Math 151 Lab 7

Use Python to solve each problem.

1. Given $f(x) = \begin{cases} 36 - x^2 & \text{if } -6 \le x < 0 \\ 4x - 2 & \text{if } 0 \le x \le 6 \end{cases}$

   a) Plot f on the domain $x \in [-6, 6]$. You do not have to show open/closed points on the graph (though you should mentally note which points are open and which are closed!)

   b) Use the graph in part (a) to find the absolute maximum and absolute minimum of f on $[-6, 6]$. Use a print statement to give your answers in the form: **"The absolute (maximum/minimum) of *f* on [-6, 6] is *y-value*, which occurs at x= *x-value*."**

2. Given $f(x) = e^x + e^{-3x}$:

   a) Find the critical values of f (exact and approximate)

   b) Find the (approximate) absolute maximum and absolute minimum of f on $[0, 1]$.

   c) Plot the graph of the function on the interval above to verify your results.

3. The family of functions $f(x) = \sin(x + \sin(cx))$ occurs in the study of frequency modulation (FM) synthesis. For the examples below, let $c = 3$.

   a) Plot f on the domain $x \in [0, 2\pi]$. In a print command, indicate how many local extrema there appear to be.

   b) Find $f'(x)$.

   c) Plot f' in the domain $x \in [0.5, 0.7]$. Choose a y range that allows you to clearly see the critical value(s).

   d) Find all critical values in the interval in part c).

   e) Repeat parts c) and d) in the domain $x \in [5.5, 5.7]$.

   f) How many local extrema does f have on the domain $x \in [0, 2\pi]$?

(#4 on next page...)

4. (PREVIEW OF THINGS TO COME...) A box with a square base and an open top is to have a (fixed) surface area of S. What is the largest volume possible?

   a) In print statements, write down the function which is to be maximized (which will have TWO variables in it) and the equation which relates these two variables.

   b) Solve the equation for one variable (NOTE one is easier to solve for!) and substitute this expression into the maximizing function.

   c) The function (of one variable) you get in part (b) has domain $x \in (-\infty, \infty)$, BUT since the variables represent practical measurements, the practical domain is $x \in (0, \#]$. Find the missing number. (HINT: use the expression you substituted in part (b)).

   d) Find the maximum of your answer in part (b) on the domain you found in part (c). Also find the value of the variable you solved for in part (b)!