proj1_b

September 15, 2016

0.0.1 Part 2

For the second part of the project we had to compute the forward difference estimates of the derivative $f'(3)$ of the function $f(x) = x^{-3}$ with the sequence of increments $h = 2^{-n}$, where n is in $[1, 52]$. We then had to compute both the relative error r in the approximation for each of the increments, as well as the upper bound on the relative error R from a derivation that was previously provided.

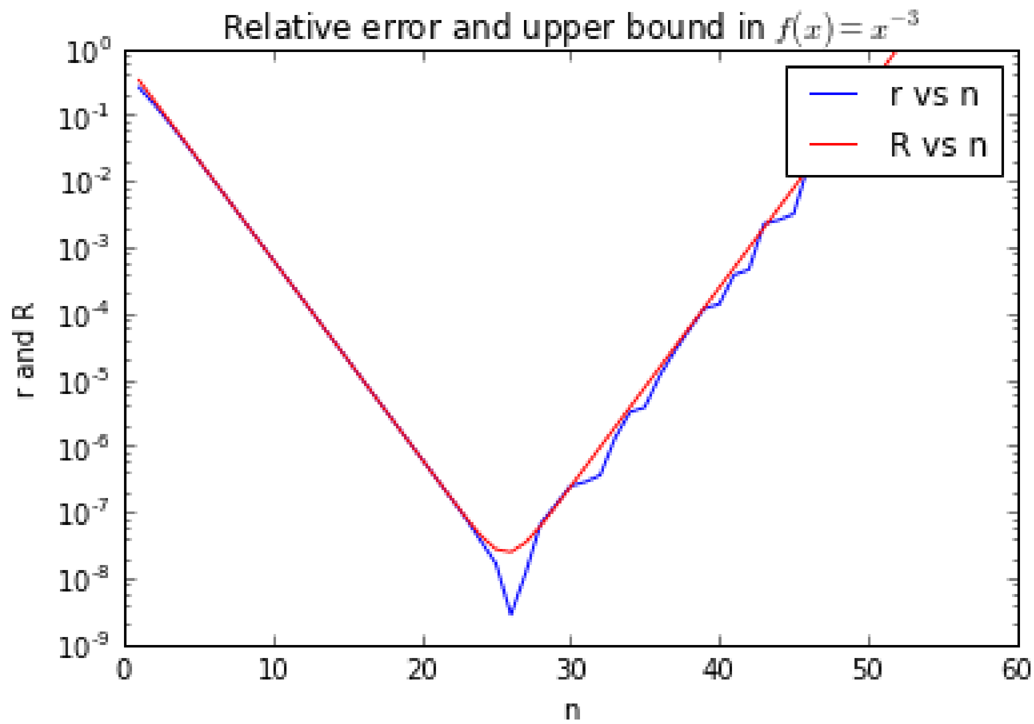
The code used implemented the provided derivations, with separate functions for each part of the equations, making use of std::vector, the math.h library, as well as the provided Matrix class to write to a text file.

```
In [35]: %pylab inline
         n= loadtxt("n.txt")
         h= loadtxt("h.txt")
         r = loadtxt("r.txt")
         R = loadtxt("R.txt")
```

```
Populating the interactive namespace from numpy and matplotlib
```

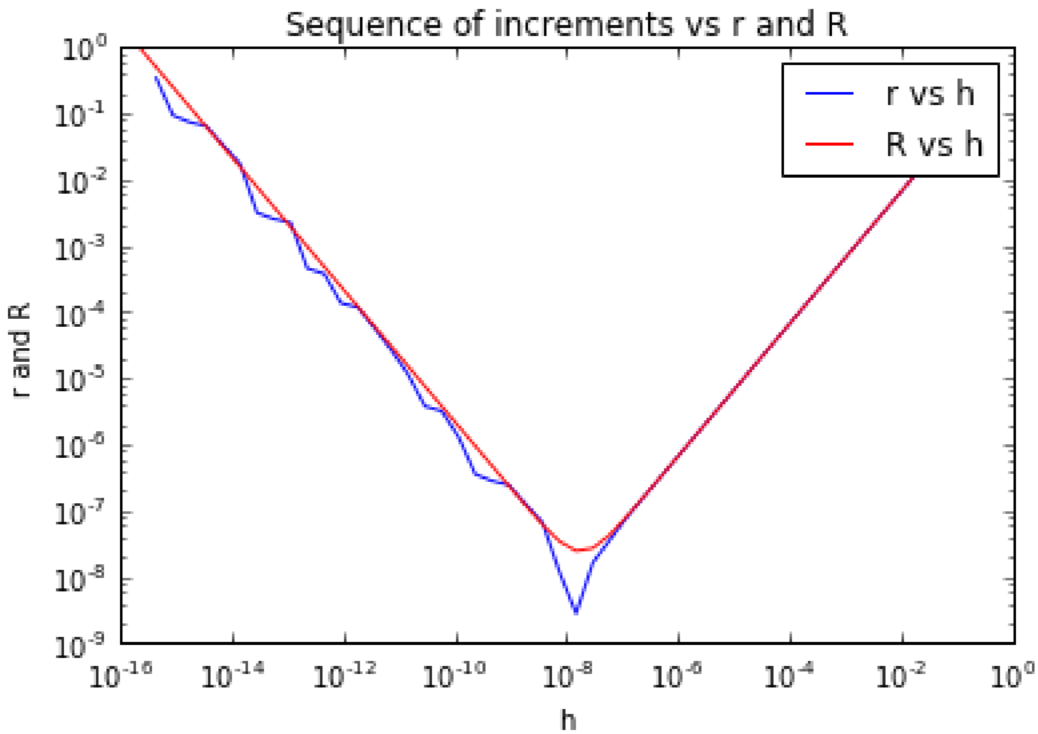
```
In [36]: semilogy(n, r, label= 'r vs n', color = 'blue')
         semilogy(n, R, label= 'R vs n', color = 'red')
         xlabel('n')
         ylabel('r and R')
         title('Relative error and upper bound in $f(x)=x^{-3}$')
         legend()
```

```
Out[36]: <matplotlib.legend.Legend at 0x7fa3ebe0c7f0>
```




```
In [37]: loglog(h, r, label= 'r vs h', color = 'blue')
         loglog(h, R, label= 'R vs h', color = 'red')
         xlabel('h')
         ylabel('r and R')
         title('Sequence of increments vs r and R')
         legend()

Out[37]: <matplotlib.legend.Legend at 0x7fa3ebd15908>
```



Based on the above computations and plots, we can see that r and R decrease as h decreases. The same happens with r and R when plotted against n. We can also notice that the closest approximations come for $n < 24$ and $h > 10^{-7}$. These derivations show consistency, since a larger n would result in a smaller h, and the plots clearly show that, with the ranges in which r and R are closest together.