Math 213, Fall 2008, Prof. Sachs Maple Assignment 1, due Monday, October 27

This assignment will enhance your understanding of level sets, tangent planes, partial derivatives, and the gradient vector field, all within the context of quadratic functions.

Use Maple to create the plots and then do the thinking and writing requested. You may turn in your work as a group of at most four either on paper or electronically. Maple is available in the student computer labs (Johnson Center, Innovation). If you collaborate with other students, **your final work should be yours and you should be capable of explaining it on an exam or quiz**.

Basic steps of assignment:
Step 1: Start Maple and load the **plots** package by typing *with(plots);* after which Maple will type out the list of commands.

Step 2: Define the function $f(x, y) = x^2 + 4y^2$ which will be the starting function.

Step 3: By hand, calculate the linear approximation to $f(x, y)$ near the point $(1, 1)$ and call the linear approximation function $g(x, y)$ (don't forget to match the value of f at $(1, 1)$ along with the partial derivatives).

Step 4: Plot both functions simultaneously in two windows: First, $[0, 2] \times [0, 2]$ followed by the "zoomed-in" window $[0.9, 1.1] \times [0.9, 1.1]$, using the *plot3d* and *display* commands.

Step 5: Plot the level sets of both functions simultaneously in two windows: First, $[0, 2] \times [0, 2]$ followed by the "zoomed-in" window $[0.9, 1.1] \times [0.9, 1.1]$, using the *contourplot* and *display* commands.

Step 6: Plot the gradient field of $f(x, y)$ in two windows: First, $[0, 2] \times [0, 2]$ followed by the "zoomed-in" window $[0.9, 1.1] \times [0.9, 1.1]$, using the *gradplot* commands. Then display the gradplot simultaneously with the level set plot in the larger window.

Step 7: Modify $f(x, y)$ in five separate trials without changing the linear approximation by adding another term with the factor $(x - 1) * (y - 1)$, multiplied by the numbers $1, 3, 5, 7, 9$. For each stage, plot the function and the linear approximation $g(x, y)$ in the window $[0, 2] \times [0, 2]$. Also make the *gradplot* for each stage of f's modification.

Step 8: Write-Up Write briefly but fully describing:

1: what you observed for the original function f and its linear approximation g in terms of level sets and graphs.

2: what you observed for the function f in terms of level sets and the gradient field.

3: what you observed for the sequence of modified versions of f. In particular, what changes? When does it change?

(over)

Commands: The main Maple commands you will use are described briefly here. As well, I will post a sample worksheet on the web page. Maple has excellent help that will show commands used as examples at the end.

Define a function: The Maple syntax uses the combination of a colon and equal sign to do "assignment" and a minus sign with a greater than to do the arrow part. As usual, exponents are typed as using the caret symbol (over the 6 on the keyboard).

plot3d and **contourplot**. These are all quite similar in syntax and fairly easy to use. **However, Maple can be picky about how you type things, so be careful.** When Maple doesn't understand your command, it echoes what you typed back. My sample uses an option in the contourplot which shows more level sets.

gradplot: The plot of the gradient field is similar in syntax. It has some options such as thickness, which is set to 2 in the sample.