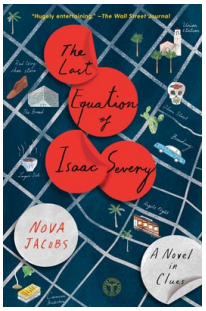
The last equation of Isaac Severy, *Nova Jacobs*, Simon & Schuster, 2018 (368 p.) isbn: 9781501175138.





Nova Jacobs

Here is one more novel, a thriller this time, in which mathematicians and mathematics plays an essential role. Isaac Severy is a mathematician, specialised in chaos theory at Caltech. He is officially working on an equation to describe the traffic in Los Angeles. He has however secretly worked out some "equation" that can predict place and precise time (date, hour, minute, and seconds) when some homicide or suicide will take place. This is a mathematical version of the TV series *Person of interest* that ran from 2011-2016. However in that series it is a computer (that has some personality) that collects and analyses all the data from cameras and mobile phones to predict where someone is in danger.



Here it is a less convincing equation that predicts it. Jacobs is wise enough not to go into a theory of nonlinear differential or difference equations but she stays at the surface about what the equation even vaguely looks like, except that it is very long and complicated. If such an equation fell into the hands of criminals or even the government, it would be dangerous since they would be able to perfectly predict the future. In fact Isaac has hired a secret hotel room where he left a computer and a map with dots indicating the place and time of the unnatural deaths predicted by his model. This includes his own death (presumably a totally unexpected and hence suspicious suicide). Isaac dies in the preface of the book and it is the MacGuffin of the whole novel. His granddaughter Hazel receives a letter from him in which she is asked to save the equation and give it only to a mysterious person she does not know and keep everything very secret. The letter has also a hint to the hidden hotel room 137 she has to unravel.

The actual novel feeds the reader with clues about where this equation is and what it is about (and about several other complications). And Hazel is not the only one who is looking for it. Here it requires to understand the rather complicated relation between the many (perhaps too many) weird characters, which is a bit difficult to remember at first.

<table>
<tr><td colspan="6">Isaac × Lily</td></tr>
<tr><td colspan="3">Philip × Jane</td><td>Paige</td><td colspan="2">Tom × Carla</td></tr>
<tr><td>Sybil × Jack</td><td>Silas</td><td>Sidney</td><td>Alex</td><td>Hazel</td><td>Gregory × Goldie</td></tr>
<tr><td colspan="2">Drew</td><td colspan="3"></td><td>Lewis</td></tr>
</table>

First there is Isaac (the grandfather). His wife Lily, a major in both comparative literature and mathematics, is now demented and stays in an institution. There are three children all geniuses. The oldest son Philip is also a professor at Caltech. He is a theoretical physicist specialized in string theory, but his scientific output is somewhat stagnating. As a youngster he has solved one of the lesser Hilbert's problems, but some other mathematician had it published a few weeks before him. Philip is married to Jane (a molecular biologist at Stanford and Harvard) and they have a daughter Sybil (an artist and a parasomniac) besides a twin Silas and Sidney who are tennis champions. Sybil is married to Jack and they also have a daughter Drew (still a preschooler) that is some kind of an autistic savant.

Isaac has also a daughter Paige who is a brilliant statistician (working on a book for decades and that she will probably never finish). She is very much on her own and assumed to suffer from

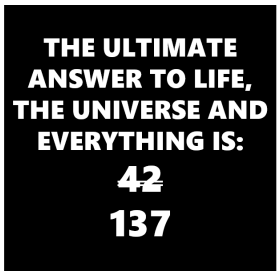
alexithymia (the inability to identify and describe emotions in her self). She has never married, but she has a son Alex (what's in a name), Alex also is a prodigy who won a fellowship for the Max Planck institute in Bonn, but after a car accident dropped out and stayed in Europe working as a freelance photographer.

Tom, Isaac's youngest son, married to Carla. Like Philip he suffers from migraine, but he takes his resort to street drugs. Both Tom and Carla are junkies. Nevertheless, they adopted two orphans: Hazel and her brother Gregory (an obvious reference to Hansel and Gretel). Hazel has a book store and Gregory is a police officer at LAPD. Tom and Carla neglect and even maltreat the children and when Carla dies and Tom is arrested, Hazel and Gregory were adopted by Isaac and Tom becomes a persona non grata of the family. Hazel recovers rather well as an adult, but Gregory keeps an aggressive killer's instinct, and there are some other family members that have hidden darker sides. It takes a while before all these family ties and all their psychology becomes clear to the reader. The chapters are told from the viewpoints of Hazel, Gregory and Philip.

The whole clan flocks together for the funeral of Isaac. In Isaac's cryptic letter to Hazel it is also predicted that three will die and he is the first. Indeed two others of this family will die (of course not the ones that the reader expects). Eventually several people find out about this equation, which turns out to be a fake because it contains an error and it will be Hazel (the only one that is not a genial scientist) that will find the correct formula and it is suggested that she eventually will be converted to a mathematician. There are some additional characters that are not family members, and some of them are also after the equation. The most important is Nellie Stone (representing her virtual boss P. Booth Lyons), from a company that operates as a matchmaker between science and government. Of course there are also some illegitimate love affairs: Philip with a bright Ukrainian PhD student Anitka Durov, and Gregory with Sybil.

I do not want to include spoilers by disclosing the whodunits or who dies how and where. The nice thing about the book is not only that many of these characters are mathematical geniuses but also that there are many references to issues from mathematics and physics. Let me give a few examples.

The logo of the organization of Booth Lyons is a Fibonacci spiral, which is described as a brain-like doodle. Haze overhears a heated discussion about Riemann's zeta function and the sense or nonsense of mathematical abstraction. Except for Newton's *Principia Mathematica*, the books that Hazel fetches from Isaac's library seem all to be fictional and so are of course also the lectures about branes and M-theory that Philip is preparing. Isaac explains to Hazel and Gregory when they were still young the principles of chaos theory by telling that one may predict the next random drip from a leaky kitchen faucet but that the slightest perturbation may change the outcome completely. Of course Lorentz's butterfly effect is also mentioned elsewhere.





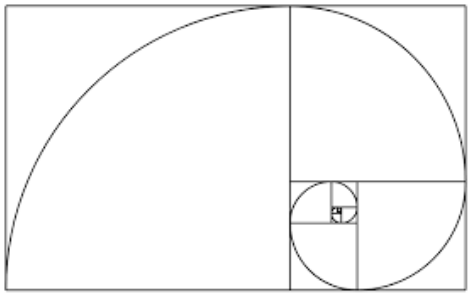
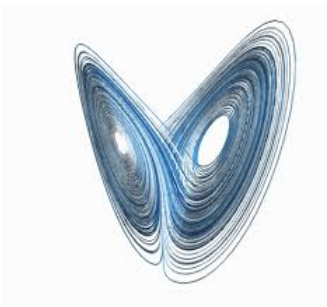
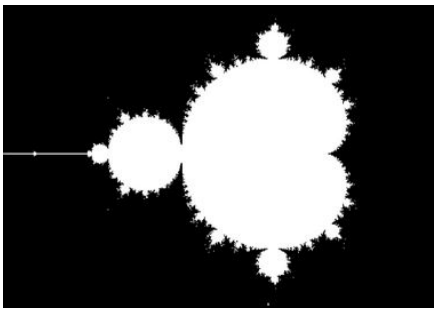
The last, yet to be discovered element with atomic number 137.



$1729 = 1^3 + 12^3 = 9^3 + 10^3$

Many physicists and mathematicians are mentioned and discussed in different contexts: Oppenheimer, Einstein, Schrödinger, Heisenberg, Turing, and Weyl, even their assumed love life. John Britton however, a monster mind from Princeton, is fictional. Philip for example hopes his picture will once be between two other very real Nobel Prize winners from Caltech: Richard Feynman and Marray Gell-Mann. Hazel's initials H.S. are not mistaken by Alex for Horst Störmer, another Nobel Prize winner.

The number 137 is not only prime but it also plays an important

role in physics (and also in the novel). Wolfgang Pauli was obsessed by it and he died in a hospital room with that number. It is strange that Anitka claims that the search for the "God particle" has failed to produce measurable experimental results. However the Higgs-Englert particle was detected in 2012. This can not be explained by the time frame of the novel which plays at the end of 2015. Isaac for example died at 101715055531, which is 17 October 2015 at 5:55:31 AM.


PIERRE DE FERMAT

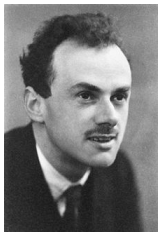
Fermat Numbers

$$F_n = 2^{2^n} + 1$$

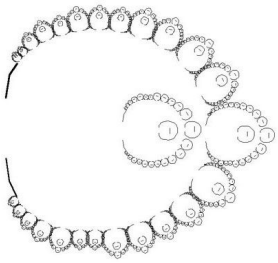
Fermat Primes

$$F_0 = 2^{2^0} + 1 = 3$$
$$F_1 = 2^{2^1} + 1 = 5$$
$$F_2 = 2^{2^2} + 1 = 17$$
$$F_3 = 2^{2^3} + 1 = 257$$
$$F_4 = 2^{2^4} + 1 = 65537$$

When looking for a password, Axel tries many mathematical constants (Euler's constant, Planck's constant, e, the golden ratio, Ramanujan's number (1729), Mersenne primes, the largest known prime ($2^{57885161} - 1$, although a larger one $2^{82589933} - 1$ was found in 2018)). The number π is not among them, probably considered to be too obvious as a password. Someone falls down a stair with 257 steps, which is identified as a Fermat prime but Philip refers to the numerology of searching a number with some meaning after every event as blatant nonsense. Drew (as a preschooler) can recite all the first 100 prime numbers. There is a poem that is often attributed to Paul Dirac that he wrote in his twenties:



Age is of course a fever chill
That every physicist must fear
He is better dead than living still
When past his thirtieth year


Fractal nature of an African village

There is a discussion about fractals and about the self-similarity in the fractal shapes of African villages when Nellie serves Philip a cappuccino in which the foam is representing a Mandelbrot set.

Jacobs plays an interesting shell game with her readers, setting them on the wrong tracks and delivering clues bit by bit. This is culminating in thrilling events when, after the interpretation of the numbers on the map has become clear to some of the characters, the readers witness how the tension is whipped up as the fatal moment is approaching. But there is an happy ending. The good guys turn out to be not so good but the bad ones are not so bad after all, while the survivors live happily ever after. The reader however is left uninformed about the true nature of Isaac Severy's last equation, which will not be a surprise if it is a mathematician. Adhemar Bultheel