Killing Imaginary Numbers
From Today's Asymmetric Number System
to a Perfect Symmetric Number System

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Abstract

In this paper, we point out an interesting asymmetry in the rules of fundamental mathematics between positive and negative numbers. Further, we show that there exists an alternative numerical system that is basically identical to today's system, but where positive numbers dominate over negative numbers. This is like a mirror symmetry of the existing number system. The asymmetry in both of these systems leads to imaginary and complex numbers.

We suggest an alternative number system with perfectly symmetric rules – that is, where there is no dominance of negative numbers over positive numbers, or vice versa, and where imaginary and complex numbers are no longer needed. This number system seems to be superior to other number systems, as it brings simplicity and logic back to areas that have been dominated by complex rules for much of the history of mathematics. We also briefly discuss how the Riemann hypothesis may be linked to the asymmetry in the current number system.

Key words: Atomism, asymmetry, symmetry, imaginary numbers, Riemann hypothesis.

1 Asymmetry in Today's Number System

Looking across many decades of theory and practice, there is a lack of symmetry in the basic rules of modern mathematics. When multiplying any positive real number with another positive real number, for example, the result stays positive. However, when we multiply a negative number by a negative number, the result suddenly also becomes positive. Further, when multiplying a negative number with a positive number, the negative number will dominate over the positive number and the result will always be negative.

Why do negative numbers dominate over positive numbers when they are multiplied together? And yet in contrast, why does the result flip its sign to positive when two negative numbers are multiplied, while the result of a positive number multiplied by a positive number keeps its sign? While the reasoning behind the common conventions cannot be proven, these rules are the axioms of modern number theory, something that is taken for granted. It is not right or wrong per se, but is it the optimal number system, or does it lead to unnecessarily complex rules and lay the foundation for deeper problems within the field of mathematics and perhaps other fields as well?

The reason for this set of dominance rules could be that the fundamental understanding of math was developed at a time when we did not have a very deep understanding of the world. As the field grew, early mathematicians added new concepts and rules to fit in neatly with previously established rules. The asymmetry where negative numbers dominate over positive numbers is the reason we need imaginary numbers, for example. There is no simple and logical answer for what the square root of a negative number is, based on the rules described above. So, in order to get the existing number system to work for the square root of a negative number, imaginary numbers, $\sqrt{-1} = i$, were introduced, which are also related to complex number theory.

Interestingly, we can create a alternative number system that is the mirror image of today's number system, although this may not have been explored much, if at all, in the past. In such a system, positive numbers will dominate over negative numbers. When multiplying any positive real number with another positive real number, for example, the result would have a negative sign. But when multiplying two negative numbers together, the sign of the answer will be negative. Finally, when multiplying a positive with a negative number, the answer will be positive. This number system should work just as well, except that the thinking around it would be the mirror image of today's system. We will still run into challenges when trying to take the square root of positive

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numbers, but the solution is to introduce imaginary numbers for $\sqrt{1} = i$, instead of for $\sqrt{-1}$. Again, such a number system is the mirror image of the existing number system, where the rules concerning dominance are switched from negative to positive numbers.

2 Perfect Symmetry

In the section above, we have seen how negative numbers dominate over positive numbers in our current number system. We have also shown that there must exist an equivalent number system where positive numbers dominate over negative ones. These number systems are basically identical, or we could say they are mirror images of one other. That is, both of these number systems are asymmetric, and both need the concepts of imaginary and complex numbers in order to handle the square root function for all numbers.

Wouldn't it be nice to have a set of perfectly symmetrical mathematical rules that are identical for negative and positive numbers? This is also possible. We will suggest the following axioms:

1. A negative number multiplied with a negative number always gives a negative number.
2. A positive number multiplied with a positive number always gives a positive number.
3. A positive number multiplied by a negative number, or a negative with a positive number, always gives two solutions, namely a plus and minus solution of the absolute value of the result.

The fact that we now have two solutions rather than one (under axiom 3) may seem strange at first, but this will help us to eliminate multiple solutions in the answer when it comes to the square root function. The square root of a positive number will now always be positive, and the square root of a negative number will always be negative. Only the square root of a plus/minus number will have a plus/minus solution, and the plus/minus solution means that $\sqrt{\pm 4} = -2 \times 2$, since ± 4 can only be created by multiplying a positive number with a negative number.

Table 1 show the three number systems mentioned here. The left hand column is today's number system, the middle column is the mirror number system of our current system, and the right hand column is the newly suggested perfect symmetric number system. Again, we ask: ?What is the rationale behind having negative numbers dominating over positive ones, or positive numbers dominating over negative ones?? Such asymmetry rules do not sound logical or appear to have any fundamental reasoning behind them. The asymmetric rules are a main cause behind more complex mathematics, such as imaginary numbers and complex number theory. Our symmetric number system seems more logical and may open up new possibilities in the field of mathematics, as well as other fields that rely heavily on the theory and practice of math. Obviously, as it is a new number system, there could be challenges that we have not yet understood. However, it is clear that small changes in the fundamental properties and rules of the prevailing number system can have a series of consequences for rules "higher" up in the constructions of math and physics, for example.

Today's number system **Asymmetric rules**	**Mirror of today's system** **Asymmetric rules**	**Perfect Symmetry** **Yin-Yang system**
Negative numbers dominate	**Positive numbers dominate**	**No dominance**
$+ \times + = +$	$+ \times + = -$	$+ \times + = +$
$- \times - = +$	$- \times - = -$	$- \times - = -$
$+ \times - = -$ $- \times + = -$	$+ \times - = +$ $- \times + = +$	$+ \times - = \pm$ $- \times + = \pm$
$\sqrt{+} = \pm$	$\sqrt{+} = i$	$\sqrt{+} = +$
$\sqrt{-} = i$	$\sqrt{-} = \pm$	$\sqrt{-} = -$
$\sqrt{\pm} =$? No rule	$\sqrt{\pm} =$? No rule	$\sqrt{\pm} = - \times +$
Numerical examples		
$2 \times 2 = 4$	$2 \times 2 = -4$	$2 \times 2 = 4$
$-2 \times -2 = 4$	$-2 \times -2 = -4$	$-2 \times -2 = -4$
$2 \times -2 = -4$ $-2 \times 2 = -4$	$2 \times -2 = 4$ $-2 \times 2 = 4$	$2 \times -2 = \pm 4$ $-2 \times 2 = \pm 4$
$\sqrt{4} = \pm 2$	$\sqrt{4} = 2i$	$\sqrt{4} = 2$
$\sqrt{-4} = 2i$	$\sqrt{-4} = \pm 2$	$\sqrt{-4} = -2$
$\sqrt{\pm 4} =?$	$\sqrt{\pm 4} =?$	$\sqrt{\pm 4} = -2 \times 2$ $\sqrt{\pm 4} = 2 \times -2$

Addition is identical for all systems, as there is no sign dominance.		
$2 + 2 = 4$	$2 + 2 = 4$	$2 + 2 = 4$
$-2 + 2 = 0$ $2 - 2 = 0$	$-2 + 2 = 0$ $2 - 2 = 0$	$-2 + 2 = 0$ $2 - 2 = 0$
$-2 - 2 = -4$	$-2 - 2 = -4$	$-2 - 2 = -4$

Table 1: This table summarizes three different number systems. The first one is today's number system, where negative numbers dominate over positive. The next one is the mirror image of that system, where positive numbers dominate over negative. The third system is a number system with perfect symmetry, where negative and positive numbers have the same status. Only in the first two asymmetric number systems do we need imaginary and complex numbers.

3 The Riemann Hypothesis and its Possible Link to Asymmetric Number Systems

One of the most interesting mathematical problems yet to be solved is the Riemann hypothesis. It is one of the seven "Millennium" Problems described by the Clay Mathematics Institute (CMI) and the only problem remaining from David Hilbert's original set of 23 problems, curated and presented in 1900.

As described by the CMI, the Riemann hypothesis states that "some numbers have the special property that they cannot be expressed as the product of two smaller numbers, e.g., 2, 3, 5, 7, etc. Such numbers are called prime numbers, and they play an important role, both in pure mathematics and its applications. The distribution of such prime numbers among all natural numbers does not follow any regular pattern. However, the German mathematician G.F.B. Riemann (1826 - 1866) observed that the frequency of prime numbers is very closely related to the behavior of an elaborate function, called the Riemann Zeta function.

The Riemann hypothesis asserts that all interesting solutions of the equation $\zeta(s) = 0$ lie on a certain vertical straight line. This has been checked for the first 10,000,000,000,000 solutions. A proof that it is true for every interesting solution would shed light on many of the mysteries surrounding the distribution of prime numbers."[1]

Interestingly, there can be no Riemann hypothesis in our new symmetric number system, as there are no imaginary numbers and complex planes in this system. In other words, the Riemann hypothesis actually seems to be linked to and perhaps may even arise from the asymmetry in today's number system. In addition, we conjecture that the Riemann Zeta function, if developed under the mirror system (where the rules of dominant negative number rules are switched so positive number rules are dominant) then what we could call the mirror Riemann Zeta function should have all of its zeros only at the positive even integers and complex numbers with real part $-\frac{1}{2}$. In other words, we suggest that the Riemann hypothesis is partly rooted in the choice of the asymmetric number system. We have two asymmetric number systems that are the mirror of each other, reflecting the Riemann hypothesis around zero (and it is suggested that all non-trivial solutions are at 1/2 and -1/2). Further, it appears that we have one symmetric number system with no equivalent Riemann hypothesis. This leads us to think that the Riemann hypothesis is mostly about understanding the complex effects of a fundamental issue that is rooted in asymmetric rules between positive and negative numbers.

[1] See the general entry for the Riemann hypothesis on the Clay Mathematics Institute website at: http://www.claymath.org/millennium-problems/riemann-hypothesis.

4 Conclusion

We have pointed out that our modern number system has "strange" asymmetric rules, where negative numbers dominate over positive numbers. These asymmetric rules likely came into being because early mathematicians first developed rules for positive numbers and then tried to fit negative numbers into this system. The main focus was to have a practical everyday number system. Later on, it was necessary to develop a rule for the square root of numbers, which required some accommodation in the rules that were used. The dominance of negative numbers over positive numbers seems to lead to the need for imaginary numbers, for example. Further, we have shown that there exist an identical or mirror number system, where the dominance rules are switched from negative numbers to positive. In this case, the imaginary numbers are linked to the square root of one rather than the square root of minus one.

We have also introduced a new perfectly symmetrical number system, where there is no dominance of negative over positive numbers, or positive over negative numbers. In this perfectly symmetrical number system, there is no need for imaginary numbers or complex number theory. We also have indicated that the Riemann hypothesis likely is rooted in the asymmetry of the dominance rules in the existing number system.