MathsJAmbulation

Oceania MathsJam Gathering 2021

"Walking is also an ambulation of the mind" – Gretel Ehrlich

BATTY BAT POLITICS (OR, THE BAT-HOLE PROBLEMS)

Did you know? Talbot forest is home to pekapeka, the NZ native long-tailed bat, and it's one of the only places in the eastern South Island you can see them. Look out for roosting trees marked by DOC.

•Show that in any group of n bats, there are two bats who have an identical number of friends within the group.

•There are 51 bats in a forest, all looking for a roosting tree to sleep in. Each bat secretly hates exactly three other bats in the group (hate is not necessarily mutual, so if bat A hates bat B, bat B might not hate bat A.) Find the smallest number of roosting trees required so that no bat is forced to share a roosting tree with a bat that it hates.
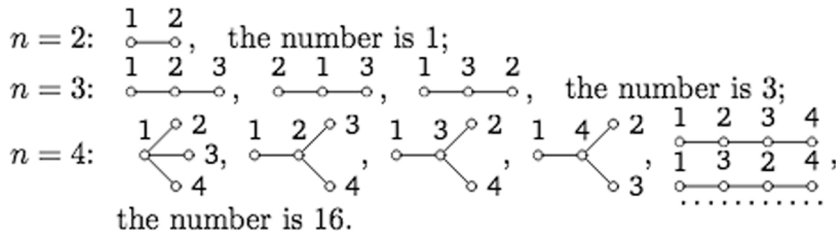
A RANDOM WALK AND A RANDOM BAT

Having indulged in a little too much sugar at the OMG Bakeoff, Tom decides to take a rather random walk through Talbot Forest. Every step he takes has equal (1/4) probability of going either North, East, South or West. What's the chance that Tom will eventually return to his orignal starting point?

A very confused bat tries Tom's method too. As well as going N, E, S & W, it also moves up and down in the air, each direction randomly with probability 1/6. What's its chance of returning to its starting point?

Figure 1.24: Examples of plant-like structures generated by bracketed OL-systems. L-systems (a), (b) and (c) are edge-rewriting, while (d), (e) and (f) are node-rewriting.

BOOK RECOMMENDATION:

The Algorithmic Beauty of Plants by Aristid Lindenmayer explores L-systems and how they generate the above fractal figures.

A DIFFERENT SORT OF TREE

Join n points $1, 2, \ldots, n$ by intervals ($n-1$ of them) to obtain a tree. How many different trees may be obtained (the $n = 5$ case is already interesting!)?
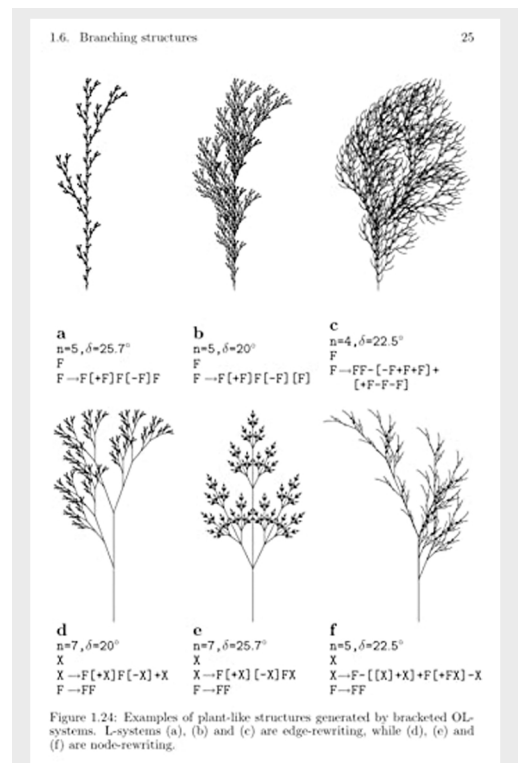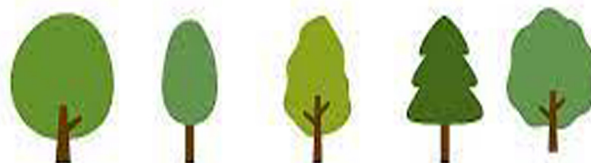
ESCAPE THE FOREST!

Originally posed by CheltenhamMathsJam

You are in a forest that covers a half plane. You know that you are within 2 kilometres of the border of the forest, but you don't know in which direction it is in. Design a route that will guarantee to emerge after walking no more than 13 kilometres.

TREES IN A LINE

A problem inspired by Crux Mathematicorum, September 2008

Five trees stand along the length of a section of straight path. Rata measured the distance between each pair of trees on the pathway. Here are her findings (in metres), listed from smallest to largest:

2, 4, 5, 7, 8, d, 13, 15, 17, 19

What is the distance d?

THE SQUARE ROOT OF TREE

How would you find the square root of tree without a calculator? photo: reddit

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THE LONG LOOP ROUND

With Apologies to V I Arnold and Peter Winkler.

Two MathsJammers walk along the same long loop track in opposite directions. They leave at the same time, and met again at noon, but don't stop to chat. Instead, each of them carry on walking with the same speed. The first MathsJammer finishes the loop track and exits at 4 p.m., and the second MathsJammer completes their loop at 9 p.m. What time did they start walking?

Six of the other MathsJammers, including you, prudently select a much shorter loop for their MathsjAmbulation. You each enter this loop track at a random point, planning to travel either clockwise or counterclockwise with equal probability. At exactly 3pm, all six of you start walking at the same speed. Unfortunately, the path is very narrow so whenever you (or any of the others) encounter another MathsJammer, you can't pass. Instead you both instantaneously turn around and start walking back the way you've come.
If the loop would take a single MathsJammer 30 minutes to complete, what is the chance that you will be in exactly the same place as when you started at exactly 4pm?

HOW MANY BOTTLES?

Every now and then on a walking trip, someone might pipe up with a singalong of the classic "100 bottles of beer on the wall" (We'll *refrain* from putting it in MathsJam Jam...)
For those unfamiliar, the round goes as follows:

100 bottles of beer on the wall,
100 bottles of beer.
Take one down, pass it around,
99 bottles of beer on the wall.

The refrain then repeats, starting with 99 bottles reducing to 98 & so on. The song finally ends when there are no bottles left.
If you were to sum every number mentioned in the song, every time it came up, what would be the total number of bottles?
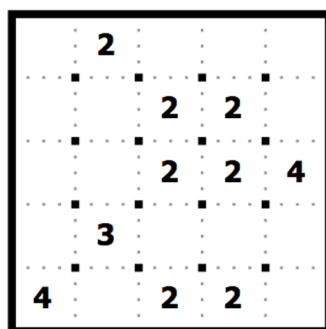
TRIG STATIONS

A triangulation station, also known as a trigonometrical point, or "trig," is a fixed surveying station, used in geodetic surveying. If you often walk to them on sunny days you might get a tan.
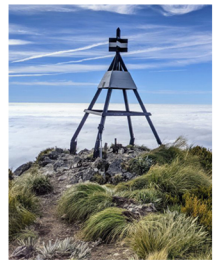
Two hills, one 300m high and one 400m high, are half a kilometre apart. A surveyor, at a point on the flat somewhere between the two hills, calculates that she is exactly the same distance as-the-crow-flies from the both trig stations that sit on the respective summits of each hill. Where is she between the hills?

SHIKAKU IN NUMBER-FOREST

Puzzles from https://www.puzzle-shikaku.com/

Here in number forest, each number-bird wants to claim a rectangular territory exactly the same size as the number-bird itself. So a number "3" bird should have a rectangle composed of three cells of the number forest, while a number "6" bird would have a rectangle six cells in size. The number-birds refuse to share any part of their territory, or have more than four sides to their territory.

*Can you divide up these 5x5 and 10x10 number forests into boxes so all number-birds are happy?*