Generalize numbers

Equality

Intersection

Subsets

set Relations

Relation Types

Human relations

Number relations

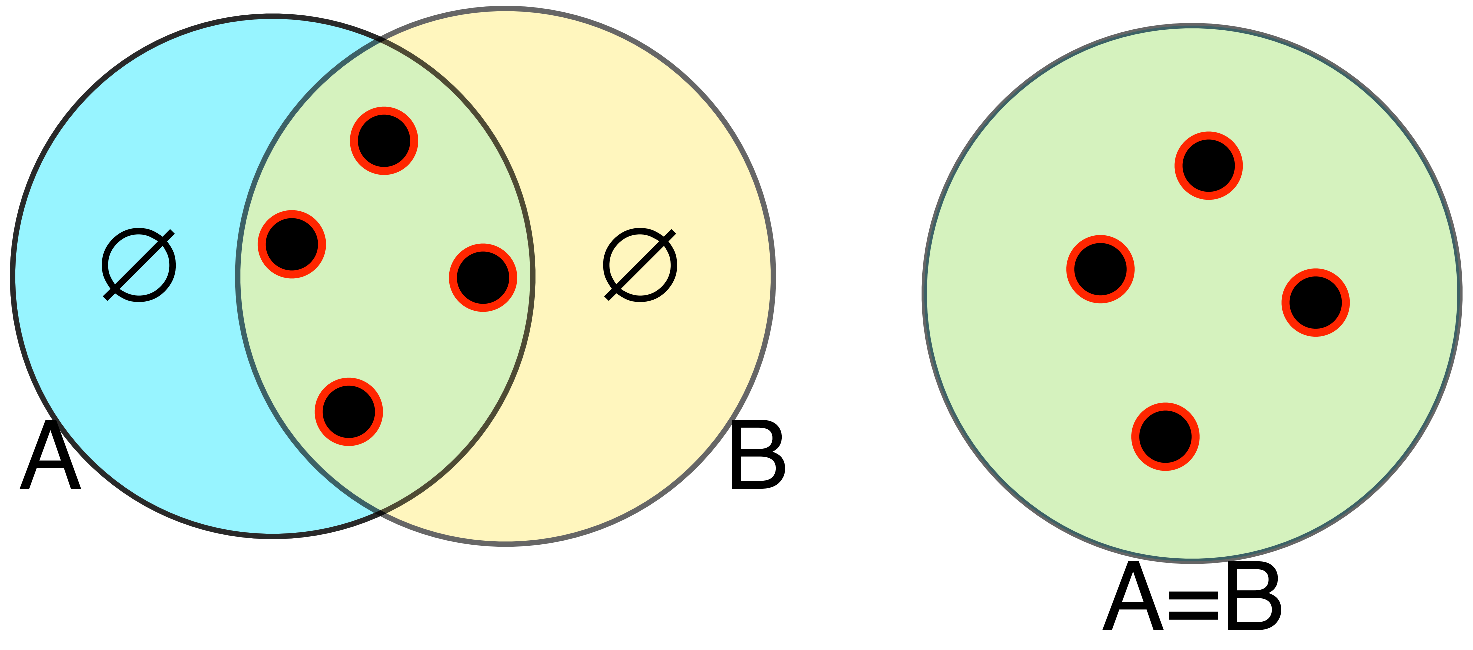
$=$ $\leq$ $<$

Generalize to sets

All men are created equal

generalize = of numbers

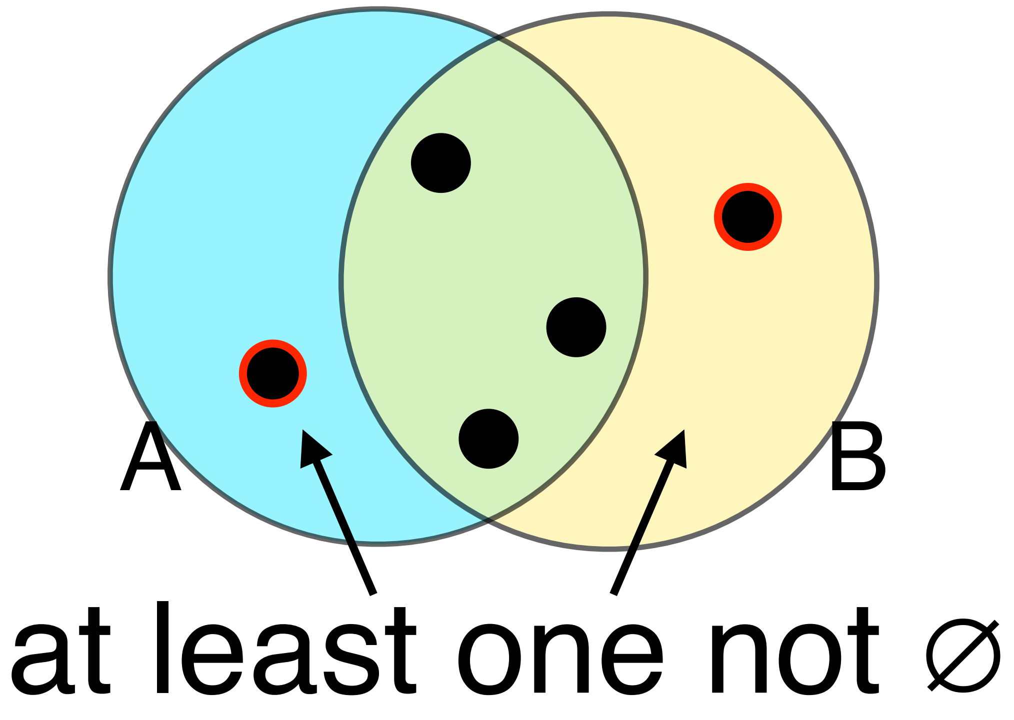
Sets A and B are equal, denoted A = B, if they have exactly the same elements



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

All sets are not created equal

If A and B are not equal, they are different, denoted $A \neq B$



$\{0,1\} \neq \{1,2\}$

Equality QUIZ

What does set equality have in common with trust?

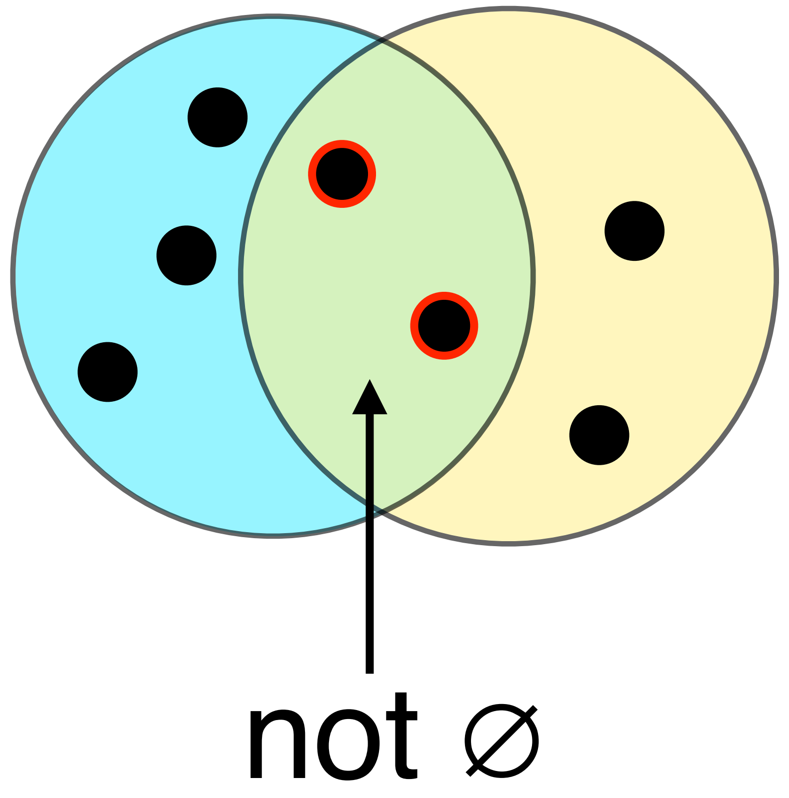
= All elements must be identical $\{1,2,4\} = \{4,1,2\}$

≠ One different element enough $\{1,2,4\} \neq \{1,2,4,8\}$

Intersection

Two sets **intersect** if they share at least one common element

$\exists x$
$x \in A \wedge x \in B$



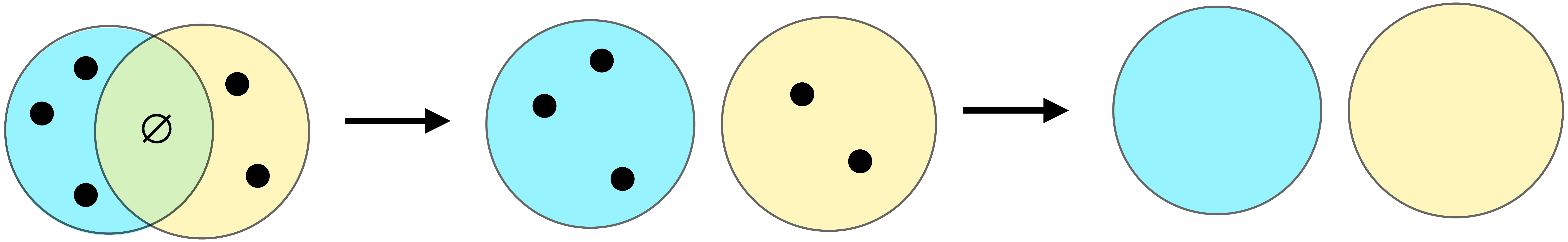
{0,1} {1,2} (1)   [3,4] [2,5] (3.5,..)

Two sets are **disjoint** if they share no elements

$\neg \exists x$
$x \in A \wedge x \in B$

Notætion
Mutually Exclusive

{0,1} {2,3}   [3,4] (4,5]

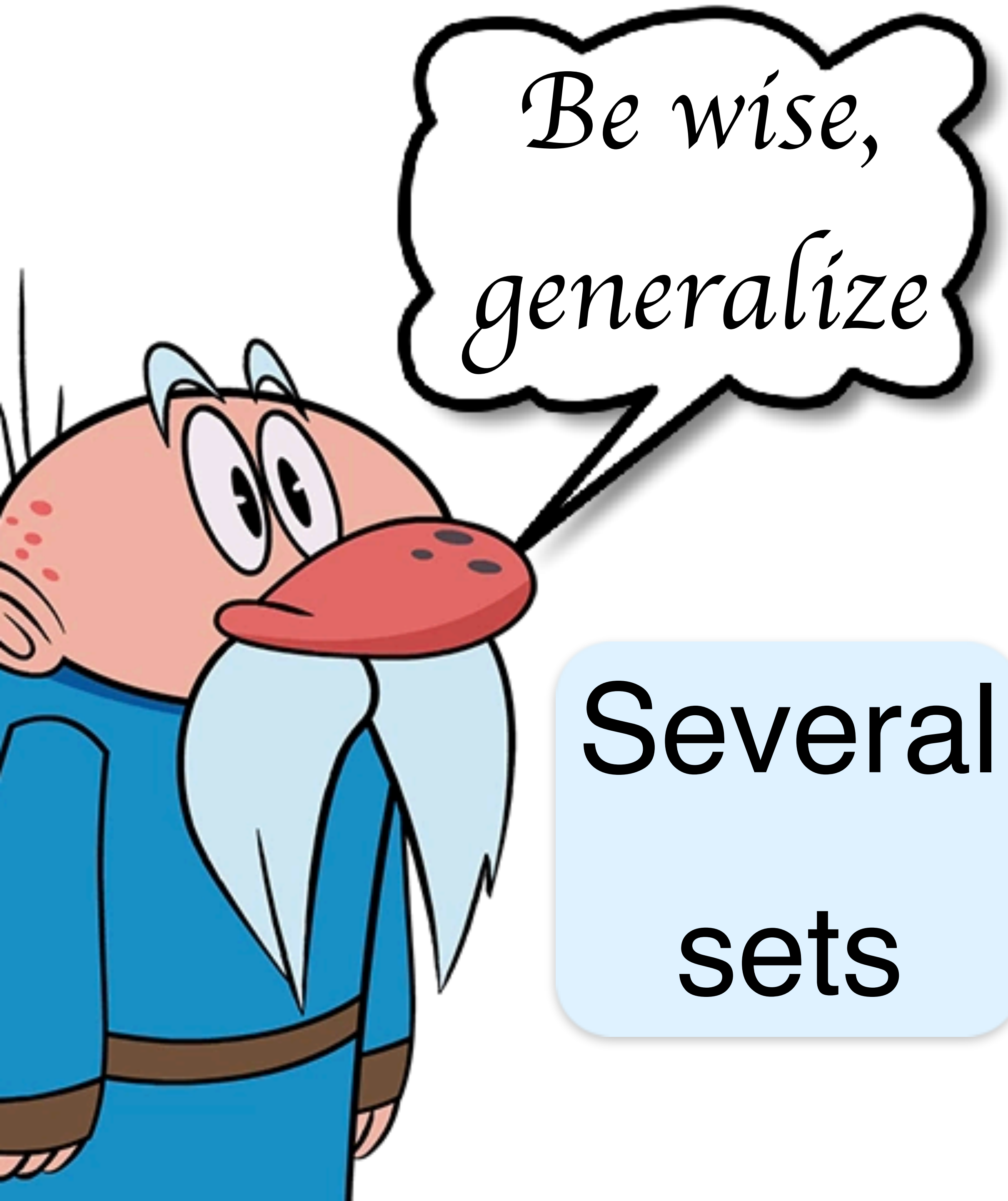


Intersection

∅ disjoint from any set

Non-empty Ω intersects every set

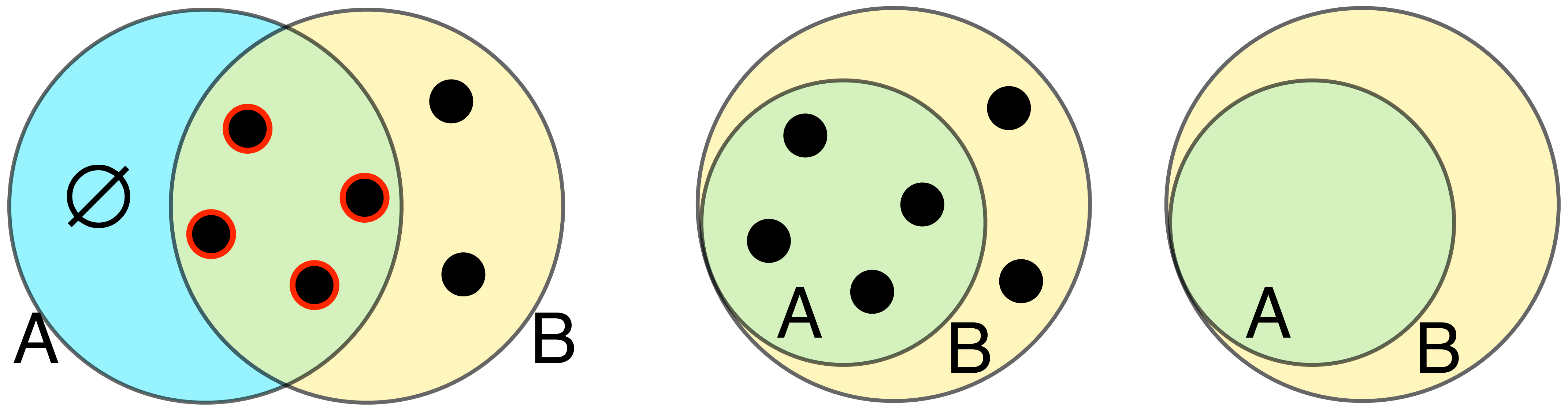
A set intersects itself iff it is non-empty



Several sets	
	intersect if all share a common element
	mutually disjoint if every two are disjoint

Subsets

generalize $\leqslant$



If every element in A is also in B, then A is a **subset of** B, denoted $A \subseteq B$

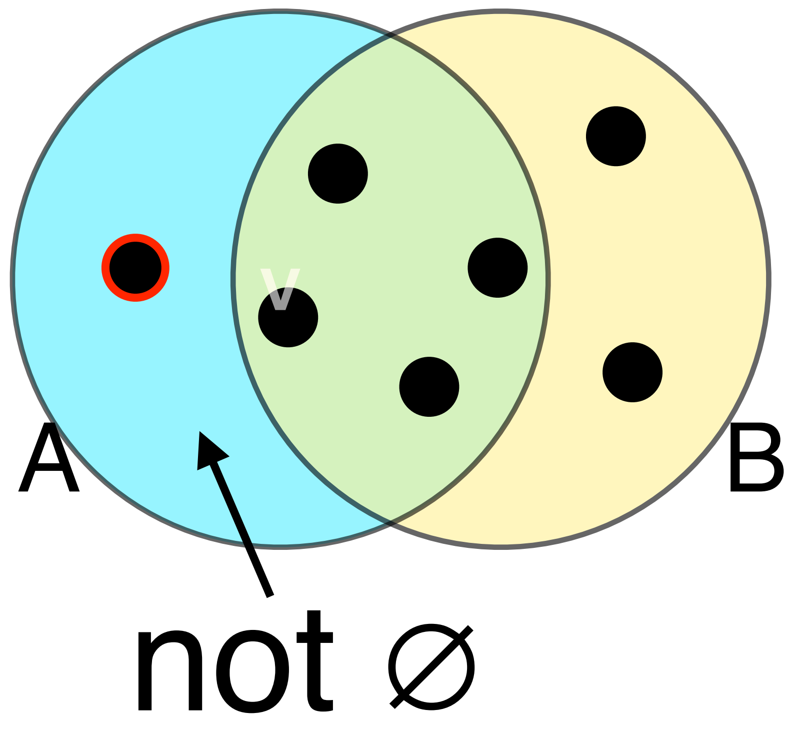
$\{0\} \subseteq \{0,1\}$

$\{0\} \subseteq \{0\}$

Equivalently, B is a **superset** of, or contains, A, denoted $B \supseteq A$

$\{0,1\} \supseteq \{0\}$

If A has an element that's not in B, then A is **not a subset** of B, denoted $A \nsubseteq B$, or $B \nsupseteq A$

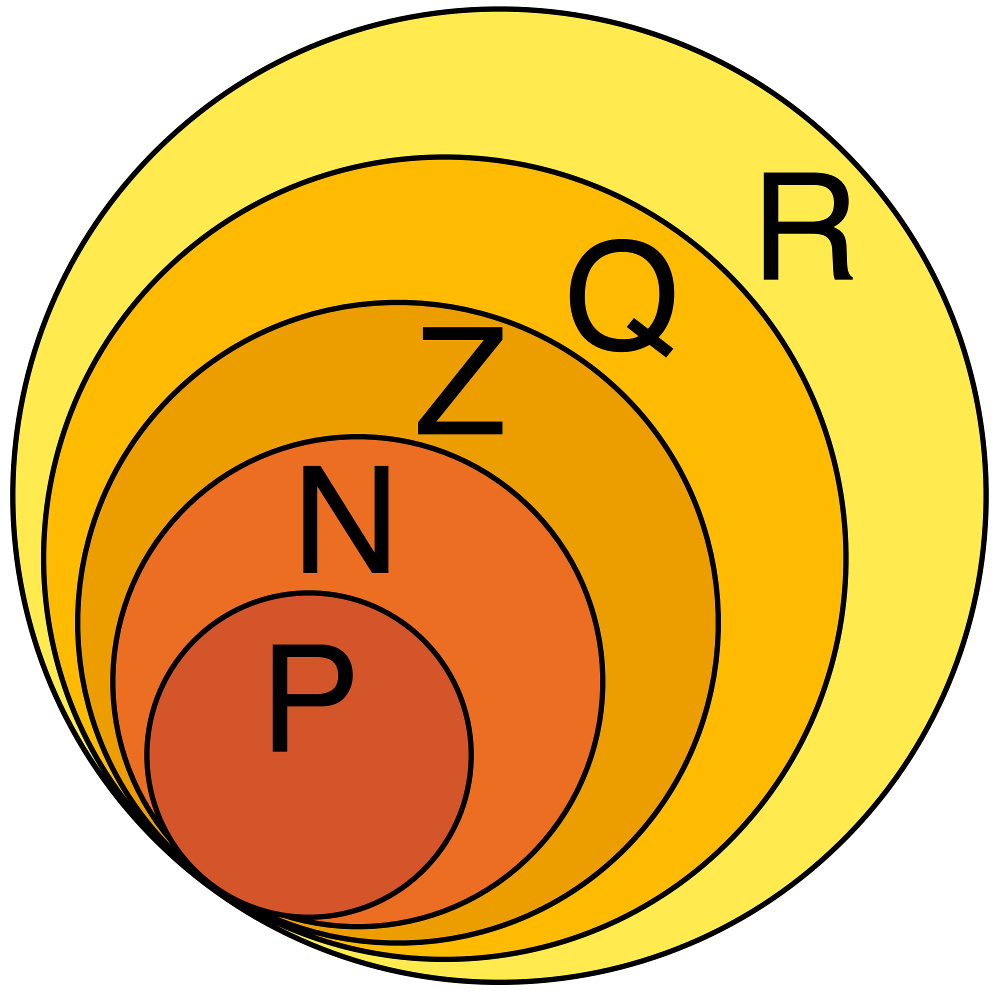


$\{0,1\} \nsubseteq \{1,2\}$

$\{1,2\} \nsupseteq \{0,1\}$

Subsets

$P \subseteq N \subseteq Z \subseteq Q \subseteq R$

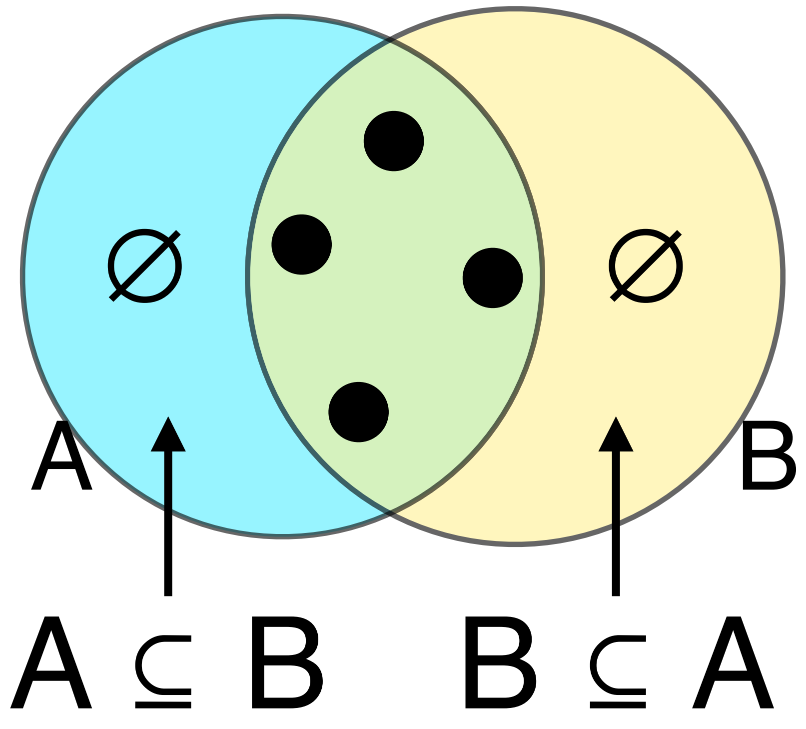


$\varnothing \subseteq A \subseteq A \subseteq \Omega$

$A \subseteq B$ and $B \subseteq C \rightarrow A \subseteq C$

$\subseteq$ is transitive

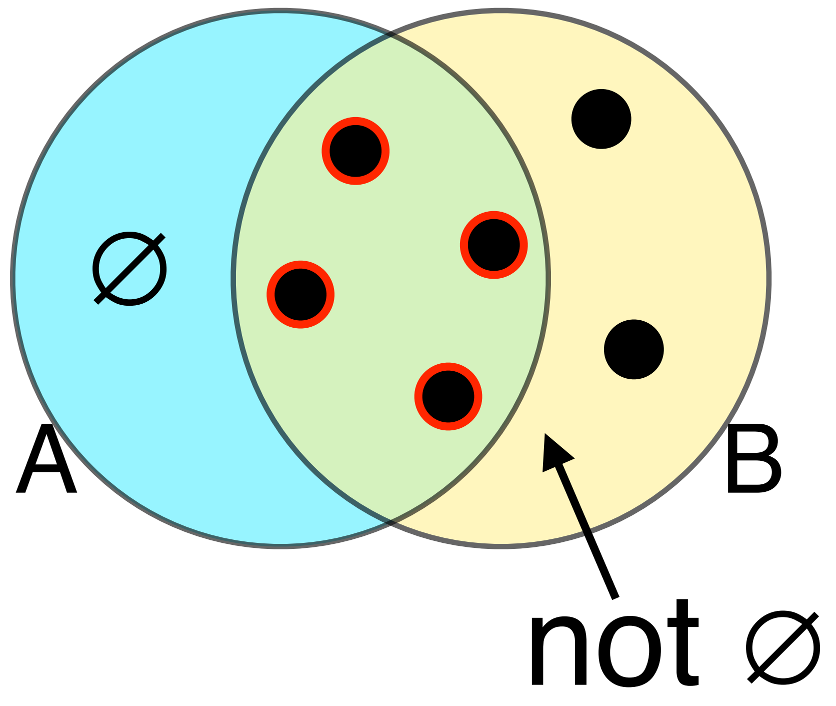
$A \subseteq B$ and $B \subseteq A \rightarrow A = B$



Strict Subsets

generalize <

If $A \subseteq B$ and $A \neq B$, A is a strict subset of B, denoted $A \subset B$, and B is a strict superset of A, denoted $B \supset A$



$\{ 0 \} \subset \{ 0, 1 \}$

$\{ 0,1 \} \supset \{ 0 \}$

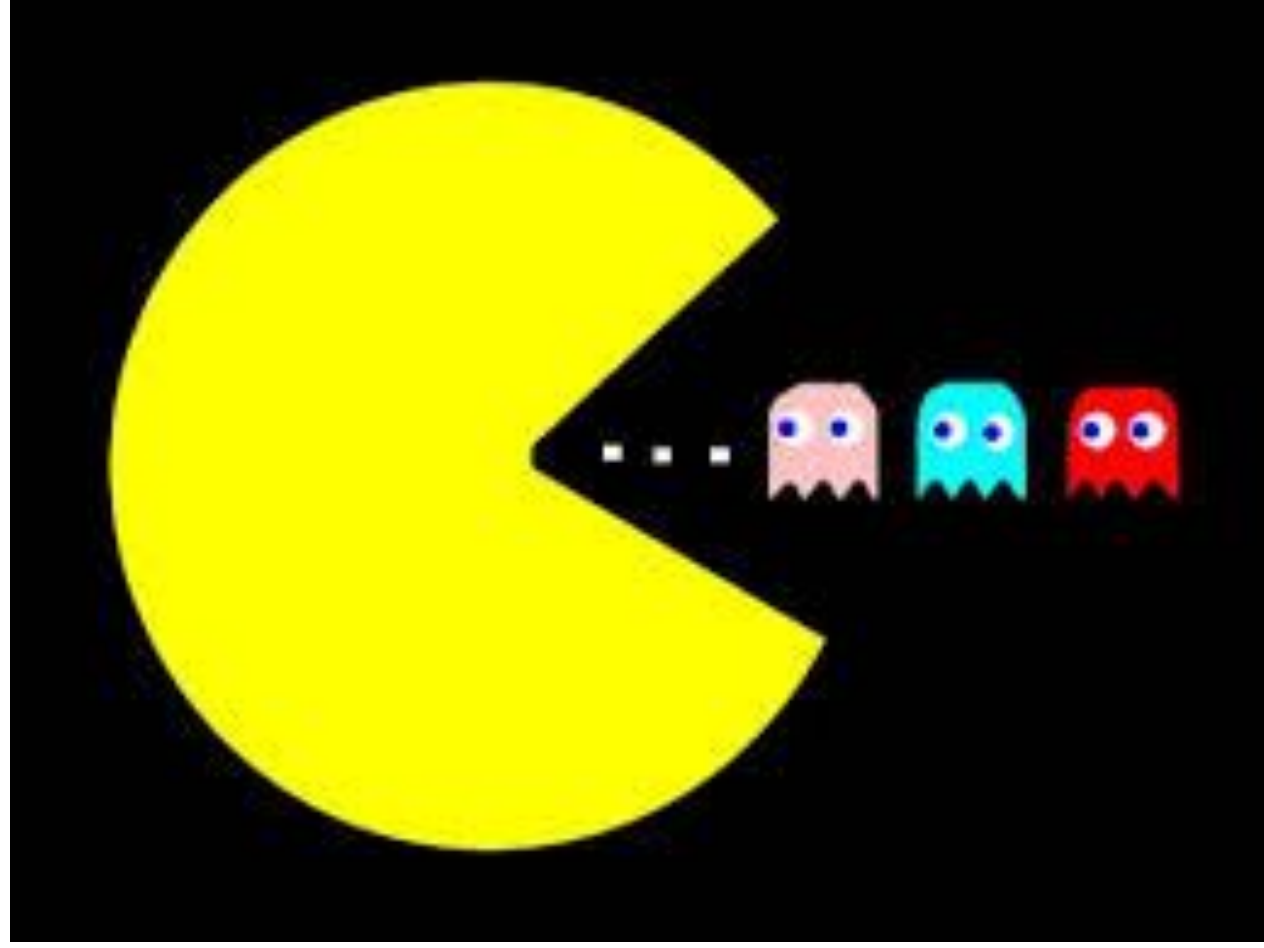
If A is not a strict subset of B, we write $A \not\subset B$ or $B \not\supset A$

Two possible reasons

$A \not\subseteq B$ $\{ 0 \} \not\subset \{ 1 \}$

$A = B$ $\{ 0 \} \not\subset \{ 0 \}$

belongs to $\in$ **VS.** $\subseteq$ subset of



$\in$ Relation between an element and a set

$x \in A$: element x belongs to, or is contained in, set A

{0,1} has two elements: 0 and 1

$\boxed{0 \in \{0,1\}}$ $\boxed{0 \in \{0,1\}}$ $\boxed{\{0\} \notin \{0,1\}}$

$\subseteq$ Relation between two sets

$A \subseteq B$: set A is a subset of set B

{0,1} two elements: 0 and 1

{0} one elt: 0

$\boxed{\{0\} \subseteq \{0,1\}}$

0 is an element of {0,1}, but 0 is not a set

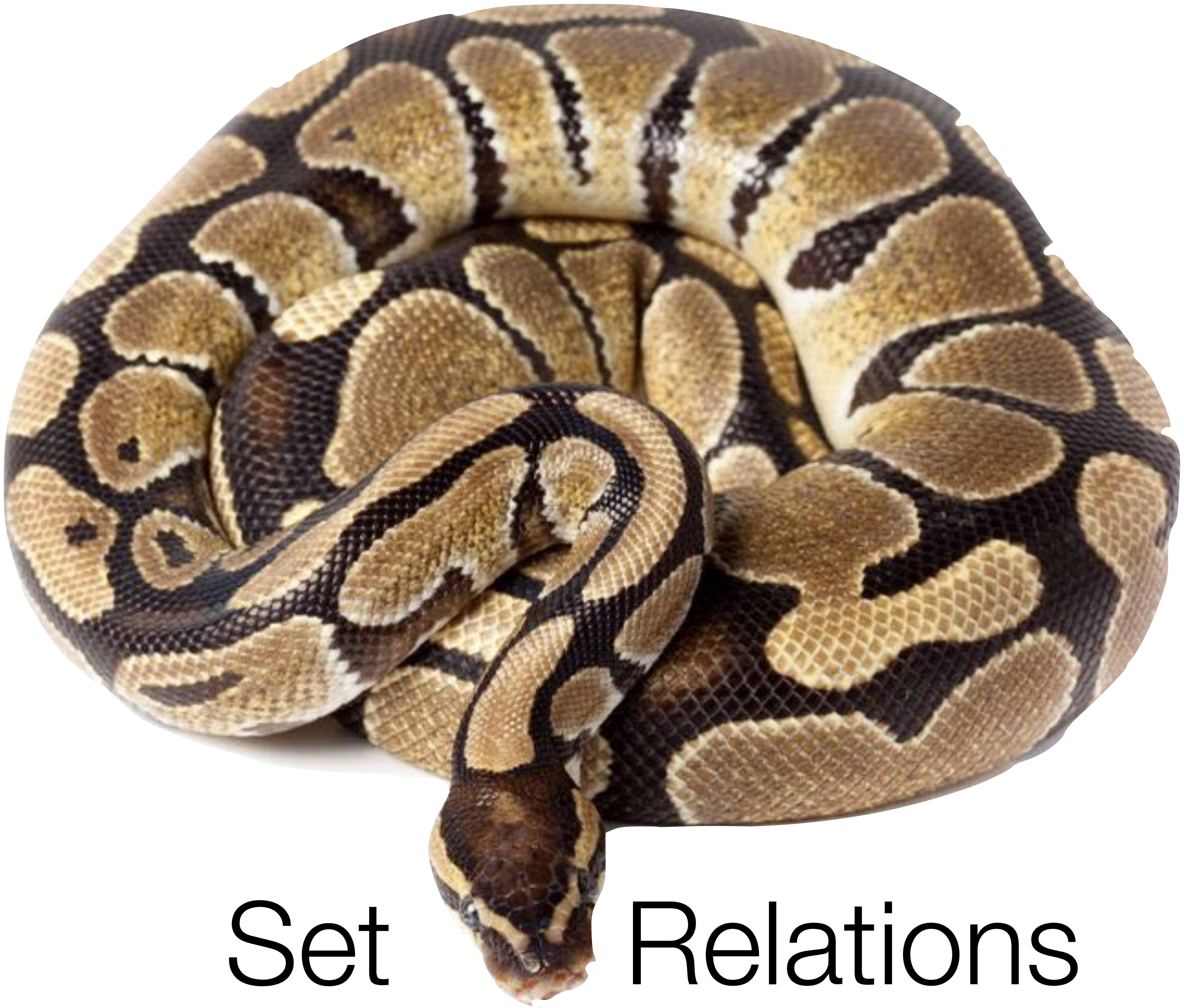
$\boxed{0 \not\subseteq \{0,1\}}$

$\mathcal{P}$ $\mathcal{U}$ $\mathcal{Z}$ $\mathcal{Z}$ $\mathcal{L}$ $\mathcal{E}$

Are there sets A and B such that
A is both an **element** and a **subset** of B?

$A \in B$ and $A \subseteq B$

Next lecture



Set Relations

Equality, Inequality, Disjoint

```
S1 = {0,1}
S2 = set({0,1})
S3 = {1,0,1}
T  = {0,2}
```

= `==`

```
S1 == T
False
S1 == S2
True
S1 == S3
True
```

≠ `!=`

```
S1 != S2
False
S1 != T
True
```

disjoint **`isdisjoint`**

```
S1.isdisjoint(T)
False
S1.isdisjoint({2})
True
```

Subsets and Supersets

```
zero = {0}
```

```
zplus = {0,1}
```

```
zminus = {0,-1}
```

⊆ **`<= or issubset`**

```
zminus <= zplus
False
zero <= zplus
True
zero.issubset(zplus)
True
```

As it sounds
zero ⊆ zplus

⊇ **`>= or issuperset`**

```
zplus >= zminus
False
zplus.issuperset(zminus)
False
zplus.issuperset(zplus)
True
```

⊂

<

```
zplus < zero
False
zero < zminus
True
```

⊃

\>

```
zminus > zminus
False
zminus > zero
True
```

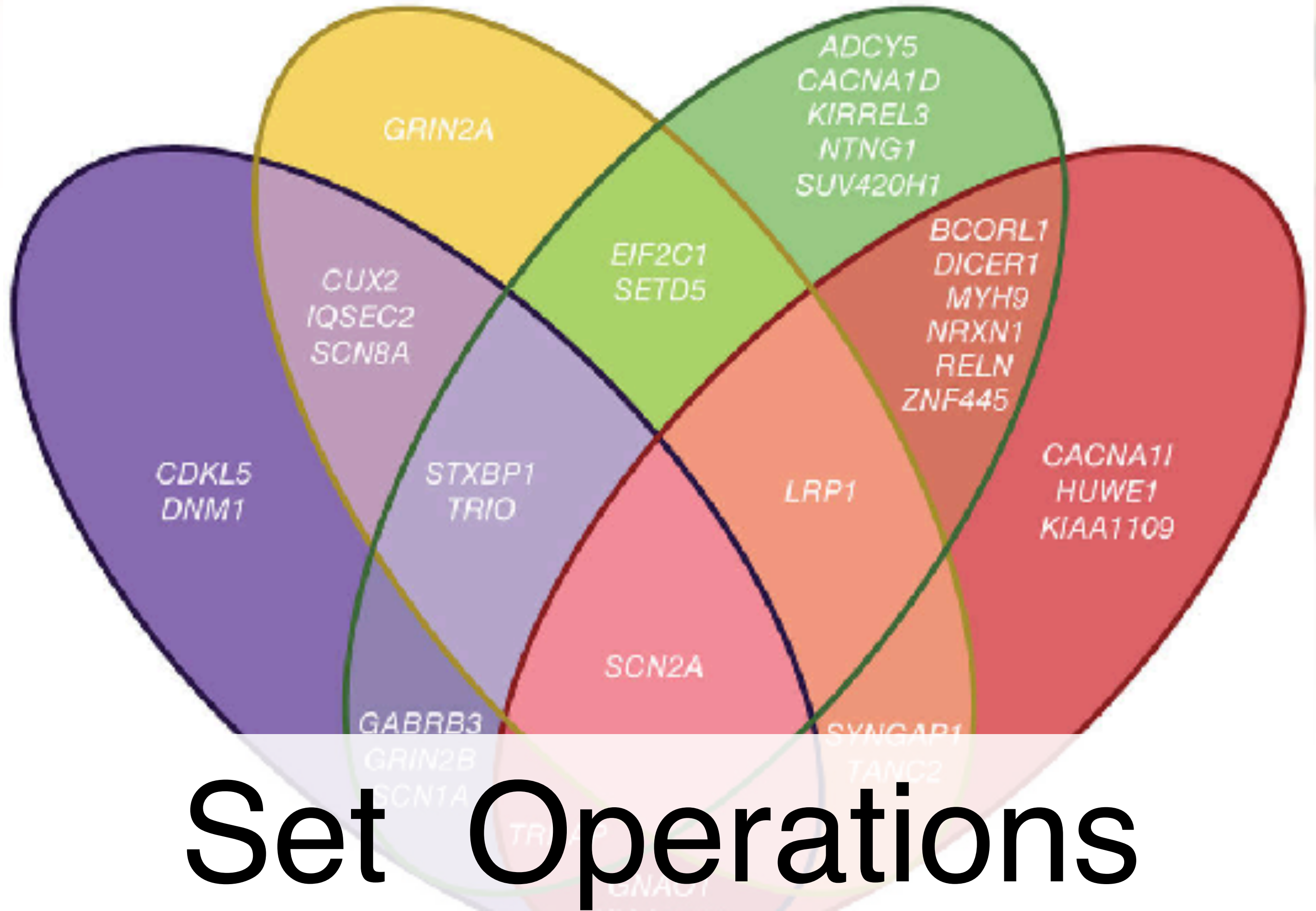
Set Relations

Equality and inequality = ≠

Intersection and disjointness

Subsets and Supersets ⊆ ⊂ ⊇ ⊃ negations

Python `==` `!=` `isdisjoint` `<=` `<` `>=` `>` `issubset` …



Set Operations