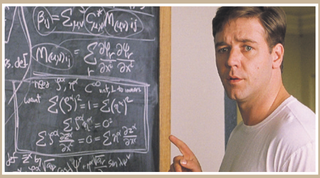
Science



MYTH DEBUNKED

Is Mathematics a thing of the past?

When people think of a mathematician, what do they picture?

Probably, they would visualise a person (invariably male) in front of a blackboard chock-full of numbers and esoteric, intimidating symbols.

Maybe someone with unkempt hair, quirky manners and questionable social skills would come to mind.

Perhaps they would retrieve the story of a past mathematician, whose life was illustrated in some movie or book.

It is usually imagined that a mathematician is someone who lived hundreds, maybe even thousands of years ago, and that such human specimens are extinct today.

It is true that the mathematics we know and study today is based on the great works of mathematicians such as Euclid, al-Khwarizmi, Bombelli, Cauchy, Gauss, Euler and Hilbert. But mathematics is not just a thing of the past.

Mathematics is still evolving today, and mathematicians are still among us. In fact, we are literally surrounded by mathematics and we are likely not even conscious of this fact.

For example, suppose you are browsing some online store to buy an album of your favourite music artist.

Often, the website would display other recommended albums for your consideration; albums of artists who are to your liking as well, even though not all of them are of the same music genre as the album you were going to buy.

How does the website infer your musical taste in such an uncanny, almost omniscient, way?

It turns out that these accurate predictions are made by behind-the-scenes algorithms that analyse your past album purchases and correlate them with those of other people who have bought similar albums to yours. And the basis of these algorithms is mathematics.

This illustrates that mathematics is still very much relevant to today's world; so much, in fact, that it is influencing our daily life choices – even though we are probably unaware of this.

Perhaps, mathematics is not just important in our daily lives, but its significance is nowadays deeper than ever before.

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Divisibility rules

Alexander Farrugia

We represent a number by a sequence of digits. For example, 532 represents a number made up of five 100s, three 10s and two units. Three 10s (30) is divisible by two, because 10 is. Similarly, 500 is divisible by two because 100 is.

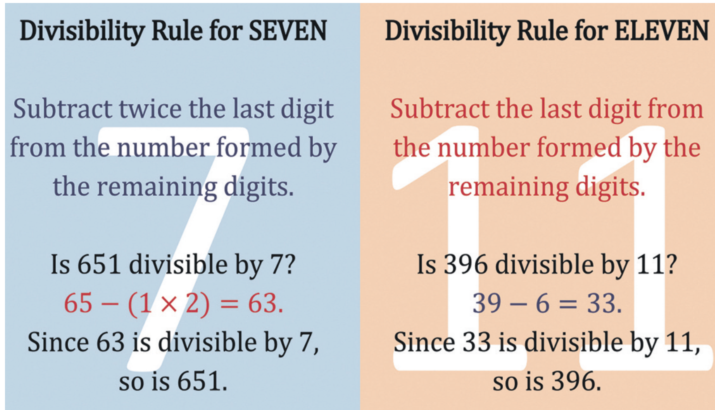
1,000, 10,000, 100,000... these numbers are all divisible by two too.

The last digit is the only number that is not guaranteed to be divisible by two. Because of this, we obtain the familiar divisibility rule of two: a number is divisible by two whenever its last digit is divisible by two, that is, whenever its last digit is 0, 2, 4, 6 or 8.

Similar divisibility rules exist for many other numbers. From the argument of the previous paragraph, we may also deduce the well-known divisibility rules of five and 10. A number is divisible by five whenever its last digit is 0 or 5, the only two digits that are divisible by five. Moreover, it is divisible by 10 if its last digit is 0, because 0 is the only digit that is divisible by 10.

Other divisibility rules are not as straightforward. For example, when is a number divisible by four? This happens whenever the sum of the last digit and twice the penultimate digit is divisible by four. For example, the number 19,376 is divisible by four since 6 + (2 x 7) = 20 and 20 is divisible by four. The divisibility rule for eight adds this number (20, in the previous example) to four times the third digit from last. Therefore, the number 19,376 is divisible by eight as well, because 6 + (2 x 7) + (4 x 3) = 32, which is divisible by eight.

The divisibility rules for three and nine are based on the sum of the digits of the number. If this sum of digits is divisible by three or by nine, then so is the original number. For example, the number 12,345 is divisible by three but not divisible by nine, since 1 + 2 + 3 + 4 + 5 = 15, which is divisible by three but not by nine. These rules work because the numbers 1, 10, 100, 1,000, ... all leave a remainder of one when divided by three or by nine.



The divisibility rules for the numbers seven and 11. The numbers 13 and 17 have similar divisibility rules. For every divisibility rule, if the resulting number is still too big to determine its divisibility by inspection, then the rule may be reapplied repeatedly as needed.

The test for whether a number is divisible by seven or by 11 utilises the entire sequence of digits of the number as well, as explained in the figure above. The divisibility rules of 13 and 17 are very similar.

For 13, subtract nine times the last digit from the number formed by the remaining digits, while for 17, subtract five times the last digit.

These rules work because the numbers 21, 11, 91 and 51 are divisible by seven, 11, 13 and 17, respectively.

Can you spot the pattern?

DID YOU KNOW?

- The number system in use today is called the Hindu-Arabic numeral system, originally developed in India between the first and the fourth century AD. The Indian mathematician Aryabhata originally used nine symbols, then later Brahmagupta introduced the tenth symbol 0 to stand for zero.
- At around 2,000 BC, the Babylonians used a numeral system having 60 different symbols. By stark contrast, computers internally use the binary system, which represents numbers using just the two symbols 0 and 1.
- The Dozenal Society of America (www.dozenal.org) is a non-profit corporation that advocates the use of 12 symbols to represent numbers, rather than 10. Apart from the usual 10 symbols from 0 to 9, they use an upside-down '2' symbol (pronounced 'dek') to represent 10 and an upside-down '3' symbol (pronounced 'el') to represent 11.
- The current year, 2016, has the following curious property. The number 2016 is divisible by all the numbers from two to nine, except five, whereas the previous number (2015) is only divisible by five and by none of the other numbers from two to nine! 2016 is the smallest number having this property.

For more trivia see: www.um.edu.mt/think

SOUND BITES

- *From the international scene*: In 2013, Yitang Zhang, at the time a lecturer at the University of New Hampshire, USA, proved that there are infinitely many pairs of prime numbers whose difference is at most 70 million. He received several prestigious awards for this achievement, which is one of the recent highlights in mathematics. Remarkably, he had been a virtually unknown mathematician! His proof was published in the paper *Yitang Zhang, Bounded gaps between primes, Annals of Mathematics 179 (2014), 1121–1174*. This paper spurred much research into the topic of so-called 'gaps' between prime numbers. At the forefront of this research was the so-called *Polymath8* project, a project encouraging the collaboration among several mathematicians working on the same problem. This group of mathematicians managed to lower the number 70,000,000 of Zhang's result to just 246. Their discovery was published under the pseudonym of *D. H. J. Polymath* in the paper *D. H. J. Polymath, The 'bounded gaps between primes' Polymath project: A retrospective analysis, Newsletter of the European Mathematical Society 94 (2014), 13–23.*
- *From the local scene*: In mathematics, a matrix is a rectangular array of numbers arranged in rows and columns. Recently, researchers in molecular chemistry developed results that link the presence or absence of electrical conductivity through a molecule, across which there is a voltage via a pair of atoms, to entries of a matrix related to the molecule. These researchers predicted the existence of certain molecular structures that enable conductivity for any two distinct atom terminals and that bar conductivity when contacts are attached to the same atom. In the recent paper *Irene Sciriha and Alexander Farrugia, No chemical graph on more than two vertices is nuciferous, Ars Mathematica Contemporanea 11 (2016), 397–402*, two mathematicians at the University of Malta proved that the only possible molecule, occurring in nature or otherwise, that has these properties is the hydrocarbon ethene. This shows that research in mathematics contributes to important discoveries in science.
- For more science news, listen to Radio Mocha on Radju Malta 2 every Monday and Friday at 1pm.

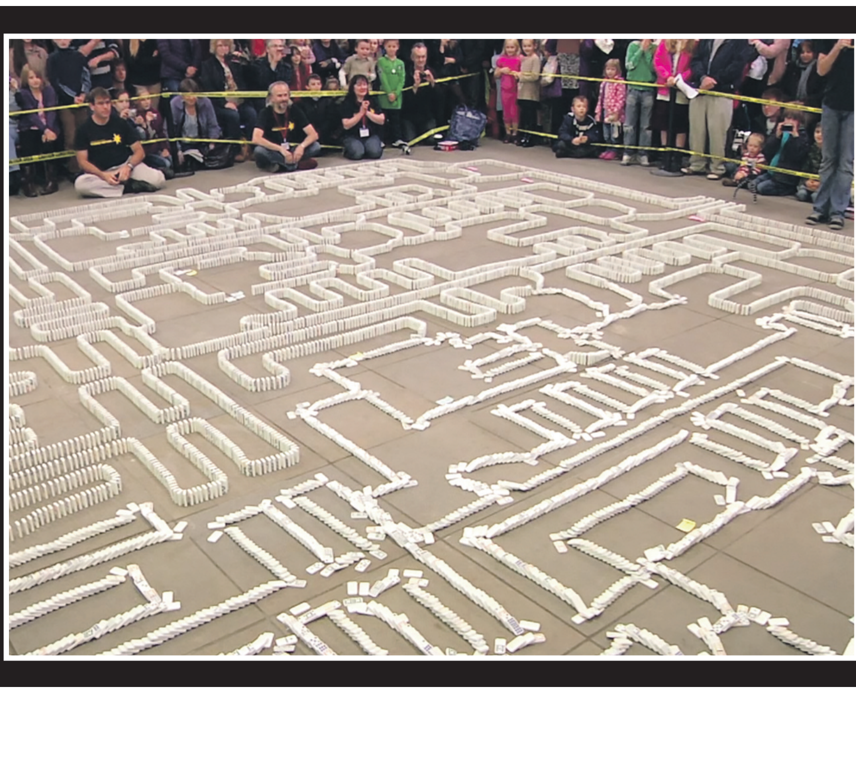


PHOTO OF THE WEEK

A domino computer built by Matt Parker and his team in 2014. Matt Parker is an Australian mathematician and stand-up comedian based in London. He is also the Public Engagement in Mathematics Fellow at Queen Mary University of London. Matt set out to build, in his words, "the world's slowest computer" that could sum up two numbers, each between zero and seven, using just dominoes. He and his team successfully used the giant domino computer to work out the sum of four and six. A day later, they extended the domino computer to work out the sum of two numbers between zero and 15. This required building a much bigger circuit using 10,000 dominoes! The photo shows this second, bigger, domino computer. You may watch how the second attempt fared on the following Youtube link: https://www.youtube.com/watch?v=OpLU__bhu2w
Photo: http://thescienceexplorer.com/technology/watch-computer-made-out-dominoes-do-basic-math