APPM 2450 Calculus 3 Computer Lab
Lab Exercise 5

Create a Mathematica notebook that does all of the following. Feel free to ask your neighbor or your lab instructor for help if you get stuck. Items with a ➠ are required, items with a ✰ are optional.

➠ Use `Solve` to solve the quadratic equation, $a * x^2 + b * x + c = 0$. Remember to use a double equals sign! `==`. Will `Solve` work on a general cubic, $a * x^3 + b * x^2 + c * x + d = 0$?

➠ Define $f(x) = x^3 - e^x + \cos(10x)$. Remember (once again) that e^x is entered in Mathematica as `Exp[x]`.

➠ Make a nice plot of $y = f(x)$ for $-4 \leq x \leq 4$.

➠ Use `Solve` to solve $f(x) = 0$. If for some reason `Solve` does not work, try `FindRoot`. Remember the syntax for `FindRoot` is `FindRoot[f[x]==0,{x,guess-for-x}]`. Be sure to find all the roots.

➠ Try to solve the system of equations,

$$\begin{cases} x^2 + y^2 = 1 \\ 2x + 3y = 2 \end{cases}$$

Type `?Solve`, click `More`, scroll down to `Further Examples` and open the cell named `Poly. equations in more than one variable` for a similar example.

➠ Define $f(x, y) = e^{2y^2 - y^4 - x^2 + 0.5y}$.

➠ Calculate the following: $\frac{\partial f}{\partial x}$, $\frac{\partial f}{\partial y}$, $\frac{\partial^2 f}{\partial x^2}$, $\frac{\partial^2 f}{\partial x \partial y}$, $\frac{\partial^2 f}{\partial y^2}$

➠ Make a nice plot of $f(x, y)$. You will have to choose your domain (x and y values to plot over), set your `PlotRange`, and use any other options that are appropriate. Label your axes!

➠ Make a contour plot of $f(x, y)$.

➠ Use `Solve` to solve $\nabla f = \mathbf{0}$, thus finding critical points.

➠ You should have found 3 critical points above. Make a 3D plot with a "zoomed in" window around each one (total of 3 plots) so you can clearly see what type of critical points you found.

✰ Use the second derivative test to prove one the critical point near $(x, y) = (0, -1)$ is indeed a maximum.

➠ Go to 'Kernel', then 'Delete All Output' before you save. Save your notebook as *YourLastName5.nb* and email as an attachment to your instructor.