

# 1.1 - The real number system

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keys to understanding:

- 1) Read the section in the book prior to class. Print the notes
- 2) Come to class and be engaged. Ask questions!
- 3) Stay after class or make an appointment for further questions
- 4) Do the WebWork assignments in a timely manner so you have time to think about the problems

A set is a collection of objects

• EX:  $\{1, 2, 3\}$  - The set with the numbers 1, 2, and 3  
↳ we usually use braces for sets.

$\{1, 2, 3, 4, \dots\}$  - the set of natural numbers. (The 3 dots means continue in the same way) *ellipsis*

- we can add and multiply & get another number in the set.
- we can't always subtract.

↳  $6 - 3 = 3 \rightarrow$  in the set

$3 - 6 = -3 \rightarrow$  not in set

- Need more numbers for subtraction.

$\{\dots, -4, -3, -2, -1, 0, 1, 2, 3, 4, \dots\}$  - the set of integers

- We can multiply, add, & subtract, but can't always divide.

↳  $7 \div 4 = \frac{7}{4} \rightarrow$  not in the set

- we need more numbers

Rational numbers have the form  $\frac{p}{q}$  where  $p$  and  $q$  are integers and  $q \neq 0$ .

- we have all fractions, terminating decimals, & repeating decimals.

↳  $0.128 = \frac{128}{1000} \rightarrow$  all terminating decimals can be written as fractions

↳  $0.818181\dots = \frac{9}{11} \rightarrow$  all repeating decimals can be written as

Fractions

- Are we missing any numbers? ~~\_\_\_\_\_~~

Irrational numbers like  $\pi$  and  $\sqrt{2}$  cannot be written as fractions. (2)

- They are nonterminating decimals.

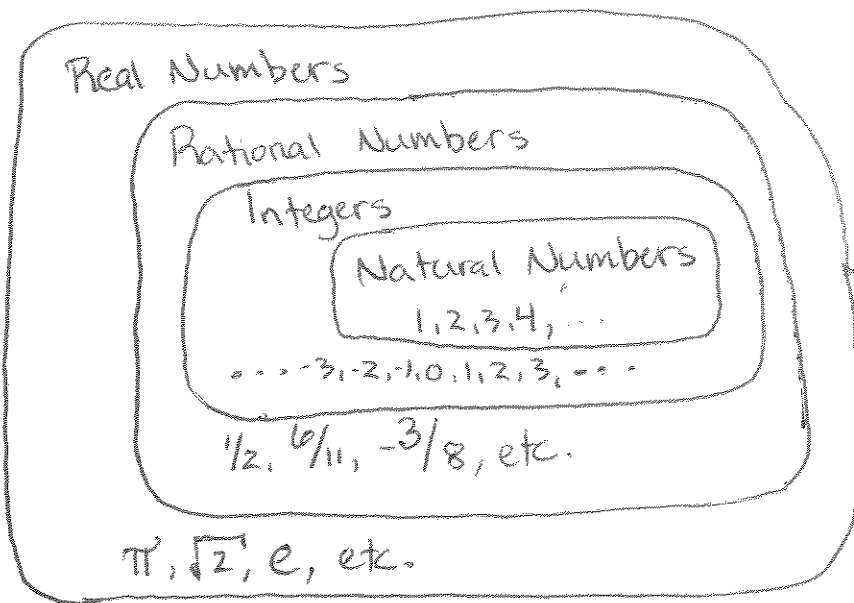
EX:  $\pi = 3.14159\dots$

$\sqrt{2} = 1.41421\dots$

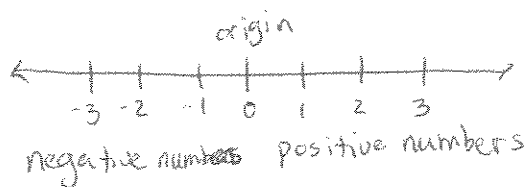
Putting rational and irrational numbers together gives the Real numbers

↳ real numbers are all the normal things we think of as number

All the other sets we've talked about are nested inside the real numbers.



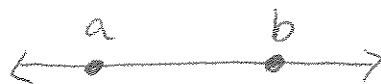
## Real Number Line



↳ it's a way to visualize real numbers

Ordering:  $a < b$  - "a is less than b" mean a is to the left of b on the real number line

↳ inequality



~~the~~  $x > y$  - "x is greater than y" means x is to the right of y. (3)



We also have:  $\leq$  → "less than or equal to"  
 $\geq$  → "greater than or equal to"

EX Fill in the symbol

a)  $-2 < 4$

b)  $3 < 6$

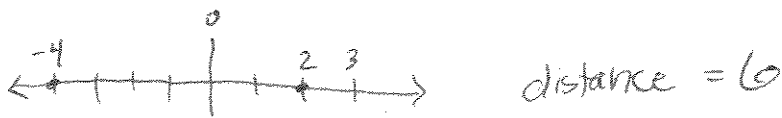
c)  $\frac{1}{2} > \frac{1}{4}$

d)  $-4 > -5$

e)  $-\frac{3}{8} < -\frac{1}{8}$

istance between real numbers

→ What is the distance between -4 and 2?



note that  $2 - (-4) = 2 + 4 = 6$

→ We can find the distance by doing the number on the right minus the number on the left.

X Find distance between:

a) 3 and 5

b) 6 and -2

c)  $\frac{1}{3}$  and  $\frac{1}{2}$  →  $\frac{1}{2} - \frac{1}{3} = \frac{3}{6} - \frac{2}{6} = \frac{1}{6}$

d) -1.4 and 2.63 →

$$\begin{array}{r} 2.63 \\ + 1.40 \\ \hline 4.03 \end{array}$$

The absolute value of a number is its distance from zero

(4)

Ex a) Absolute value of 3 (written  $|3|$ ) is 3

b) Absolute value of -3 ( $|-3|$ ) is also 3

c)  $|2.34| = 2.34$

d)  $|\frac{-8}{13}| = \frac{8}{13}$

harder example:

If the distance between  $x$  and 2 is 4, what is  $x$ ?

→ we're really solving the absolute value equation

$$|x-2| = 4$$

→ we'll learn this later

→ there are 2 answers:  $x = -2$  and  $x = 6$

interval example:

If Billy's age is at least 25 but less than 32, how can we express this using inequalities?

↳ Denote the age,  $a$

→ at least 25 means  $25 \leq a$

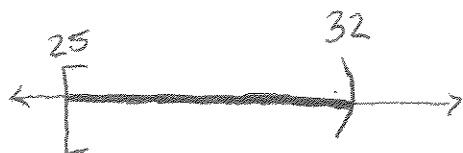
→ less than 32 means  $a < 32$

→ combining gives

$$25 \leq a < 32 \quad \text{or} \quad [25, 32)$$

→ square for  $\leq$   
→ parentheses for  $<$

→ on the real number line



→ This restriction on  $a$  is called an interval.