ColAUMS Space

ADELAIDE UNIVERSITY MATHEMATICS SOCIETY

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The Abel Prize

The Abel Prize is often cited as the 'Nobel Prize of mathematics'. Offered yearly, it is considered less prestigious than its cousin the Fields Medal (offered every four years to mathematicians under 40) but is accompanied by a larger cash prize of 6 million Norwegian Kroner, about AUD $1 million. The Abel Prize was established in 2003 by the Norwegian government to make up for the lack of an equivalent Nobel Prize. There are many stories about why Alfred Nobel did not establish a prize in mathematics, including a mathematician stealing his potential wife, but it is believed that the truth is that Nobel didn't consider mathematics to be of great benefit, as his will speaks of prizes for those inventions or discoveries that are of 'great practical benefit' to mankind.

The Abel Medal

This year the Abel Prize was awarded to Karen Uhlenbeck, who is the first woman to receive the award. Uhlenbeck was awarded the prize for "her pioneering achievements in geometric partial differential equations, gauge theory and integrable systems, and for the fundamental impact of her work on analysis, geometry and mathematical physics". The chair of the award committee considers her theories to have revolutionised our understanding of minimal surfaces.

Uhlenbeck is known for being a trail-blazer for women in mathematics, and her plenary lecture at the 1990s International Congress of Mathematicians was the first delivered by a woman since Emmy Noether in 1932. Noether is considered one of the greats in abstract algebra and theoretical physics.

Another great mathematician of recent years was Maryam Mirzakhani, an Iranian mathematician who received the Fields Medal in 2014 for her contributions to the dynamics and geometry of Riemann surfaces and their moduli spaces. She currently remains the only woman to have received the Fields Medal. Unfortunately Mirzakhani was diagnosed with breast cancer in 2013 and died on 14 July 2017 at the age of 40.

The historical contributions of women in mathematics are unmistakable, and the awards of the Abel Prize and the Fields Medal serve to solidify their place in history. If these women are any example to go by, the future promises many more inspiring female mathematicians.

Sum of Three Cubes

There is an open problem in mathematics pertaining to the integers that are, or rather are *not*, the sum of three integer cubes. It's easy to find a number which is the sum of three cubes, simply by taking three numbers, cubing them, and adding them; for instance $3737830626090^3 + 1490220318001^3 + (-3815176160999)^3 = 2$.

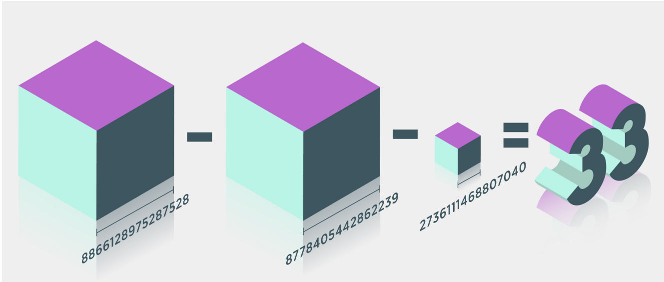
The real difficulty comes in finding numbers which cannot be expressed as the sum of three cubes. From modular arithmetic, we can quickly deduce that n cannot equal 4 or 5 modulo 9, because the cubes modulo 9 are 0, 1, and 1, and no three of these numbers can sum to 4 or 5 modulo 9. However, it is not known whether this condition is sufficient.

For small cases we have some results. The number 0 cannot be expressed as the sum of three cubes, other than the trivial case $a^3 + (-a)^3 + 0^3 = 0$, as such a solution would be a counterexample to Fermat's last theorem which was proven for all cases in 1995.

For representations of 1 and 2, there are families of solutions $(9b^4)^3 + (3b - 9b^4)^3 + (1 - 9b^3)^3 = 1$ and $(1+6c^3)^3 + (1-6c^3)^3 + (-6c^2)^3 = 2$. There exist other families of solutions for 1, and there three other known representations for 2, one of which was mentioned before. These are the only numbers whose solutions can be parameterised by quartic polynomials.

There are only 2 known representations of the number 3: $1^3 + 1^3 + 1^3 = 4^4 + 4^3 + (-5)^3 = 3$.

In 2009 and 2016 a computational search was conducted which found solutions to all $n < 100$ (not equal to 4 or 5 modulo 9) except for 33 and 42. An exciting result came in March this year, when Andrew Booker published a solution for 33 and the method he developed to find it. It turns out that $(8866128975287528)^3 + (-8778405442862239)^3 + (-2736111468807040)^3 = 33$.



Recent progress has found a solution for $n = 33$

For many mathematicians, the most exciting part about this discovery is the method. Booker managed to develop a search strategy with a running time proportional to $\min(|x|, |y|, |z|)$, rather than the maximum of these three like previous search methods. Booker is reportedly currently running his search for the number 42.

- Alex Schutz

Puzzle: Hitori

6	3	7	4	7	8	7	1
3	1	8	6	2	6	1	5
2	4	5	7	1	1	1	6
1	8	2	8	4	5	3	5
5	8	5	1	1	3	1	7
8	2	5	1	3	7	6	4
7	6	1	3	5	4	5	2
5	2	7	6	8	1	4	3

Shade the squares so that:

- No number appears in a row or column more than once.
- Shaded squares do not touch each other vertically or horizontally.
- When completed, all un-shaded squares create a single continuous area.

Historical Profile: Noether

Emmy Noether was the German daughter of a Jewish mathematician. After completing her dissertation in mathematics in 1907, she worked at the Mathematical Institute of Erlangen without pay for seven years. At the time, women were largely excluded from academic positions. In 1915, she was invited by David Hilbert and Felix Klein to join the mathematics department at the University of Göttingen. The philosophical faculty objected, however, and she spent four years lecturing under Hilbert's name. Her habilitation was finally approved in 1919. By the time of her plenary address at the 1932 International Congress of Mathematicians in Zürich, her algebraic acumen was recognized around the world. The following year, Germany's Nazi government dismissed Jews from university positions, and Noether moved to the United States. In 1935 she underwent surgery for an ovarian cyst and, despite signs of a recovery, died four days later at the age of 53.