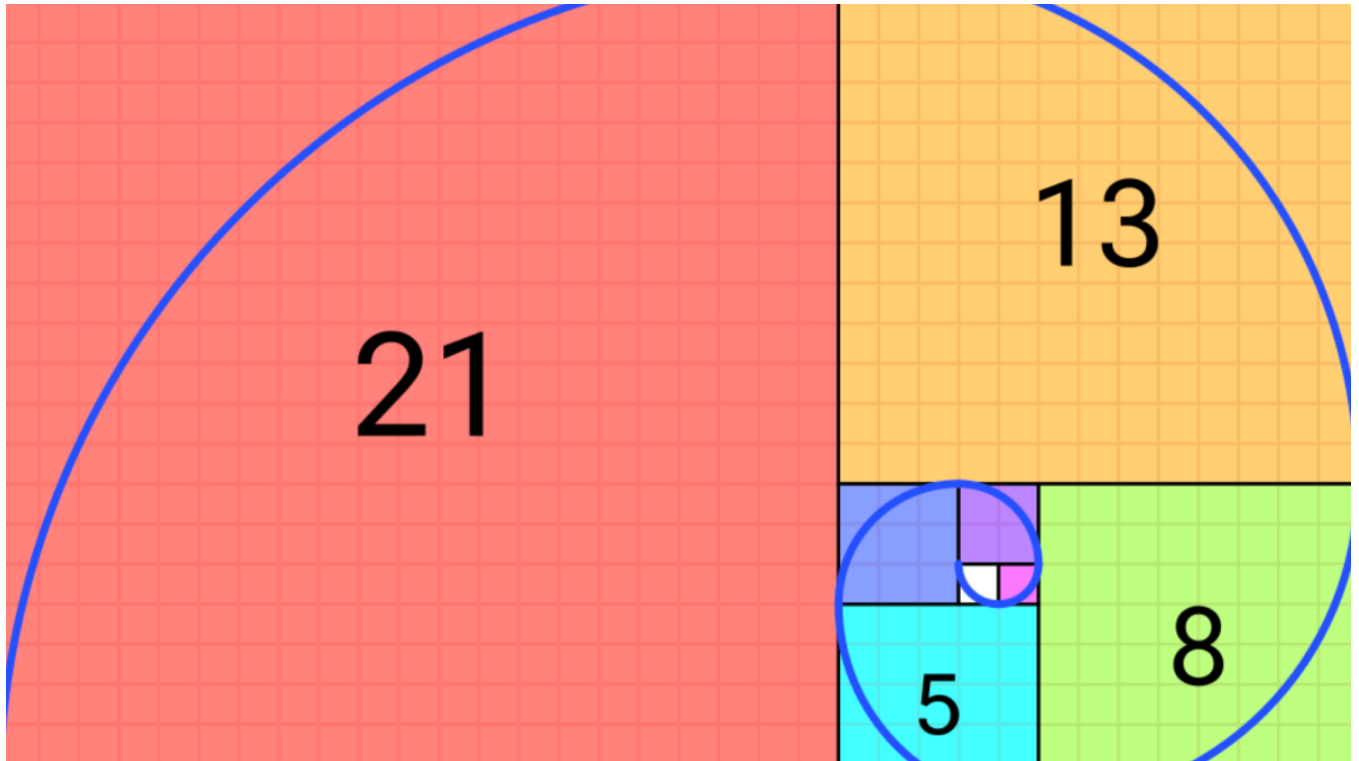


Four Interesting Types of Mathematical Numbers

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Some of the special numbers of the Fibonacci sequence represented in spiral form

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Unique Numbers

At school, we all become familiar with certain types of numbers. We are taught about square numbers (1, 4, 9, 16, 25, etc.) and even cube numbers (1, 8, 27, 64, 125, etc.). We learn about the primes (numbers with exactly two factors: 1 and themselves) and even triangular numbers (1, $1 + 2 = 3$, $1 + 2 + 3 = 6$, etc.).

But these aren't the only types of special numbers. There are numbers out there with some remarkable properties and often very imaginative names. They may not be important in our day-to-day lives, but they are beautiful and worth looking at for this reason alone.

Four Special Types of Numbers

1. Fibonacci Numbers
2. Perfect Numbers
3. Vampire Numbers
4. Narcissistic Numbers

1. Fibonacci Numbers

Introduced by the Italian mathematician Leonardo of Pisa (also known as Fibonacci), this sequence of numbers is actually based on the population levels of immortal breeding rabbits.

The list is constructed in a very simple way. We start with two 1s. We add these together to get the next number, $1 + 1 = 2$. We then add this 2 to the 1 that came before it to get 3 and so on, each time adding the last two numbers created to get the next one.

This gives us the list of [Fibonacci numbers](#):

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, etc.

The remarkable thing about this sequence is just how often it [appears in the world around us](#).

If you count the number of petals on a flower or even the number of spirals on a pineapple, you

will generally find the total to be a Fibonacci number. Four-leaf clovers are so rare because clovers usually have three leaves, and as you can see, 3 is in the sequence.

Even more remarkable than this, if you divide one number in the sequence by its predecessor, e.g., $8 \div 5 = 1.6$, $89 \div 55 = 1.618\dots$, you will find that the further you get through the sequence, the closer the answer gets to $1.618033\dots$, a number known as the Golden Ratio.

The Golden Ratio is special because things that are constructed or drawn in the ratio $1:1.618\dots$, whether it be a painting, a building or even a person's face, are generally considered extremely aesthetically pleasing.

2. Perfect Numbers

A perfect number is a positive integer that is equal to the sum of its factors (not including itself). So, for example, the factors of 4 are 1, 2 and 4 (these are the numbers that divide exactly into 4), so if we add these together, not including 4 itself, we get $1 + 2 = 3$; hence, 4 is not a perfect number.

In fact, the smallest perfect number is 6. Its factors are 1, 2, 3 and 6. The sum of these is $1 + 2 + 3 = 6$; hence, 6 is perfect.

We don't find another perfect number until we get to 28. Its factors are 1, 2, 4, 7, 14 and 28. $1 + 2 + 4 + 7 + 14 = 28$.

Perfect numbers are quite rare. We don't get another one until 496 and then 8128. The fifth one is an incredibly large 33 550 336 (that's more than 33 and a half million).

Mathematicians using supercomputers have found some staggeringly large perfect numbers (the largest so far has almost 50 million digits); however, it is not known if there are an infinite number of them and it is also unknown whether any odd ones exist; every perfect number found so far has been even.

3. Vampire Numbers

This is almost certainly one you didn't learn about at school.

A number is known as a vampire number if you can take its digits, rearrange them into two new numbers with the same number of digits as each other, and then multiply them together to get back to the original number.

For example, look at 1260. These four digits can be rearranged into two 2-digit numbers 21 and 60 which, if multiplied together, give an answer of 1260. That makes 1260 a vampire number with 21 and 60 being its fangs.

The next number in the list is $1395 = 15 \times 93$.

There are bigger vampire numbers and sometimes numbers that can have multiple pairs of fangs. Consider 125 460.

$125\,460 = 204 \times 615$ or 246×510 .

By tweaking the definition a bit we can get similar numbers such as:

- **Pseudovampire numbers:** The fangs are different sizes e.g. $1\,206 = 6 \times 201$
- **Prime vampire numbers:** A vampire number whose fangs are its prime factors e.g. $117\,067 = 167 \times 701$.

- **Double vampire numbers:** A vampire number whose fangs are also vampire numbers
e.g. $1\ 047\ 527\ 295\ 416\ 280 = 25\ 198\ 740 \times 41\ 570\ 622 = (2\ 940 \times 8\ 571) \times (5\ 601 \times 7\ 422)$

4. Narcissistic Numbers

A narcissistic number (named after the Narcissus of Greek myth, a handsome hunter who fell in love with his own reflection) is one such that if you take each digit of the number, raise them separately to the power of how many digits there are and then add these together, you return to your original number.

E.g. Take 153. This has three digits so we raise each of these to the power of three and add them together. $1^3 + 5^3 + 3^3 = 153$.

A bigger example would be 9474 with its four digits. $9^4 + 4^4 + 7^4 + 4^4 = 9474$.

There are only 88 narcissistic numbers ranging from the smallest, 0, up to the largest, 115 132 219 018 763 992 565 095 597 973 971 522 401 which has 39 digits.

Just like with the vampire numbers, there are some interesting twists on the narcissistic numbers:

- **Dudeney numbers:** Add the digits together before raising to the power of three e.g. $5832 = (5 + 8 + 3 + 2)^3$.
- **Munchausen number:** Raise each digit to the power of itself and then add together e.g. $3435 = 3^3 + 4^4 + 3^3 + 5^5$. The only other Munchausen number is 1.
- **Ascending power number:** Increase the power raised to by one for each digit and then add together e.g. $2646798 = 2^1 + 6^2 + 4^3 + 6^4 + 7^5 + 9^6 + 8^7$.