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

$\digamma$ for integers, counting in german

rational numbers: a/b $a, b\digamma$

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't make a number not in the set
```

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?

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

2.0.1 | axioms:

- there exists an identity
- each element has an inverse
- it's closed
- associativity

3 | Matrices

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

3.0.1 | 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

3.0.2 | vectors:

special case of matrix

column vec (1, 2)

row vec (1, 2)

cannot add diff dimensions

3.0.3 | 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
```

Homework: - KBxGroupAndMatricesIntro