Random Points

October 31, 2019

1 Homework 8 - Q7

We will now generate some random points, using a Points class that I wrote.

We will also use the `random` class that is made available in Python.

[1]:
```
from Points import Point
import random as rd
```

Now, we will choose how many points to plot: (Try out with different numbers)

[2]:
```
how_many = 5
```

Next, we will actually generate some random points, using the function `random.randint(0,10)`, which will basically enable us to create a random number in the range (0,9). (10 is excluded)

We will append those points to a list, and then print that list

[3]:
```
t = []
for i in range(how_many):
    if i==0:
        t.append(Point([rd.randint(0,10),rd.randint(0,10)]))
    else:
        t.append(Point([rd.randint(1,10),rd.randint(1,10)])+t[i-1])

for i in t:
    print(i)
```

```
[8,4]
[13,8]
[19,17]
[27,19]
[33,25]
```

For the next step, we need to create a list of variables. For this, I took some help from here.

In this process, we create `n` variables to fit an n^{th} degree equation, given n points.

[4]:
```
s = list(var('a_%d' % i) for i in range(how_many))
```

Next, we want to create Sage expressions that will equate the value of the function evaluated at a certain `x` with the corresponding value of `y`.

[5]:
```
expr = []
for i in range(how_many):
    ex = t[i][0]
    y = t[i][1]
    expr_str = ""
    for j in range(how_many):
        if j==(how_many-1):
            expr_str+="s[%d]*ex**(%d)-y==0" % (j,j)
        else:
            expr_str+="s[%d]*ex**(%d)+" % (j,j)
    expr.append(eval(expr_str))
```

We now have all our expressions in `expr`, and all our variables in `s`. Then all we need to do is solve the equation, and then take the `rhs()` of each of them, and send them to a new list.

[6]:
```
Soln = solve(expr,s)
soln_expr = []
for i in Soln[0]:
    soln_expr.append(i.rhs())
```

Next, we need to create the plot, which also contains numerical parts, which is why we need to evaluate them using the `eval()` command. So, that's what we do:

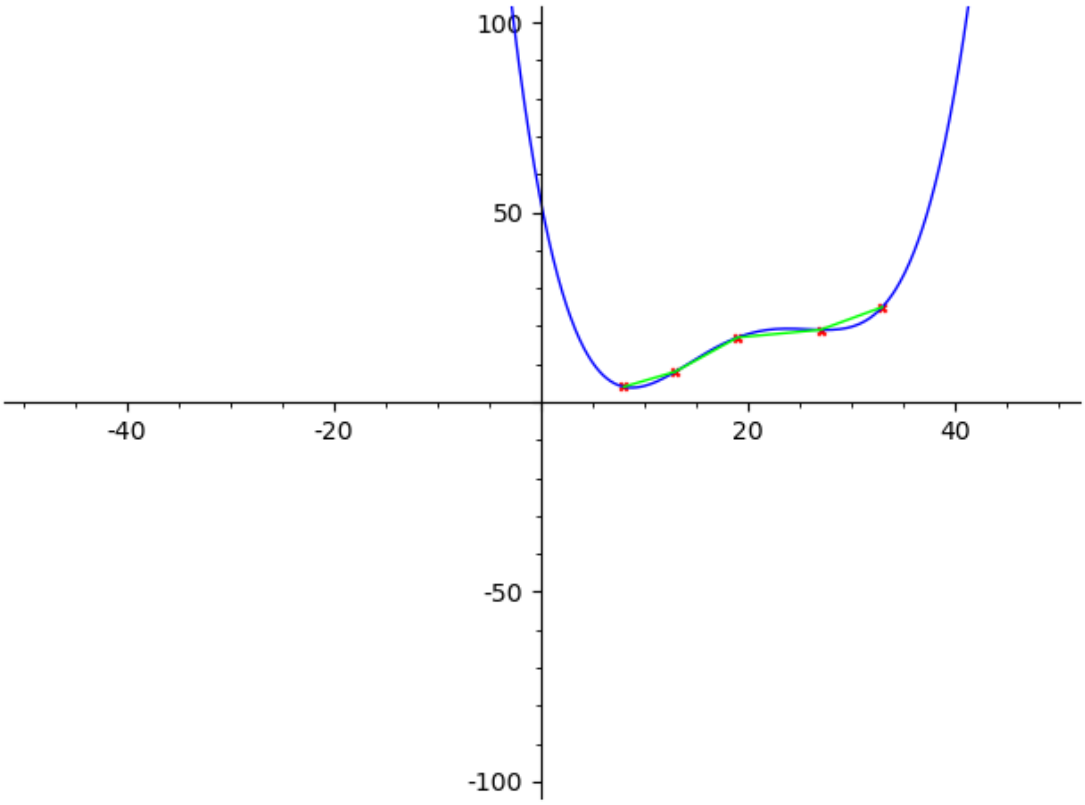
[7]:
```
plot_str=""
for i in range(len(soln_expr)):
    if i==len(soln_expr)-1:
        plot_str += str(float(soln_expr[i]))+"*x**"+str(i)
    else:
        plot_str += str(float(soln_expr[i]))+"*x**"+str(i)+"+0"

plot_expr = eval(plot_str)
plot_expr.show()
```

```
0.000607655502392344 5*x^4 - 0.0487614490772385 54*x^3 + 1.3474962406015039*x^2 - 14.03807108680
```

Now, we have our final `plot_expr`, which we will plot using the plot command. We also plot the random points we had generated, and the line joining the points.

This is the final result:

[8]:
```
p1 = plot(plot_expr,(x,-50,50),ymin=-100,ymax=100)
p2 = line(t,rgbcolor=(0,1,0))
p3 = point(t,rgbcolor=(1,0,0),marker='x')
z = p3+p1+p2
z.show()
```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