Math 151 – Python Lab 5

Directions: Use Python to solve each problem. (Template link)

1. Given $f(x) = e^x(1 + x^2)$:
   (a) Find the first 8 derivatives of f.
   (b) In a print command, state the formula for the nth derivative of f.
   (c) Verify your formula by finding the $50th$ derivative of f.

2. Consider the differential equation $4y'' + 25y = 0$.
   (a) For what values of k would the function $y = \cos(kt)$ be a solution to the differential equation?
   (b) For those values of k, verify that every member of the family of functions $y = A\sin(kt) + B\cos(kt)$ is also a solution.

3. (a) Find the derivative of $g(t) = \left(\dfrac{t-2}{2t+1}\right)^9$.
   (b) **Simplify** the derivative you found in part (a)
   (c) Given part (b), where would g have horizontal tangent line(s)?
   (d) Find the derivative of $f(t) = (2t+1)^5(t^2 - t + 2)^4$.
   (e) What happens if you **simplify** part (d)?
   (f) What happens if you **factor** part (d)?
   (g) Which simplified version would be most useful for locating the horizontal tangent line(s) of $f(t)$? Where would the horizontal tangent line(s) be?

4. An object with weight W is dragged along a horizontal plane by a force acting along a rope attached to the object. If the rope makes an angle θ with the plane, then the magnitude of the force is
$$F = \frac{\mu W}{\mu \sin\theta + \cos\theta}$$
where μ is a constant called the coefficient of friction.
   (a) Find the rate of change of F with respect to θ.
   (b) Find a formula for when the rate of change is equal to 0?
   (c) If $W = 100$lb and $\mu = 0.6$, plot the graph of F as a function of θ from $\theta = [-\pi, \pi]$ and use it to estimate the value of θ for which $dF/d\theta = 0$. (Consider using **ylim=(***min y-value, max y-value***)** to help your estimate.)
   (d) Use your formula from part (b) to find the actual location(s) where $dF/d\theta = 0$ on $[-\pi, \pi]$ given the conditions of part (c).