Senior Project Proposal

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What:

 An interactive Mathematics Modeling System. I’d like to create something that is focused showing mathematical ideas as an “alive” concept made of up of its infinite smaller pieces. MatLab or Wolfram Alpha are made with computations in mind; this will be made with an emphasis on exploratory learning in mind. Numbers will be manually movable across the screen, with a right click menu bringing up options concerning delving into what that number really is. (e.g. “What groups is 4 in?”, “Is it an algebraic number? If so, what is one of its corresponding equations?”) Groups will also have this functionality. (e.g. “Do any of these elements generate the group?”, “Is the group cyclic/Abelian/also a ring/field?”) Like a playground in which the user can interact with mathematical concepts in a very visual manner.

How:

 I will be using the SmallTalk programming language to create this project. SmallTalk already has that “alive” feel that I want, and it’s use of objects as building blocks for the whole language reflects some of the underlying structure of mathematical groups. I will be using Pharo 5.0 (which can be found at: http://pharo.org/download). Pharo doesn’t come with any concept of groups of the mathematical nature, so I will be starting with only the objects that SmallTalk defines numbers as. I will be using the morphic library for displaying everything.

(Dear God) Why:

 I hope to gain a deeper understanding of object oriented programming; and how to translate mathematical concepts into a rigorous, code based environment.

Goals and Grading Info:

 Basics [20]

* If a user types in a number, is it displayed? [5]
* Graphical representation for groups. (e.g. Z\_5 = {0, 1, 2, 3, 4}) [5]
* User can clear screen. [3]
* Click and drag items. [5]
* Colors! [2]

 Finite Groups [20]

* Are modular groups present? (If I right click on 4, can I see and play with Z\_4?) [8]
* Can I tell if an element is a generator for a group? (An iterative function that runs through a group and checks.) [3]
* Can I identify additive inverses? (4 and 1 in Z\_5) [2]
* Multiplicative inverses? (2 and 3 in Z\_6) [2]
* Is the group a ring? (Closed under another operation) [3]
* A field? (Ring + existence of inverses and identity element) [2]

Roots of Unity [20]

* While I understand this concept from a meek undergraduate perspective, I’m going to need to look into this a bit more to be comfortable enough to code it up. [5]
* Can I identify the roots of unity for a given integer? (If I right click on 4, can I choose to see the four roots of unity?) [15]

Algebraic Numbers [10]

* Like the roots of unity, I will need to get more comfortable with this (as comfortable as a person can get with this monster). [3]
* Can I view an equation corresponding to a given algebraic number? (If I right click on √2 can I see x2 – 2 = 0?) [7]

Pascal’s Triangle [20]

* Can I generate n rows of Pascal’s Triangle? [5]
* Clicking on the structure created above, can I see the counting/triangular/rectangular numbers highlighted? [5]
* Can I see how the powers of 11 correspond to the triangle? (I’m thinking a popup to the side that shows what’s happening) [5]
* Can I see how the outcome of a coin toss correlate to the triangle? (Same as previous for implementation) [5]

Iterative Functions [10+]

* Given a function and a step value, can I iterate it n times and display the results? [7]
* BONUS: Graph the above results! [10]
* If applicable, can I identify sinks and saddles? [3]

>= 85pts A

> 75pts B

> 60pts C

> 50pts D

> F