Calculus

in the words of a beginner

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TBC

Relations

As humans—or as sapiens, mammals, animals, living organisms, or simply as a part of the universe—we sometimes think about things that seem to have no proper meaning and yet feel profoundly significant. Take naming things, for example. I was named "Sabbir." It's fascinating that someone could associate a sound like "sa-bee-r" with me, or say "stone" and refer to countless objects that may or may not resemble each other.

Now, as a so-called “maths guy” (AKA “mathematician” or “mathmagician”), I can’t help but foolishly push beyond this and say that we can relate other things too. For instance, you relate “mango” to “sugar” by saying, “A mango (if ripe) tastes sweet, like sugar.” That’s interesting to notice, but for the key takeaway is that you’ve created a relationship between “mango” and “sugar.”

Can you:

Relate: *Sun to light, Cloud to Sky* and *love to life*?

In fact, you can relate anything to anything else that your brain can imagine (and your brain can even think about things you can’t imagine—you’re probably imagining that now).

Since this book is for the maths guys, let’s deal with something that feels like home to them—their natural habitat: numbers.

Now, let’s relate some numbers:

1 to 2, 2 to 4, 3 to 6 and 4 to 8

Notice anything? The numbers are doubled!

It is simple to write down for four relations now think writing down for a hundred terms!

1 to 2	11 to 22	21 to 42	31 to 62	41 to 82	51 to 102	61 to 122	71 to 142	81 to 162	91 to 182
2 to 4	12 to 24	22 to 44	32 to 64	42 to 84	52 to 104	62 to 124	72 to 144	82 to 164	92 to 184
3 to 6	13 to 26	23 to 46	33 to 66	43 to 86	53 to 106	63 to 126	73 to 146	83 to 166	93 to 186
4 to 8	14 to 28	24 to 48	34 to 68	44 to 88	54 to 108	64 to 128	74 to 148	84 to 168	94 to 188
5 to 10	15 to 30	25 to 50	35 to 70	45 to 90	55 to 110	65 to 130	75 to 150	85 to 170	95 to 190
6 to 12	16 to 32	26 to 52	36 to 72	46 to 92	56 to 112	66 to 132	76 to 152	86 to 172	96 to 192
7 to 14	17 to 34	27 to 54	37 to 74	47 to 94	57 to 114	67 to 134	77 to 154	87 to 174	97 to 194
8 to 16	18 to 36	28 to 56	38 to 76	48 to 96	58 to 116	68 to 136	78 to 156	88 to 176	98 to 196
9 to 18	19 to 38	29 to 58	39 to 78	49 to 98	59 to 118	69 to 138	79 to 158	89 to 178	99 to 198
10 to 20	20 to 40	30 to 60	40 to 80	50 to 100	60 to 120	70 to 140	80 to 160	90 to 180	100 to 200

Wooooooaow!!! Only a mad person would write all of this down. It wastes both time and space. Instead, we can express it in a much smarter way:

For all numbers $\boldsymbol{a}$ *from one to a hundred relate* $\boldsymbol{a}$ *to* $\mathbf{2} \times \boldsymbol{a}$.

Many pages saved!

The "*one to a hundred"* part for our one-line statement of a hundred-line statements is a bit more meaningful. Here is another example:

Relate: 1 to 2, 3 to 6, 4 to 8, 5 to 10, 11 to 22 and 13 to 26.

It is the same doubling magic but now with number out of order. We can write it in the same way

For numbers 1, 3, 4, 5, 11 and 13 as $\boldsymbol{a}$ *relate* $\boldsymbol{a}$ *to* $\mathbf{2} \times \boldsymbol{a}$.

You see, this is similar to what we do with the word "stone" (when you picture it, many things might come to mind). Here, $\boldsymbol{a}$ has taken the form 1, 3, 4, 5, 11 or 13. In a sense, these numbers now belong to the same "family." This commonality is denoted using curly brackets:

$$\{1, 3, 4, 5, 11, 13\}$$

These in more formal terms are called a "set". We may name our family/set say,

$$\text{Bob} = \{1, 3, 4, 5, 11, 13\}$$

Or more boringly (but saving ink, pages, etc.):

$$\mathbf{B}^{1} = \{1, 3, 4, 5, 11, 13\}$$

Now, the relation can be written as:

For $\boldsymbol{a}$ *as a member of* $\boldsymbol{B}$*, relate a to* $\mathbf{2} \times \boldsymbol{a}$

This notation is further shrunk down by replacing "*as a member of*" by the membership symbol ∈ (the Greek letter epsilon, I know weird).

For $\boldsymbol{a} \in \boldsymbol{B}$*, relate a to* $\mathbf{2} \times \boldsymbol{a}$

Just as a family isn't defined solely by blood ties but by the love that binds its members, a set can contain unrelated elements brought together within curly brackets.

Takeaways:

1) A set is a group of things (related or not) and are denoted using curly brackets. Example: {Sabbir, π, you, 3}

2) When we write $\boldsymbol{a} \in \mathbf{W}$ we mean $\boldsymbol{a}$ "as a member of" or "is a member of" or "belongs to" the set $\mathbf{W}$.

[1] *Note: Sets are denoted using big letters (though you won't be put in jail if you don't do that).*