AP Computer Science A

Java Programming Essentials [Ver. 2.0]

Unit 1: Elementary Programming

WEEK 2: CHAPTER 2 NUMBER SYSTEM (EXTRA MATERIAL)

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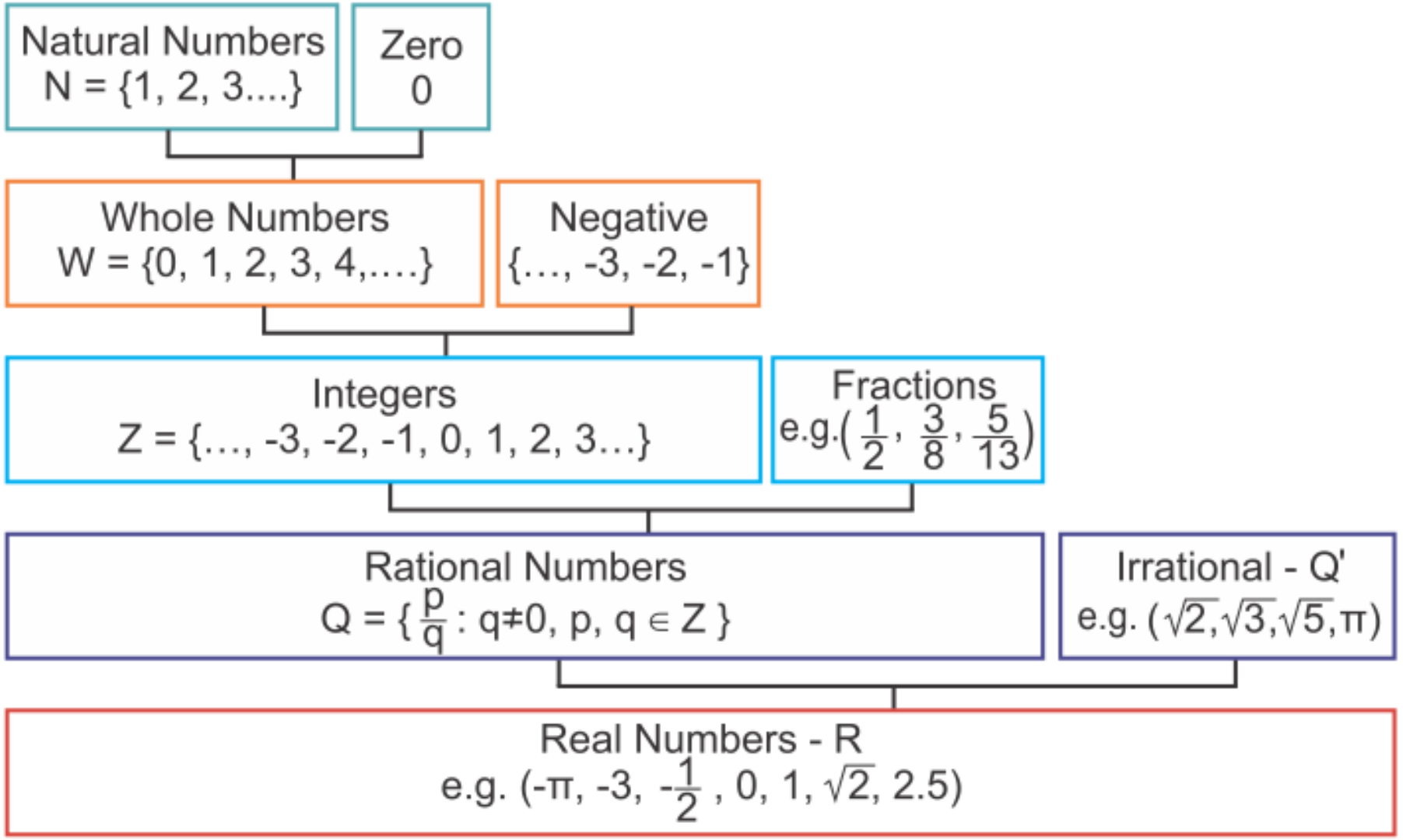
The Number System



Number Line and Properties of Operations

Property	Notation	Description
Closure	a, b ∈ W, then a + b = c ∈ W	If the result obtained from an operation, belongs to the same number set as the operands, then the number set is said to be closed under that operation.
Commutative	a + b = b + a	The order of numbers can be changed without changing the result.
Associative	(a + b) + c = a + (b + c)	The grouping of numbers can be changed without changing the result.
Distributive	a x (b + c) = ab + ac	If a number is multiplied by the sum of two other numbers, then first number can be distributed to both the numbers and multiplied by each number separately and then added without changing the result.

* ∈ means "*belongs to*"; a, b, c belong to the set of whole numbers (W)

Integers

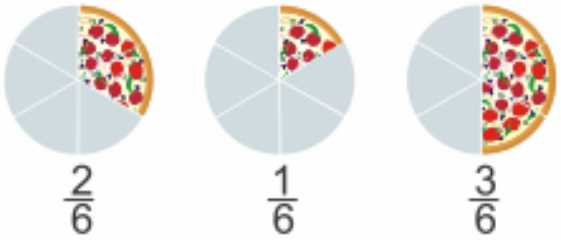
Integers consist of whole numbers and negative numbers.
$Z = \{...., -3, -2, -1, 0, 1, 2, 3,....\}$

Property	Operations on Integers			
Name	**Addition**	**Subtraction**	**Multiplication**	**Division***
Closure	$a + b \in Z$	$a - b \in Z$	$a \times b \in Z$	$a \div b \notin Z$
Commutative	$a + b = b + a$	$a - b \neq b - a$	$a \times b = b \times a$	$a \div b \neq b \div a$
Associative	$(a + b) + c = a + (b + c)$	$(a - b) - c \neq a - (b - c)$	$(a \times b) \times c = a \times (b \times c)$	$(a \div b) \div c \neq a \div (b \div c)$
Distributive	$a \times (b + c) = ab + ac$	$a \times (b - c) = ab - ac$	Not applicable	Not applicable
where $a, b, c \in Z$ (set of integers)				*b is a non-zero integer

Types of Fractions

Types of Fractions

Like



$\frac{2}{6}$ $\frac{1}{6}$ $\frac{3}{6}$

Same Denominator

Unlike

$\frac{1}{2}$ $\frac{2}{3}$ $\frac{3}{4}$

Different Denominators

Equivalent

$\frac{1}{2} = \frac{2}{4} = \frac{3}{6}$

Represents the same amount

Proper

$\frac{3}{4}$

Numerator less than Denominator

Improper

$\frac{7}{4}$

Denominator less than Numerator

Mixed

$1\frac{3}{4}$

Whole number combined with fraction

Addition and Subtraction of Fractions

Addition

Like Fractions

$\frac{2}{6} + \frac{1}{6} = \frac{3}{6} = \frac{1}{2}$

Unlike Fractions

$\frac{1}{2} + \frac{1}{4} = \frac{3}{4}$

Convert to like fractions: LCM of 2 and 4 = 4

$\frac{1}{2} \times \frac{2}{2} + \frac{1}{4} = \frac{2}{4} + \frac{1}{4} = \frac{3}{4}$

Subtraction

Like Fractions

$\frac{3}{4} - \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$

Unlike Fractions

$\frac{1}{2} - \frac{1}{6} = \frac{1}{3}$

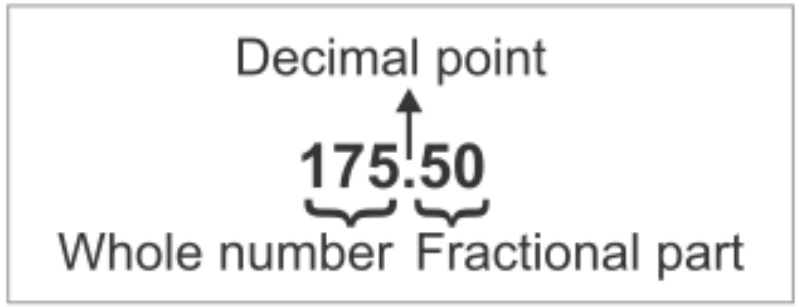
Convert to like fractions: LCM of 2 and 6 = 6

$\frac{1}{2} \times \frac{3}{3} - \frac{1}{6} = \frac{3}{6} - \frac{1}{6} = \frac{2}{6} = \frac{1}{3}$

Fractions with 10 or its multiples as denominator are written as decimals.

Examples: $\frac{1}{10} = 0.1$, $\frac{35}{100} = 0.35$

In a decimal number a point or dot separates the whole number part from the fractional part of the number.



Place Value:

Moving towards the left, each position is ten times bigger

Moving towards the right, each position is ten times smaller

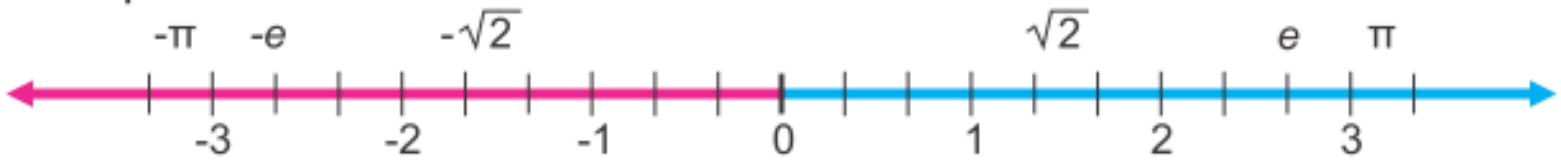
A number of the form $\frac{p}{q}$, where 'p', 'q' are integers and $q \neq 0$.

Property	Operations on Rational Numbers			
Name	**Addition**	**Subtraction**	**Multiplication**	**Division***
Closure	$a + b \in Q$	$a - b \in Q$	$a \times b \in Q$	$a \div b \in Q$
Commutative	$a + b = b + a$	$a - b \neq b - a$	$a \times b = b \times a$	$a \div b \neq b \div a$
Associative	$(a + b) + c = a + (b + c)$	$(a - b) - c \neq a - (b - c)$	$(a \times b) \times c = a \times (b \times c)$	$(a \div b) \div c \neq a \div (b \div c)$
Distributive	$a \times (b + c) = ab + ac$	$a \times (b - c) = ab - ac$	Not applicable	Not applicable

where $a, b, c \in Q$ (set of rational numbers); *b is a non-zero rational number

Irrational Numbers

A number which cannot be represented in the form $\frac{p}{q}$, where 'p', 'q' are integers and $q \neq 0$. An irrational number has a non-terminating and non-repeating decimal representation.



Property	Operations on Irrational Numbers			
Name	**Addition**	**Subtraction**	**Multiplication**	**Division**
Closure	$a + b \notin Q'$	$a - b \notin Q'$	$a \times b \notin Q'$	$a \div b \notin Q'$
Commutative	$a + b = b + a$	$a - b \neq b - a$	$a \times b = b \times a$	$a \div b \neq b \div a$
Associative	$(a + b) + c = a + (b + c)$	$(a - b) - c \neq a - (b - c)$	$(a \times b) \times c = a \times (b \times c)$	$(a \div b) \div c \neq a \div (b \div c)$
Distributive	$a \times (b + c) = ab + ac$	$a \times (b - c) = ab - ac$	Not applicable	Not applicable
where $a, b, c \in Q'$ (set of irrational numbers)				