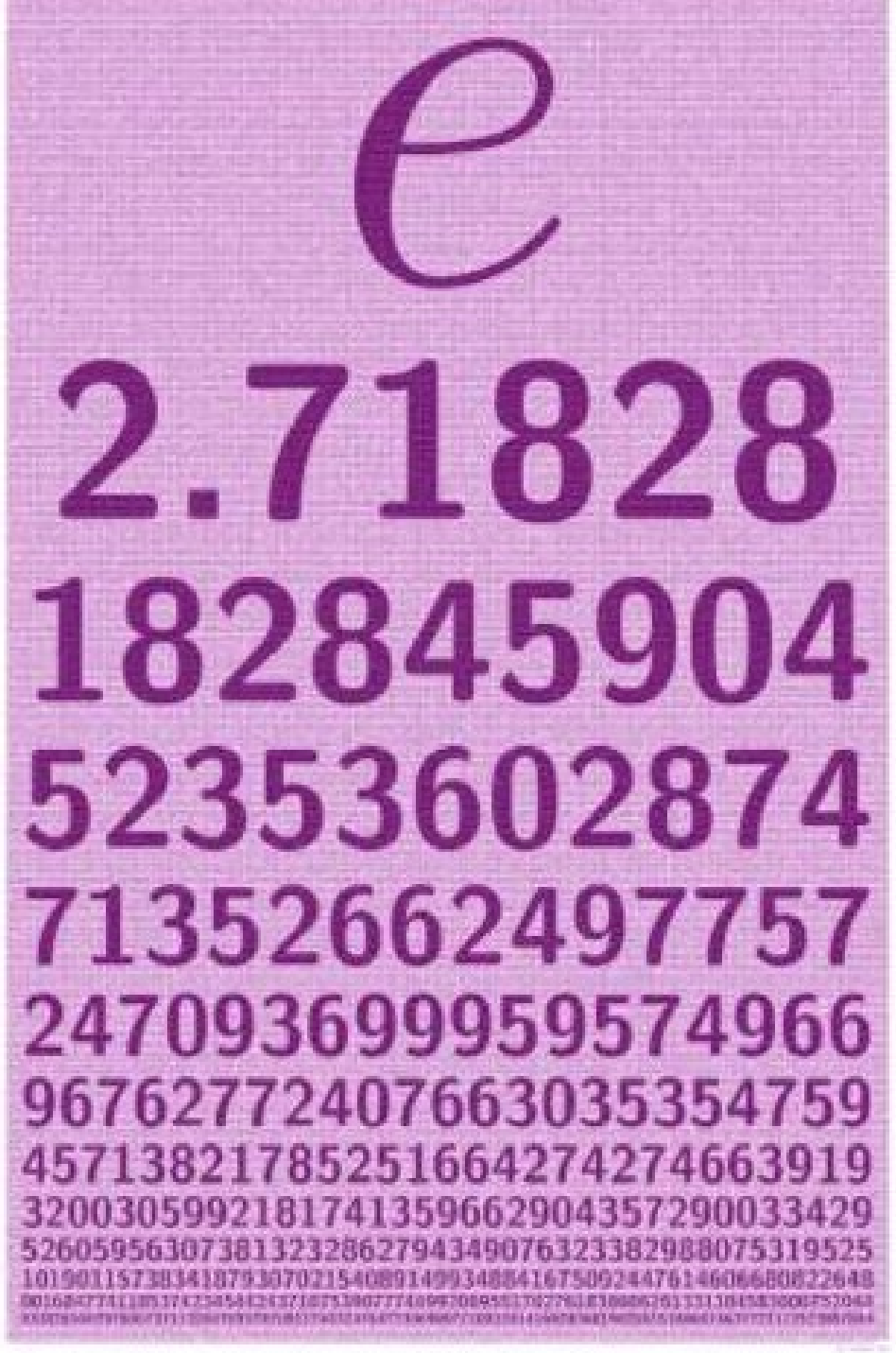
Let's Begin (with some math memes, P.S: I couldn't decide which one to put so I put all of them, enjoy!)

Bernoulli Brothers: Jacob Bernoulli & Johann Bernoulli

Their Contribution To Mathematics Fields



Remember the irrational number *e?*

- Jacob Bernoulli was the one who discovered the approximate value of *e* which is equal to $\mathrm{Lim}(1+1/n)^n$ as n approaches ∞.
- He did it while exploring the compound interest on loan such as:
- When $1 is compounded annually with 100% interest, it becomes $2.
- And $2.25 when compounded semi-annually.
- And $2.44 when compounded quarterly.
- And $2.61 when compounded monthly.
- And $2.69 when compounded weekly.
- And $2.71 when compounded daily.
- And at the last $2.718281828459045... when compounded infinitely many times.

The Math Family Background

- The ancestors of the Bernoulli family originally lived in Holland. In 1583, they migrated to Switzerland and settled at Basel.
- Bernoulli family is an extraordinary Swiss family from Basel that produced eight outstanding mathematicians within three generations. **Jacob(1654-1705) and Johann (1667-1748) are considered the most important founders of calculus (apart from Newton and Leibniz).**
- Following his father's wish, Jacob studied theology and entered the ministry. But he developed a passion for mathematics in 1676. Jacob Bernoulli basically taught himself in these subjects and went on to lecture in experimental physics at the University of Basel. Jacob Bernoulli became a professor of mathematics in the same university in 1687.
- Around the time, his younger brother Johann, meeting the wishes of his father to go into commerce, enrolled at the university to study medicine. However, Johann secretly studied mathematics with his brother Jacob. Just over two years, Johann's mathematical level was close to his brother's.

Ever heard of Leonhard Euler?

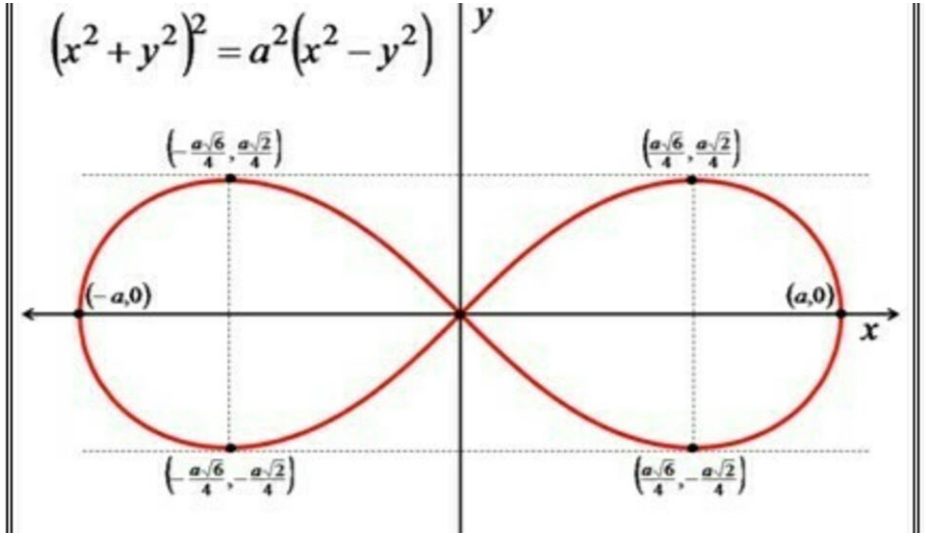
Mathematical notation created or popularized by Euler

e	the base of the natural logarithm, a constant equal to 2.71828...
i	the "imaginary unit", equal to the square root of -1
$f(x)$	the function f as applied to the variable or argument x
Σ	sigma, the sum or total of a set of numbers
a, b, c x, y, z	a, b, c are constants, such as the sides of a triangle; x, y, z are variables or unknowns in an equation
$\sin, \cos, \tan,$ $\cot, \sec, \csc$	trigonometric functions for sine, cosine, tangent, cotangent, secant, cosecant
π	pi, the ratio of a circle's circum-ference to its diameter

- He was the most important student of Johann Bernoulli when he took over the position of his older brother (Jacob Bernoulli) after his death and became chair of Mathematics department at the University of Basel.

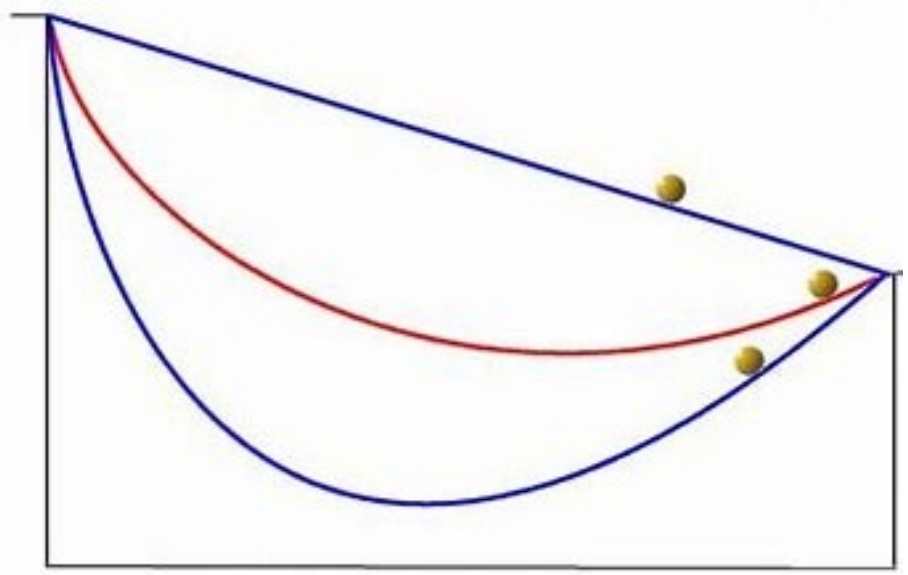
Jacob's Contributions to Calculus

- Jacob Bernoulli published five treatises on infinite series between 1682 and 1704.
- The first two of these contained many results, such as fundamental result that $\Sigma_{n=1}(1/n)$ diverges, which Bernoulli believed were new, but they had been proved.
- Bernoulli also showed that $\Sigma_{n=1}(1/n^2)$converged to a finite limit less than 2 (however, Euler was the first to find the sum of this series, $\pi^2/6$, in 1737).
- In 1690 Jacob Bernoulli showed that the problem of determining the isochrone is equivalent to solving a first-order non-linear differential equation.
- After finding the differential equation, Bernoulli then solved it by what we now call separation of variables. Jacob Bernoulli's paper of 1690 is important for the history of calculus, since the term integral appears for the first time with its integration meaning.
- n 1696 Bernoulli solved the equation, now called the Bernoulli equation, $y' = p(x)y + q(x)y^n$.



Johann's Contributions to Calculus

- He applied calculus on differential equations, finding the lengths of curves and the areas enclosed by curves, isochronous curves, and curves of fastest descent.
- Both Jacob and Johann were the inventors of the calculus variations because of their contribution to the problem of the brachistochrone.
- After Jacob’s death, Johann Bernoulli took over his chair in University of Basel, where he remained for forty-three more years. After 1700, he mainly concerned himself with problems of mechanics.
- After Leibniz died and Newton retreated from scientific work, he was regarded as Europe’s leading mathematics.



Dispute Between Jacob and Johann

- Johann and Jacob two had challenged to each other on mathematics and had bitter arguments about the quality of each other's work.
- Irked by Johann’s bragging, Jacob publicly claimed that his younger brother had copied his owned results.
- As the chairman of mathematics at Basle, Jacob succeeded in blocking his brother’s appointment to the same department, forcing him to take a teaching job at the University of Groningen instead.

Standing with Leibniz

- Jacob and Johann brothers were firmly standing with Leibniz to challenge Newton.
- To find out how much Newton really knew, John Bernoulli, published in June 1696 a challenging problem, which he addressed “to acutest mathematicians of the world”.
- Leibniz and Bernoulli were confident that only a person who knows calculus could solve this problem.
- 29 January 1697 Newton returned home from working and found the problem in his post that Bernoulli had sent to him directly.
- Newton solved the problem. Although Newton’s solution was anonymous, he was recognized by Bernoulli as its author; Johann said: “we know the lion by his claw.”

Johann and L'Hˆospital's rule

- Johann instructed l'Hˆoospital, who later incorporated some of his Johann's results in a textbook he wrote, so that it has come to be known as **l'Hˆospital's rule**.
- l'Hˆospital paid a large monthly salary to exchange for Bernoulli's teaching and results. This was the first textbook on calculus, "l'Analyse des Infiniment Petits pour l'Intelligence des Lignes Courbes".
- Johann Bernoulli was unhappy that his work was being published by another with only a bare acknowledgement. He kept silent for some times, and eventually published his own lectures on that material.

Daniel Bernoulli

- Johann has three sons and Daniel Bernoulli (1700-1782) is the most mathematically talented one among the three. Sadly, Johann repeated his father's mistake and tried to force Daniel into a career as a merchant, which he didn't want.
- When the attempt failed, Johann only allowed Daniel to study medicine so that his son would not become his competitor.
- While studying medicine, Daniel took lessons in mathematics from his older brother Nikolaus II. When he was 24, Denial was offered a professor position at the Academy of Science in St. Petersburg.
- He returned to Basle in 1734 to discover that he and his father both had been jointly awarded a prize by the French Academy of Sciences. His father became angry and was unhappy to admit that his son was at least his equal. As a result, Johann kicked him of the family house.

Sources/Bibliographies

- "Bernoulli Brothers -the Math Family." *The Story of Mathematics - A History of Mathematical Thought from Ancient Times to the Modern Day*, 20 Feb. 2020, https://www.storyofmathematics.com/18th_bernoulli.html.
- *Lecture 29. Bernouilli Brothers - UH*. https://math.uh.edu/~shanyuji/History/h-29.pdf.
- "Leonhard Euler - Swiss Mathematician." *The Story of Mathematics - A History of Mathematical Thought from Ancient Times to the Modern Day*, 20 Feb. 2020, https://www.storyofmathematics.com/18th_euler.html.

math teachers seeing this meme:

THE END (with some more memes)

Thank You!