February 14, 2012

MATH 171—Lab 4—Parametric equations

INSTRUCTIONS: This goal of this project is very simple: you are to use parametric curves to draw a work of art in Grapher.

Your final picture is due at the beginning of class on **Monday, February 20.** Please upload to Moodle (1) your Grapher file, (2) a pdf of the image (to do this go to *Print* → *PDF* → *Save as PDF...*) The more creative you are with this assignment, the better your grade will be. See the attached grading rubric for more information.

Some comments:

- To begin, open Grapher (which can be found in the *Utilities* folder, which is in the *Applications* folder) and choose 2D graph.
- To add a new parametric equation go to *Equation* → *New Equation From Template...* → *Cartesian Curve*. Click OK. Then add the $x(t)$ and $y(t)$ equations in the menu box. Finally, enter the limits on t, and hit return.
- To change the color of a curve: highlight the parametric equation in the menu box on the left (using the arrow pointer), then click the *Inspector* button on the upper right corner. Click on the first box after the word *Line* (it has a colored rectangle on it), and select your color.
- To change the thickness of a curve: highlight the parametric equation in the menu box on the left (using the arrow pointer), then click the *Inspector* button on the upper right corner. Click on the second box after the word *Line* (it has a broken line on it), and increase or decrease the line width.
- You can turn on/off the grid lines by going to *Format* → *Axes & Grids...*
- Use the *Equalize Axes* button to give the x- and y-axes the same scale.

Here is a website that gives information about some famous curves that you might use for inspiration:

http://xahlee.org/SpecialPlaneCurves_dir/specialPlaneCurves.html

Note: not all of the curves on this website have parametric expressions. Here are some tips to help use these curves.

- If you want to move a curve $x = f(t)$, $y = g(t)$ horizontally a units and vertically b units, replace the parametric equations by $x = a + f(t)$, $y = b + g(t)$.
- If you want to reflect a curve $x = f(t)$, $y = g(t)$ about the y-axis, replace the parametric equations by $x = -f(t)$, $y = g(t)$. (Use a similar trick to reflect about the x-axis.)
- If you want to stretch or compress a curve $x = f(t)$, $y = g(t)$ by a factor of c in the x direction and by a factor of d in the y direction, replace the parametric equations by $x = cf(t)$, $y = dg(t)$.
- If you want to rotate your curve $x = f(t)$, $y = g(t)$ around the origin by an angle θ, replace the parametric equations by $x = f(t)\cos\theta - g(t)\sin\theta$, $y = f(t)\sin\theta + g(t)\cos\theta$.
- Sometimes it is possible to convert from an equation in rectangular coordinates (containing only x and y) into parametric equations. If your equation is $y = f(x)$, then the there is an easy conversion: $x = t$, $y = f(t)$. If y is not a function of x (or x is not a function of y) then it could be trickier.
- Some of the equations are given in polar coordinates. For example, $r = \cos(\frac{9}{5}\theta)$ is a rose. You can convert the polar equation $r = f(\theta)$ into parametric equations as follows: $x = f(t)\cos(t)$, $y = f(t)\sin(t)$.

HAVE FUN!