Douglass Houghton Workshop, Section 1, Mon 9/19/11

Worksheet Dauntless

1. *The Saga of Michael Phelps: Conclusion* Last time we found that Michael Phelps can always make himself dryer by splitting his towel, but there's a limit to how dry he can get. In particular, here are the numbers for not splitting the towel at all and for splitting it into 10,000 pieces:

Towel Size	.25	.5	1	2	3	4
wetness (1 piece)	0.8000	0.6667	0.5000	0.3333	0.2500	0.2000
wetness (10,000 pieces)	0.7788	0.6065	0.3679	0.1354	0.0498	0.0183

Cutting into more than 10,000 pieces doesn't seem to make much difference. So for each towel T, there is a wetness $N(T)$ after normal toweling, and there seems to be a "magic number" $M(T)$, which is the *limit* to how dry Michael can get by splitting the towel.

   (a) Make a graph with towel size on the x-axis and wetness on the y-axis. Plot the points you have for $N(T)$, the result of normal toweling, and $M(T)$, the result of split towelling.

   (b) What's the formula for $N(T)$? (We found this last week).

   (c) What kind of function does $M(T)$ look like? Hint: Compare $M(1)$ with $M(2)$.

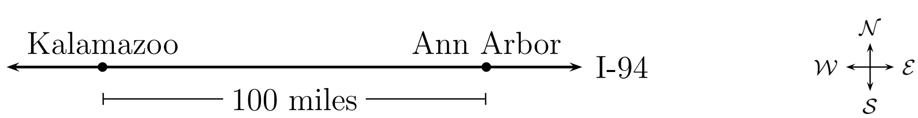
   (d) Verify your guess by finding a formula that fits the data.

   (e) Try to explain the relationship between $M(1)$ and $M(2)$.

   (f) Using the formula we found on Tuesday, write a limit equation to express the result in part (d).

2. Kalamazoo is 100 miles west of Ann Arbor along Route 94. Suppose we know the temperature at every point on the road between the two cities, and we express that information as

$$T(x) = \text{ the temperature in Fahrenheit at a point } x \text{ miles west of Ann Arbor.}$$



   (a) Define a function A in terms of T so that $A(m)$ is the temperature in Fahrenheit at a point m miles east of Kalamazoo.

   (b) Define a function B in terms of T so that $B(k)$ is the temperature in Fahrenheit at a point k **kilometers** east of Kalamazoo. (1 mile = 1.6 kilometers.)

   (c) Define a function C in terms of T so that $C(k)$ is the temperature in **Celcius** at a point k kilometers east of Kalamazoo.

3. dBase™ was a database management system popular on IBM PCs back in the 80s. It included a programming language with limited capabilities; for instance, there was no command in the language to take the square root of a number. There were, however, two functions called `LOG`(x) and `EXP`(x) which produced $\ln(x)$ and e^x, respectively. How could you use them to produce $\sqrt{x}$?

4. Examine the YouTube video of the double Ferris wheel:

   `http://www.youtube.com/watch?v=xj6DVY5s8HU`

   Assume that when the wheel starts the big arm is horizontal, and you are seated in a chair which is as far to the right as a chair can get.

   (a) Use a watch to estimate the periods of the large rotation and the smaller rotation.

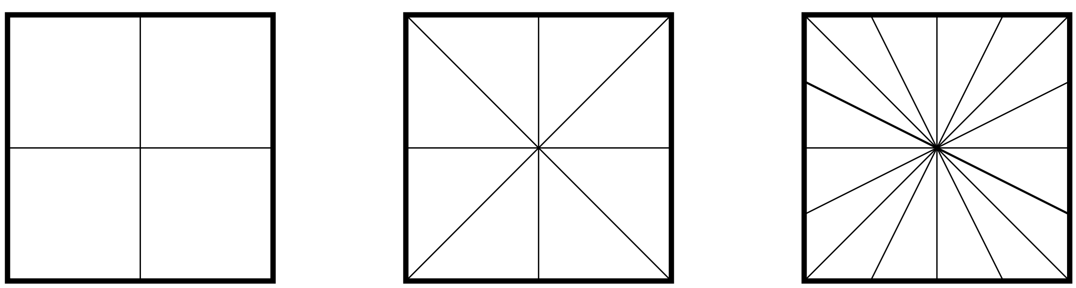
   (b) Estimate the radii of the two rotations, knowing as you do that the seats are designed for humans.

   (c) Write a formula for your height t seconds after the wheel starts.

   (d) Do the same for your horizontal position.

   (e) Draw a two-dimensional picture of your motion, and mark some times on the picture. Then watch the video again and see if it looks right.

5. So we still have this square cake, 10 inches on a side and 2 inches high, frosted on the top and all four sides. It is a yellow cake with chocolate frosting. It's getting *extremely* drippy while we decide how to cut it. Here are some solutions we found for 4, 8, and 16 people.



   (a) Recall exactly how these solutions are defined, and how they can be generalized to 32 people.

   (b) How about 12 people?