

PreCalculus Final Project 2008: *Mathematics and Digital Images: Seeing Math Everywhere*

You will compile a portfolio of at least 5 digital images that depict a mathematical concept. Join our class group <http://www.flickr.com/groups/ccsprec08/> Post your pictures to the class group by the end of your presentation day. Print out your best image for display in the classroom.

All portfolios will include: at least one photo taken of a public image in Canton, at least four different types of functions, at least one symmetry concept; and at least one number concept. NO photos of people's faces allowed for privacy reasons. You (or your family or friends) must take or have taken the photos yourself. You are posting them to the internet as your own work. No images from the internet or copyright images are permitted. I use the term images in a broad sense to include images of original art, and computer generated images, including "PhotoShopped" images as long as they are YOURS!

Resources: I have a digital camera or you can check one out of the LRC.

Symmetry: line, rotational, tessellations (translation symmetry), glide translations, etc. Read <http://en.wikipedia.org/wiki/Symmetry> to get an overview of the wide variety of symmetries.

Numerical: golden rectangles, Fibonacci numbers, perfect squares, triangular numbers, prime numbers, arithmetic or geometric sequences

Get ideas by checking out photos in Flickr with a mathematical slant:

Fibonacci Group <http://www.flickr.com/groups/99544099@N00/pool/>

Spiral Group <http://www.flickr.com/groups/spiral23/pool/>

Squared Circle Group: <http://www.flickr.com/groups/circle/>

Another PreCalculus class: <http://www.flickr.com/search/?q=pc40sf06&w=all&s=int>

Your task

- I. Take at least five digital photographs that depict mathematical ideas to you. Use Geometer's Sketchpad to model any functions in your image. Use the PrintScreen key and Paint (crop and save your image with the function graph and equation as a jpg image.) Upload your images to Flickr with the appropriate tagging (class tag is CCSPreC08). Label symmetry and/or number concepts in Flickr with notes on the image. Set the privacy settings of your math photos to anyone. Geotag your Canton image(s) on the map. Add a description of each photo, including decisions you made while modeling the image. Add your images to the CCSPreC08 group by the end of your presentation day.
- II. At the beginning of your presentation, hand in a summary paper, with your Flickr screen name, that includes a small version of each photo, before and after any function modeling, a clear equation of the function and a written justification of your choice of function, and/or a description of how your image shows symmetry or conveys a number idea. Do this for each image.
- III. Hand in your best 8" by 10" image with the model, printed in color.
- IV. Give an oral presentation to the class (5 – 10 minutes.)
- V. You can use Flickr for your presentation. PP presentations must be on a USB key (available for checkout in the library) so you don't have to log off and on for every presentation.
- VI. Be sure to use the rubric as a checklist to prepare your presentation.

Using Flickr

Sign in with your Yahoo ID and password or create a new account. Choose a screen name that is appropriate for use in school. Upload some photos to start your account and get it reviewed for public access (do this early.)

Geotag your photos (place this photo on a map), required for at least one taken of a public image in Canton.

Flickr tags

Class tag (required for every image)	CCSPreC08
Canton tag (for any image taken in a public spot in Canton)	Canton
	Math
Function tag	i.e. sin, polynomial, linear, etc
Symmetry tag	i.e. rotational, glide, etc
Number tag	i.e. Fibonacci, geometric

Visit the class group, <http://www.flickr.com/groups/ccsprec08/> and join the group. Send your photos to the group, CCSPreC08, by the end of your presentation day (after the presentation, if you want them to be a surprise.)

Precalculus Final Project 2008

Name _____

Score _____

Flickr Screen Name:

Comments

0	-	$\sqrt{-}$	$\sqrt{}$	$\sqrt{+}$	+																
Not done	Below standard on a major point or a major mistake	Below standard on a minor point or a small mistake	Meets standard, all areas correctly performed	Above standard on a minor point or in small way	Above standard on a major point or in an impressive way																
Criteria																					
(70 points) Images											1	2	3	4	5	6	7	8	9	10	
Image: original, no faces, appropriate for school																					
Quality of image: focused, well framed, object and location identified (at least five images)																					
Flickr tagging: Class tag, Canton tag, function tag, symmetry tag, number tag, geotag Canton image(s)																					
Symmetry: correctly identified, accurately described in mouse over notes (at least one)																					
Numbers: numerical concept accurately described in mouse over notes (at least one)																					
Function Modeling: accurate model, graph and equation on image (at least four different types)																					
Linear																					
Polynomial: quadratic, cubic, quartic																					
Trigonometric: sin/cos/tan plus for arcsin/arcs/arctan																					
Exponential/log/logistic																					
Absolute Value																					
Polar curve																					
Conic section: circle/ellipse/hyperbola (rect. coords)																					
Step function																					
Composition of functions --plus																					
Piece-wise defined function --plus																					
Other																					
Class Presentation: organized, clear, interesting voice and manner (do NOT read your paper) (10 points)																					
Gallery Image: best 8" x 10" image with model, printed in color, name and date (5 pts)																					
Paper: neat, clear, typed summary with equations as appropriate, includes images, before and after function graphs, justification of models, description of symmetries and numerical concepts, watch spelling! (10 points)																					
Timeliness: you will lose points if you are not prepared or absent (-10 points), including absent during class presentations by classmates (-5 points per period/ -10 points for a double period)																					

95 is the baseline score—met the standard in each category. If you want a higher score, be prepared to impress me!

This is from the Geometer's Sketchpad Help: How to Construct a Piecewise Function

Sometimes you may want to construct a function that behaves one way in part of its domain and differently in another part of its domain. Such functions, called *piecewise* functions, are very important in interpolation, in fitting curves to data, and in designing and producing shapes and surfaces in applications such as automobile design. The signum function makes it possible to do this in Sketchpad.

The signum function is useful any time you want a calculation which makes some sort of decision—which performs a different calculation when some value changes.

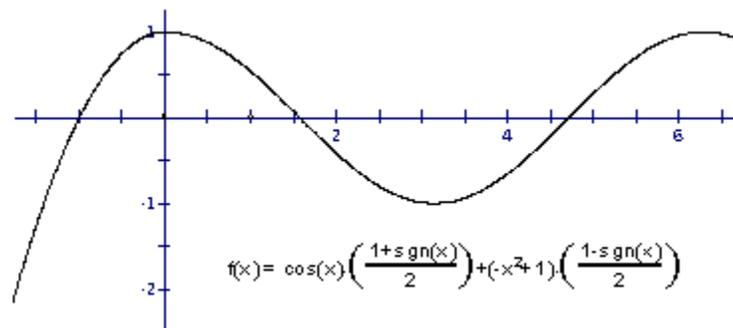
For instance, you could construct a function whose plot is in the shape of a cosine wave when $x > 0$, but is parabolic when $x < 0$. Here's how to do this with the signum function:

1. Choose **Plot New Function** from the Graph menu.

$\cos(x) \cdot \left(\frac{1+\text{sgn}(x)}{2}\right)$ 2. Enter the cosine-wave part of the function, as shown at left. When $x > 0$, the signum function returns +1, and the value of the multiplier is 1. But when $x < 0$, the signum function returns -1, and the value of the multiplier is 0. This first part of the function will be a cosine wave to the right of the origin, but will always be zero to the left of the origin.

$(-x^2+1) \cdot \left(\frac{1-\text{sgn}(x)}{2}\right)$ 3. Enter the parabola part of the function as shown at left. When $x > 0$, the multiplier will be 0, and when $x < 0$, the multiplier will be 1.

Here's the result when you click OK:



The functions in this example were chosen in such a way that the two functions join continuously and smoothly.

Here's how to use the signum function to solve the general problem of defining a function $h(x)$ whose value is $f(x)$ for all $x < k$ and is $g(x)$ for all $x > k$:

$$h(x) = f(x) \left(\frac{1-\text{sgn}(x-k)}{2}\right) + g(x) \left(\frac{1+\text{sgn}(x-k)}{2}\right)$$

Geometer's Sketchpad Directions

Here is how you can create sliders for $f(x) = a*x^2 + b*x + c$

1. Open Sketchpad and a blank sketch will be on the screen. Click on the sketch to make the logo disappear. Under the Graph menu, select Show Grid.
2. Go to the applications folder in your hard drive, open the Sketchpad folder, then open the Samples folders, then open Custom Tools, then open the document Slider.gsp.
3. Click the GSP sketch which you had previously opened to hide the sliders.gsp page.
4. Use the custom tool to select sliders in toolbox. You will see a variety of choices.  Select "adjustable horizontal".
5. Each time you click the document another slider appears.
6. Click the text tool in the toolbox to stop adding new sliders.
7. Unfortunately, all the sliders are named 'a'. Using the text tool, double-click a letter that needs to change and rename it on both the number and the point on the slider.
8. Repeat with other labels as needed.
9. Click Graph in the top menu, then "Plot new function".
10. Using the selection tool, enter $a*x^2 + b*x + c$ in the calculator window by clicking the "a" slider label for "a", the "b" slider label for "b", and the "c" slider label for "c" and the calculator buttons for everything else.
11. Click OK
12. I find it useful to move the slider so 0 and 1 are on adjacent lines on the grid for a scale. Move the number label next to the slider.
13. Paste your photo in the document and fit your curve.
14. You can use sliders with polar functions in the polar grid, too.

General notes about typing functions:

Remember to type * for multiplication. π and e are found under Values. Watch as you type to make sure your parentheses are doing what you want.

