what's the point of...

ALGEBRA?

How many make a crowd?

If $2x + 1 = 7$ what is x? To solve for x, subtract 1 from each side, so $2x = 6$, so $x = 3$, so what! Algebra, what's the point?

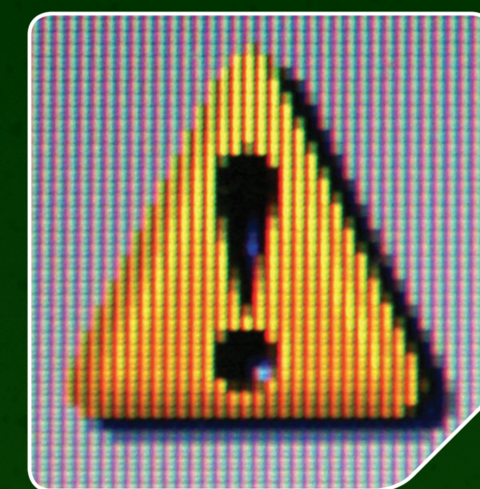
Algebra is used all over the place: if we aren't sure what a value can be, for example the number of people who are going to be at my party, we can use a letter to represent that value. Let's call the total number of people at my party p, where that p could be anything from a popular 70 to a sad 2.

The number of people will depend on the number of people I invite, let's call that number i, and suppose we estimate that only half of them will actually turn up, that will give us $0.5i$ people. Of those that do turn up, about half will bring someone else with them, so that's an extra $0.5 \times (0.5 \times i)$ people. So the total number of people will be $p = 0.5i + (0.5 \times 0.5i) = 0.75i$, oh and I'll be there too so that's $p = 0.75i + 1$.

Of course they'll all want something to eat. The recipe for my famous spag boll says I'll need 1 kg of spaghetti for five people, but how much will I need for the party? The amount of spaghetti needed per person is 0.2 kg, so for the party I'll need $s = 0.2 \times (0.75i + 1)$ kg, so that everyone can taste the wonder! I now, thanks to algebra, have a way of predicting how much spaghetti, or any other party ingredient, I need based on the number of invitations so I can estimate the cost of the party. So now it's decision time, how many invitations?

Solving almost any problem in life which involves money, time, distance, the amount or size of something or even simply comparing prices when shopping, all use algebra.

Zeroing in on a puzzle with algebra



Historically the word 'algebra' is believed to come from the Arabic word 'al-jabr', which scholars believe refers to the act of restoration or balancing.

In algebra the equations you have will contain an equals sign and the rule is what you do to one side of the equation, you do to the other side too, to keep the equation balanced. But you need to be careful with algebra. The steps below all seem to follow one after another but something must have gone wrong somewhere along the line. Can you spot the mistake in this algebraic balancing puzzle?

$a = x$	(which is true for some a's and x's)
$a^2 = ax$	(multiply both sides by a)
$a^2 - x^2 = ax - x^2$	(subtract x^2 from both sides)
$(a + x)(a - x) = x(a - x)$	(factorise)
$a + x = x$	(divide both sides by $a - x$)
$2x = x$	(as $a = x$)
$2 = 1$	(divide both sides by x)

Two is equal to one – I don't think so! Where did it go wrong?

The mistake is near the end, when we did the division. We said at the start that a equals x, so $(a - x)$ is zero and dividing by zero just doesn't work mathematically. Think about it. How many nothings are there in something?

Many mathematical theories have come to an abrupt end because of this divide by zero problem. You can't do it; if you try you get nonsense!

A well-known example of why this sort of algebraic error is important in the real world is the case of the US navy ship *Yorktown*. In its time it was state-of-the-art computer controlled but, in September 1997 while on manoeuvres, a crew member entered a zero by mistake into the ship's software. The computer system couldn't cope with this error and the computer control systems failed leaving the ship without any working engines for a few hours.

Using algebra to check that computer software is correct is now big business. In safety-critical computer systems, such as deploying aeroplane landing gear, algebra plays a key role in checking that all the possible inputs lead to safe outputs.

A drive for using algebra

Algebra isn't just about solving textbook equations like $2x + 1 = 7$; it's a way to mathematically model the world. The word model here doesn't have anything to do with catwalks, it's a scientific term that refers to a way of building a description of sometimes complicated situations using letters or symbols to represent possible values. $v = u + at$ is a mathematical model: it tells you how fast your car will be going if it starts at speed u and accelerates for t seconds with acceleration a. Slot in the values you fancy and, vrooom, you have the answer you need. Car designers, in fact designers of all types of products, and also architects and engineers, use algebra all the time to ensure that they know exactly how the things they are making will turn out. Algebra is even part of the process for designing and testing new medicines. Without these mathematical models and the power of algebra to capture the way the world works we wouldn't have the products we all need to get along. Salesmen and truck drivers use algebra to calculate mileage, nurses use it to give correct doses of medicines and many others need to do some to fill in that dreaded tax return.

• Written by Tom Button, Peter McOwan, Matt Parker and Zia Rahman
• Special thanks to Professor David Arrowsmith (QMUL), Makhan Singh, Melanie Ashfield and James Anthony, University of Birmingham

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