CHAPTER I: Newton -v- Leibniz

Section 1: Isaac Newton

Reading: http://www-history.mcs.st-and.ac.uk/Biographies/Newton.html

Isaac Newton is one of the most accomplished, brilliant and remarkable men in the history of the world. If you asked any mathematician to name the top five mathematicians of all time, using whatever standard they wanted to use, Newton's name is sure to be included. Obviously, there could be many debates over a wide variety of men and women throughout the history of mathematics, but Newton would undoubtedly stand with Archimedes and Gauss as unanimous selections to "Greatest All Time". That is largely due to his contributions to the development of the calculus, but not entirely.

Newton's calculus used different notation than our modern day calculus. He considered the variable of a function a ***fluent*** (a flowing quantity) and its rate of change was the ***fluxion*** of the fluent. In his work *Method of Fluxions* (written in 1671, published in 1736), he uses the notation $\dot{x}$ for the fluxion of the fluent x. He also introduced the notion of the ***moment*** of a fluent, which is the very small amount a fluent changes over a small time period o. To see his terminology/notation in action, consider this: If a fluent x has fluxion $\dot{x}$, then over the time period o, its moment would be $\dot{x}o$ and the new value of the fluent is $x+\dot{x}o$. If we replace the variables in an equation with these new values, we find an equation between the original variables and their fluxions.

Example 1.1.1 In *Method of Fluxions*, Newton considers the cubic curve $x^3 - ax^2 + axy - y^3 = 0$. Replacing x with $x+\dot{x}o$ and y with $y+\dot{y}o$, we get

$$\begin{aligned}(x+\dot{x}o)^3 - a(x+\dot{x}o)^2 + a(x+\dot{x}o)(y+\dot{y}o) - (y+\dot{y}o)^3 &= x^3 + 3x^2\dot{x}o + 3x(\dot{x}o)^2 + (\dot{x}o)^3 \\ &\quad - ax^2 - 2ax\dot{x}o - a(\dot{x}o)^2 \\ &\quad + axy + ax\dot{y}o + ay\dot{x}o + a\dot{x}\dot{y}o^2 \\ &\quad - y^3 - 3y^2\dot{y}o - 3y(\dot{y}o)^2 - (\dot{y}o)^3 \\ &= 0\end{aligned}$$

At this point, Newton argued that all terms with a second or higher power of o could be ignored (since it was such a small quantity). Using this fact, along with the original assumption that $x^3 - ax^2 + axy - y^3 = 0$ yields

$$3x^2\dot{x}o - 2ax\dot{x}o + ax\dot{y}o + ay\dot{x}o - 3y^2\dot{y}o = 0 .$$

Dividing this equation by o produces what we would get using modern differentiation.

There are many quotes and anecdotes about Newton and his intellectual prowess and powers of concentration. He was well known to get lost in thought even while doing other things. One such story relates that he was invited to a dinner and as he left his house to walk to his friend's house, he got lost in thought and wandered around town missing dinner time. His friend meanwhile had already set the table with the baked chicken entrée on a dish under a cover. Realizing Newton wasn't going to show, he finally removed the cover, ate the meal, and then replaced the bones of the chicken under the cover. When Newton eventually remembered he had a dinner engagement, he greeted his friend, sat down at the dinner table, removed the cover to the dish and discovered the remains. "Dear me," he said, "I had forgotten that we had already dined."

Newton's accomplishments were poetically expressed by Alexander Pope:

Nature and Nature's laws lay hid by night;
God said, 'Let Newton be,' and all was light.

Even his nominal rival Gottfried Leibniz had high praise for Newton: "*Taking mathematics from the beginning of the world to the time when Newton lived, what he did was the better half*."