

# **Transreal Computing**

## **Research and Portfolio-Company Showcase**

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# Dedication

This presentation is dedicated to the *USS Yorktown* which was stranded for 2 hours 40 minutes when a division-by-zero error crashed its entire network of computers, causing its engines to stop.



# Outline

- Who am I, and where am I from?
- Transreal arithmetic – or how to divide by zero and do infinitely many “impossible” things.
- How to make computers that calculate “impossibly” fast.
- Commercial potential.
- What am I going to do next?
- Conclusion.



## Who am I?

- A psychology graduate who worked in Electrical and Electronic Engineering departments at Sussex University and Plymouth Polytechnic.

I wrote one program that reduced the time to compute a spacetime convolution of MRI images from 9 days to 3 seconds.

And another one that could recognise a double decker bus in one second.

- Reading University made me a lecturer and then gave me a doctorate for developing a canonical description of the perspective transformations in whole numbered dimensions.



# Where am I from?

The School of Systems Engineering:

- 40 Academic Staff.
- 55 Research, Technical, and Administrative Staff.
- 120 Postgraduate Students.
- 650 Undergraduate Students.
- Offers degrees in Computing, Cybernetics, Electronics, and Artificial Intelligence.



# Where am I from?

Research groups:

- Informatics Research Centre (IRC).
- Reading E-Science Centre (RESC).
- Infra-red Multilayer Filters (IMF).
- Advanced Computing and Emerging Technologies (ACET).



# What's wrong with arithmetic?

It doesn't work:

- Can't find the tangent of a right angle ( $\infty$ ).
- Can't find the logarithm of zero ( $-\infty$ ).
- Can't find zero to the power of zero ( $\Phi$ ).
- Can't explain how computers work (NaN).
- Mathematical arithmetic does not describe the arithmetic that people use in their daily lives as programmers or users of computer systems:
- Mathematical arithmetic is sociologically **invalid**.



# What's wrong with computers?

- NaN, Inf, and  $-\text{Inf}$  are not numbers.
- $\text{NaN} \neq \text{NaN}$ , but equals means  $x = x$  for all  $x$  so computer arithmetic is **invalid**.





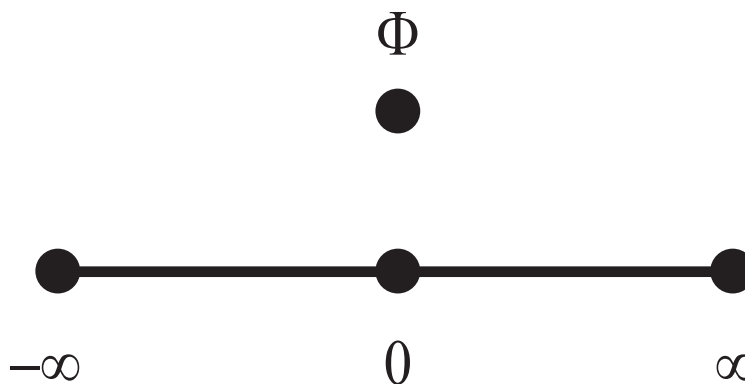
# Transreal Arithmetic

- I developed transreal arithmetic over the last ten years.
- For the first time in 3,000 years it makes every fraction  $n/d$  a number.
- For the first time in 1,200 years it handles division by zero *arithmetically*.
- Division by zero has been possible in calculus since Newton and Leibniz 300 years ago.
- Division by zero has been possible in algebra since Hamilton 200 years ago.



# Transreal Arithmetic

- Transreal numbers are defined by a number line:



# Transreal Arithmetic

All fractions (including numbers over zero) are transreal numbers:

For all positive numbers  $k$ :

- $\infty = \frac{k}{0}$  and in least terms  $\infty = \frac{1}{0}$
- $\Phi = \frac{0}{0}$  is already in its least terms
- $-\infty = \frac{-k}{0}$  and in least terms  $-\infty = \frac{-1}{0}$



# Transreal Arithmetic

There are just three special rules in transreal arithmetic.

- Numbers are always reduced to least terms as soon as they are produced.

- $\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$

- $\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c}$

**Q.** But you already know these rules, so why can't you divide by zero?



# Transreal Arithmetic

**A.** Because school teachers and university lecturers do not teach arithmetic so that it works for all combinations of numbers.

- I can teach you transreal arithmetic in ten minutes.
- I am willing to help school teachers develop a curriculum for transreal arithmetic.
- I teach my own students transreal arithmetic.
- Other lecturers are free to follow my lead.



# Transreal Arithmetic

- This year I axiomatised transreal arithmetic.
- Essex University gave a computer proof that the axiomatisation is correct.
- Cambridge University, “Can not find any fault in the machine proof and believe it is correct.”



# Transreal Arithmetic

All of the standard counter-proofs which attempt to demonstrate that division-by-zero is impossible in arithmetic are:

- Falsified by the computer proof of the consistency of transreal arithmetic.
- Explicitly shown to be erroneous by my hand proofs.
- I will defeat any counter proof you care to present me with.



# Transreal Arithmetic

For the last 1,200 years no one has been able to evaluate zero to the power of zero arithmetically.

**Q.** How hard can it be?

**A.** Key Stage 4.





# Transreal Arithmetic

$$\begin{aligned}0^0 &= 0^{(1-1)} \\ &= 0^1 \times 0^{-1} \\ &= \left(\frac{0}{1}\right)^1 \times \left(\frac{0}{1}\right)^{-1} \\ &= \frac{0}{1} \times \frac{1}{0} \\ &= \frac{0}{0} \\ &= \Phi\end{aligned}$$



# Fast Computers

Having an arithmetic that works on all combinations of numbers means I can build computers with:

- No circuitry for handling arithmetical exceptions, because there are no arithmetical exceptions.
- No circuitry to choose instructions because there is only one instruction.
- No circuitry to decode an instruction because an instruction is itself.

This means my computers will run orders of magnitude faster than today's computers.



# Commercial Opportunity

How much would you pay:

- To know that the engine in your ship, car, aeroplane, or heart pacemaker won't just stop dead.
- To know that your Government's computer controlled military hardware won't just stop or misfire.



# Commercial Opportunity

How much would you pay for a computer that runs:

- 10 times faster than a PC?
- 100 times faster than a PC?
- 1,000 times faster than a PC?
- 10,000 times faster than a PC?
- 100,000 times faster than a PC?
- 1,000,000 times faster than a PC?
- 10,000,000 times faster than a PC?



# What Next?

- Build a transreal computer.
- Implement an Abstract Syntax-Tree (AST) so that users can display a program in any language.
- Implement software for Computational Fluid Dynamics (CFD).
- Derive Maxwell's equations and classical gravitation in transreal numbers so they have no naked singularities (infinities affecting a neighbourhood of space).
- Collaborate with anyone who wants to unify Quantum Electro-Dynamics (QED) with gravitation.



# Conclusion

- Standard arithmetic is invalid.
- Transreal arithmetic is just standard arithmetic with standard arithmetical algorithms applied correctly.
- I will help you develop a curriculum for transreal arithmetic if you want me to.
- I will help you unify QED and gravitation if you want me to.
- I will build a transreal supercomputer.
- I will defeat any counter-proof of division by zero you care to present me with.

