SAGE LAB: A SIMPLE APPLICATION OF DERIVATIVES

MAT 167H FALL 2012

Directions: This project has group & individual components. The individual portion is on the back; it is due by 6.30p on the Monday after Thanksgiving Break. For the group portion, the assignments are:

Group 1	Group 2	Group 3	Group 4	Group 5
Matthew Bennett	Samuel Dent	Cassie Mahler	Joseph Ross	Kristen Van deVoorde
Jeremy Norris	Corey Simmons	Nathan Sims	Cade Willis	Stephanie Ye
William Walker	Rachel Vogle	Nickolas Whitehead	Alex Wink	

USEFUL RESOURCES

My email	john.perry@usm.edu
Modules/Lessons	http://www.math.usm.edu/sage/calc1.html (I wrote these for a previous class. You don't have to look at any of them, but some lessons could be helpful.)

PART I: WORKSHEET

Download and work through the lab, *Connecting two highways*, from

`www.math.usm.edu/perry/mat167Hfa12/Connecting_two_highways.sws`

Please work on this lab *in your groups,* during class, on Friday, 16th November. *Before the end of class on that day,* send me an email with an update on how far you have gotten. If you solve the problem on that lab during class, send me the solution.

Some of the Sage commands used are:

`diff(f,x)` computes the derivative of the expression f with respect to the variable x.

`point((a,b),rgbcolor=color,pointsize=r)`
: creates a plot of a point at (a,b), colored *color*, with a radius of r "dots". Possible colors include black, red, blue, brown, yellow, green, purple; indicate these in single quotes, e.g. `rgbcolor='red'`. You can obtain additional colors using `(r,g,b)` where r,g,b are values from `0` to 1 indicating the intenstity of red, green, and blue, e.g. `rgbcolor=(1,0,0)`.

`solve([eq1,eq2,...],[var1,var2,...])`
: solves the system of equations $eq_1, eq_2, \ldots$ for the variables listed by $var_1, var_2, \ldots$. For example, the command `solve([x+y==1,x-y==1],[x,y])` returns the solution `[[x == 1],[y == 0]]`.

PART II: ADDITIONAL

In the lab, you found the class of polynomial best suited to connect those two highways at two specific points. Suppose we generalize (1) the points of the connection, and (2) the equations for the highways.

If you use Sage to help with the following, save and email me the worksheet. If you choose to do it or write it out by hand, turn in the paper.

1. Given
   - the two highways in the worksheet, $f(x) = 4x$ and $g(x) = x/2$, and
   - two *arbitrary* points $x = a, b$, (not necessarily -1 and 1)

   determine a formula for the best highway that will connect $(a, f(a))$ to $(b, f(b))$. It may be useful that $a \neq b$ (otherwise, you wouldn't need to build a connector).
2. Given
   - two arbitrary highways $f(x) = m_1 x$ and $g(x) = m_2 x$, and
   - two arbitrary points $x = a, b$,

   determine a formula for the best highway that will connect $(a, f(a))$ to $(b, f(b))$. It may be useful that $m_1 \neq m_2$ (otherwise, you wouldn't have two different highways).
3. Until this point, the two highways that need connecting, f and g, were linear functions, like the intersection of Highway 98 and I-59. Many highways are not linear at any reasonable point near their intersection, but are curved instead. Suppose a contractor claims that linear functions are all that you need to use: just use the tangent lines instead of the curves themselves. Another contractor claims that's balderdash. What do you think?