0.1 | **Types of Numbers**

algebra:

```
algebra is doing stuff to things
```

- idea of a number changes – 500yago they didnt know about negs

natural numbers are the most natural, apparently 0 not in natural, 0 in whole

F for integers, counting in german

rational numbers: a/b a, bF

real numbers: infinite all the way down way more real numbers than rational numbers

- Zero: important for groups – starting point on number lines. true neutral, **Additive Identity**
  - **Multiplicative Identity**: 1
  - identity lets it keep it's identity? when the op doesn't change
- negs: so we can deal with negs? so we can undo addition

```
subtraction is a lie! add negs
subtraction on the natural numbers is not closed

closed: can make a number not in the set
```

0.2 | **Groups**

```
any set of mathematical elemements under one operation such that there is an identity each element has
```

- they do not need to be **communitive**
  - a+b = b+a
- **associativity**
  - (a+b)+c=a+(b+c)
  - order doesnt matter
  - most things we are doing will be associative
  - nice number systems are almost always associative

can add dimensions, like complex adding more leads to quaternions or hamiltonians, then to sadonians?

```
called the cayley dickson construction, or smt
```

0.3 | **Matrices**

- can be called an array
- 2d can use rows and columns as coords

operations: addition: only if same dimensions, loop through indicies dot: cross: wrong! first row by first column with addition to make first entry, first row by second column for second entry loop through indicies like addition

vectors: special case of matrix
column vec (1, 2)
row vec (1, 2)
cannot add diff dimensions

representations can draw up to 3, ish geometric is just arrow on graph to coords
adding vecs on the graph is just tip to tail, then first tip to last tail for resultant just like phys

```
(
    a1
    a2
    .
    .
    .
    an
)
```

is a vector of $\setminus^n$

```
matrix multiplication identity?
multiplication on group? multiplication on to collum vectors
```