Elements

Sets

Common sets

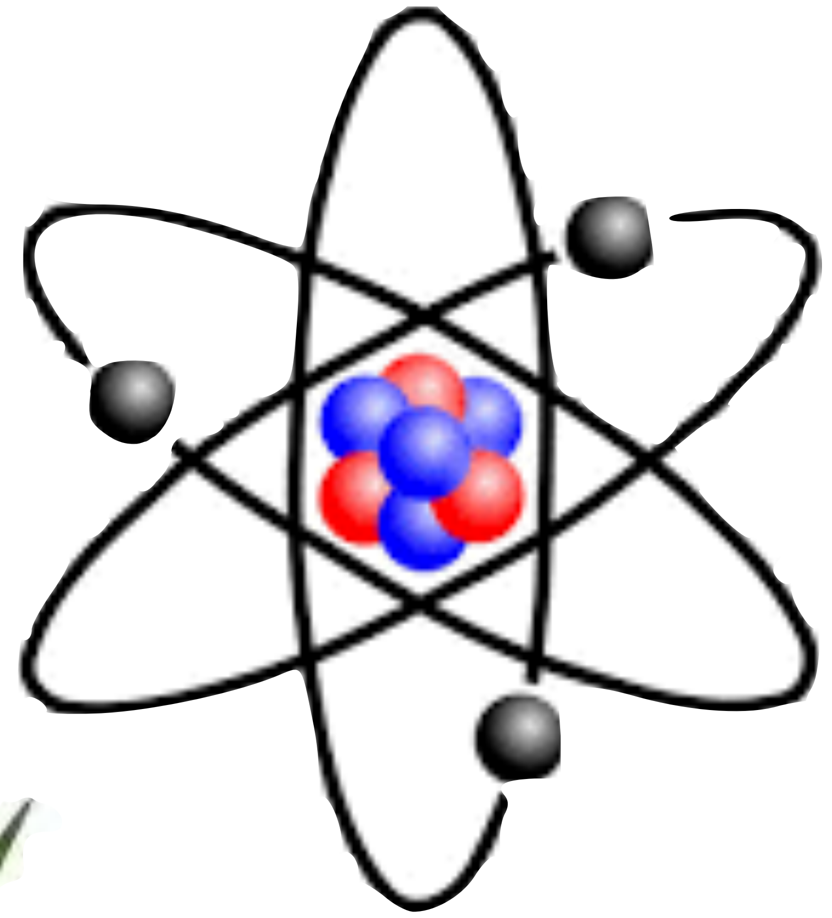
Membership

Empty & universal sets

set Notation

Elements

Foundations, building blocks of sets



Lithium

Can be anything

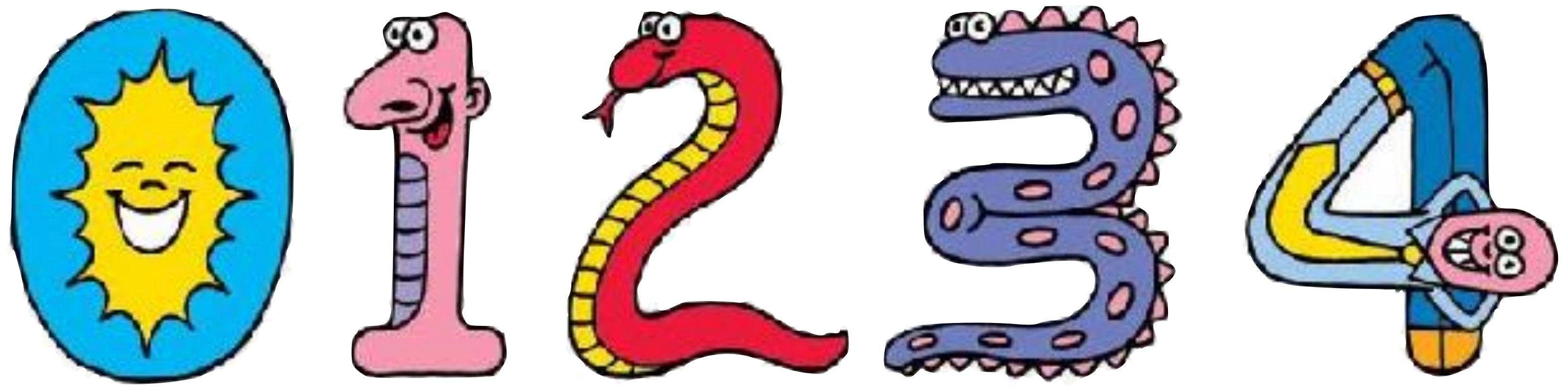
Messi

Google

Aspirin

Structured

Numbers



→ 0 1 2 3 4

Elements to Sets

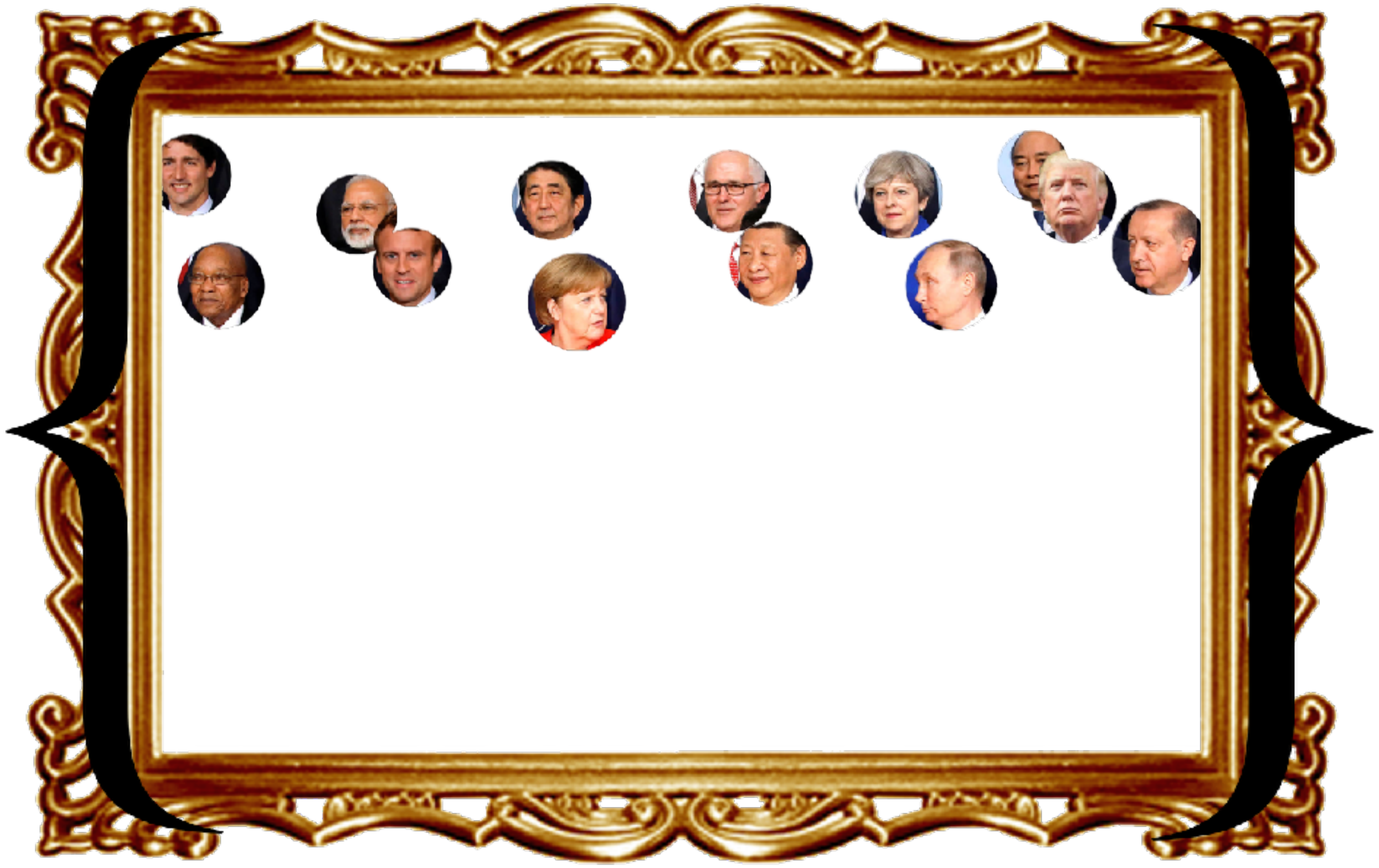
Beyond individual elements

"Bigger picture"

= set

Set Collection of elements

Define specify elements



Specification

Explicit	Coin	{ heads, tails }	
	Bits	{ 0, 1 }	
	Die	{ 1, 2, 3, 4, 5, 6 }	
Implicit	Digits	{ 0, 1, …, 9 }	
	Letters	{ a, b, …, z }	
	Days	{ Monday, …., Sunday}	
Descriptive	{four-letter words} = {love, like, dear ,…}		

More

Compact ✅

Expressive ✅

Ambiguous ⚠️

Common Sets

Integers $\{ \ldots, -2, -1, 0, 1, 2, \ldots \}$ $\mathbb{Z}$

Naturals $\{ 0, 1, 2, \ldots \}$ $\mathbb{N}$

Positives $\{1, 2, 3, \ldots \}$ $\mathbb{P}$

Rationals { integer ratios m/n, $n \neq 0$ } $\mathbb{Q}$

Reals { … Google … } $\mathbb{R}$

Mnemonic

Zahl - number

CONVENIENT
CONVENTION

Sets UPPER CASE A

Elements lower case a

Membership

If element x is in a set A, it is a member of, or belongs to A, denoted $x \in A$

$0 \in \{0,1\}$ $1 \in \{0,1\}$ $\pi \in \mathbb{R}$

Equivalently, A contains x, written $A \ni x$

$\{0,1\} \ni 0$ $\{0,1\} \ni 1$ $\mathbb{R} \ni \pi$

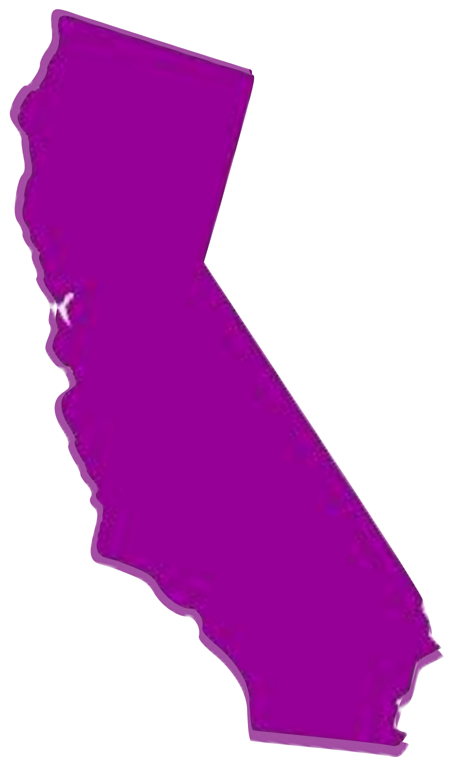
If x is not in A, then x is not a member, or does not belong to A, denoted $x \notin A$

$2 \notin \{0,1\}$ $\pi \notin \mathbb{Q}$

Equivalently, A does not contain x, $A \not\ni x$

$\{0,1\} \not\ni 2$ $\mathbb{Q} \not\ni \pi$

Set of United States

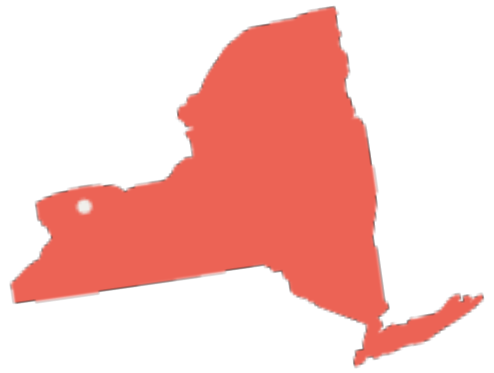


$\in$

$\notin$

$\in$

$\notin$



$\in$

$\notin$

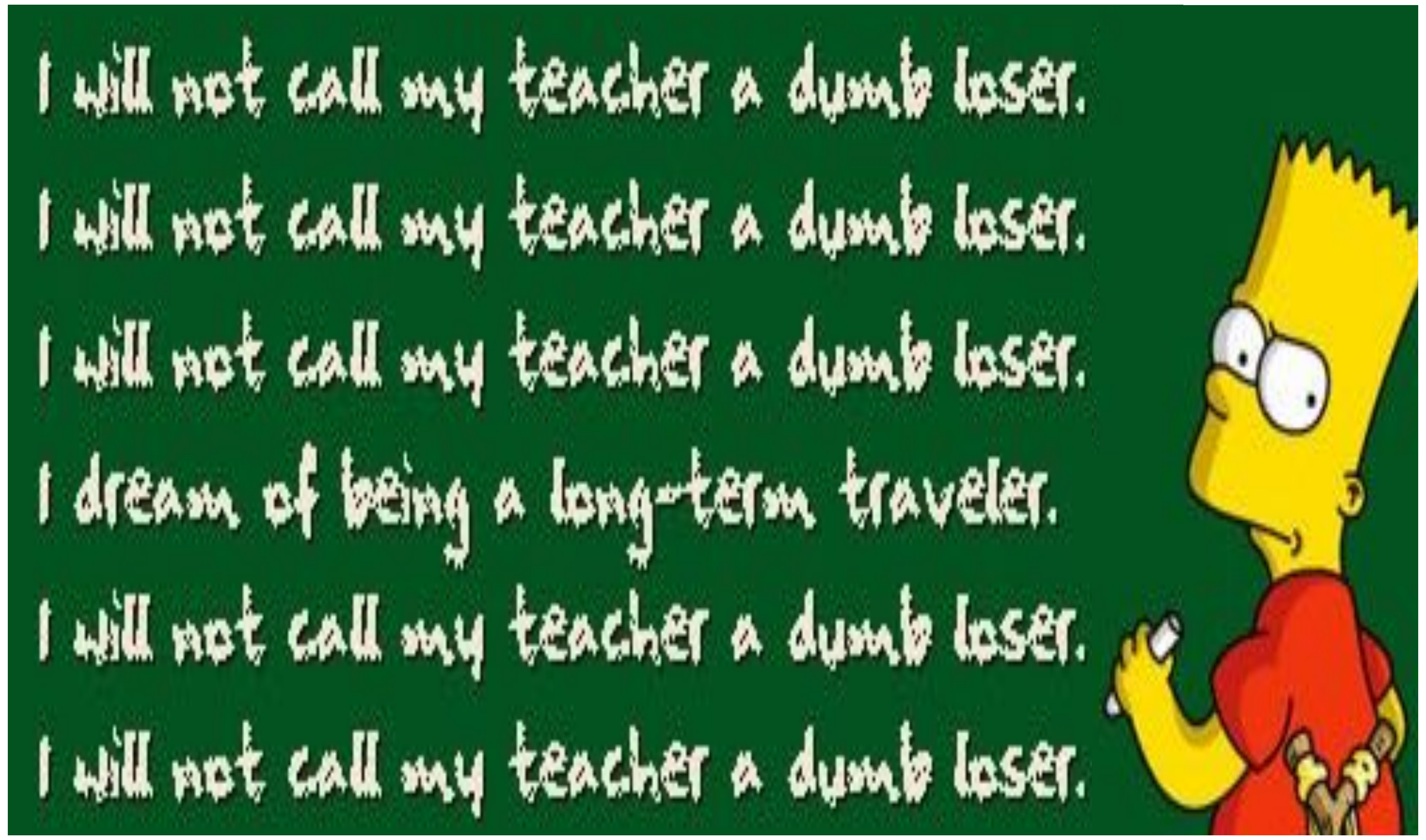
$\in$

$\notin$

Doesn't Matter

Order $\{0, 1\} = \{1, 0\}$

Repetition $\{0,1\} = \{0,1,1,1\}$



Order matters: use ordered tuples $(0,1) \neq (1,0)$

Repetition matters: use multisets, or bags

Special Sets

Empty set | contains no elements | $\varnothing$ or $\{\,\}$ | $\forall x, x \notin \varnothing$ | $\forall$ - All, every

Universal set | all possible elements | Ω | $\forall x, x \in \Omega$

Ω lets us consider only relevant elements

$\Omega = \mathbb{Z}$

integers

"prime"

Means

2, 3, 5,…

Not

amazon Prime

Ω depends on application

temperature
$\Omega = \mathbb{R}$

text
$\Omega = \{\text{words}\}$

Only one $\varnothing$

set with no elements

Sets

Set Definition

Define a set

{…} or **set({…})**

```
Set1 = {1,2}
print(Set1)
{1,2}
```

```
Set2 = set({2,3})
print(Set2)
{2,3}
```

For empty set

use only **set()** or **set({})**

```
Empty1 = set()
type(Empty1)
set
print(Empty1)
set{}
```

```
Empty2 = set({})
type(Empty2)
set
print(Empty2)
set{}
```

```
NotASet = {}
type(NotASet)
dict
```

{} is not an empty set

Membership

$\in$ **`in`**

```
Furniture = {'desk','chair'}
'desk' in Furniture
True
'bed' in Furniture
False
```

$\notin$ **`not in`**

```
Furniture = {'desk','chair'}
'desk' not in Furniture
False
'bed' not in Furniture
True
```

Testing if Empty, Size

Test empty

`not`

```
S = set()
not S
True
```

```
T = {1,2}
not T
False
```

Size

`len()`

```
print(len(S))
0
```

```
print(len(T))
2
```

Check if size is 0

`len()==0`

```
print(len(S)==0)
True
```

```
print(len(T)==0)
False
```

set Notation

Elements

Sets

Common sets $\mathbb{Z}$ $\mathbb{N}$ $\mathbb{P}$ $\mathbb{Q}$ $\mathbb{R}$

Membership $\in$ $\notin$

Empty set $\varnothing$

Universal set Ω