Mathematics in Computing
4COSC007C

Lecture 3: Supplementary Materials

September Intake 2021

Mathematical Preliminaries : (Natural Numbers -$\mathbb{N}$)

- Whole Numbers

- Whole Numbers are simply the numbers 0, 1, 2, 3, 4, ...

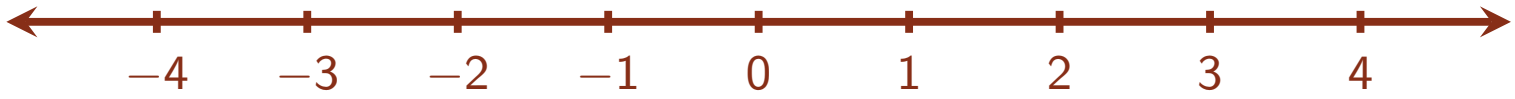
- Counting Numbers

- Counting Numbers are Whole Numbers, without 0.

- Some definitions, begin the natural numbers with 0, corresponding to the non-negative integers 0, 1, 2, 3, ... , whereas others start with 1, corresponding to the positive integers 1, 2, 3, ... In the questions clearly it will be indicated which definition is used.

Mathematical Preliminaries : (Integers -$\mathbb{Z}$)

- Integers are similar to whole numbers, but they also include negative numbers.



- Integers $= \{..., -4, -3, -2, -1, 0, 1, 2, 3, 4, ...\}$
- Negative Integers $= \{..., -4, -3, -2, -1\}$
- Positive Integers $= \{1, 2, 3, 4, ...\}$
- Non-negative Integers $= \{0, 1, 2, 3, 4, ...\}$

Mathematical Preliminaries : (Rational Numbers -$\mathbb{Q}$)

- A rational number is a number that can be in the form $\frac{p}{q}$ where p and q are integers and q is not equal to zero.

p	q	p/q	$p/q =$
1	1	1/1	1
1	2	1/2	0.5
55	100	55/100	0.55
1	1000	1/1000	0.001
253	10	253/10	25.3
7	0	7/0	No! $q \neq 0$!
0	7	0/7	0

Mathematical Preliminaries : (Irrational Numbers-Q′)

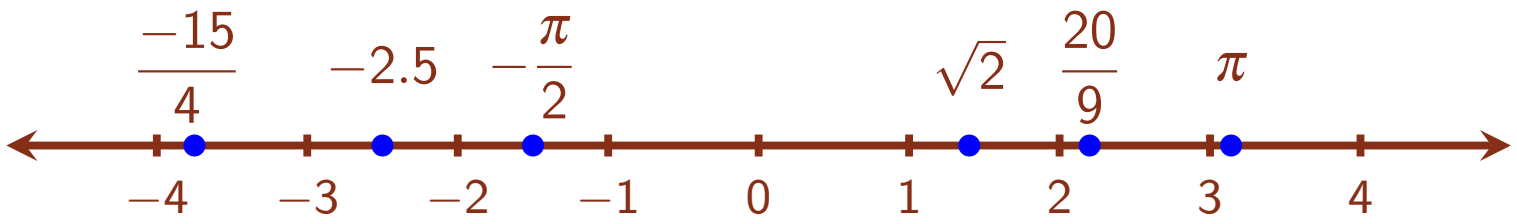
- An irrational number is a number that cannot be in the form $\frac{p}{q}$.

Number	**As a fraction**	**Rational or Irrational?**
1.75	$7/4$	Rational
0.001	$1/1000$	Rational
$\sqrt{3} = 1.732050807568...$	?	Irrational
$\pi = 3.1415926535897...$	?	Irrational

- As of December 2013, the numerical value of $\sqrt{3}$ in decimal has been computed to at least ten billion digits.

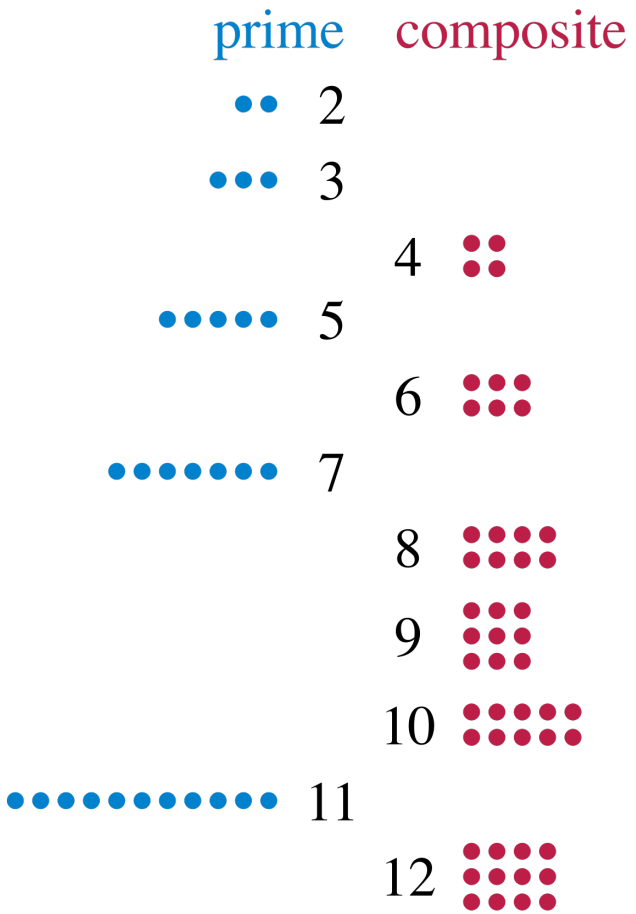
Mathematical Preliminaries : (Real Numbers -$\mathbb{R}$)

- Nearly any number you can think of is a Real Number.



- Real Numbers include:
  - Whole Numbers
  - Rational Numbers
  - Irrational Numbers
  - Integers
  - Natural Numbers.

Mathematical Preliminaries : (Prime Numbers)

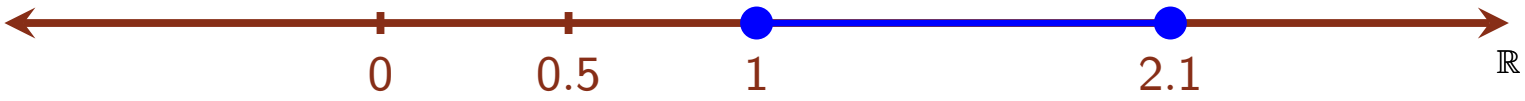


- A whole number greater than 1 that can not be made by multiplying other whole numbers.
- Simply, Prime numbers are numbers that have **only 2 factors: 1 and themselves**.
- 5 is a prime number. We cannot multiply 2, 3 or 4 together to make 5.
- 6 can be made by 2 x 3 so is NOT a prime number.
- All the prime numbers less than 20 is given by the set:

  $\{2, 3, 5, 7, 11, 13, 17, 19...\}$.

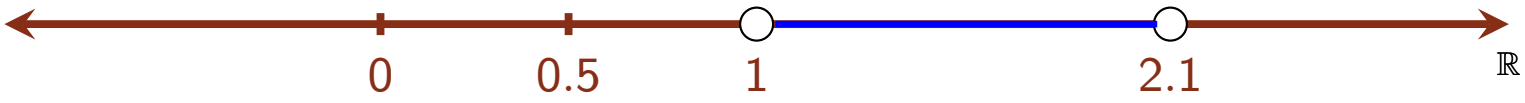
Figure source: `https://en.wikipedia.org/wiki/Composite_number`

Mathematical Preliminaries : (Closed Interval)



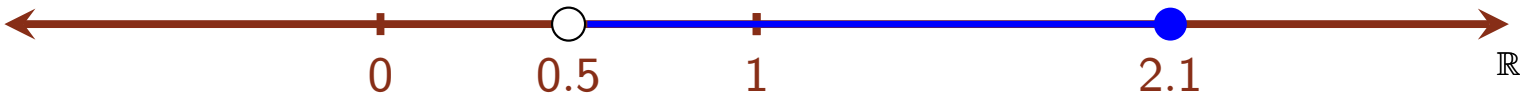
- $1.3 \in [1, 2.1]$
- $1 \in [1, 2.1]$
- $2.1 \in [1, 2.1]$
- $0.5 \notin [1, 2.1]$
- Interval in set builder notation is, $[1, 2.1] = \{x \in \mathbb{R} : 1 \leq x \leq 2.1\}$

Mathematical Preliminaries : (Open Interval)



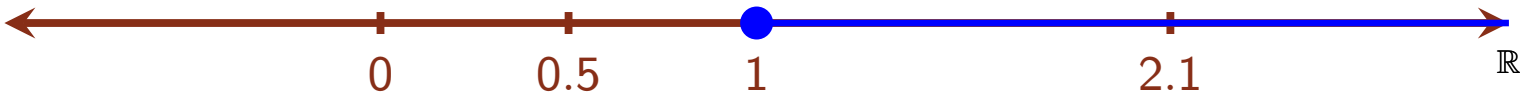
- $1.3 \in (1, 2.1)$
- $1 \notin (1, 2.1)$
- $1.00001 \in (1, 2.1)$
- $2.1 \notin (1, 2.1)$
- Interval in set builder notation is, $(1, 2.1) = \{x \in \mathbb{R} : 1 < x < 2.1\}$

Mathematical Preliminaries : (Half Open Interval)

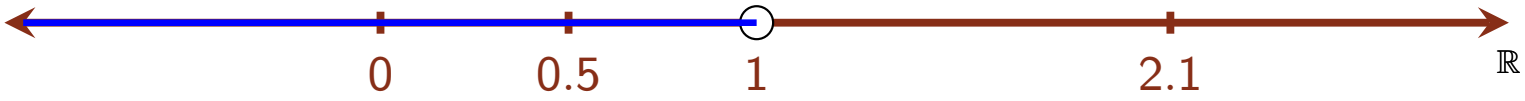


- $0.5 \notin (0.5, 2.1]$
- $0.51 \notin (0.5, 2.1]$
- $2.1 \in (0.5, 2.1]$
- $1 \in (0.5, 2.1]$
- Interval in set builder notation is, $(0.5, 2.1] = \{x \in \mathbb{R} : 0.5 < x \leq 2.1\}$

Mathematical Preliminaries : (Rays)



- Interval in set builder notation is, $[1, \infty) = \{x \in \mathbb{R} : x \geq 1\}$



- Interval in set builder notation is, $(-\infty, 1) = \{x \in \mathbb{R} : x < 1\}$

Mathematical Preliminaries : (Equality vs Inequality)

- Solving an equality gives you a number:

$$x + 5 = 10 \Rightarrow x = 5$$

- Solving an inequality give you an interval:

$$1 \leq x + 5 < 10 \Rightarrow -4 \leq x < 5 \Rightarrow x \in [-4, 5)$$


THANK YOU
Any Questions?