MathBlox

Intro

Hello, my name is Blocky. I'm going to guide you through this booklet!

Intro

We’ll go over all these subjects in this booklet, on your own terms of course!

1.

Factorials

MathBlox

Factorial

This is the Factorial Block. It looks like an exclamation mark, but there is no need to say everything before it extra loud.

Factorial

$$5! = 5 \times 4 \times 3 \times 2 \times 1 = 120$$

$$x! = x \times (x - 1) \times (x - 2) \times ...$$

The factorial of a value is multiplying it by all integers below it, except negative values and zero.

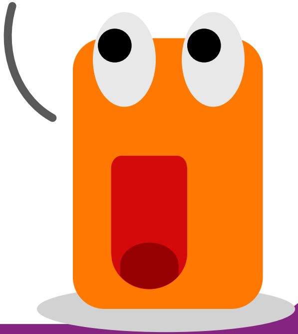
2.

Absolute Values

MathBlox

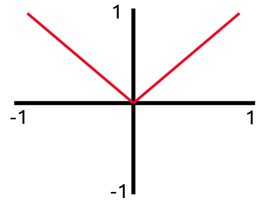
Factorial

This is a pair of Absolute Value Blocks. Just like brackets, they go on both sides of whatever you want to take the absolute value of.



Absolute Values

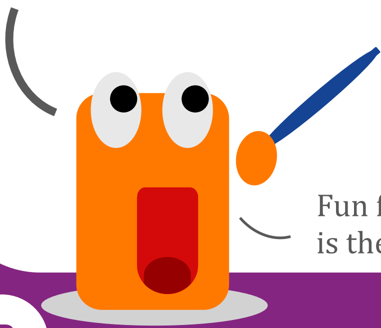
$y = |-x|$



An absolute value is indicated by two straight lines next to a value. It means that everything between these lines will become positive. Look at the graph for example.

$|-x| = x$ if $x \geq 0$

$|-x| = -x$ if $x < 0$



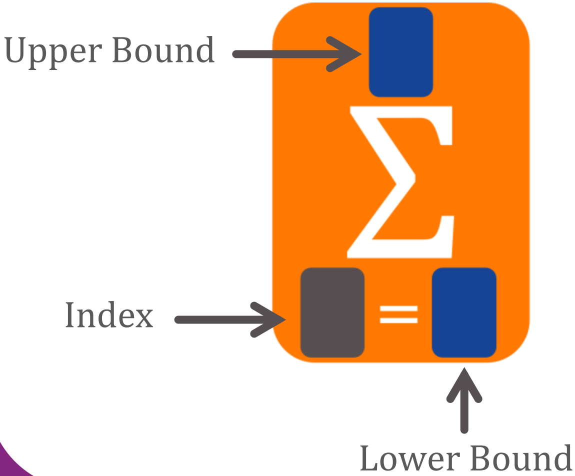
Fun fact: The root of the square of a value is the same as the absolute value.

MathBlox

3. Summation

MathBlox

Summation



This is the Summation Block. You can use it if you want to add up a lot of things that follow a pattern.

Summation

Lets look at some examples. Usually we use i as our index, but feel free to use other letters!

$$\sum_{i=0}^{3} i = 6$$

$$= 0 + 1 + 2 + 3$$

Summation

Here is another exmple. Now, the lower bound is not zero!

$$\sum_{i=3}^{5} i^2 = 50$$

$$= 3^2 + 4^2 + 5^2$$

Summation

The bounds can even be letters. This summation adds up the first n even numbers.

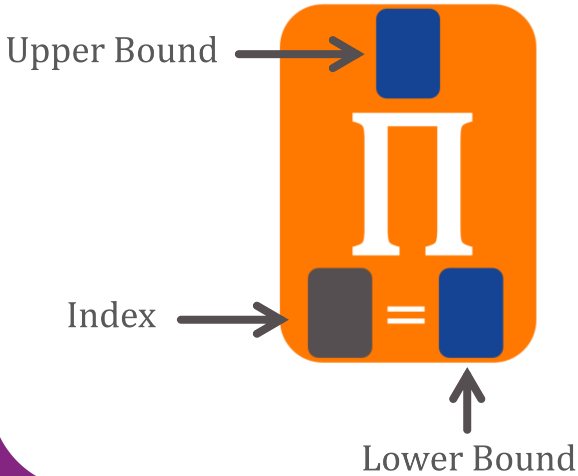
$$\sum_{i=0}^{n} 2i = n(n+1)$$

4.

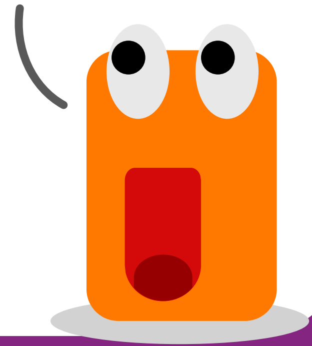
Product

MathBlox

Product



This is the Product Block. It works very similar to the Summation. You can use it if you want multiply a lot of things that follow a pattern.



Product

Lets look at some examples. Usually we use i as our index, but feel free to use other letters!

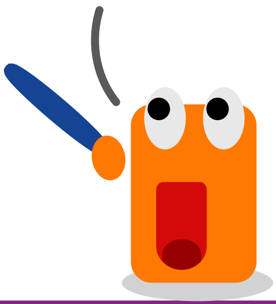
$$\prod_{i=1}^{3} i = 6$$

$$= 1 \times 2 \times 3$$

Product

$$\prod_{i=0}^{n} 2i = 2^{n} \times n!$$

We can also simplify the product of the first n even numbers. Can you figure out why this is the case?



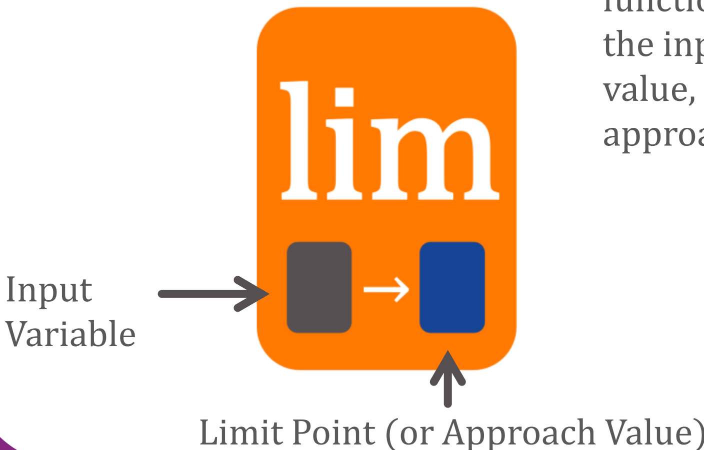
5.

Limits

MathBlox

Limits

This is the Limit Block. You can use it to find what a function or sequence does as the input nears a certain value, like division by zero or approaching infinity!



Limits

Lets look at some examples. For basic functions, a limit works just like plugging in.

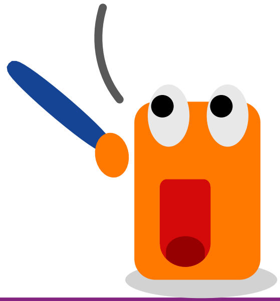
$$\lim_{x \to 3} x^2 = 3^2$$

$$= 9$$

Limits

$$\lim_{x \to \infty} (1 \div x) = 0$$

Using limits, we can also study what happens when the input approaches infinity!



Limits

We can even use limits when simply plugging in fails!

$$\lim_{x \to 1} \frac{x^2 - 1}{x - 1} = 2$$

This works because we are now allowed to factor out x-1

Limits

$$\lim_{x \to \infty} \left(1 + \frac{1}{x}\right)^{x} = e$$

$$\approx 2{,}718$$

Even the ***e*** block is defined using a limit! If you grow something by 1/x many times (x times), it approaches ***e*** .

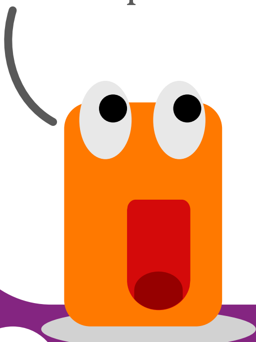
6.

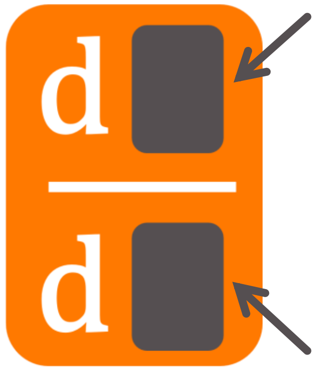
Differentiation

MathBlox

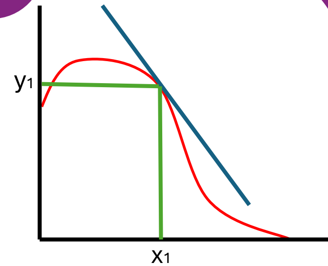
Differentiation

This is the Differentiation Block. You can use it if you want to know the slope of the graph at a certain point.

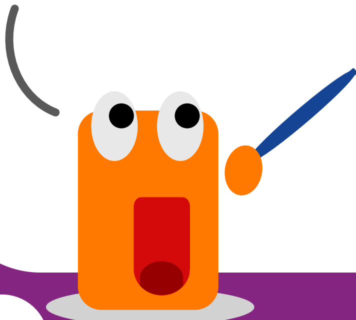




Differentiation



You can use the derivative to figure out the minima and maxima of a graph, this is where the slope of the graph is 0



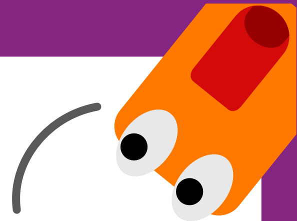
$$p'(x) = \frac{d}{dx} p(x)$$

Differentiation

$$\frac{d}{dx} a = 0$$

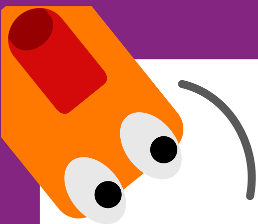
$$\frac{d}{dx} a x = x$$

$$\frac{d}{dx} x^{n} = n \times x^{n-1}$$



Here are three of the most elementary differentiation rules.

Differentiation



Here is a way to solve more complicated derivatives: the chain rule.

Most formulas can be broken into the following:

$$h(x) = f(g(x))$$

$$h'(x) = f'(g(x)) \times g'(x)$$

This is a complicated formula to help you understand I'll give some examples on the next page!

Differentiation

Let's look at the following derivative: $\frac{d}{dx}(4x^2 - 2x)^3$

This can be written as: $(u)^3$

Where: $u = 4x^2 - 2x$

From the previous definition we can see that: $u = g(x)$

Differentiation

Using the elementary differentiation calculations, we can see that:

$$\frac{d}{dx}\left(4x^2 - 2x\right) = 8x - 2 = g'(x)$$

and

$$\frac{d}{du}u^3 = 3u^2 = f'(u)$$

Differentiation

Now we have all elements of the chain rule equation, so we can fill it in:

$$h'(x) = f'(g(x)) \times g'(x)$$

So:

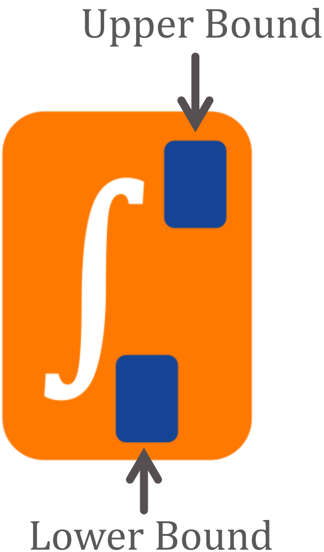
$$h'(x) = 3(4x^2 - 2x)^2 \times (8x - 2)$$

7.

Integration

MathBlox

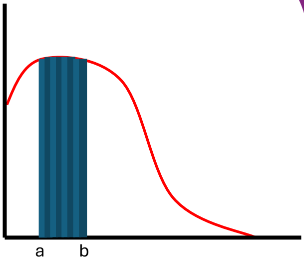
Integrals

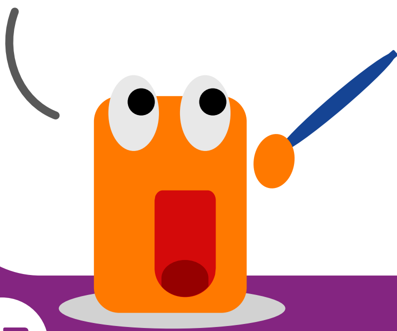


This is the Integration Block. You can use it if you want to calculate the area below a graph between two values of x.

Integrals

The integral is a mathematical operation where you calculate the area under a graph. This is done by summation of infinitely many strips of an infinitely small thickness. The integral is the mathematical opposite of differentiation.





$$\int_a^b p(x)\,dx$$

Integrals

As I said, an integral is basically the opposite of a differentiation; you can also call them antiderivatives.

$$\int a\,dx = ax + c$$

The c is a constant variable, because:

$$\frac{d}{dx}\,ax + c = a$$

Integrals

$$\int a x^{n} \, dx = (a x^{n+1}) \div (n + 1) + c$$

In which

$$n \neq -1$$

Because:

$$\frac{d}{dx}\left((a x^{n+1}) \div (n + 1) + c \right) = a x^{n}$$

8.

Imaginary Numbers

MathBlox

Complex Numbers

i is called an Imaginary Number, this is defined as:

$$i^2 = -1$$

You would think this is impossible, but it is a definition, same as:

$$x^0 = 1$$

Complex Numbers

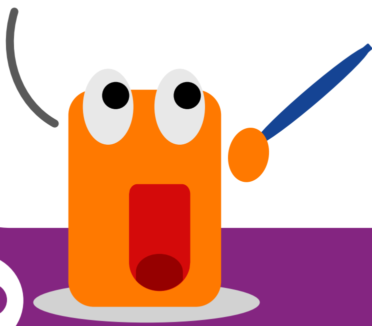
All multiples of i are called Imaginary Numbers. If you add or subtract a real number from that, you have constructed a Complex Number

bi

Imaginary

$a + bi$

Complex



Complex Numbers

$$4i + 6i + 2 = 10i + 2$$

$$(i + 6) \times i = i^2 + 6i =$$

$$6i - 1$$

Recall the previous definition

Here are a few examples on how to work with Imaginary Numbers.

Group 4

Charlotte Parks
Daniëlle van der Vlist
Irati Zabalbeitia
Jelle Vuursteen
Nathan Palsma
Thies Harms

Industrial Design Engineering
Project Design for Specific Users

UNIVERSITY OF TWENTE.