

# Mathematics for Computing

## Number Sets

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## Blackboard Bold Typeface

- ▶ Conventionally the symbols for numbers sets are written in a special typeface, known as **blackboard bold**.
- ▶ Examples :  $\mathbb{N}$ ,  $\mathbb{Z}$  and  $\mathbb{R}$ .

# Number Sets

## Natural Numbers ( $\mathbb{N}$ )

- ▶ The whole numbers from 1 upwards.
- ▶ The set of natural numbers is

$$\{1, 2, 3, 4, 5, 6, \dots\}$$

- ▶ In some branches of mathematics, 0 might be counted as a natural number.

$$\{0, 1, 2, 3, 4, 5, 6, \dots\}$$

# Number Sets

## Integers ( $\mathbb{Z}$ )

- ▶ The integers are all the whole numbers, all the negative whole numbers and zero.
- ▶ The set of integers is

$$\{\dots, -4, -3, -2, -1, 0, 1, 2, 3, \dots\}$$

- ▶ The notation  $\mathbb{Z}$  is from the German word for numbers: *Zahlen*.
- ▶ All natural numbers are integers.

$$\mathbb{Q} \subset \mathbb{Z}$$

# Number Sets

## Integers ( $\mathbb{Z}$ )

- ▶ Natural numbers may also be referred to as positive integers, denoted  $\mathbb{Z}^+$ .  
(note the superscript)
- ▶ Negative integers are denoted  $\mathbb{Z}^-$ .

$$\{\dots, -4, -3, -2, -1\}$$

# Number Sets

## Integers ( $\mathbb{Z}$ )

- ▶ 0 is neither positive nor negative. The following set of non-negative numbers

$$\{0, 1, 2, 3, 4, 5, 6, \dots\}$$

might be denoted  $0 \cup \mathbb{Z}^+$

- ▶  $\cup$  is the mathematical symbol for **union**.

# Number Sets

## Rational Numbers ( $\mathbb{Q}$ )

- ▶ Rational numbers, also known as quotients, are numbers you can make by dividing one integer by another (but not dividing by zero).
- ▶ If a number can be expressed as one integer divided by another, it is a rational number.

$$\mathbb{Q} = \left\{ \frac{p}{q} \mid p \in \mathbb{Z}, q \in \mathbb{Z}, q \neq 0 \right\}$$

# Number Sets

## Rational Numbers ( $\mathbb{Q}$ )

- ▶ All integers are rational numbers

$$\mathbb{Z} \subset \mathbb{Q}$$

(and by extension all natural numbers are rational numbers too)

- ▶ Examples of rational numbers

$$9500, 7, \frac{1}{2}, \frac{3}{7}, -2.6, 0.001$$



## Irrational Numbers

- ▶ A number that can not be written as the ratio of two integers is known as an irrational number.
- ▶ Two famous examples of irrational numbers are  $\pi$  and  $\sqrt{2}$ .

$$\pi = 3.141592 \dots$$

$$\sqrt{2} = 1.41421 \dots$$

# Number Sets

## Real Numbers ( $\mathbb{R}$ )

- ▶ Irrational numbers are types of real numbers.
- ▶ Rational numbers are real numbers too.

$$\mathbb{Q} \subset \mathbb{R}$$

- ▶ A real number is simply any point anywhere on the number line.

# Number Sets

## Real Numbers ( $\mathbb{R}$ )

- ▶ There are numbers that are not real numbers, for example **imaginary numbers**, but we will not cover them in this presentation.