DIGITAL SCHOOLHOUSE
together with
NINTENDO SWITCH

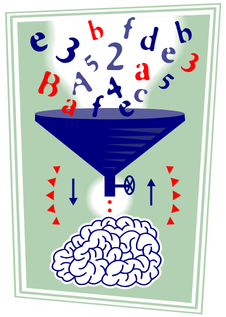
Beautiful Numbers.

Mathematical Art

Digital Schoolhouse, 18a Blackbull Yard, 24-28 Hatton Wall, London EC1N 8JH.

ukie PlayStation SEGA Warwickshire County Council UBISOFT

I have a Super Brain!



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2 volunteers to challenge me!

1 volunteer to write up 2 numbers (less than 30) on the board

Another volunteer to begin doing the maths!

How did I do it?

CAN YOU GUESS? WHAT WAS MY SECRET?

I don't really have a super brain...I just did some clever maths....

Adding the first and second numbers to get the third number in the sequence then adding the second and third numbers to get the fourth number, and so on creates a Fibonacci sequence.

Let's look at the trick. Well the sum of all ten numbers every time is just eleven times the fourth number from the bottom, and multiplying by 11 is easy even without a calculator - you *just multiply by 10 and add the number back again!*

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So, a little more about Fibonacci and Beauty!

Can numbers be beautiful?

Did you ever think a number could be beautiful?

How do these grab you?

3.1416

6.238673?

1.61803399?

Does any of them catch your eye?... They should do!

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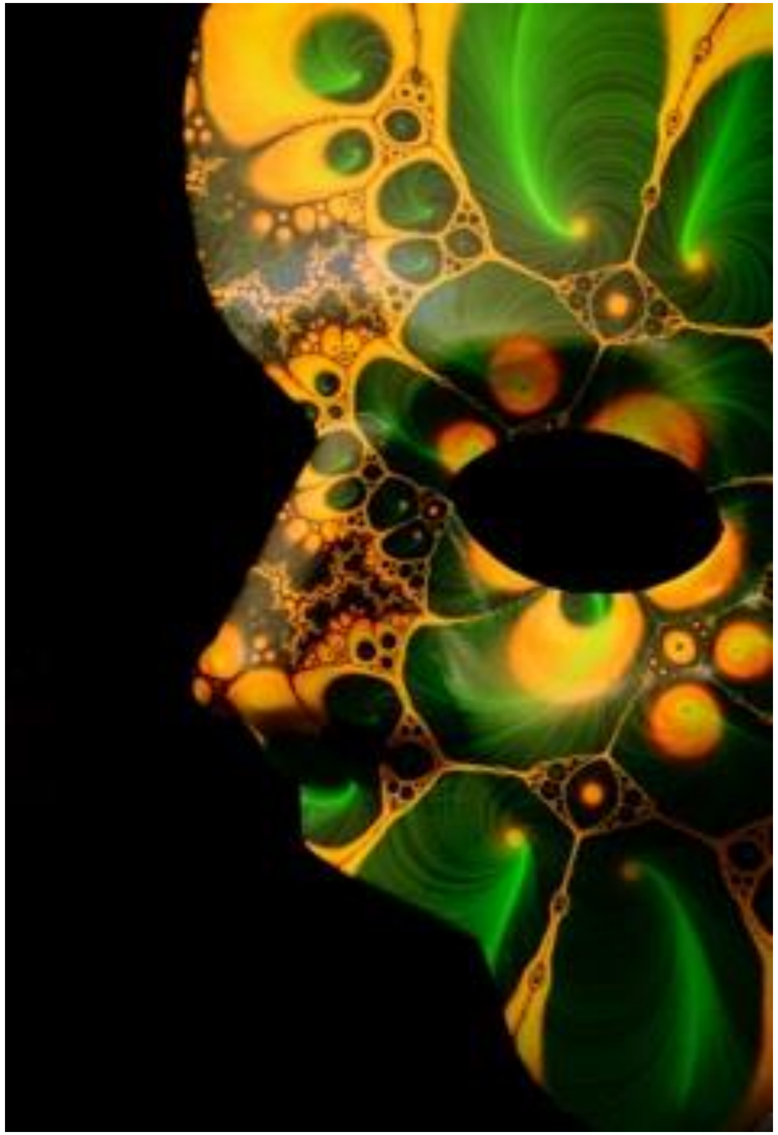
Golden Ratio.

1.61803399 is responsible for some of the most beautiful things in the world around us.

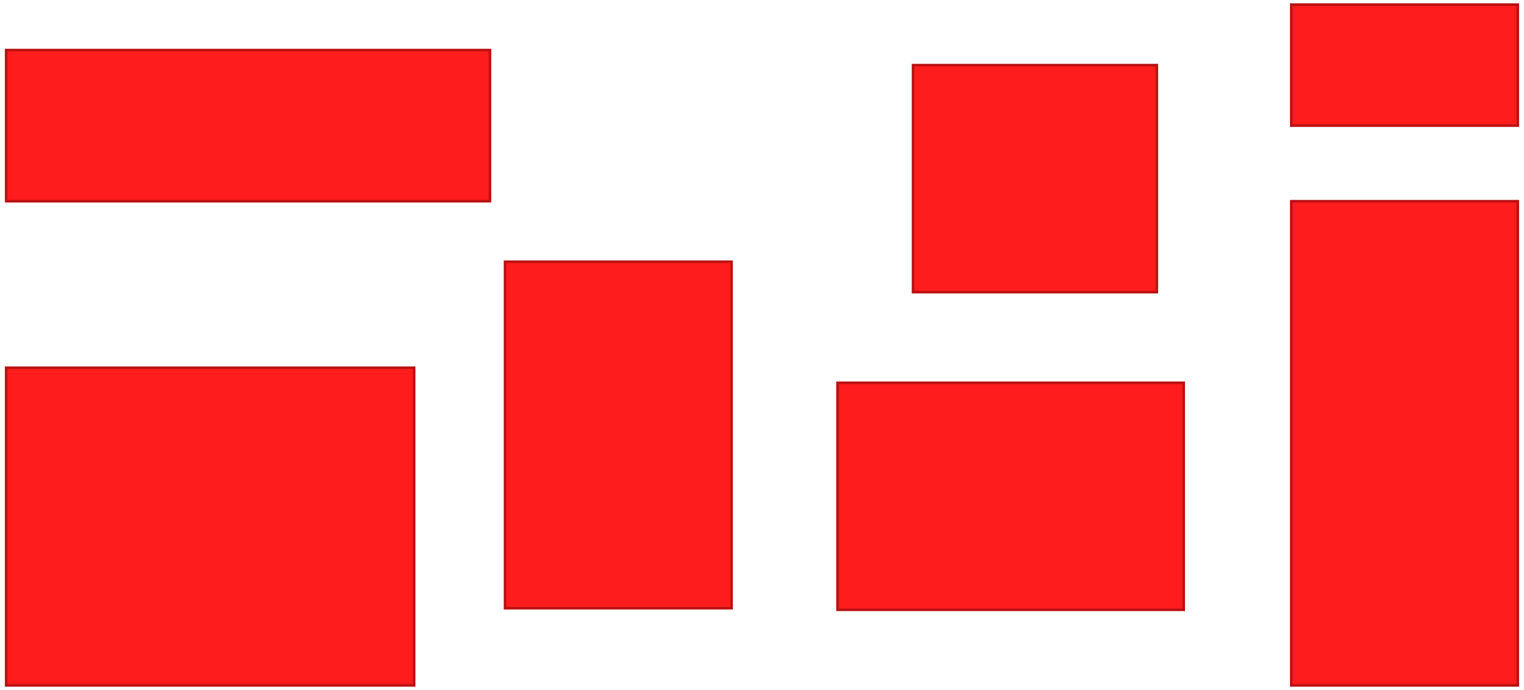
It's called the Golden Ratio and it has been used for centuries in art and architecture.

So what's so special about this number?



An Example.

Which of these shape looks the best proportioned i.e. where the width and height look just right and easy on the eye.



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Where will I see this?

You may find that you've picked the rectangle where the length and width are in the golden ratio. That is, if you divide the length by the width the answer is close to 1.61803399.

Length divided by height = 1.618

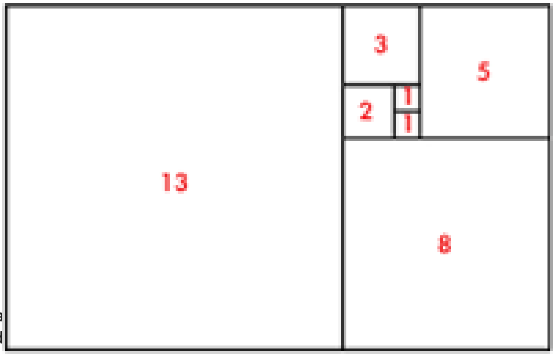
Why is this special...?

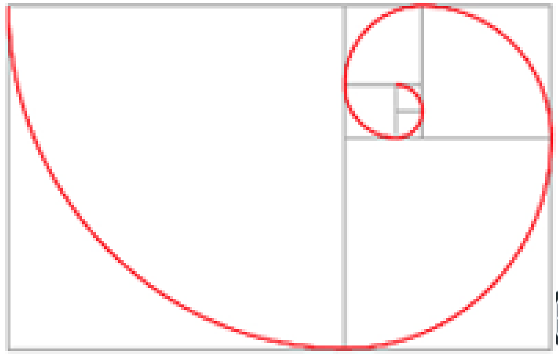
The Fibonacci sequence is a series of numbers which appear throughout nature. This sequence can be used to calculate the *golden mean* (or the *golden section*) which is represented by the Greek letter Phi.

The Fibonacci sequence and Phi can be found visually in plants and seashells, and in the reproductive family trees of animals.

Phi, also known as the golden mean, is the ratio between two sequential numbers in the Fibonacci sequence.

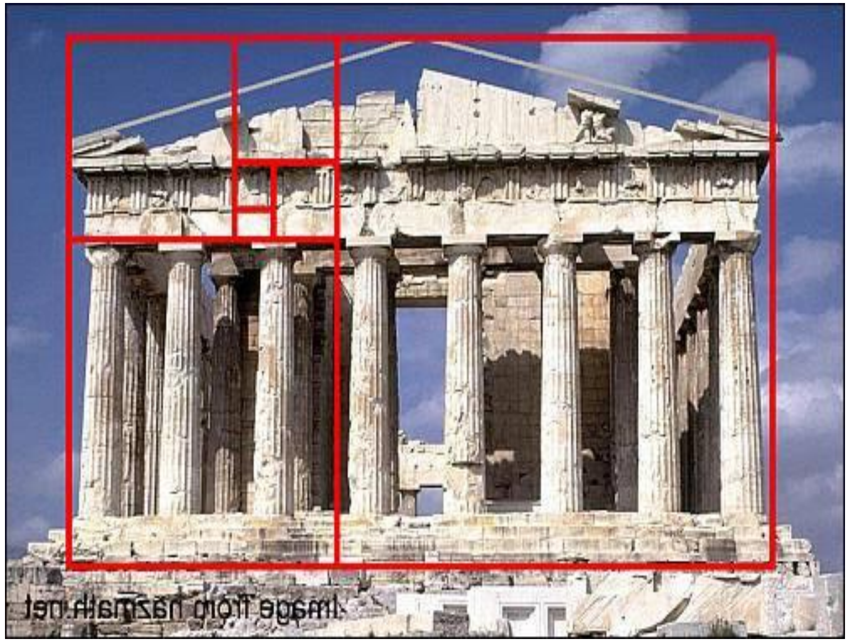
When 1597 is divided by 987 the result is 1.618034447821682, which rounds to 1.618. The higher the numbers used to create the ratio, the more exact the calculation becomes.

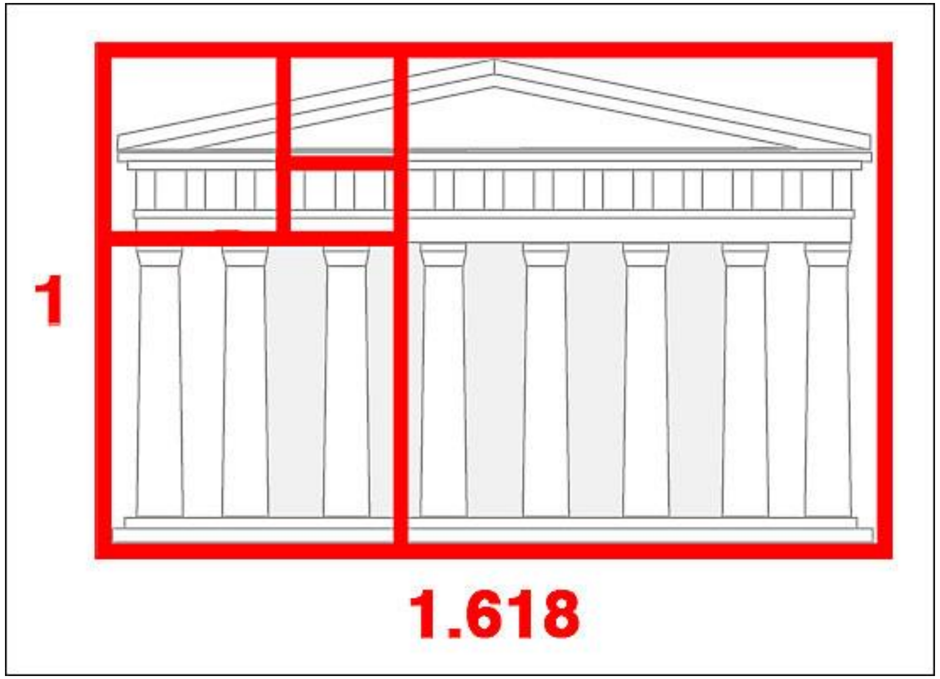




Coincidence…? In architecture!

The Parthenon in Greece also has the Golden Ratio built into its shape

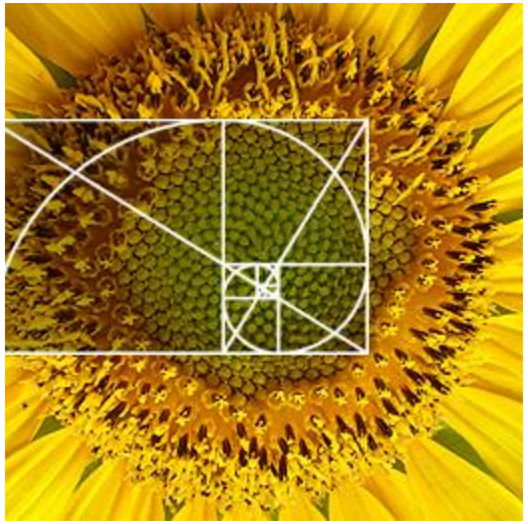




Coincidence...? In nature!

A fibonacci spiral is duplicated, rotated around the centre, and the circular pattern is mirrored.

When we assemble the results form the pattern seen in sun flowers.



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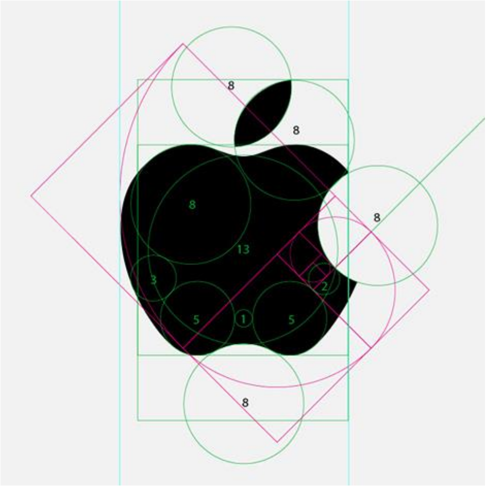
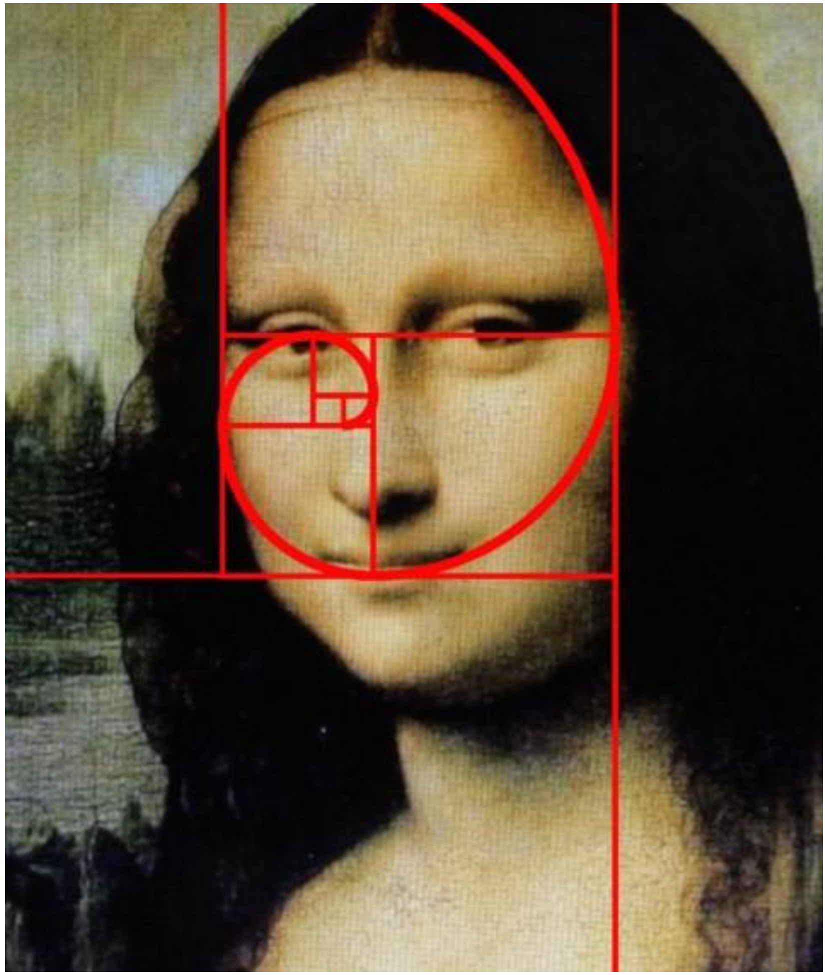
Coincidence...? In design!

It is no coincidence that the Fibonacci sequence/spiral is used in modern design. Everything from logo's to household products and more!



Where is the art?

Leonardo Da Vinci and other Renaissance painters used the golden ratio to structure their pictures.



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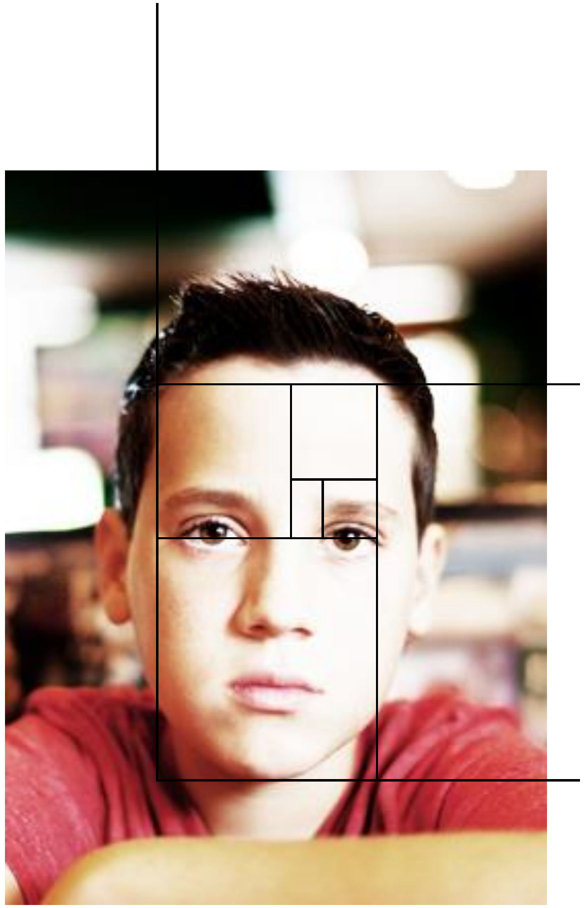
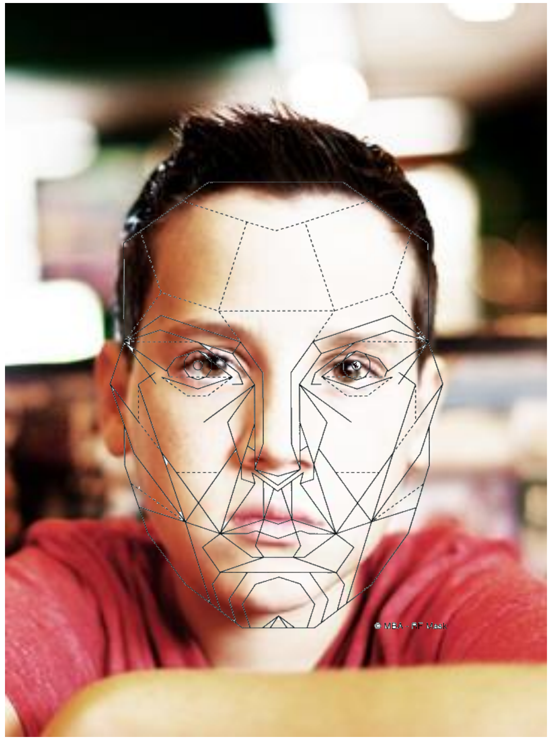
Your turn to have a go...!





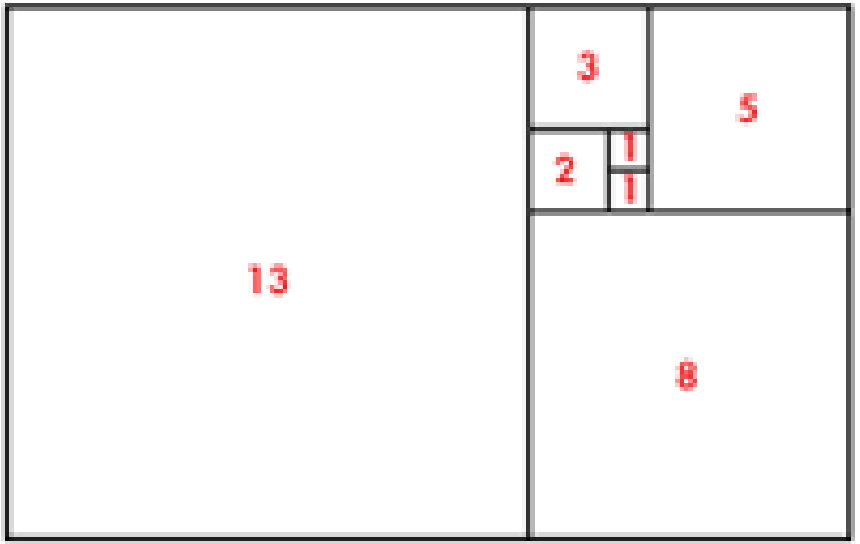
She loves...?!?

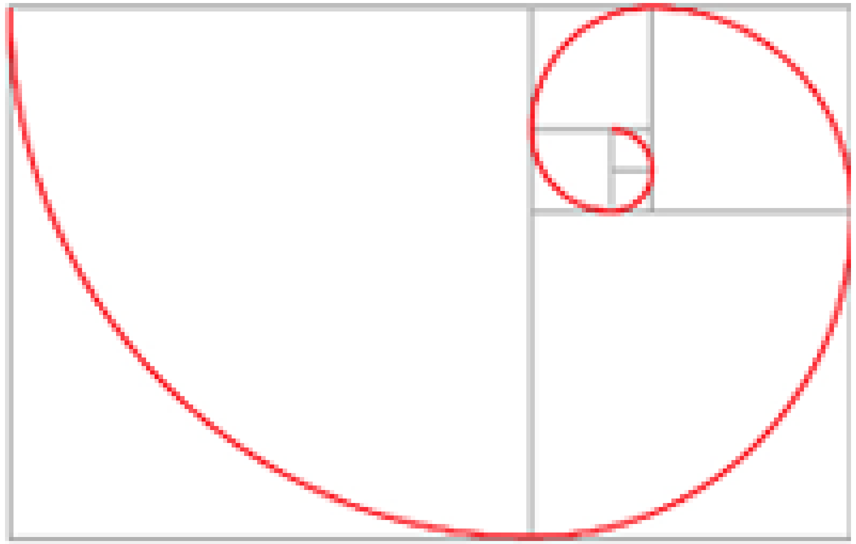
Fibonacci numbers crop up in nature lots...

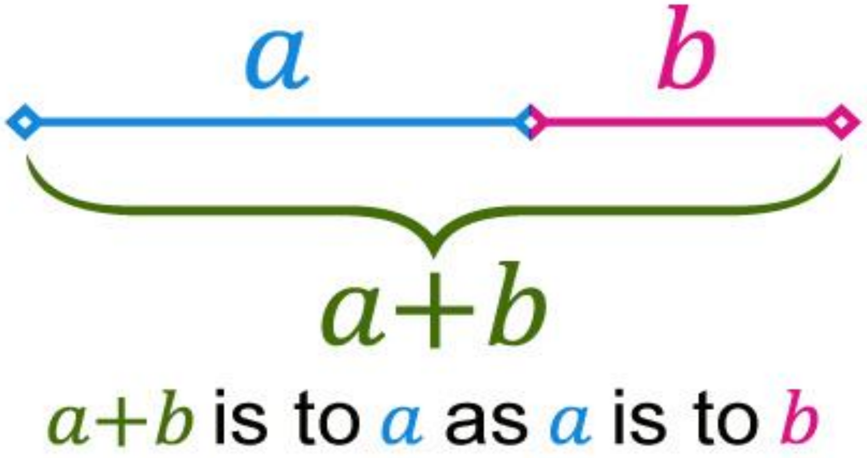
Count the number of petals on a flower "She loves, me. She loves, me not, She loves me, ..."

Whether she loves you or not, the chances are the count of petals was a Fibonacci number (Daisies usually have 34, 55 or 89 petals, for example - all Fibonacci numbers).

How does that work?





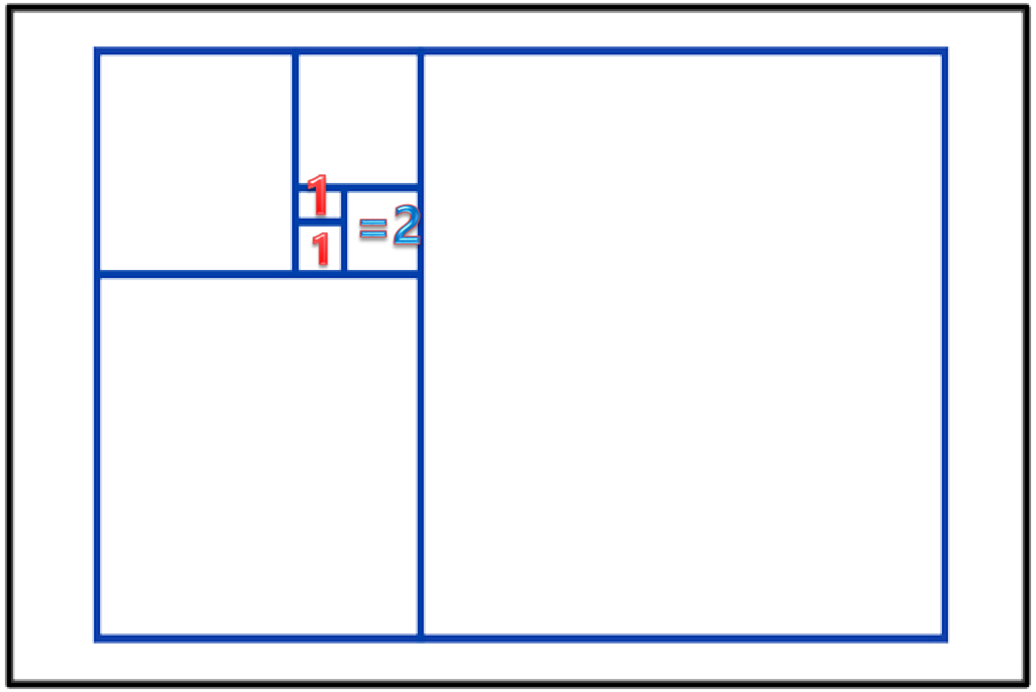


a divided by b = 1.618

Can you see a pattern?

How does this work?

1, 1, 2



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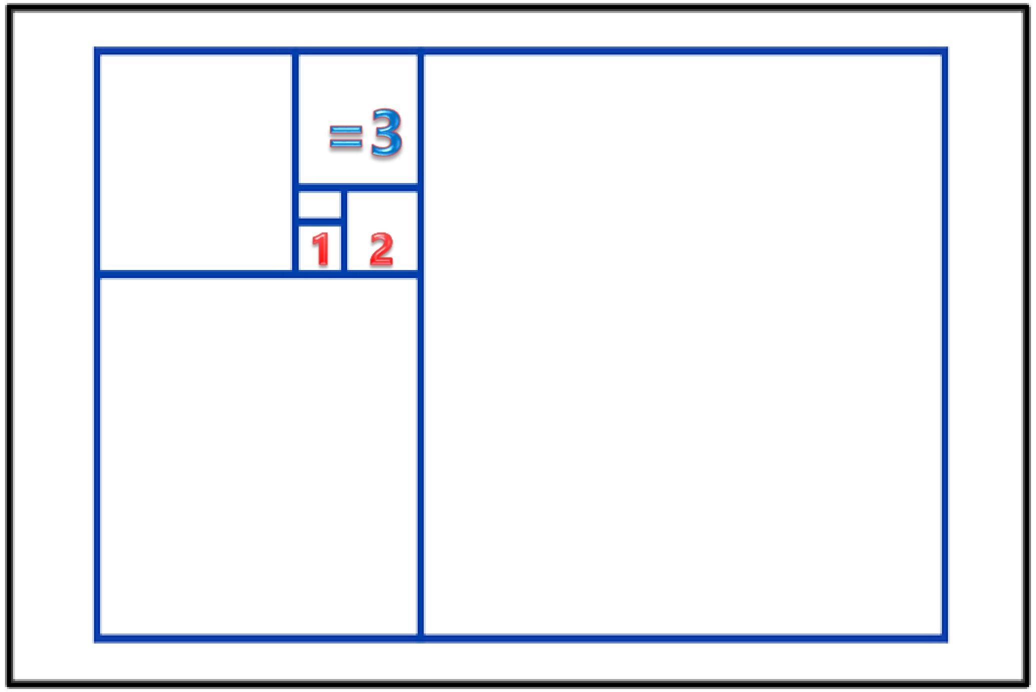
How does this work?

0, 1, 1, 2, 3



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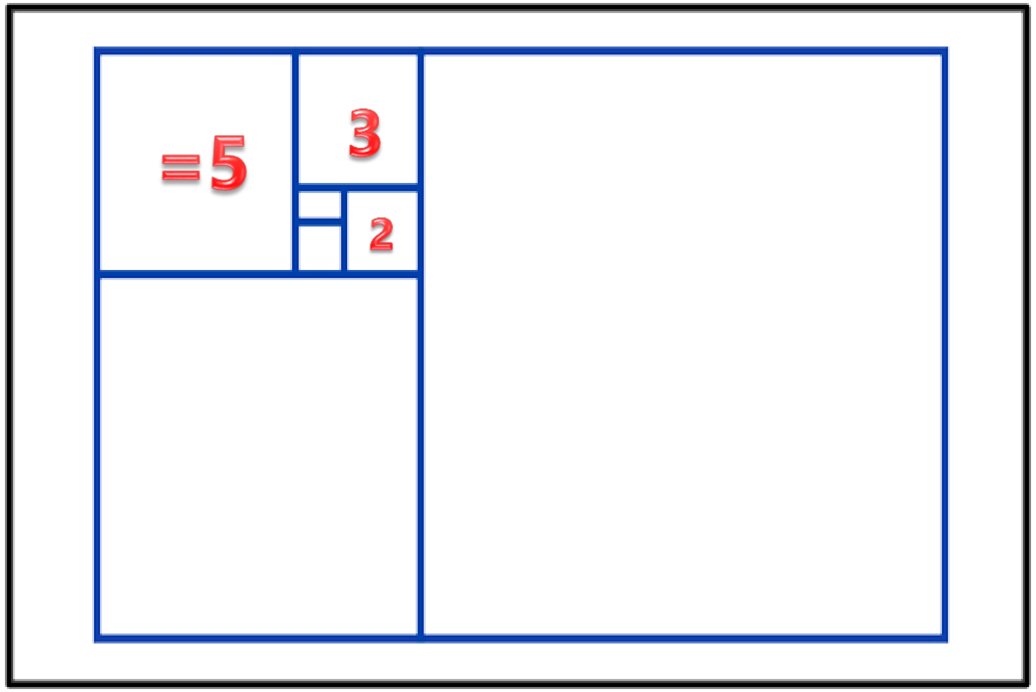
How does this work?

0, 1, 1, 2, 3, 5



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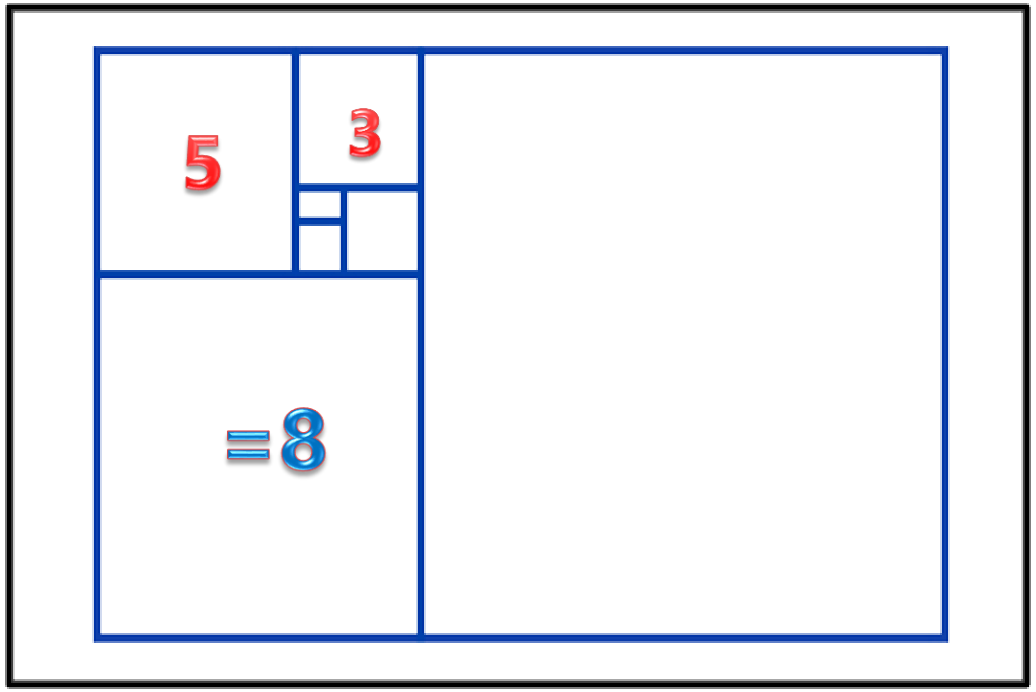
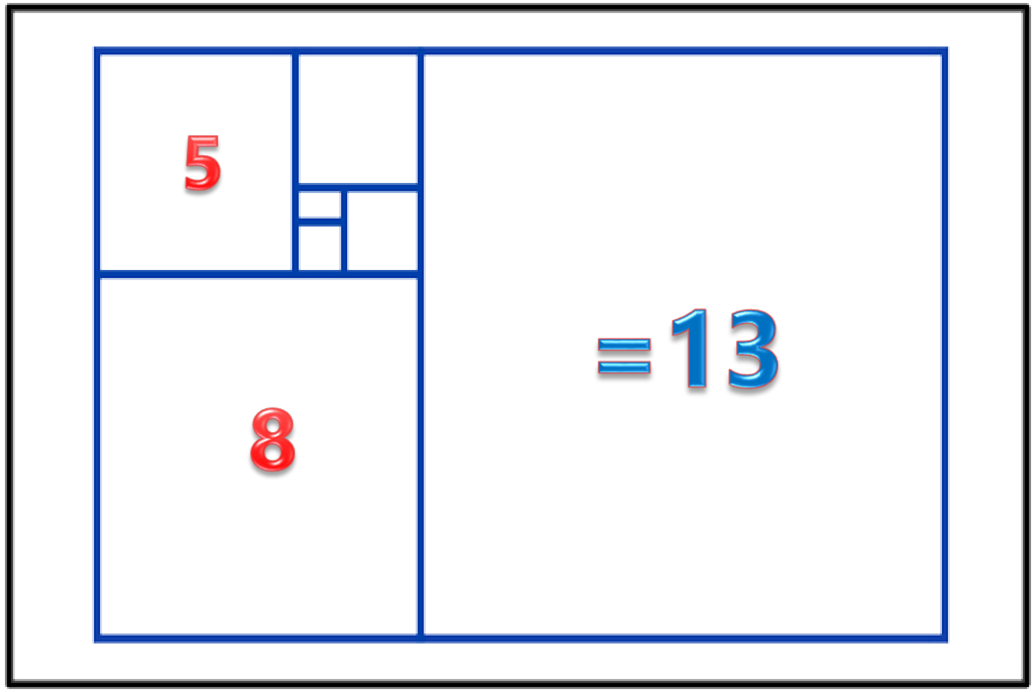
How does this work?

0, 1, 1, 2, 3, 5, 8



How does this work?

0, 1, 1, 2, 3, 5, 8, 13



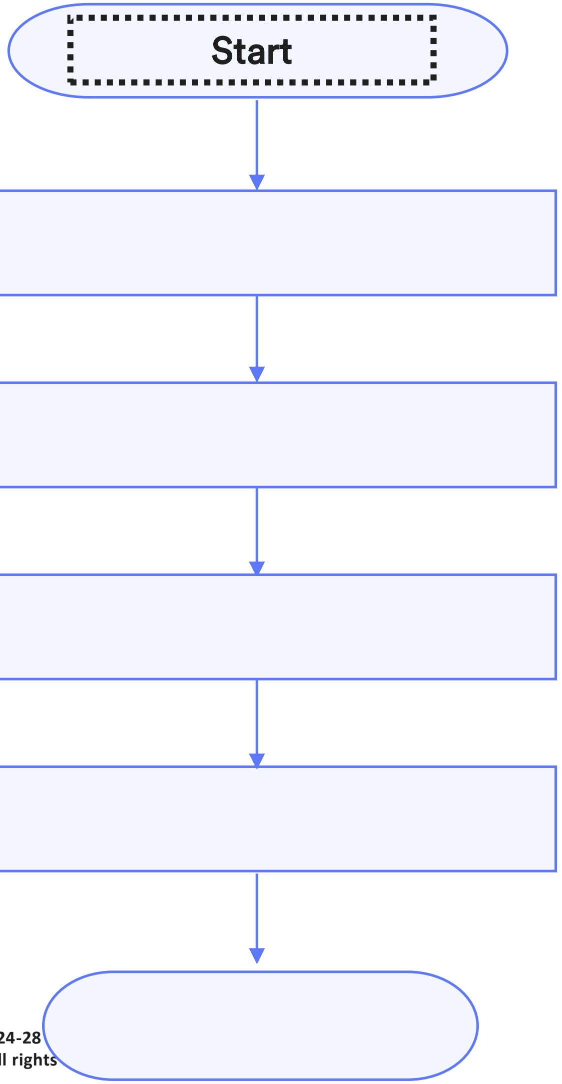
Algorithms

To make a computer do anything, you have to write a computer program. To write a computer program, you have to tell the computer, step by step, exactly what you want it to do. The computer then "executes" the program, following each step mechanically, to accomplish the end goal.

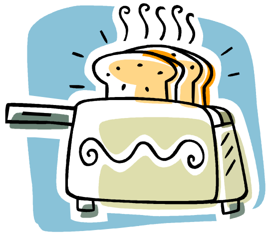
When you are telling the computer *what* to do, you also get to choose *how* it's going to do it. That's where **computer algorithms** come in.

An **algorithm** is a set of instructions to be followed in sequence to achieve a result such as **making toast.**

Algorithm – what's so important?



To understand how to make a set of instructions to perform a task.



Remove toast from toaster

Wait 2 minutes

Put bread into toaster

Stop

Push down handle

Algorithm – what's so important?

Start

Put bread into toaster

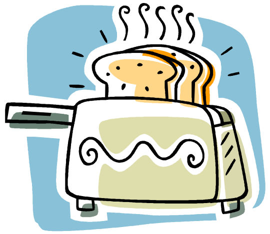
Push down handle

Wait 2 minutes

Remove toast from toaster

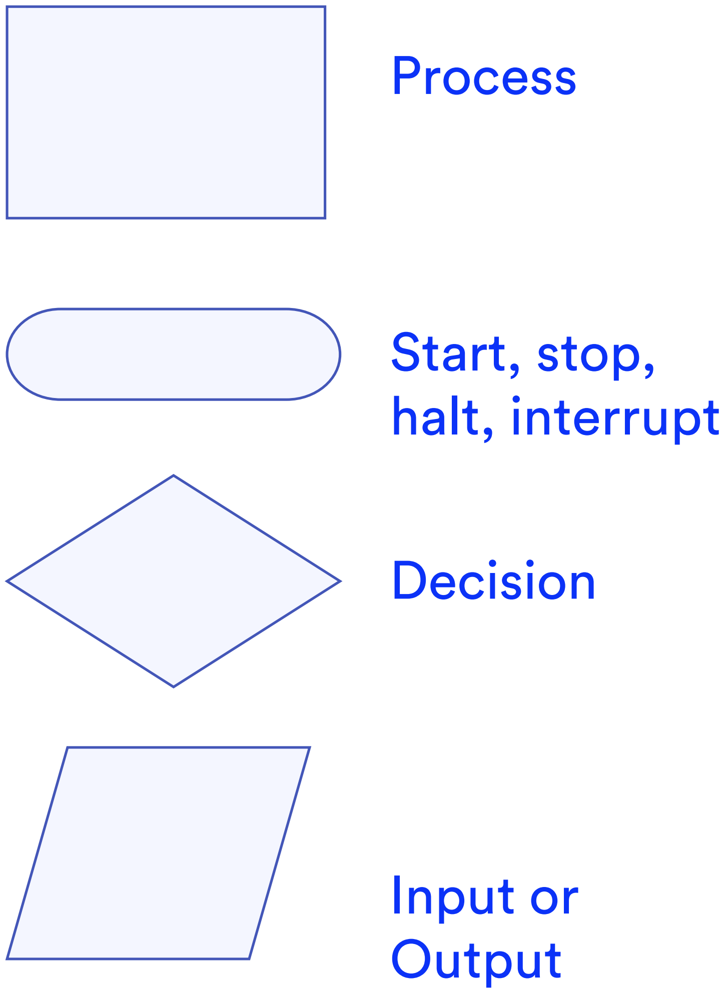
Stop

To understand how to make a set of instructions to perform a task.



Flow diagrams

A flow diagram is a graphical means of presenting, describing, or analyzing a process.



$7 + 8 = \boxed{}$

$7 + \boxed{} = 13$

$\boxed{} + 13 = 17$

Var**A** Var**B** Var**C**

Operators

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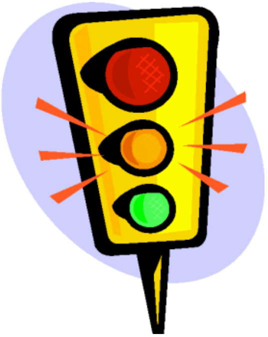
Word Association Game



Selection

‘Select’ion

Choice

Decision

Question

If…

Variable

‘Vary’ + ‘able’

change + can

Un-fixed

updatable

Constant

Steady

Unchangeable

Fixed

Locked

Loop

Repeat

How does this work?

0, 1, 1, 2, 3, 5, 8, 13

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Ok, so how does this work?

The sequence starts out: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, and continues *ad infinitum*.

Each new number in the sequence is created by adding the previous two numbers.

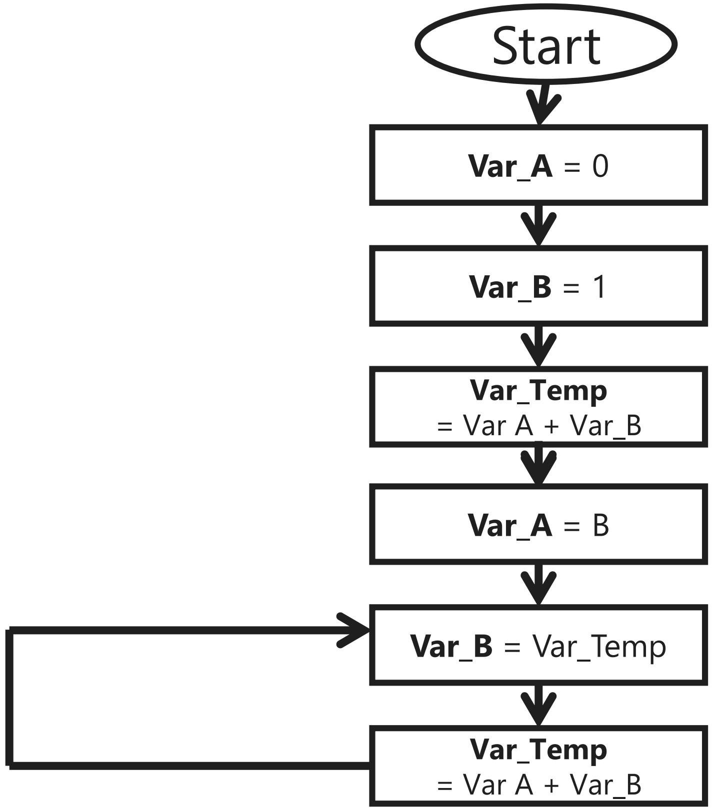
By definition the first two numbers are:

Fibonacci(0) = 0
Fibonacci(1) = 1

The next number is always the sum of the previous two. Fibonacci(n) = Fibonacci(n-1) + Fibonacci(n-2)

Fibonacci(2) = 0 + 1 = 1
Fibonacci(3) = 1 + 1 = 2

Flow diagram



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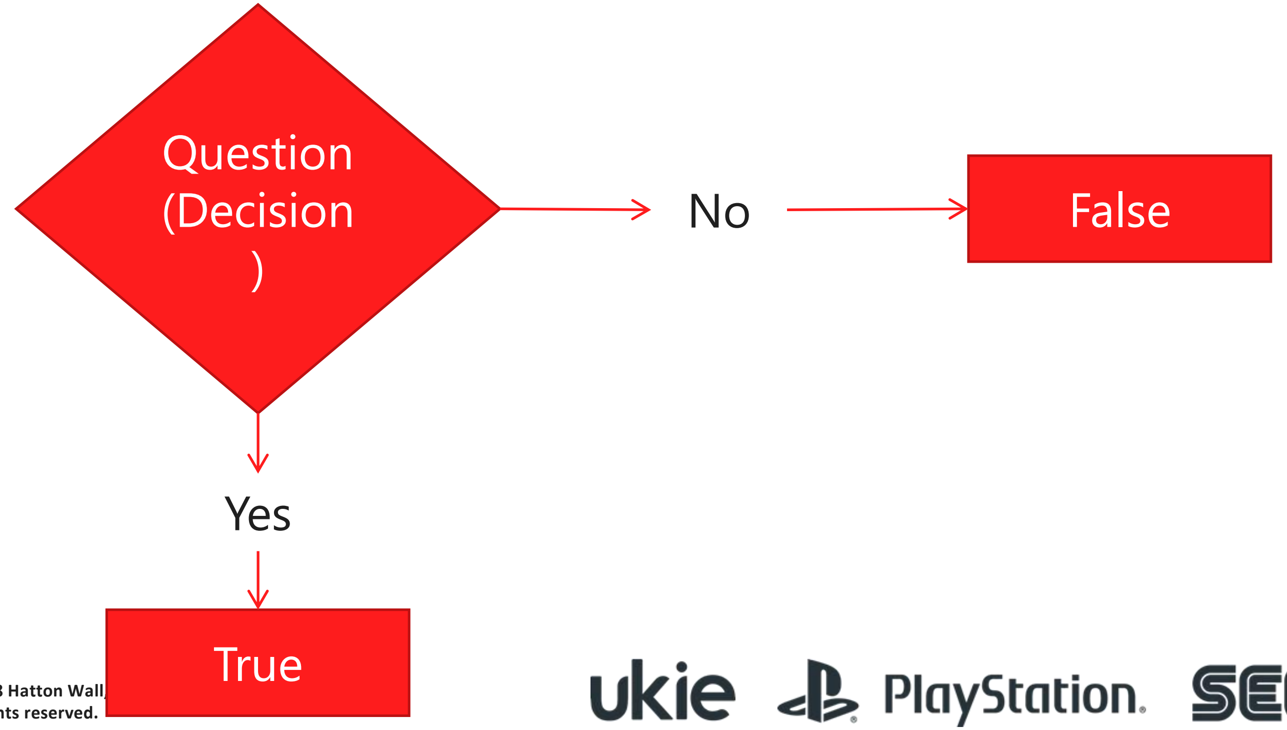
Selection

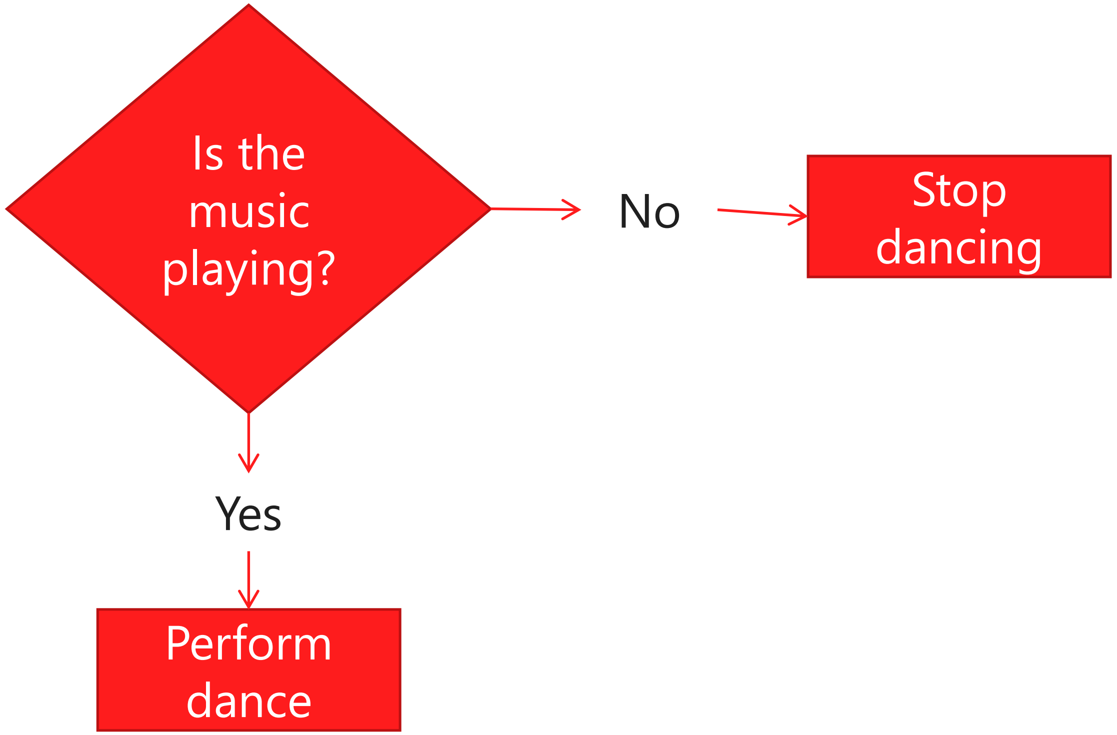
Using the computing concept of **selection.**

A question is asked, and depending on the answer, the program takes one of two courses of action.



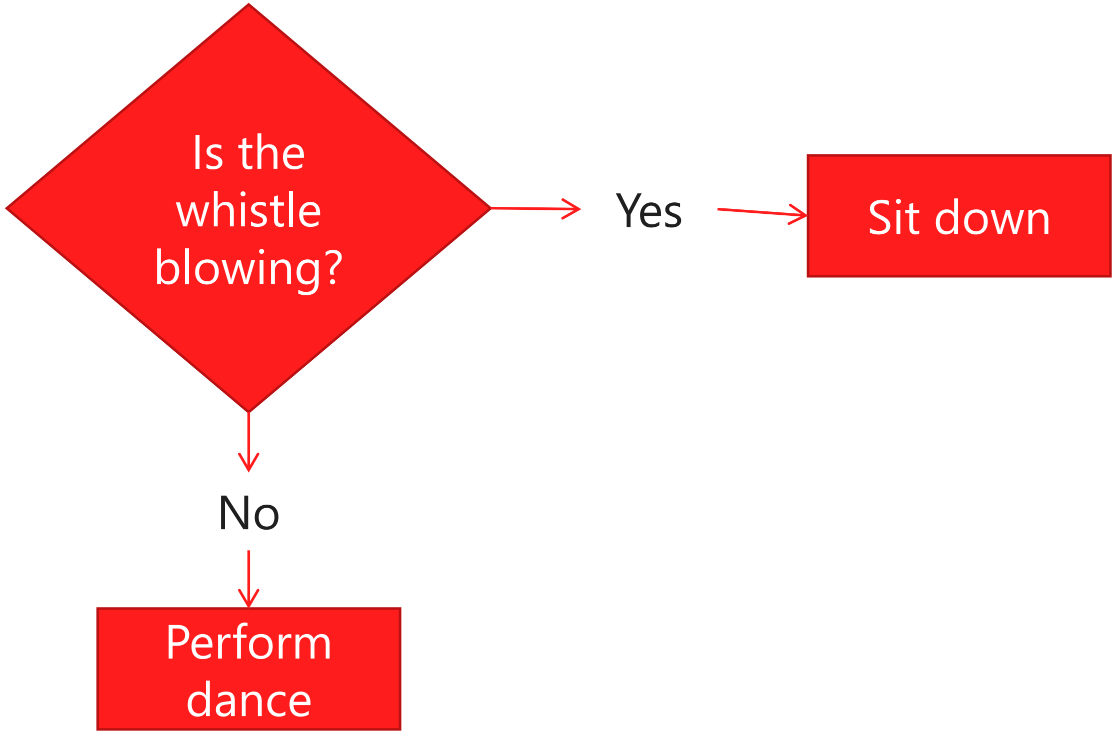
Selection

If *it is sunny outside* **then** (True) *play football* **else** (False) *do my homework*.

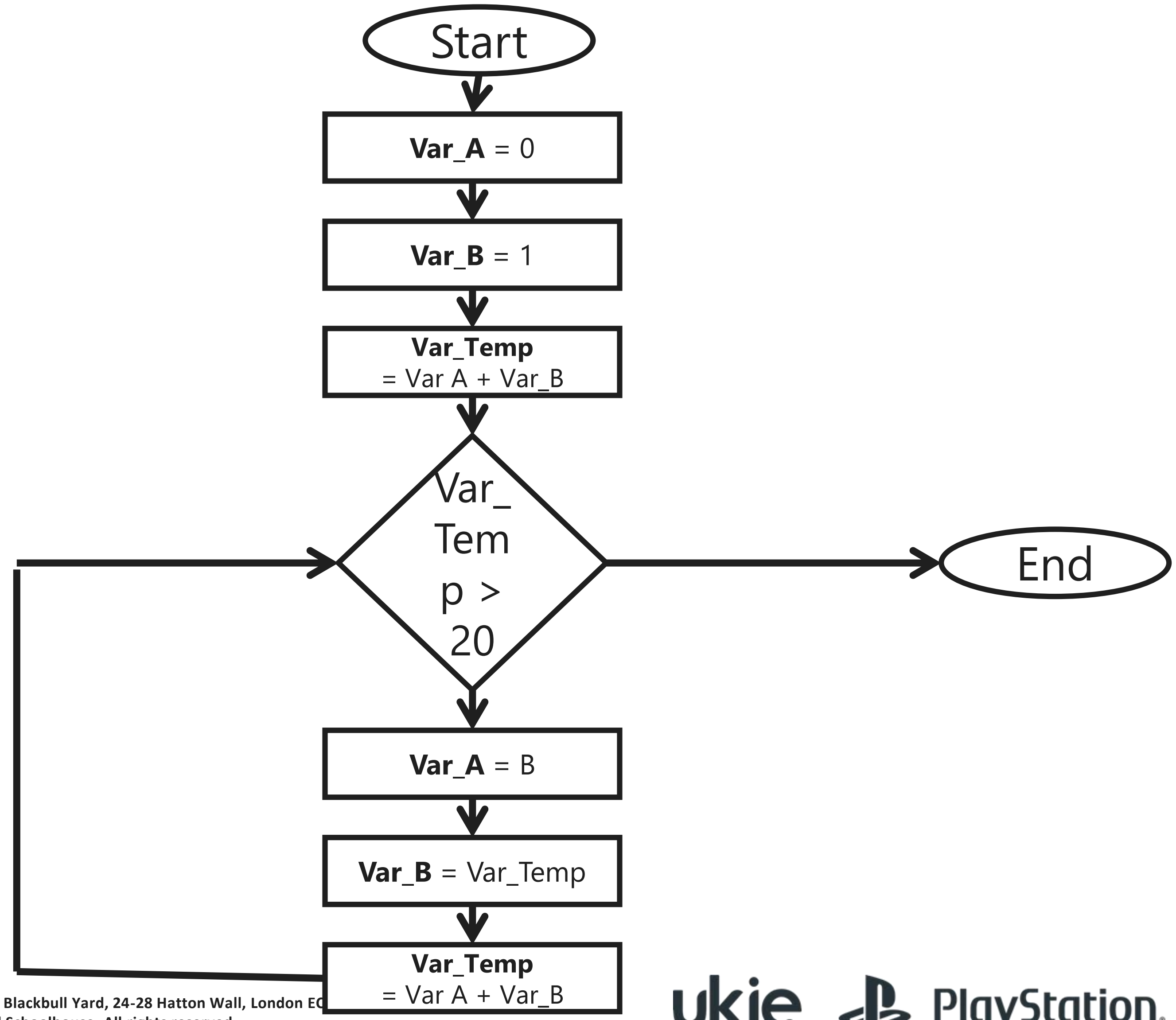


Selection

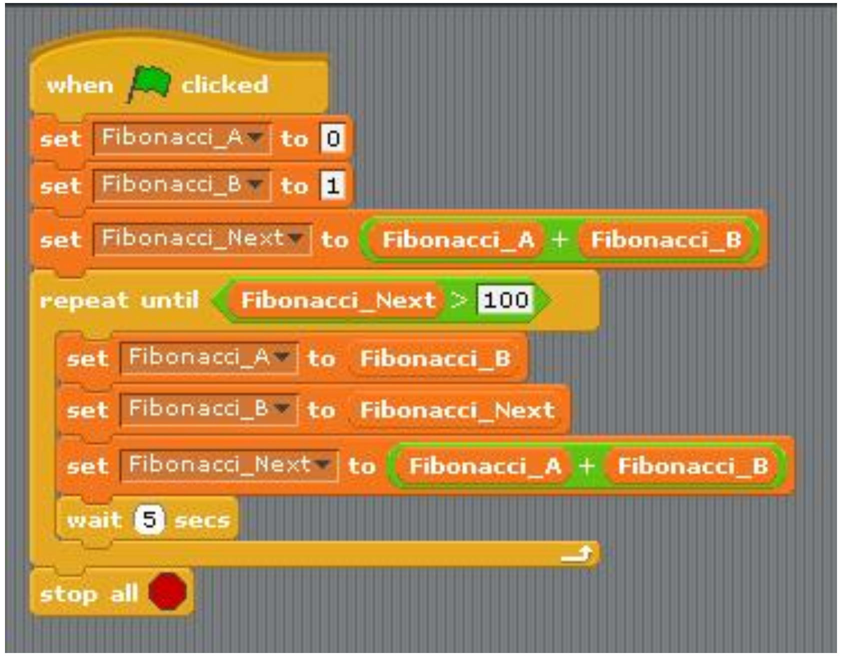
If *the whistle blows* **then** (True) *sit down* **else** (False) *carry on playing*.

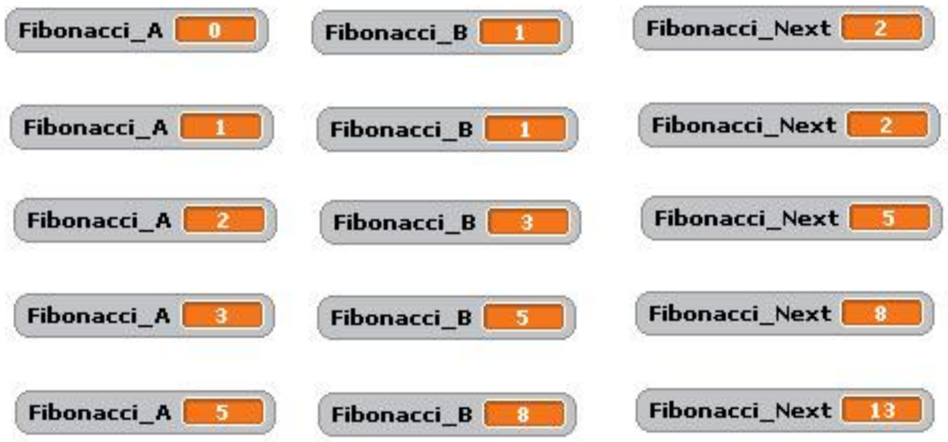


Answer: Flow diagram



Answers: Scratch





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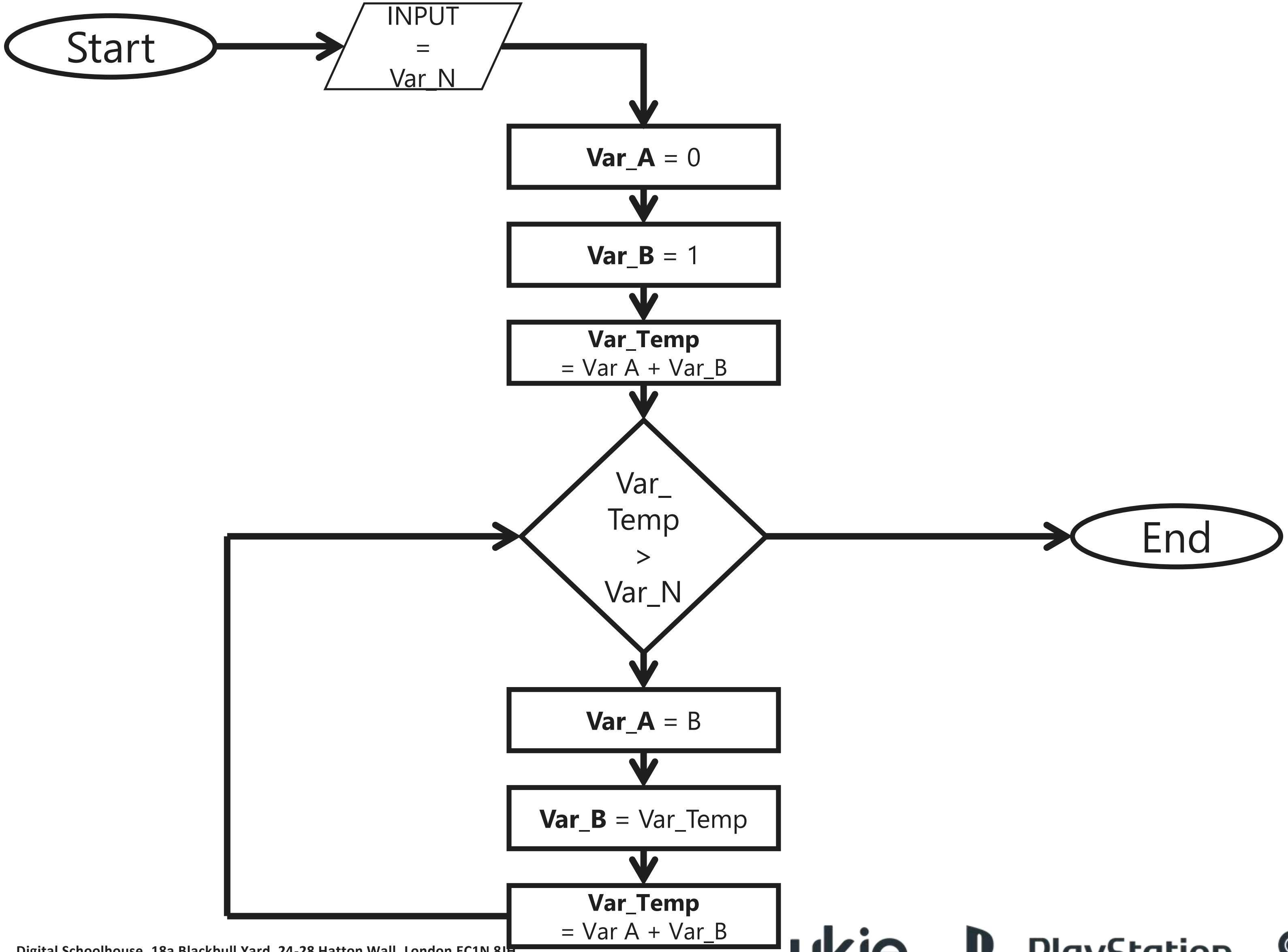
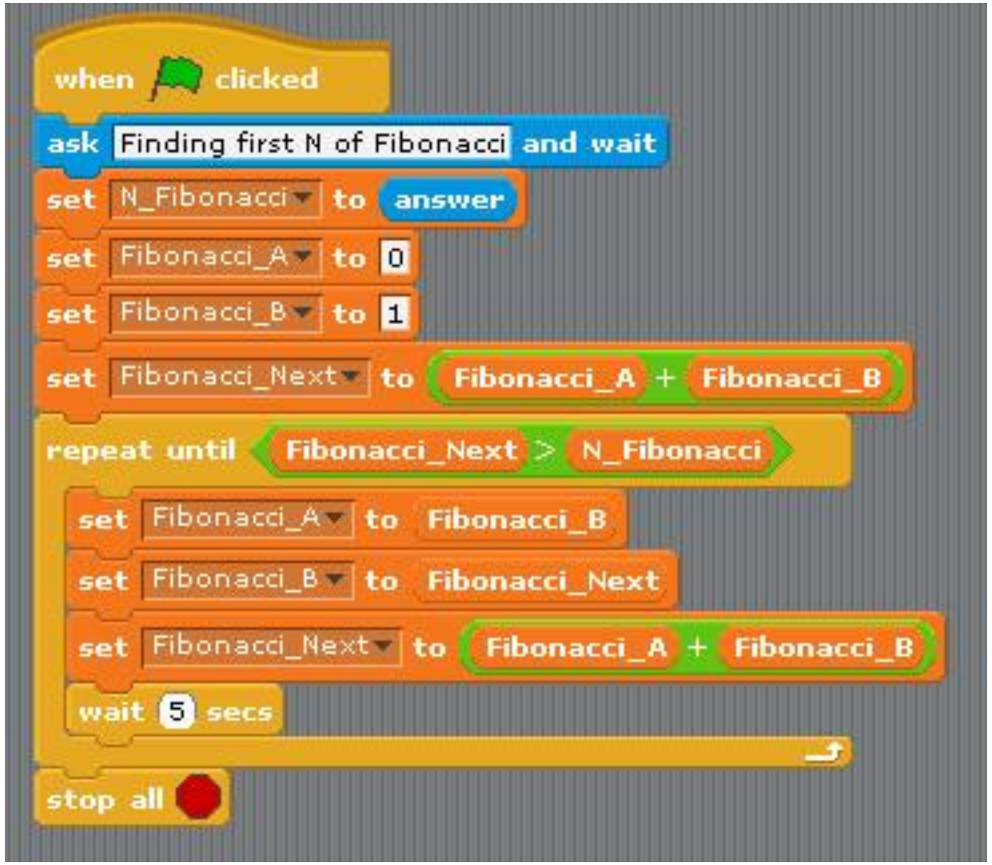
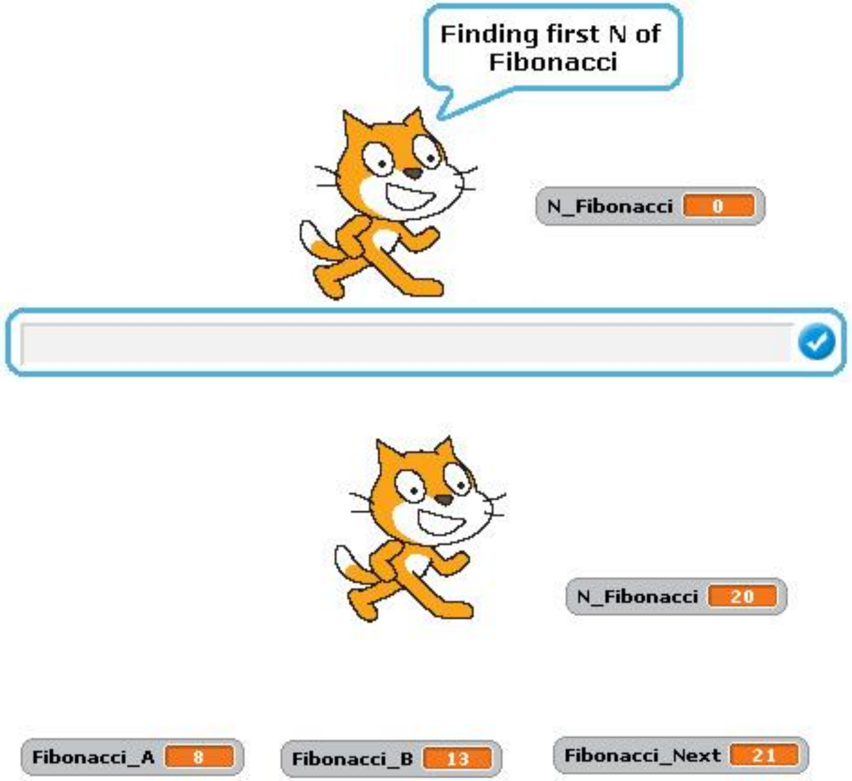
Answer: Flow diagram



Answers: Finding first 'N' of Fibonacci



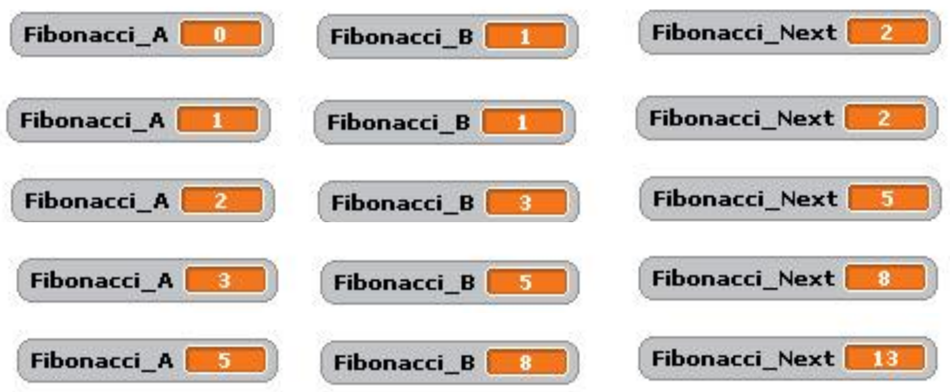


Extension: Recursion

Computer Scientists like the Fibonacci sequence because it is a good example of something that can be programmed easily using what is known as **recursion**.

The next number is always the sum of the previous two. Fibonacci(n) = Fibonacci(n-1) + Fibonacci(n-2)

Fibonacci(2) = 0 + 1 = 1
Fibonacci(3) = 1 + 1 = 2
Fibonacci(4) = 1 + 2 = 3
Fibonacci(5) = 2 + 3 = 5
Fibonacci(6) = 3 + 5 = 8
Fibonacci(7) = 5 + 8 = 13
Fibonacci(8) = 8 + 13 = 21



Recursion just means you define something using a simpler version of itself: If we write the 5th Fibonacci number (which is 8) as fib(5), the 4th (which is 5) as fib(4) and so on then we can calculate it as:

Define fib(5) = fib(3) + fib(4)

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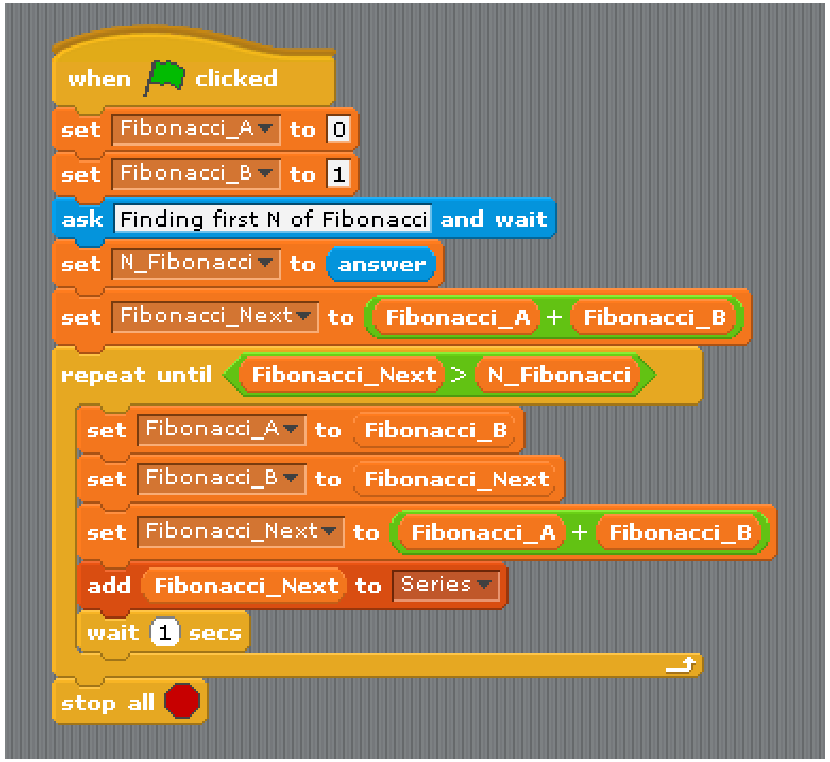
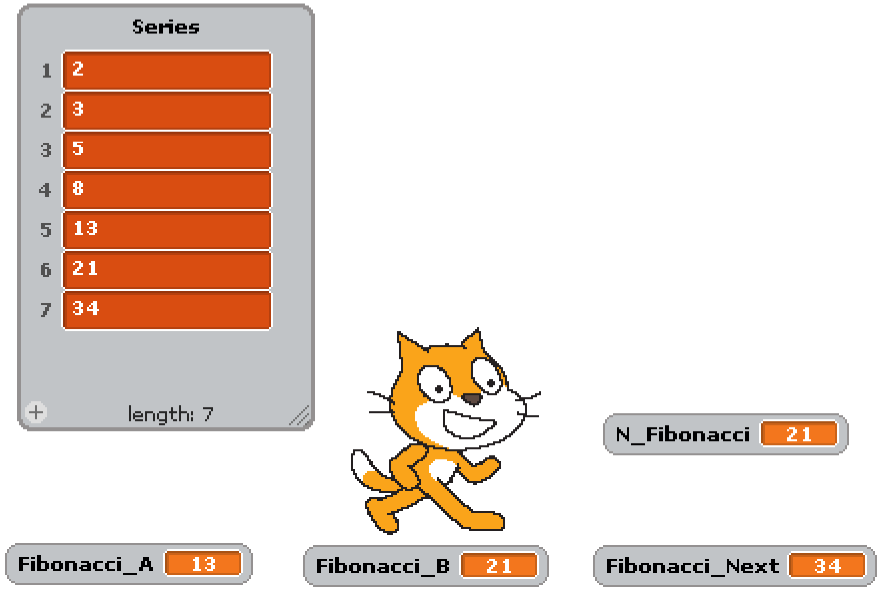
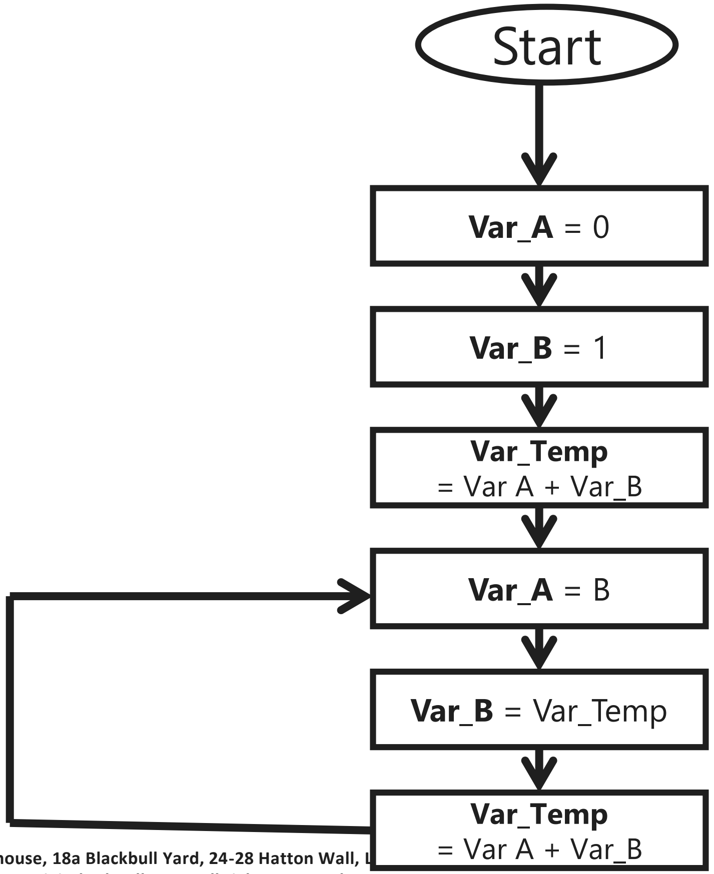
Extension: Using a list



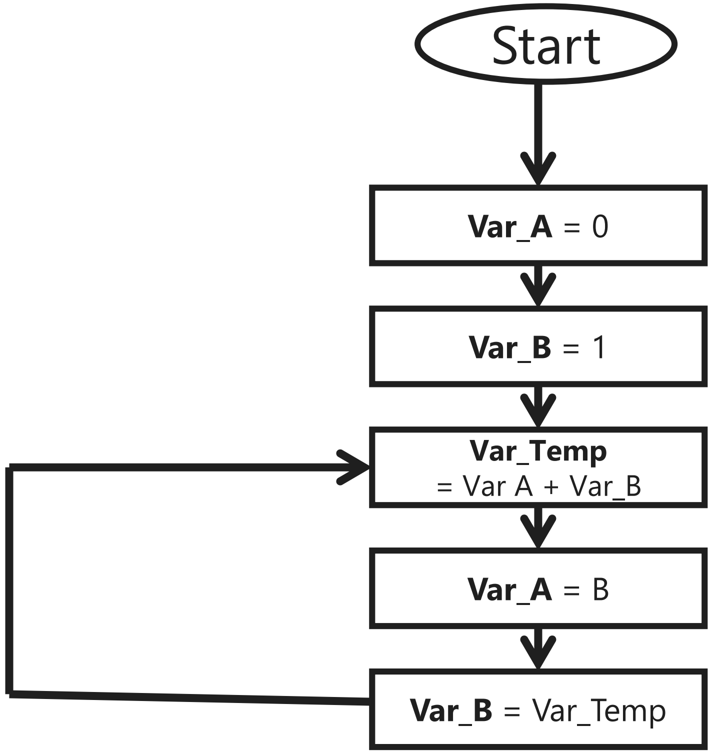


How can we make this basic Fibonacci more efficient?

*** Hint: Look for duplicate instructions… and where you place the loop



Answer: How can we make this basic Fibonacci more efficient?



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