SET THEORY : By 20th Century, ALL OF MATH IS CONSTRUCTED FROM SET THEORY

$F := \{$ Jane, Mary, Susan, Dana $\} \longrightarrow$ THERE IS NO ORDER!

↑ begin   Represents Objects/   ↑ end
Elements

ASSIGNMENT / DEFINITION

SET NAME F for FEMALE NAMES.

$M := \{$ BOB, Joe, Max, Dana $\}$

↳ male names

$N := \{1, 2, 3, \ldots \}$ ← implied

↳ set of aaNural numbers

$\mathbb{Z} := \{\ldots, -1, 0, 1, \ldots \}$

↳ SYMBOL GR Integers

JANE $\in$ F $\longrightarrow$ Reads as "Jane is in the set F"

[Element $\in$ set]

"set inclusion"

Venn Diagram (for M & F)

or
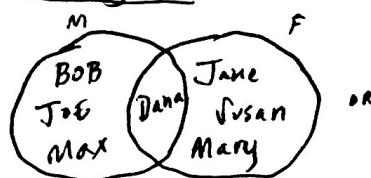
Jane Mary Susan	F
DANA	
BOB JOE Max	M

SUBSETS

$\{$Jane, Mary$\} \underline{\subseteq}$ F ← subset

- All elements in L.H.S $\in$ R.H.S

left hand side   right " "

$\{$Jane, Mary$\} \subset$ F

↳ proper subset

- ALL elements in L.H.S $\neq$ R.H.S

| EXAMPLES |

$\{$Jane$\} \subseteq$ F $\rightarrow$ TRUE

$\{$Jane$\} \in$ F $\rightarrow$ FALSE

Jane $\in$ F $\rightarrow$ TRUE

SINGLETON SET

Jane $\subseteq$ F $\longrightarrow$ FALSE (it's not a set, so this makes NO sense)
⌐ SUBSET

UNION (∪)

set   set   sets combined
↓   ↓   ↓
F ∪ M = COMBINE $\longrightarrow$ { {Jane, Mary, Susan, Dana}, { Bob, Joe, Max, Dana} }
      "and/or"

"FLATTENS" OR "COLLAPSES"

{ Jane, Mary, Susan, Dana, Bob, Joe, Max }

• The 2nd Dana in the 'M' set is removed.

- Dana ∈ F ⟹ Dana ∈ F∪M   must include the brackets

• To add θ into a natural number set, you do $\mathbb{N} \cup \{\theta\}$ because you can only UNION 2 sets.

INTERSECTION (∩)

F ∩ M   set of all elements ∈ L.H.S
              & ∈ R.H.S   ⌐ EMPTY SET / NULL SET

F ∩ M = { Dana }   F ∩ { Bob, Max } = { }

• A, B are mutually exclusive if ~~A∩B≠~~ A ∩ B = ∅

EXAMPLE PROBLEMS:

  • ∅ $\subseteq$ F $\longrightarrow$ TRUE
    ∅ $\subset$ F $\longrightarrow$
    ∅ $\in$ F $\longrightarrow$ FALSE

SET DIFFERENCE / SUBTRACTION

- Set of all elements of L.H.S save elements of R.H.S

  - Element in both sets gets removed

  - $F \setminus M =$ {Jane, Mary, Susan}

    (Dana got removed)

- $A \cap B = \emptyset$

  so $\Rightarrow A \setminus B = A$

  $\qquad B \setminus A = B$

$A \subseteq B \Rightarrow A \setminus B = \emptyset$

↳ all elements in A has to be in B, so

if you do difference, you wipe out __EVERYTHING__.

- $\{2n : n \in \mathbb{Z}\}$

  $\underbrace{\qquad}_{2 \times n}$

↳ All elements of $\mathbb{Z}$, such that n is an element of integers.

$$E := \{ \ldots, -2, 0, 2, \ldots \}$$

↳ EVEN NUMBERS/Set

- $A = \{1, 2, 3\}$

  - $\{B : B \subseteq A\}$

  ↳ All elements of B, such that B is an element of A

  $2^A := \{ \underset{1}{\{\emptyset\}}, \underset{2}{\{1\}}, \underset{3}{\{2\}}, \underset{4}{\{3\}}, \underset{5}{\{1,2\}}, \underset{6}{\{1,3\}}, \underset{7}{\{2,3\}}, \underset{8}{A} \}$

  ↳ power set

SET SIZE / CARDINALITY

$|A| = 3$

↳ Absolute value symbol

↳ All this means is number of element in the set

"PIPE"

EXAMPLE:

$|F \cup M| \overset{?}{=} |F| + |M|$

$\quad \downarrow \qquad\qquad \downarrow$

$\quad 7 \qquad\qquad 4 + 4$

$\quad 7 \quad \neq \quad 8$

$|2^A| = 8 \quad |2^{F \cup M}| = 128$

$|F \setminus M| = 3$

↳ gets rid of Dana so 3

Special set "Ω" (capital omega)

"universe", "sample space", "space of discourse"

- set of all elements under consideration

You pick the....

COIN FLIP:
$$\Omega = \{H, T\} = \{T, H\}$$

DIE ROLL:
$$\Omega = \{1, 2, 3, 4, 5, 6\}$$

Ω = FUM

↳ a name chosen among elements where all are "equally likely"

- What is the probability a random number is female? (Assume Ω)

- 4/7...
- 3/7.. ?
- etc...

$$\frac{|F|}{|\Omega|}$$

Working Definition:
$$p(A) = \frac{|A|}{|\Omega|}$$

PROBABILITY of A.

(4)