MA456 Graded Homework 2

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1 MA456 Numerical Analysis

1.1 Graded Homework 2

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Use a computing method to find the largest root of a function using Newton and Secant methods. - Easy to change inputs - Include tolerance - Include maximum iterations - Include error term

The function in question:
$$f(x) = x^6 - x - 1$$
The function and its derivative as code:

```
In [1]: def f(x):
            return x**6.0 - x - 1.0


        def df(x):
            return 6.0*x**5.0 - 1.0
```

Basic variables:

```
In [2]: guess = 1.0
        guess_2 = 2.0 # used only for Secant Method
        tolerance = .00001
        maximum_iterations = 10000
```

1.1.1 Newton's Method Code:

```
In [3]: def newtons_method(f, df, x0 = 0, tol = 1e-6, max_iter = 1000):
            iter = 0
            diff = abs(0-f(x0))
            while diff>tol and iter<max_iter:
                iter+=1
                x0 = x0-f(x0)/df(x0)
                diff = abs(0-f(x0))

            print('Root is at: ', x0)
            print('f(x) at root is: ', f(x0))
            print('')
```

```python
        print('Took ', iter, " iterations to complete")
        print('Difference to solution was ', x0 - 1.1347 )
```

```
In [4]: newtons_method(f,df, guess, tolerance, maximum_iterations)
```

```
Root is at:  1.1347242213865578
f(x) at root is:  8.537194391422531e-07

Took  4  iterations to complete
Difference to solution was  2.4221386557776725e-05
```

1.1.2 Secant Method Code:

```python
In [12]: def secant_method(f, x0, x1, tol = 1e-6, max_iter = 1000):
            iter = 0
            diff = abs(0-f(x0))
            while diff > tol and iter < max_iter:
                iter+=1
                x2 = x1 - f(x1)*((x1-x0)/(f(x1)-f(x0)))
                diff = abs(x2 - x1)
                x0 = x1
                x1 = x2


            print('Root is at: ', x2)
            print('f(x) at root is: ', f(x2))
            print('')
            print('Took ', iter, " iterations to complete")
            print('Difference to solution was ', x0 - 1.1347 )
```

```
In [13]: secant_method(f, guess, guess_2, tolerance, maximum_iterations)
```

```
Root is at:  1.1347241383964999
f(x) at root is:  -5.164002558899483e-11

Took  8  iterations to complete
```

```python
In [1]:    import os
           os.environ['PATH']
```

```
Out[1]: '/Users/jonkelley/Virtualenvs/ipython-daily/bin:/Users/jonkelley/Virtualenvs/ipython-da
```