

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  $\blacktriangleright$  are required, items with a  $\star$  are optional.

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

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

$\blacktriangleright$  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!

$\blacktriangleright$  Make a contour plot of  $f(x, y)$ .

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

$\star$  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.

$\blacktriangleright$  Type `Options[Plot3D]` to see a list of all the available options for `Plot3D`. Note this works for all functions in Mathematica.

Carefully define the following function:

$$f(x, y) = \cos(x) \cos(y) e^{\frac{-\sqrt{(x^2 + y^2)}}{4}}$$

Remember that  $e^x$  is entered as `Exp[x]`, and remember to use parentheses where needed!

$\blacktriangleright$  Make a 3D plot of  $f(x, y)$  for  $-2\pi \leq x \leq 2\pi$ ,  $-2\pi \leq y \leq 2\pi$ . Then, using options like `PlotRange`, `PlotPoints`, `Mesh`, and `AxesLabel`, make the plot look as nice as you can.

$\blacktriangleright$  Use the option `ViewPoint->{2,0,0.5}` to view the plot as if you were standing in the positive x-direction, and slightly in the air (z-direction), looking at the origin.

$\blacktriangleright$  Play with `ViewPoint{}` or the ViewPoint Selector (In the menu bar, Input -> 3D ViewPoint Selector) and find an angle that looks nice.

$\blacktriangleright$  Run the command `<<RealTime3D'`, then Copy-and-paste your `Plot3D` command from before you used `ViewPoint`. Run your just-pasted plot command. Now, you can rotate the plot by hand! (Note: the `'` is the single left quote that is on the top-left of your keyboard.)

$\blacktriangleright$  Run the command `<<Default3D'` to return to the original style of plotting.

$\blacktriangleright$  Make a `ContourPlot` for  $f(x, y)$ . Using the options `Contours`, `ContourLines`, and `PlotPoints` as you see fit, make the contour plot as nice as you can

$\blacktriangleright$  Remember that a `ContourPlot` has a frame, not axes. As such, use `FrameLabel->{...}` to label the axes. See today's demo for details.