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

$\mathbb{F}$ for integers, counting in german

rational numbers: a/b $a, b\mathbb{F}$

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 a
```

- 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?

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: