

## GROUP PRESENTATION

### PENN SUMMER PREP PROGRAM EXPLORATIONS IN MATHEMATICAL INQUIRY

MATT DECROSS

To be presented on Friday, August 4. As a group, please choose one of the topics from the below list, which represent various modern mathematics concepts. Investigate it, using any and all resources at your disposal. A general Google/Wikipedia search is a good place to start - the arXiv may have some references, but they may be difficult to read. I can also help point you in the right directions. Try to learn enough about the topic that you feel you have a complete story about some aspect of it. Then, prepare a 10-15 minute presentation (including time for questions) of that topic in Beamer, which you will give *as a group* to the rest of the class.

#### **Suggested Student Presentation Topics (\* indicates calculus likely required):**

- Volumes of balls and areas of spheres in arbitrary dimension\*
- Non-orientable surfaces
- The Euler characteristic and Betti numbers
- Vertex colorings and the chromatic number of graphs
- Four-color theorem and Hadwiger conjecture
- Gauss linking and writhe of knots
- Prime numbers and the Riemann zeta function\*
- The modular group and its action on the torus
- The Doomsday algorithm
- Hall's marriage theorem
- Fractal dimensions
- The Cantor set
- Weierstrass functions\*
- Cardinality and Cantor's diagonal argument
- Peano curves
- Fermat's Little Theorem
- Non-Euclidean geometry
- Bernoulli numbers\*
- Martingales and the optional stopping theorem

- Crystallographic restriction
- Self-referencing sequences
- Applications of rings and ideals
- Homotopy groups
- The Hopf fibration
- The game of Nim (and variants)
- ...or your choice!