Introducing Omnifinites and the Arithmetic Errorless Calculator

Hunter C. Fred
Ryan B. Greenwood
Prof. Shane M. Palmquist, Ph.D., P.E.
Western Kentucky University

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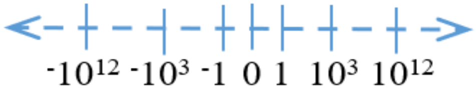
Overview

1. Goal
2. Omnifinite numbers
3. Comparative example
4. Arithmetic errorless calculator with examples
5. Conclusion and future work

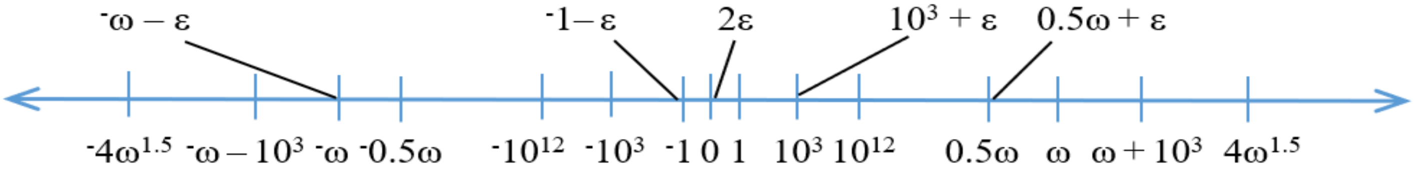
Goal

Develop a consistent arithmetic mathematical system robust enough so that infinitesimal and infinity numbers, and not just real and/or complex numbers, may be used to develop applied models, systems, and analyses.

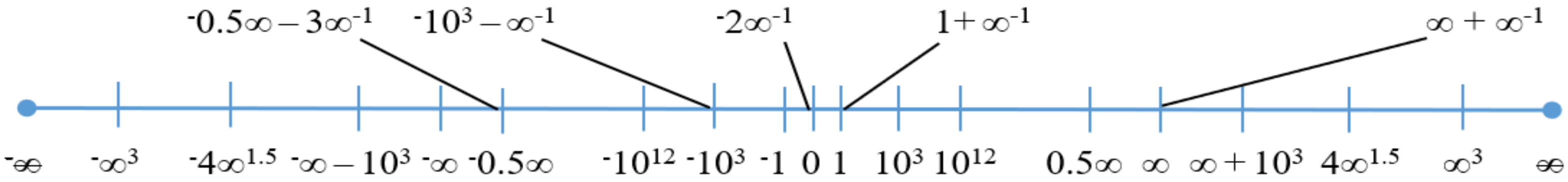
Omnifinites & Other Number Systems



Reals



Hyperreals



Omnfinites

Absolute Infinity ~~∞~~

- ~~∞~~ refers to a known largest positive nonfinite number in a closed number system.
- Often referred to as positive absolute infinity.
- This number is the infinity of all infinities.
- While this number can be reduced arithmetically, it cannot be increased or exceeded.

8 + ~~∞~~ = ~~∞~~   11 x ~~∞~~ = ~~∞~~

Absolute Infinity vs Traditional Infinity

Absolute infinity	**Traditional infinity**
~~∞~~ + ~~∞~~ = ~~∞~~	$\infty + \infty = \infty$
-~~∞~~ + ~~∞~~ = 0	$^{-}\infty + \infty = \text{NA}$
-~~∞~~ + -~~∞~~ = -~~∞~~	$^{-}\infty + {}^{-}\infty = {}^{-}\infty$
~~∞~~ – ~~∞~~ = 0	$\infty - \infty = \text{NA}$
-~~∞~~ – ~~∞~~ = -~~∞~~	$^{-}\infty - \infty = {}^{-}\infty$
-~~∞~~ – -~~∞~~ = 0	$^{-}\infty - {}^{-}\infty = \text{NA}$

Absolute Infinity vs Traditional Infinity

Absolute infinity	Traditional infinity
$\not\infty \times \not\infty = \not\infty$	$\infty \times \infty = \infty$
$-\not\infty \times \not\infty = -\not\infty$	$-\infty \times \infty = -\infty$
$-\not\infty \times -\not\infty = \not\infty$	$-\infty \times -\infty = \infty$
$\not\infty \div \not\infty = 1$	$\infty \div \infty = \text{NA}$
$-\not\infty \div \not\infty = -1$	$-\infty \div \infty = \text{NA}$
$-\not\infty \div -\not\infty = 1$	$-\infty \div -\infty = \text{NA}$

Infinity ∞

- Generally, in mathematics, infinity is regarded as a concept and not a number even though numerous times it is used as a number such as in integrals, limits, summation, and so forth.

$$\int_0^\infty \qquad \lim_{x \to -\infty} \qquad \sum_{n=1}^{\infty}$$

- For omnifinites, ∞ refers to Cantor's natural countable infinity, meaning: 1, 2, 3, ...

Infinity vs Traditional Infinity

Omnifinite infinity	Traditional infinity
$\infty + \infty = 2\infty$	$\infty + \infty = \infty$
$^{-}\infty + {}^{-}\infty = {}^{-}2\infty$	$^{-}\infty + {}^{-}\infty = {}^{-}\infty$
$\infty \times \infty = \infty^2$	$\infty \times \infty = \infty$
$^{-}\infty \times {}^{-}\infty = \infty^2$	$^{-}\infty \times {}^{-}\infty = \infty$

Omnifinite Zero 0

$$0 = \not\infty^{-1} = {}^{-}\not\infty^{-1} = 1 \div \not\infty = {}^{-}1 \div \not\infty = 1 \div {}^{-}\not\infty = {}^{-}1 \div {}^{-}\not\infty$$

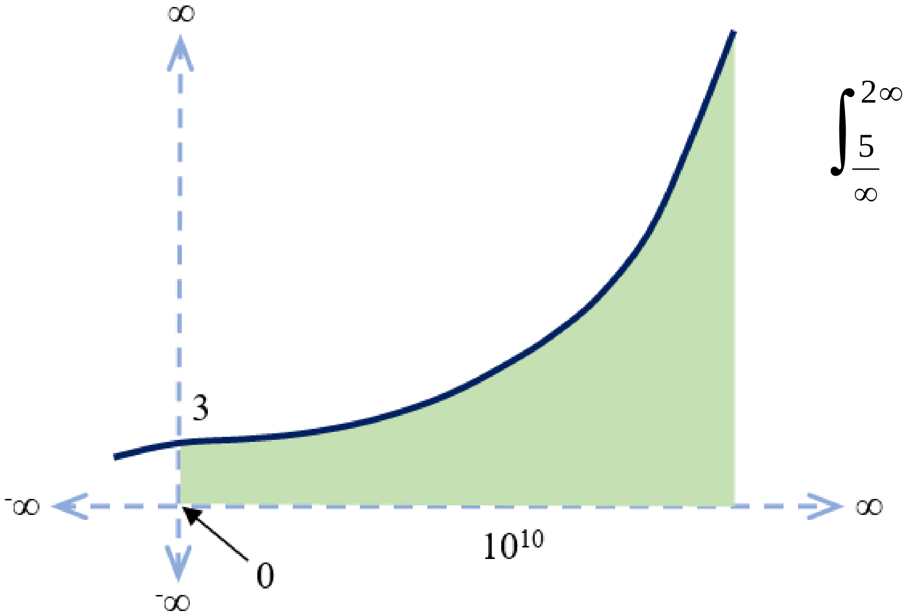
$$a \div \not\infty = a \div {}^{-}\not\infty = 0$$

where a is any number but $\not\infty$ and ${}^{-}\not\infty$.

Note, $\not\infty$ and ${}^{-}\not\infty$ are numerically the opposite of 0.

Comparative Example

Find the area under the curve by integrating the function: y(x) = 3 + x³ from 5/∞ to 2∞.

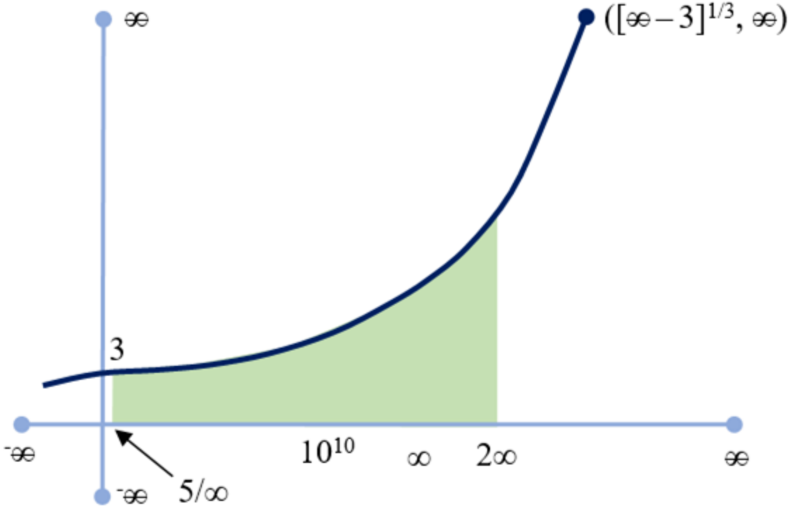


$$\int_{\frac{5}{\infty}}^{2\infty}(6+x^{3})\,dx = \lim_{t\to\infty}\int_{\frac{5}{t}}^{2t}(6+x^{3})\,dx$$

$$=\lim_{t\to\infty}\left(6x+\frac{x^{4}}{4}\right]_{\frac{5}{\infty}}^{2\infty}$$

$$=\infty$$

Comparative Example



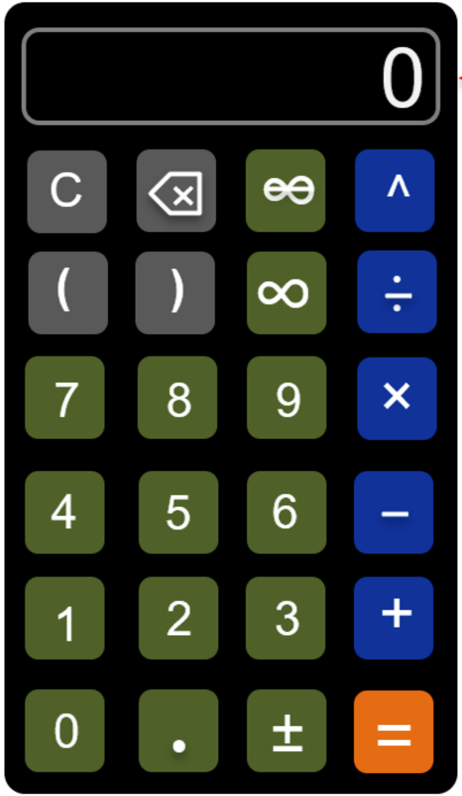
$$\int_{\frac{5}{\infty}}^{2\infty}(6+x^3)\,dx=\left(6x+\frac{x^4}{4}\right]_{\frac{5}{\infty}}^{2\infty}=\left[\left(6\times 2\infty+\frac{(2\infty)^4}{4}\right)-\left(6\times\frac{5}{\infty}+\frac{\left(5/\infty\right)^4}{4}\right)\right]$$

$$=\left[12\infty+4\infty^4-\frac{30}{\infty}-156.25\infty^{-4}\right]=4\infty^4+12\infty-30\infty^{-1}-156.25\infty^{-4}$$

Limits are not needed for solving.

Arithmetic Errorless Calculator

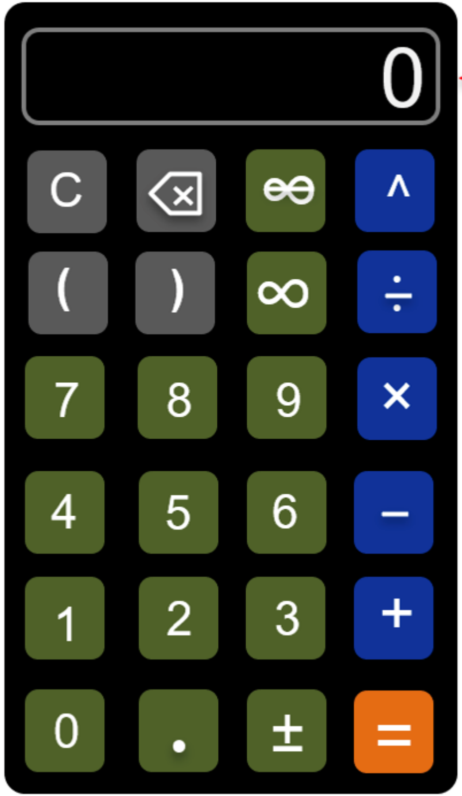
- World's first fully defined arithmetic calculator.
- Allows for computations with both finite and nonfinite numbers
- Eliminates all arithmetic errors of which there are an infinite number of such.



Arithmetic Errorless Calculator

Output: order of number parts

Input	Output
$-\infty^{-1} + 22\infty^{2} + 78$	$22\infty^{2} + 78 - \infty^{-1}$
$13 + 3\infty^{-2} - 7 + 9\infty - 4\infty^{-1}$	$9\infty + 6 - 4\infty^{-1} + 3\infty^{-2}$
$\infty^{-1} + 7 + 5\infty + 2.2\infty^{-1} - 12\infty - 9$	$-7\infty - 2 + 3.2\infty^{-1}$



Addition Examples

Input 1	Operation	Input 2	Equals	Output
2 . 1 4	+	7 . 6	=	9.74
5 ∞	+	1 4 . 1 ∞	=	19.1∞
3 . 4	+	2 ∞	=	2∞ + 3.4
9 ∞	+	ꝏ	=	ꝏ

Subtraction Examples

Input 1	Operation	Input 2	Equals	Output
2 . 1 4	–	7 . 6	=	-5.46
5 ∞	–	1 4 . 1 ∞	=	-9.1∞
3 . 4	–	2 ∞	=	-2∞ + 3.4
9 ∞	–	ꝏ	=	-ꝏ + 9∞

Multiplication Examples

Input 1	Operation	Input 2	Equals	Output
2 . 1 4	×	7 . 6	=	16.264
5 ∞	×	1 4 . 1 ∞	=	$70.5\infty^2$
3 . 4	×	2 ∞	=	6.8∞
9 ∞	×	∞̶	=	∞̶

Division Examples

Input 1	Operation	Input 2	Equals	Output
2 . 1 4	÷	7 . 6	=	0.28157894736842
5 ∞	÷	1 4 . 1 ∞	=	0.35460992907801
3 . 4	÷	2 ∞	=	$1.7\infty^{-1}$
9 ∞	÷	~~∞~~	=	0

Exponential Examples

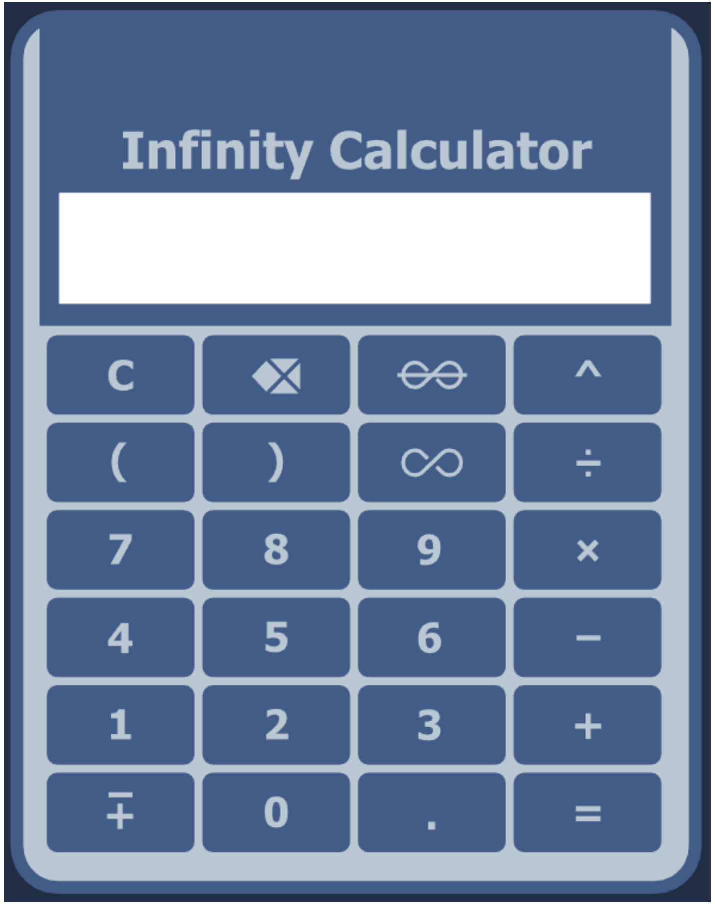
Input 1	Operation	Input 2	Equals	Output
2 . 1 4	^	7 . 6	=	324.447683302052
5 ∞	^	1 4 . 1 ∞	=	$7{,}169{,}305{,}073^{\infty}\infty^{14.1\infty}$
3 . 4	^	2 ∞	=	11.56^{∞}
9 ∞	^	∞	=	∞

Mixed Order of Operation Examples

Inputs with Mixed Operations	Equals	Output
7 ÷ 2 . 5 + 3 × 4 ∞	=	12∞ + 2.8
(2 + ∞) × 3 . 2	=	3.2∞ + 6.4
(4 . 1 + 1 . 5 ∞) ^ 2	=	$2.25\infty^2 + 12.8\infty + 16.81$
3 ^ 2 × 4 ÷ ∞ + 6	=	$6 + 36\infty^{-1}$

Arithmetic Errorless Calculator

- "basic infinity errorless" bie calculator
- Available for free at: infinicoretechnologies.com



Student Assessment

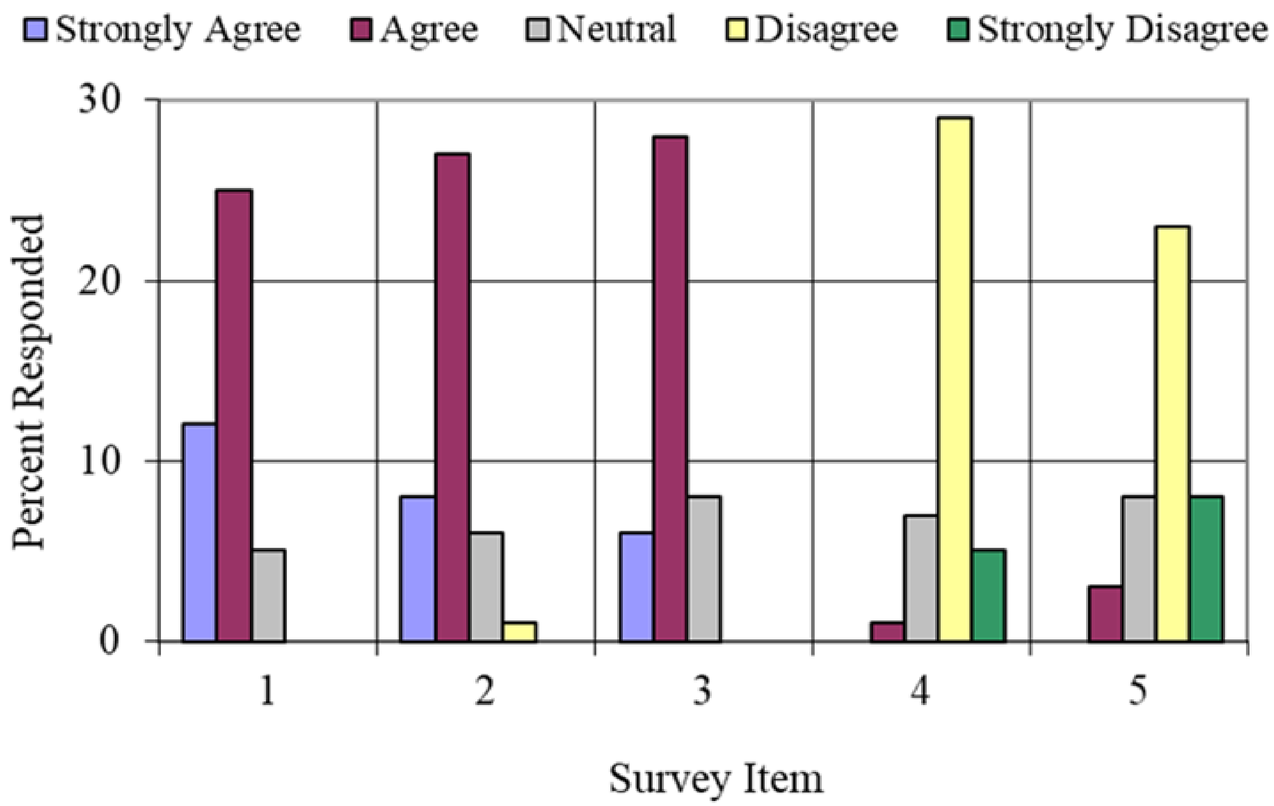
Sample of problems solved by senior engineering students using the errorless infinity calculator.

$3 + \not\infty =$ ________	$8 - {}^{-}9 =$ ________	$\not\infty \times {}^{-}\not\infty =$ ________	$\infty \div {}^{-}3\infty =$ ________
$-\infty + {}^{-}7 =$ ________	$\infty^2 - \infty^2 =$ ________	$0 \times {}^{-}\infty =$ ________	$\infty^2 \div {}^{-}\infty^2 =$ ________
$\infty + {}^{-}8 =$ ________	$9 - {}^{-}2\infty =$ ________	$9 \times {}^{-}\infty =$ ________	${}^{-}\not\infty \div {}^{-}\not\infty =$ ________
$\not\infty + 4\infty =$ ________	$\not\infty - \not\infty =$ ________	$7\infty \times {}^{-}2\infty =$ ________	$8 \div {}^{-}\infty =$ ________

5 choices:
- Strongly agree
- Agree
- Neutral
- Disagree
- Strongly disagree

1. The errorless infinity calculator is simple to use.
2. Results from errorless infinity calculator appear reasonable and logical.
3. The errorless infinity calculator seems intuitive to learn to use.
4. The errorless infinity calculator is complicated.
5. Results from the errorless infinitycalculator are unreasonable (illogical).

Student Assessment Results



Student Assessment

- Results of the senior engineering student survey were very positive and encouraging.
- Site slowdown in computing the arithmetic results likely resulted from increase in traffic on the site.
- “Bug” occurrences resulted in erroneous numerical solutions. Significant verification and testing helps to reduce erroneous numerical solutions.

Conclusions

- Open number systems, such as the reals, hyperreals or even the surreals, are NOT robust enough and will result in inconsistencies or paradoxes, which cannot be arithmetically resolved.
- The new errorless infinity calculator is a software tool that allows for computations involving all numbers, including finite and nonfinite numbers.
- The new calculator defines all arithmetic, eliminating errors such as division by zero and so forth.
- This is the world’s first fully defined arithmetic calculator.
- Relatively simple to use and logical.

Future Work

- Authors are currently working to develop and create the scientific infinity errorless (sie) calculator.
- Future work will be to create and develop the graphing infinity errorless calculator.
- The purpose of this research is to help make possibe more comprehensive and robust studies with advanced mathematical models that require computations and analyses using a full spectrum of numbers, not just real and/or complex numbers.
- Improving our knowledge of mathematical numbers and their full potential in all fields of applied study, including but not limited to science, technology and medicine, will lead to greater understanding and innovations.

Questions...?

Thank you for your time.