Assignment 1 ME5102

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January 25, 2019

Problem 6: Newton-Raphson method

Given the equation

$$e^{0.3x}ln(x) = x + 2$$

We can write it as

$$y = e^{0.3x}ln(x) - x - 2$$

Finding the derivative

$$y' = 0.3e^{0.3x}ln(x) + \frac{e^{0.3x}}{x} - 1$$

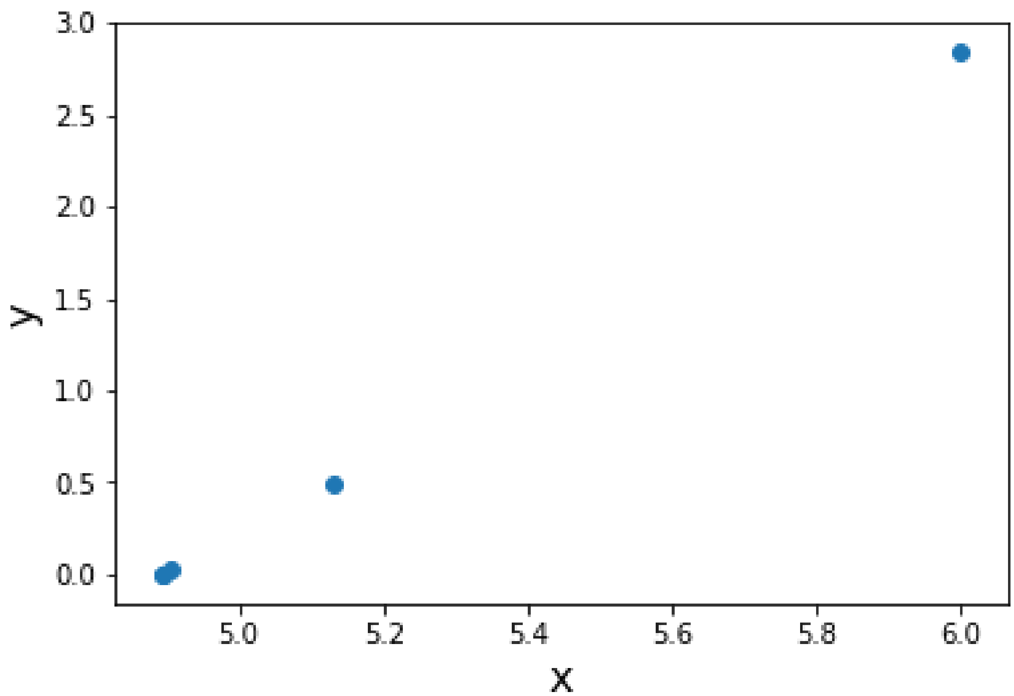
Performing iteration with the below equation taking x=6 as the initial guess

$$x_{i+1} = x_i - \frac{f_i}{f_i'}$$

```
In [6]: import numpy as np
        import matplotlib.pyplot as plt
        from astropy.table import Table, Column
        import math

        x=6
        y=np.exp(0.3*x)*np.log(x)-2-x
        lx = []
        ly = []
        while y > 0.00001:
                y=np.exp(0.3*x)*np.log(x)-2-x
                dy=0.3*np.exp(0.3*x)*np.log(x)+(1/x)*np.exp(0.3*x) - 1
                xn = x - (y/dy)
        #         print("x = ",x)
                lx.append(x)
                x = xn
        #         print("y = ",y)
                ly.append(y)
        print("x = ",x)
```

```
        # potting the points
        plt.scatter(lx, ly)
        plt.ylabel('y', fontsize=16)
        plt.xlabel('x', fontsize=16)
        # function to show the plot
        plt.show()
        t = Table([lx, ly], names=('X', 'Y'))
        print(t)
```

```
x =  4.89389362525
```




```
      X                Y
------------- -----------------
          6.0     2.83951312985
5.12901803852    0.487320542025
4.90681947262   0.0253545117731
4.89393498811 8.08754746275e-05
4.89389362568 8.30999269397e-10
```

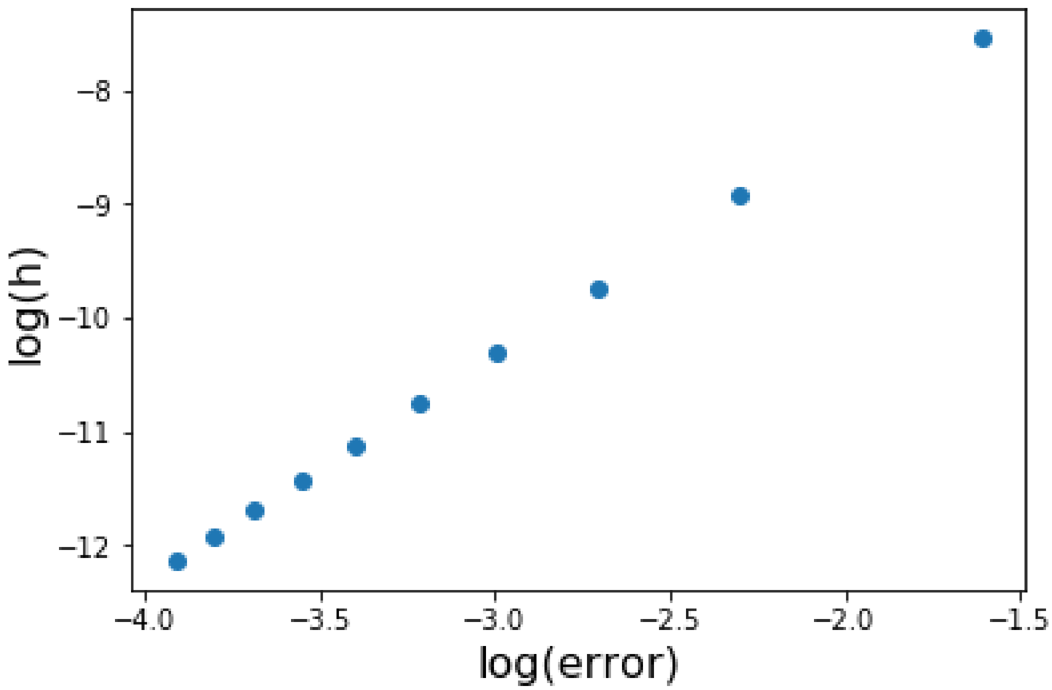
Problem 5: Trapezoidal Method

```
In [9]: from astropy.table import Table, Column
        import matplotlib.pyplot as plt
```

```
import numpy as np

a=0
b=2
ival=[]
hval=[]
no = []
exact = []
error =[]
def calculate(n):
        h=(b-a)/n
        hval.append(h)
        A=0
        for x in range(n):
                A=A+0.5*h*(1/(1+x*h*x*h) + 1/(1+(x*h+h)*(x*h+h)))
        return(A)

for x in range(1,11):
        ival.append(calculate(10*x))


for x in range(1,11):
        no.append(x)
        exact.append(1.1071487177943273)
# exact solution   1.1071487177943273

for x in range(10):
        error.append(abs(ival[x]-exact[x]))

t = Table([no , hval, ival, exact , error], names=('No','h', 'IntegralApprox' , ' Integr
print(t)

slope, intercept = np.polyfit(np.log(hval), np.log(error), 1)
print("\n Slope of the log-log curve is: ",slope)

plt.scatter(np.log(hval), np.log(error))
plt.ylabel('log(h)', fontsize=16)
plt.xlabel('log(error)', fontsize=16)
# function to show the plot
plt.show()
```

```
 No        h         IntegralApprox  IntegralExact       Error
--- --------------- -------------- -------------- ------------------
  1             0.2  1.10661589574  1.10714871779 0.000532822057604
  2             0.1  1.10701541645  1.10714871779  0.00013330134478
  3 0.0666666666667  1.10708946485  1.10714871779 5.92529394907e-05
  4            0.05  1.10711538646  1.10714871779 3.33313337444e-05
  5            0.04  1.10712738528  1.10714871779 2.13325144161e-05
```

```
 6 0.0333333333333  1.10713390337  1.10714871779 1.48144200054e-05
 7 0.0285714285714  1.10713783365  1.10714871779   1.088414074e-05
 8           0.025  1.10714038459  1.10714871779 8.33320857274e-06
 9 0.0222222222222  1.10714213351  1.10714871779  6.5842843413e-06
10            0.02  1.10714338451  1.10714871779 5.33328237085e-06

Slope of the log-log curve is:  1.99965836495
```




```
In [ ]:
```