Math 2550-03

1/25/24

Topic 0 - Sets

Def: A set is a collection of objects. The objects in the set are called the elements of the set.

If S is a set and x is an element of the set S, then we write $x \in S$.

read: "x is in S"

If x is not in the set S then we write $x \notin S$

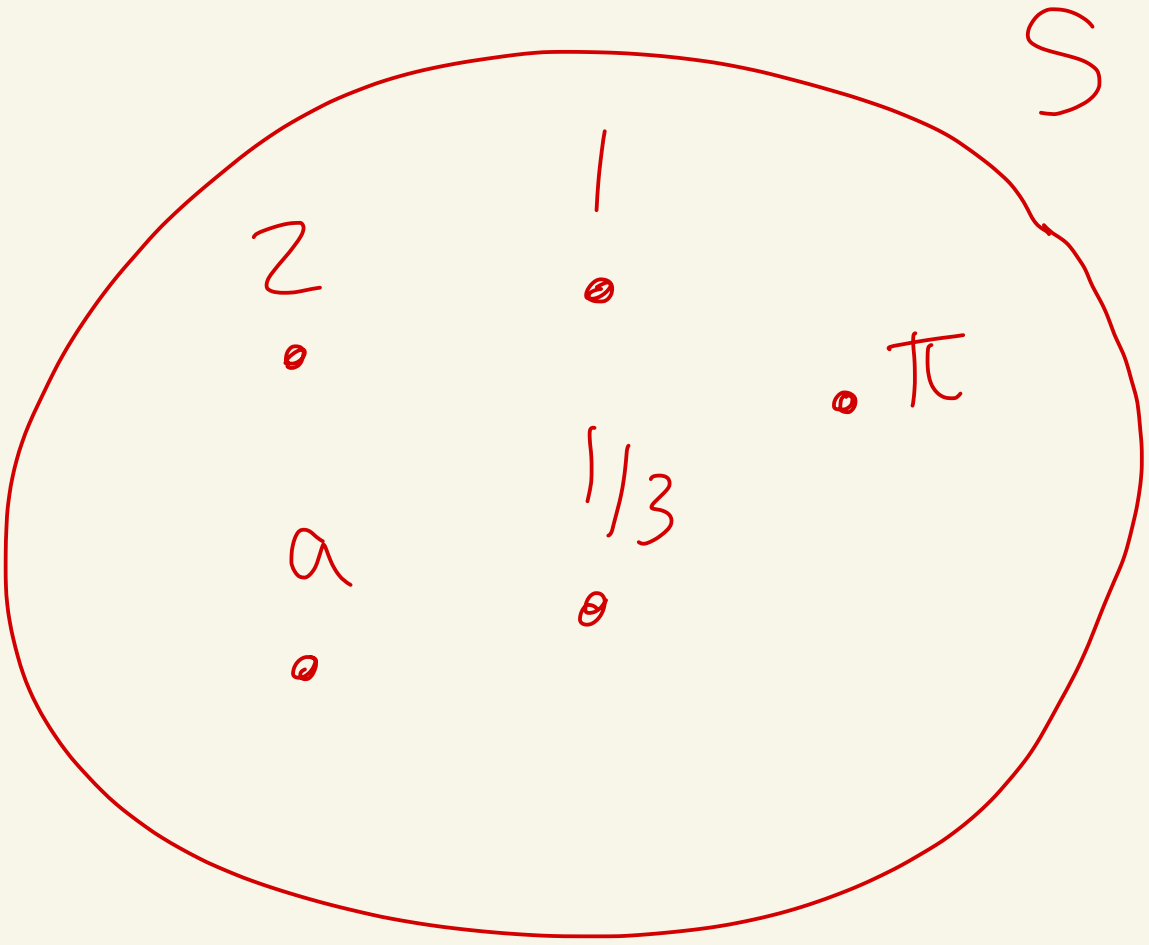
read: "x is not in S"

Ex: $S = \{2, 1, a, \frac{1}{3}, \pi\}$

$2 \in S$

$\pi \in S$

$6 \notin S$

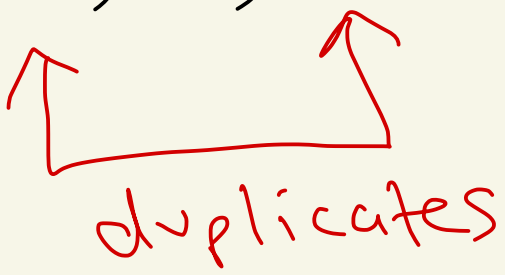


Note: In a set, order doesn't matter. So, for example

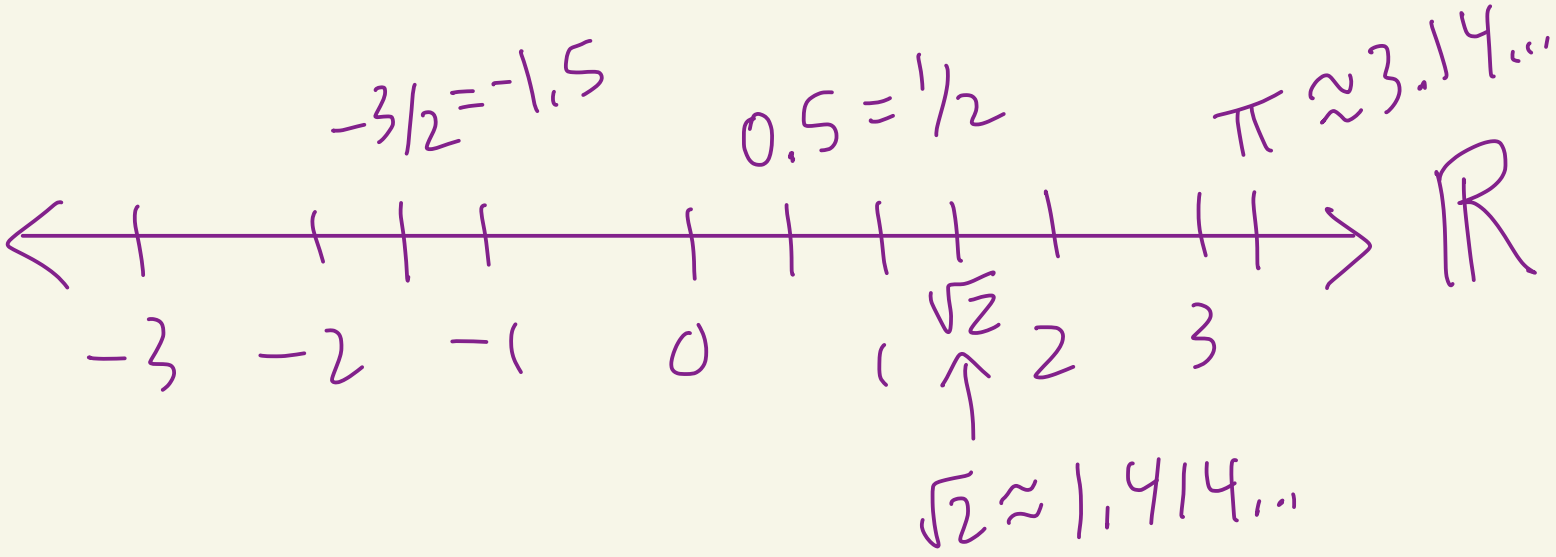
$$\{2, 1, a, \frac{1}{3}, \pi\} = \{\pi, a, 2, 1, \frac{1}{3}\}$$

Note: You can't have duplicates in a set.

So, $\{5, \pi, 5, 2\}$ is not a set.



Ex: $\mathbb{R}$ denotes the set of real numbers. That is the numbers with decimal expansions, ie the number line.



$i \notin \mathbb{R}$ ← $i = \sqrt{-1}$

$\pi \in \mathbb{R}$

$1 \in \mathbb{R}$

$-3/2 \in \mathbb{R}$

Notation:

$x, y \in S$ means $x \in S$ and $y \in S$

read: "x and y are in S"

Ex: $\pi, 1 \in \mathbb{R}$

means: $\pi \in \mathbb{R}$ and $1 \in \mathbb{R}$

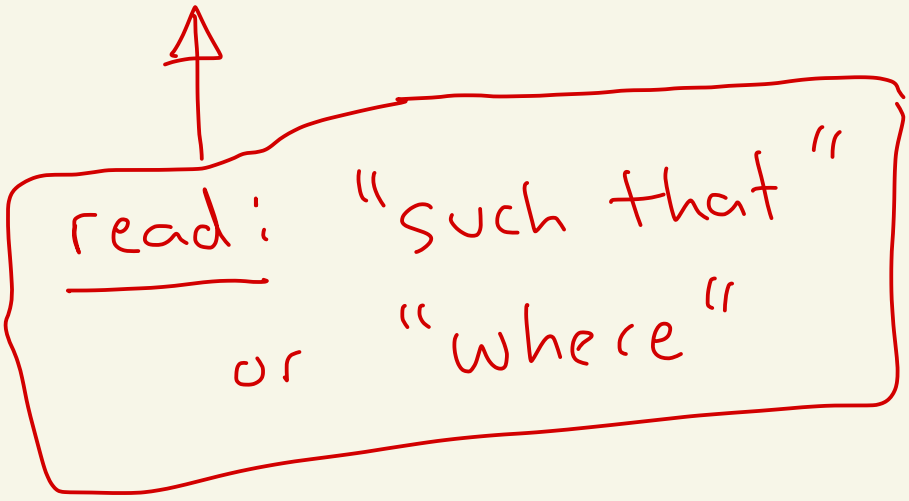
Ex: $0, 1, \frac{1}{2}, \sqrt{2} \in \mathbb{R}$

means: $0 \in \mathbb{R}$, $1 \in \mathbb{R}$,

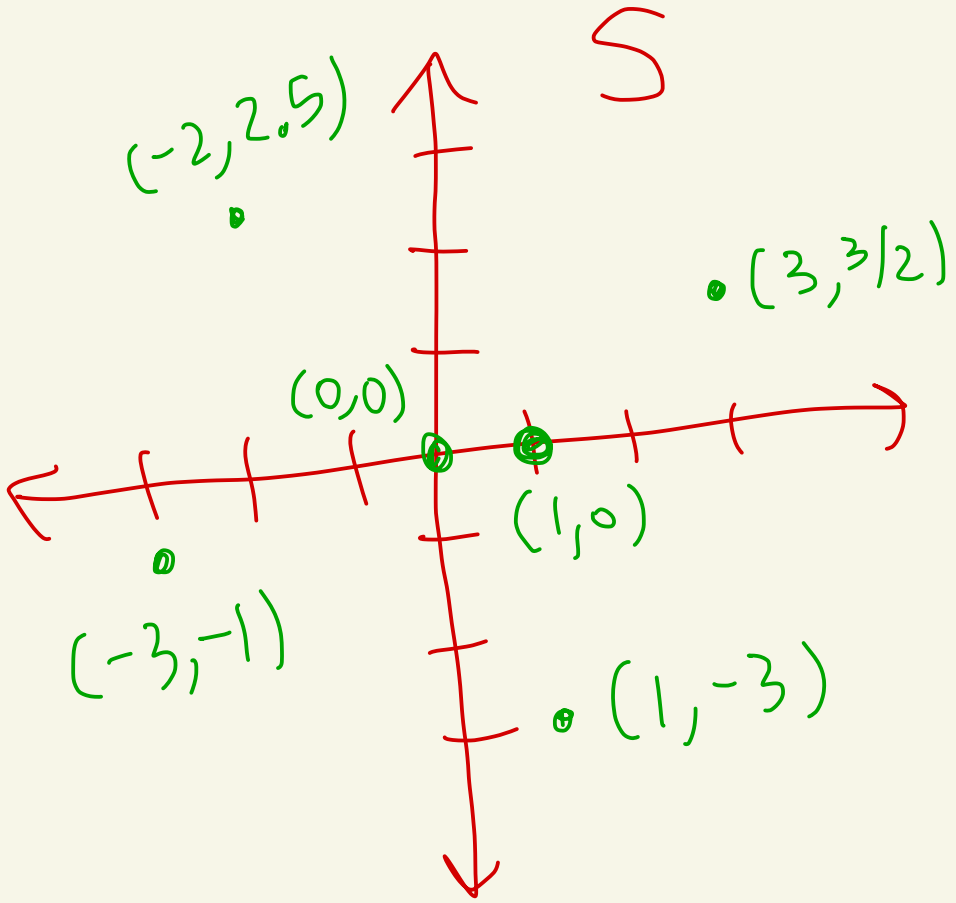
$\frac{1}{2} \in \mathbb{R}$, $\sqrt{2} \in \mathbb{R}$

General way to define a set

$$\{ \text{description of what the elements look like} \mid \text{conditions that the elements must satisfy to be in the set} \}$$



Ex: Let's describe the xy-plane using this notation.



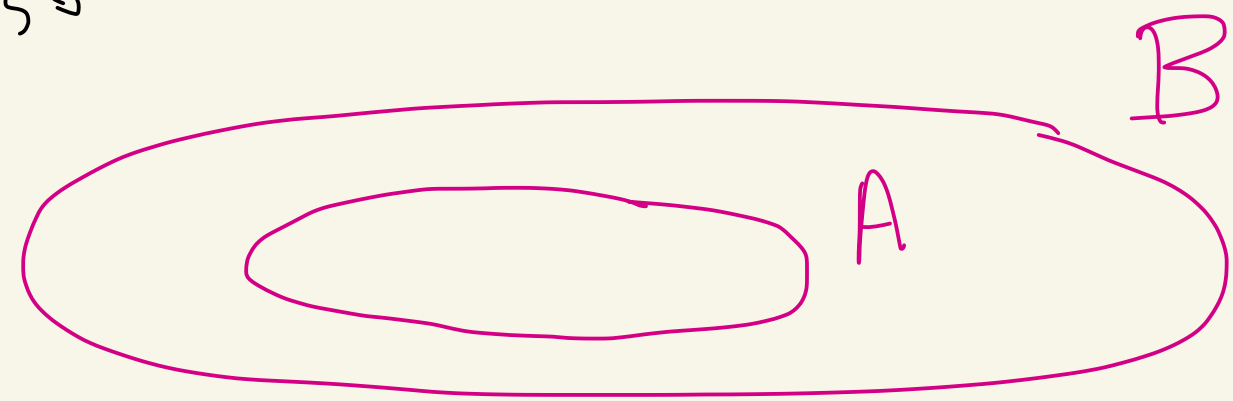
$$S = \{(x,y) \mid x \text{ and } y \text{ are real \#s}\}$$

$$= \{(x,y) \mid x, y \in \mathbb{R}\}$$

read: S consists of all (x,y) where x and y are real #s

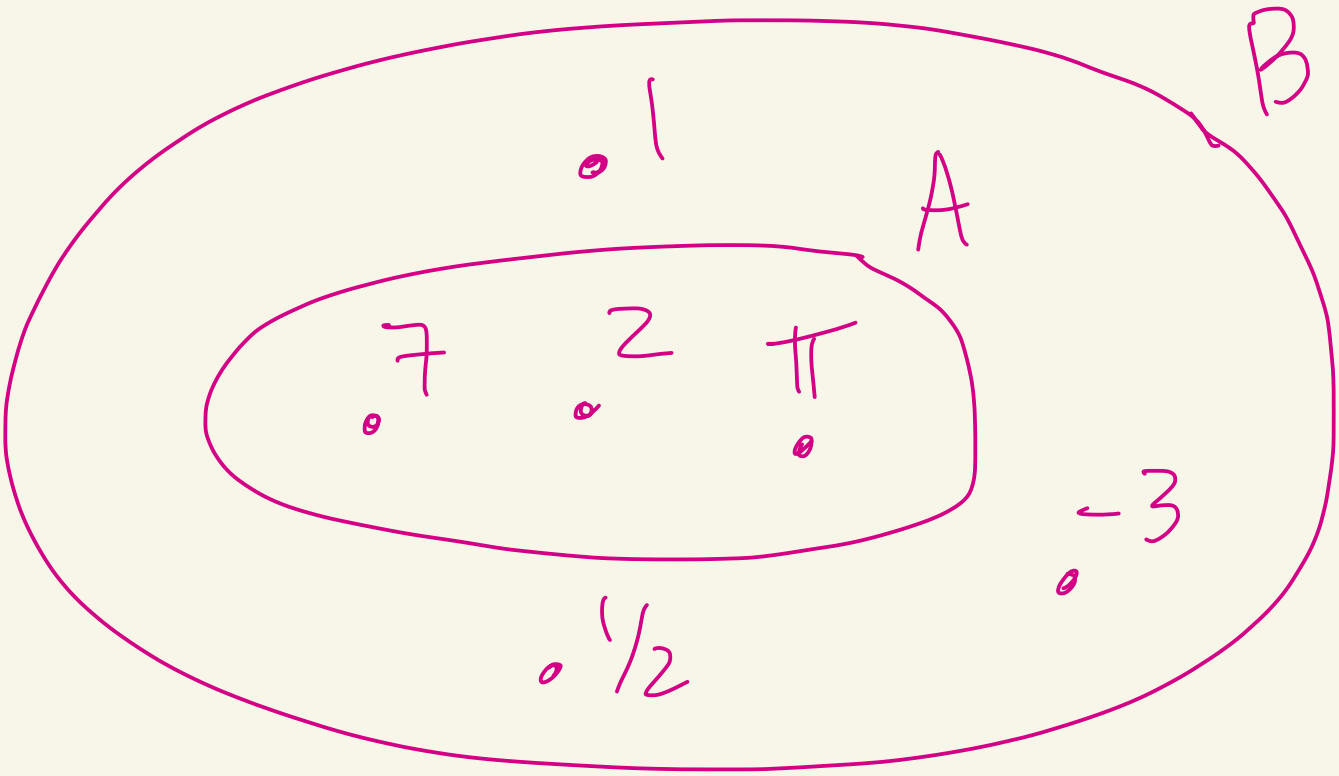
Def: The *empty set*, denoted $\emptyset$ or $\{\}$, is defined to be the set with no elements.

Def: Let A and B be sets. We say that A is a *subset* of B, and write $A \subseteq B$, if every element of A is also an element of B.



Ex: $A = \{7, 2, \pi\}$

$B = \{2, 1, -3, 7, \frac{1}{2}, \pi\}$



We have $A \subseteq B$