Mathematica Project 5: due November, 22nd (IN CLASS)
Multivariate Calculus, MTH 212, Fall 2019

It is the fifth project of the semester, so make sure to follow the instructions below! (*Note: late projects will not be accepted.*)

Use the text input mode to start your Mathematica notebook with your name and project number. Your project should be well-organized and clear to read; make sure all the exercises are clearly labeled and all questions answered. (Failure to follow these directions will result in lost points.) Make sure that you get all your Mathematica input (functions, formulas, commands you use to answer questions) and the required output (evaluate all the necessary cells to produce/display your results, plots, etc). **Provide comments on your results!**

Bring your project printout to class on 11/22/19. (Please staple it!)

1. Find all local extrema and saddle points of the function $f(x, y) = 4xy - x^4 - y^4$. Do all the necessary calculations in Mathematica: finding partial derivatives and Hessian, solving equations for critical points, evaluating the Hessian and f_{xx} at the critical points. Your results should contain the max/min/saddle values of f and the points at which these values are attained. Show all your work. Plot these points on the surface $z = f(x, y)$. *For the bonus points, plot some level curves of f in the xy-plane together with the critical points.*

   Use the demo notebook on min/max/saddle points posted on our web page for help.

2. Find the maximum and mimimum values of $f(x, y) = x^2+y^2$, subject to the constraint $g(x, y) = x^2+xy+y^2-1$. Use the method of Lagrange multipliers. Do all the necessary calculations in Mathematica: finding partial derivatives, solving equations, evaluating the objective function at the critical points. Your results should contain the maximum and minimum values of f and the points at which these values are attained. Show all your work. Choose one point of extremum and plot a level curve of f going through this point together with the constraint curve $g(x, y) = 0$ and the gradient vectors of the functions f and g there.

   Use the Project 5 Help file posted on our web page.