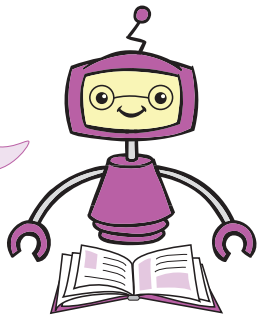
MODULE 15: WORK SHEET 1

Fibonacci numbers

Did you know that the code for my brain, like the brain of any computer, is made up of a series of 0s and 1s? I just love mathematics!

Let's find out more about mathematical patterns ...



LINKS TO:
Stage 3, Module 15
Learning Object 2: *Giving speeches*

PRIOR LEARNING:

Stage 2
Module 2 Work Sheet 7: *Zak and the mystery of the message*

1 Leonardo of Pisa

In this work sheet, you are going to read an article about a mathematics problem. First, let's find out about the fellow who gave his name to this mathematical problem!

Leonardo of Pisa was an Italian mathematician who lived in Pisa during the Middle Ages (from about 1170 AD to 1250 AD). Leonardo's father was a merchant who operated a trading post in North Africa, east of Algiers. When Leonardo was a young boy he travelled with his father.

It was during these travels that Leonardo learned about Hindu–Arabic numerals. (At the time, European mathematicians still used Roman numerals for all of their work!)

As a young man, Leonardo travelled throughout the Mediterranean. He studied with many of the leading Arabian mathematicians of the time before finally returning to Pisa in 1200 AD.

Two years after his return, he published a book called *Liber Abaci*. The *Liber Abaci* explains the use of what Leonardo called the method of the Indians, but which you know today as Arabic numerals:

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 ...

I wonder if you can even begin to imagine the difference this made! Can you imagine what it would be like if you were still doing all your mathematics in Roman numerals? The mathematical notation system that a culture uses has an enormous impact on the speed and efficiency with which they can do calculations, as well as the complexity of the calculations they can do.

The rabbit problem

Leonardo also had a problem that he solved with rabbits. Or, to put it another way, he proposed and then solved a mathematical problem using the metaphor of rabbits.

The series of numbers that Leonardo came up with is very popular. These days, these numbers are called the Fibonacci sequence, or the Fibonacci numbers, because Leonardo of Pisa was also known as Leonardo Fibonacci.

Leonardo was not the first person to study this sequence of numbers, but he was the first person to introduce the sequence to European mathematicians.

Leonardo probably first learned about Fibonacci numbers during his travels and study in the Arabian world.

Fibonacci numbers were used as early as 200 BC in Indian mathematics, but in a surprising context. They were used to describe and explain Sanskrit prosody; that is, the pattern for combining short and long syllables in Sanskrit poetry.

(continued on following page)

(continued from previous page)

The following text is a simple explanation of the Fibonacci sequence from Wanda Papa's mathematics blog.

Read the text, using all the reading strategies you have already learned in Stages 1, 2 and 3 and then answer the questions that follow.

29 Juni 2012

Lihat aku menarik kelinci keluar dari topi!

Leonardo dari Pisa menciptakan serangkaian angka yang kita sebut deret Fibonacci dalam bukunya yang berjudul *Liber Abaci*, yang diterbitkannya pada tahun 1202.

Berapa banyak kelinci, dia bertanya-tanya, yang akan muncul bila kelinci dikembangbiakkan dengan teliti menggunakan perhitungan matematika?

Mulai dengan satu kelinci. Kemudian tambahkan satu kelinci lagi. Jumlahnya dua kelinci.

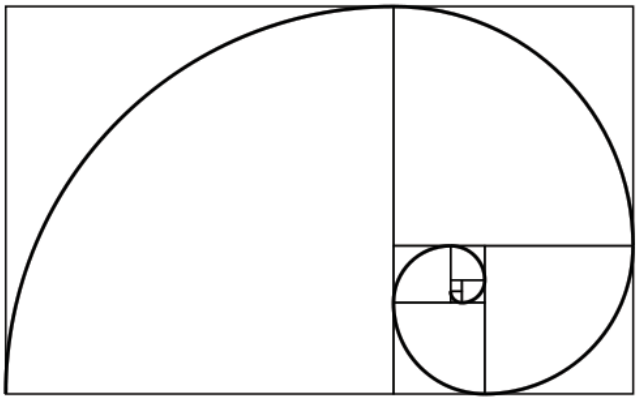
Kemudian, dan di sinilah semuanya mulai menjadi menarik, tambahkan dua angka terakhir: yaitu 1 + 2 = 3 kelinci.

Terus lakukan itu, dengan mengulangi polanya:

2 + 3 = 5 (dua kelinci ditambah tiga kelinci menghasilkan lima kelinci),
3 + 5 = 8,
5 + 8 = 13,
8 + 13 = 21,
13 + 21 = 34.

Deret Fibonacci ini cukup ajaib. Mereka berhubungan dengan cukup erat dengan serangkaian angka lainnya yang juga luar biasa yang disebut 'rasio emas'. Angka-angka ini digunakan di dalam beberapa algoritma komputer, dan muncul pada alam seperti pada kerang, daun pakis, pola-pola cabang pohon dan bunga artichoke!

Coba lihat diagram di samping ini, yang menunjukkan deret Fibonacci kalau diungkapkan sebagai sebuah spiral. Spiral ini terbentuk kalau serangkaian seperempat lingkaran, yang jari-jarinya merupakan sebuah bilangan bulat yang termasuk dalam deret Fibonacci, dihubungkan satu dengan lainnya.



Leonardo juga menulis mengenai masalah-masalah matematika lainnya, termasuk Mersenne Primes, bilangan prima Mersenne, dan teorema Chinese remainder.

Diposting oleh WANDA PAPA
jam 13:23 9 komentar

Exercises

Exercise 1

Reading comprehension

First, let's have a look at how well you understood the text.

1.1 What are the main ideas in the text? Summarise, in English, the main ideas from each paragraph.

Paragraph 1

Paragraph 2

Paragraph 3

Paragraph 4

Paragraph 5

Paragraph 6

Paragraph 7

(continued on following page)

(continued from previous page)

Paragraph 8

1.2 Were there particular words or phrases you found difficult to understand? What strategies did you use to understand these words or phrases, or to understand the text as a whole despite not being sure what some words meant?

(continued on following page)

(continued from previous page)

1.3 What natural objects reflect the Fibonacci sequence?

1.4 Calculate the next four Fibonacci numbers after 34.

1.5 What other mathematical problems did Leonardo of Pisa write about?

Exercise 2

The following text is a second post on Wanda Papa's mathematics blog, this time about Mersenne Primes.

Read the text, using all the reading strategies you have already learnt in Stages 1, 2 and 3 and then answer the questions that follow.

5 Juli 2012

Bilangan prima baru yang luar biasa!

Dalam posting saya yang terakhir, saya memperkenalkan Anda pada pengertian dasar deret Fibonacci. Fibonacci adalah salah satu matematikawan favorit saya, bersama dengan Goldbach dan Euler.

Goldbach dan Euler — dua dari antara matematikawan terhebat yang pernah ada — hidup dalam satu zaman dan merupakan teman pena. Mereka pertama kali bertemu ketika bersama-sama

(continued on following page)

(continued from previous page)

belajar di Akademi St. Petersburg. Sebenarnya, bukti-bukti paling awal yang kita miliki mengenai spekulasi Goldbach berkenaan dengan dugaan Goldbach atau 'Goldbach conjecture' yang masih belum terpecahkan itu, didapat dari surat-surat yang ditulis keduanya kepada satu sama lain pada tahun 1742.

Dugaan Goldbach masih tetap merupakan salah satu misteri matematika yang belum terpecahkan, dan dinyatakan dengan cara cukup sederhana: apakah setiap bilangan genap yang lebih besar dari 2 merupakan jumlah dari dua bilangan prima?

Salah satu dari banyak hal yang membuat Leonhard Euler terkenal adalah penemuannya akan apa yang pada waktu itu dianggap Bilangan Prima Mersenne atau 'Mersenne Prime' terbesar: $2^{31} - 1$, yaitu 2.147.483.647. Ini merupakan Bilangan Prima Marsenne terbesar yang diketahui sampai hampir satu abad kemudian.

[Untuk mereka yang sudah lupa posting saya mengenai Bilangan Prima Marsenne, sebuah M_p adalah sebuah bilangan positif yang merupakan hasil bilangan kuadrat dikurangi satu. Atau bisa ditulis seperti ini $M_p = 2^p - 1$]

Bilangan Prima Mersenne dipergunakan dalam berbagai cara yang menarik dalam dunia kontemporer, yang paling terkenal adalah dalam pembentukan sandi rahasia militer. Salah satu alasan mengapa Bilangan Prima Mersenne sangat berguna kalau dipakai sebagai kode adalah karena kita masih belum tahu semuanya. Pada kenyataannya, mungkin saja Bilangan Prima Mersenne ini tidak terhingga angkanya.

Dan ini yang paling asyik: Anda bisa memberikan sumbangan pada pemcarian yang masih terus berlangsung ini dengan bergabung dengan *GIMPS* (Great Internet Mersenne Prime Search) yang diprakarsai oleh George Woltman. Anda mungkin tidak akan menjadi terkenal dan berpengaruh seperti Euler, tapi Anda mungkin bisa menjadi sama terkenalnya dengan Joel Armengaud, seorang Perancis yang menemukan sebuah Bilangan Prima Mersenne baru pada tahun 1996 yang panjangnya 420.921 digit! Itu hampir sepanjang buku *War and Peace!*

Bilangan Prima Mersenne yang baru adalah: $2^{1.398.269} - 1$.

Diposting oleh WANDA PAPA
Jam 16:15 19 komentar

First, let's have a look at how well you understood the text.

2.1 What are the main ideas in the text? Summarise, in English, the main ideas from each paragraph.

Paragraph 1 _____

_____

Paragraph 2 _____

_____

_____

(continued on following page)

(continued from previous page)

Paragraph 3

Paragraph 4

Paragraph 5

Paragraph 6

Paragraphs 7 & 8

2.2 Were there particular words or phrases you found difficult to understand? What strategies did you use to understand these words or phrases, or to understand the text as a whole despite not being sure what some words meant?

(continued on following page)

(continued from previous page)

2.3 What other unsolved scientific, mathematical, medical or intellectual problems are you aware of? Describe at least one that you know something about. What strategies are researchers using to attempt to 'solve' the problem you identified?

(continued on following page)

(continued from previous page)

Exercise 3

Ethical and creative thinking

It is time to use some of your creative-thinking and critical-thinking skills. Don't worry, it will not hurt a bit!

3.1 In this work sheet, you learnt that Leonardo of Pisa studied with mathematicians from the Arabic world, and that the sequence he is most famous for, the Fibonacci sequence, is probably something he learnt during his travels. This is clearly reflected in his naming of the sequence, which he called the method of the Indians.

What rights and responsibilities do you think we have in terms of bringing knowledge from one culture or country to another? (In other words, what are some of the ethical problems we face when dealing with intercultural knowledge.)

Hint! You might find it helpful to think about some of the following questions:

- Can knowledge belong to a particular person or place?
- If one culture doesn't want to share a particular aspect of their knowledge, should they be obligated to?
- How can you acknowledge the source of your understanding?
- What if you create new technology or knowledge using an idea from another culture?

(continued on following page)

(continued from previous page)

(continued on following page)

(continued from previous page)

3.2 In this work sheet, you learnt that Fibonacci numbers may have first been expressed by Indian writers who were describing the patterns of Sanskrit poetry. This creative-thinking exercise invites you to use Fibonacci numbers to write your own poem, in Indonesian.

Write a six-line Fibonacci poem, in which the number of words in each line is determined by the Fibonacci sequence. That is, the first line should have 1 word, the second line 2, then 3, 5, 8 and 13.

Write your poem in Indonesian.