Plotting Extrema and Inflection Points

October 29, 2019

1 Homework 8 - Q1

We're going to plot a function, $f(x) = x^3 - 20x$, along with it's minima, maxima and inflection points.

First, we set the variable to be `x`

[1]:
```
var('x')
```

[1]:
```
x
```

Now, we make our function, $f(x) = x^3 - 20x$:

[2]:
```
f(x)=x^3-20*x
```

Next, we find the minima by solving $f'(x) = 0$...

[3]:
```
t = solve(diff(f(x),x)==0,x)
```

...and then map the actual values to a list, so that we can access the number and not just the expression.

[4]:
```
exes = list(map(lambda a: a.rhs(),t))
```

Now, we solve the equation $f''(x) = 0$ to find the points of inflection, and map those values to a list.

[5]:
```
g=list(map(lambda t: t.rhs(),solve(diff(diff(f,x),x)==0,x)))
```

Next, we plot two dotted lines that end at the maxima and minima points

First, the maxima:

[6]:
```
p1=line([(exes[0],0),(exes[0],f(exes[0]))],color='black',linestyle='--',legend_label='Maxima')
p2=line([(0,f(exes[0])),(exes[0],f(exes[0]))],color='black',linestyle='--')
```

Then the minima:

[7]:
```
p3=line([(exes[1],0),(exes[1],f(exes[1]))],color='green',linestyle='--',legend_label='Minima')
p4=line([(0,f(exes[1])),(exes[1],f(exes[1]))],color='green',linestyle='--')
```

Now, the actual function:

[8]:
```
p5=plot(f(x),(x,-8,8))
```

Now, the inflection point:

[9]:
```
p6=point((g[0],0),color='red',marker='x',legend_label='inflection point')
```

And, finally, we combine all the plots and plot them together in one nice graph!

[10]:
```
z = p1+p2+p3+p4+p5+p6
z.show()
```