Exercise 1

1. Create a Python function that will take an input of x and return $f(x) = 4x^3 - 3x^2 - 2x + 1$. For example, since $f(1) = 10$, you should get the following if you name your function efunction and input a value of $x = 1$

   ```
   In [1]: efunction(1)
   Out[1]: 10
   ```

2. Now, write a second function that finds the slope of the tangent line around a specific input. There are a number of ways to do this, but the easiest is probably to take a fixed point (for example say $x = 1$) and then the calculate the slope between two points, $x - \epsilon$ and $x + \epsilon$ for a very small number, ϵ. To check yourself, at $x = 1$ $f'(x) = 4$.

3. Now, using our discussion in class, find the slope of the tangent line for every point between -1.5 and 1.5 (inclusive of the endpoints) with a grid spacing of 0.001. That is you should find the slope for:
   $$x = \{-1.500, -1.499, -1.498, \dots, 0.000, 0.001, 0.002, \dots, 1.500\}$$
   Do this using a NumPy array for both the x input and the slopes. Or you could use a NumPy array with two columns. The first being the x input and the second being the slope. Just saying...

4. Using `matplotlib.pyplot`, plot both your function and the slope of the tangent line at each point of x. Plotting data (even data you've made yourself) is very helpful. Explain what this plot is showing you, specifically relate the slope plot to the function plot.

5. Now, find the x values where the function achieves a local minimum and maximum of the function using the zero points of the slope plot. Notice that just finding $\min(f(x))$ won't work....the function goes from $-\infty$ to ∞.

6. Repeat the previous steps for the portfolio variance we discussed in class. You should be finding the portfolio weight that will minimize the variance. Assume:
   $$\sigma_1 = 0.3, \sigma_2 = 0.4, \rho = 0.5$$
   For this one, you only need to find slopes for the range 0 to 1. Again, find the value of w that minimizes the variance.