ArtSci 1D06 2015–16 Essay

The essay should be in the range 1500–2000 words (that is, 3–5 pages single spaced or 5–8 pages double spaced, in 10–12 point font). You should choose from one of the topics below, but not more than 6 people may work on the same topic. (If you really really want to do another topic, discuss with me or your TA.) You are encouraged to meet with the other students working on the same topic in order to understand what it is about. Of course, the essays will be written individually. You should have at least three references, at least one of which is not a web source.

Topics

1) Fractals, eg Mandelbrot set, Sierpinski triangles
2) Interesting problems involving π:
   - Buffon's needle
   - $\displaystyle\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$
   - transcendence of π
3) Paradoxes
   - Borel problem
   - Banach-Tarski paradox
   - Russell's paradox
4) Infinity
5) Non-standard analysis and infinitesimals
6) Surreal numbers
7) Combinatorics
8) Graph theory
9) Group theory
10) Historical developments
    - complex numbers
    - rigor in the foundations of calculus
    - controversy about Euclid's 5th postulate
11) Non-euclidean geometry
12) Euclidean geometry
13) Irrational numbers
14) Wavelets
15) Fourier series
16) Travelling salesman problem and P versus NP conjecture
17) Poincare's conjecture
18) Twin primes conjecture
19) Fermat's last theorem
20) Monty Hall Problem (and extensions)
21) Benford's Law
22) Random Walks

Procedure and timeline

November 6 and 13: Talk about writing on technical topics
November 20: Brief description of the topics
Before end of semester: Choose topic, inform me and/or TA
January: Research the chosen topic; meet with other students working on same topic to discuss
January 29: Submit draft of essay for informal feedback
February 12: Final version of essay due