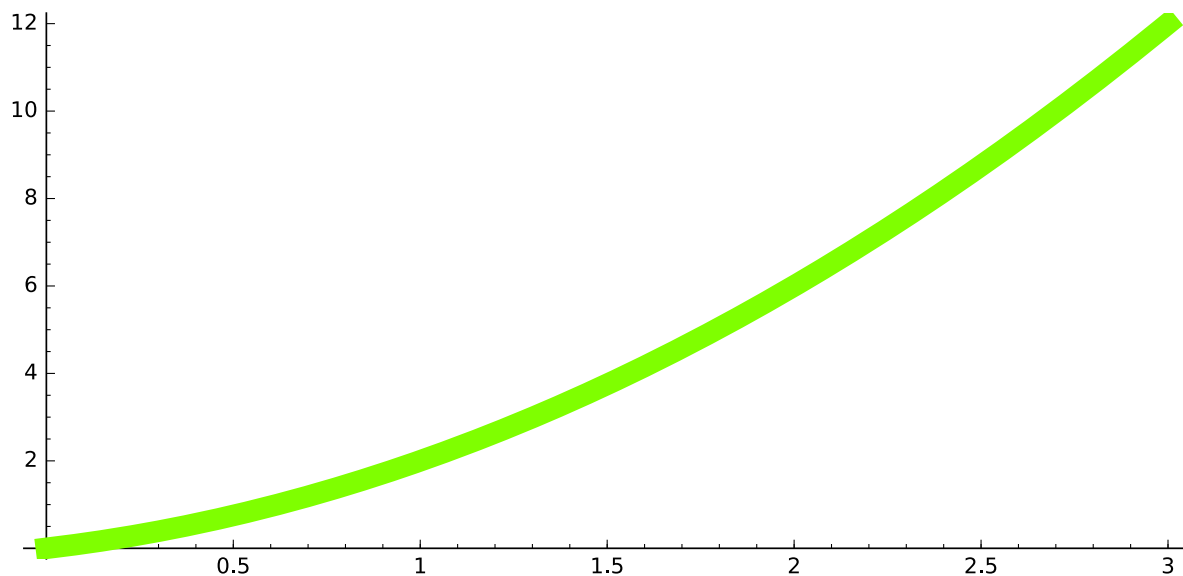
```
f(z) = z*(z+1)
```

```
print z
```

```
z
```

```
f(z) = z*(z+1)
```

```
plot(f, (0, 3), color='chartreuse', thickness=10, zorder=10) # has \  
a bazillion options
```



```
diff(x^2)
```

```
2*x
```

```
f = sin(x)*cos(x)*tan(x)
```

```
g = integrate(f, x)
```

```
show(g)
```

$$\frac{1}{2}x - \frac{1}{4}\sin(2x)$$

```
h = g.differentiate(x)
```

```
show(h)
```

$$-\frac{1}{2}\cos(2x) + \frac{1}{2}$$

```
k = h - f
```

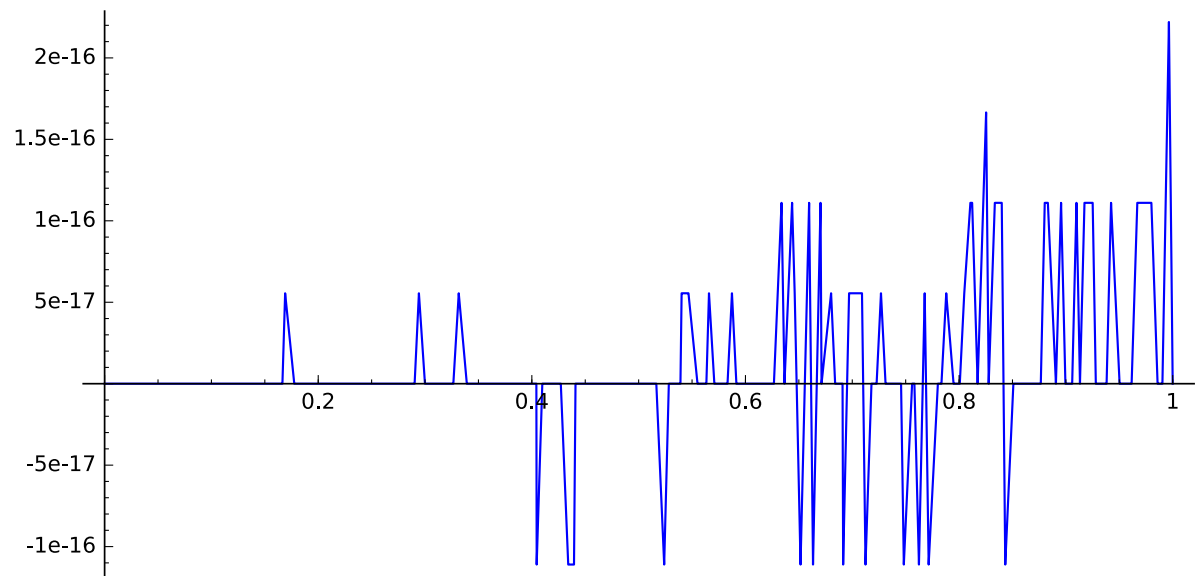
```
show(k)
```

$$-\cos(x)\sin(x)\tan(x) - \frac{1}{2}\cos(2x) + \frac{1}{2}$$

```
k
```

```
-cos(x)*sin(x)*tan(x) - 1/2*cos(2*x) + 1/2
```

```
plot(k, 0, 1)
```



```
k.simplify_full()
```

```
0
```