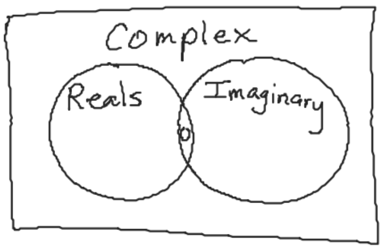
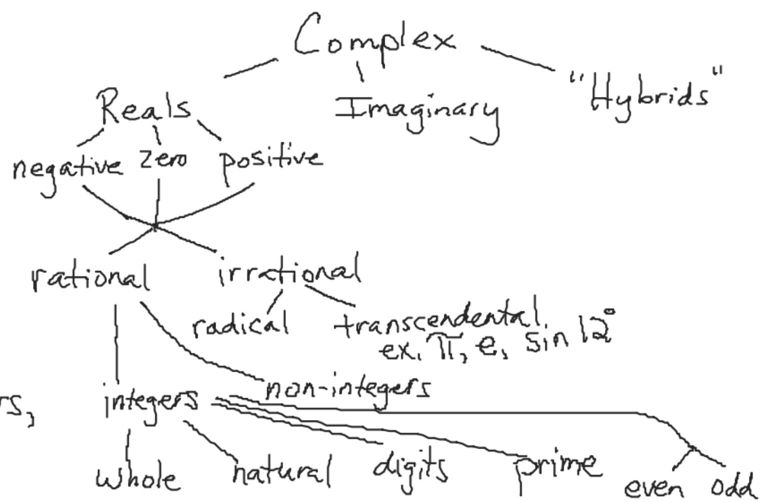
Sets of Numbers

Name some sets of numbers

integers
real
imaginery
prime
odd
even
positive
negative
transcendental
rational
irrational
complex

Let's organize this some . . .





def.

rational - can be expressed as the ratio of two integers, $\frac{a}{b}$ where $b \neq 0$

integer - any whole number or its opposite

whole $= \{0, 1, 2, 3, \ldots\}$

natural or counting $= \{1, 2, 3, \ldots\}$

digits $= \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$

To what sets does the number 5 belong? complex, real, positive, rational, integer, natural, digit, whole, odd, prime

How about the number -1.25? complex, real, negative, rational, non-integer

Name a number that is rational but not an integer and not positive.

ex. -1.25, $-\frac{2}{3}$, $-5.3\overline{64}$, etc.

Field Axioms {real numbers}, addition, multiplication

Closure

- for addition: $a+b$ is a unique real number
- for multiplication: ab " " " " "

Commutativity

- for addition: $a+b = b+a$
- for multiplication: $ab = ba$

Associativity

- for addition: $(a+b)+c = a+(b+c)$
- for multiplication: $(ab)c = a(bc)$

Distributivity

- of multiplication over addition: $a(b+c) = ab + ac$

Identity {real numbers} contains a unique identity element

- for addition, 0: $a + 0 = a$
- for multiplication, 1: $a \cdot 1 = a$

Inverse {real numbers} contains

- for addition: a unique additive inverse: $a + (-a) = 0$ "opposite"
- for multiplication: a unique multiplicative inverse: $a \cdot \left(\frac{1}{a}\right) = 1$ "reciprocal"

{positive integers}, addition, subtraction, mult.

Does the set of positive integers have closure for addition? yes

Does the set of positive integers have closure for subtraction? no

counterexample: $7-12=-5$ and -5 is not a pos. integer

Does the set of positive integers have an identity for addition? no

0 is not a positive integer

Does the set of positive integers have inverses for multiplication? no

Counterex: $5 \cdot x = 1 \rightarrow x = \frac{1}{5}$ but $\frac{1}{5}$ is not a positive integer

Does the set of positive integers form a field? no

Is exponentiation commutative? That is, is $a^b = b^a$?

ex. $2^4 = 16$ yes ... but $2^3 = 8$ $\therefore$ no
$4^2 = 16$ $3^2 = 9$

Which field axiom was used? $\therefore$ means "therefore"

$x + y = y + x$ Commutativity for Addition

$x + y = x + y$ <u>not</u> a field axiom (we'll learn later that this is the Reflexive Axiom)

$x(1) = x$ Identity for Multiplication

$x(a + b) = xa + xb$ Multiplication Distributes over Addition
$= ax + bx$ Commutativity for Multiplication