

Union, Intersection, and Difference of Sets

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Union

If A and B are sets, the union C of A and B , written $C = A \cup B$, is the set of elements of either A or B or both.

$$A \cup B = \{x : x \in A \text{ or } x \in B\}.$$

$$\{1, 2, 3\} \cup \{3, 5, 6\} = \{1, 2, 3, 5, 6\}$$

Intersection

If A and B are sets, the intersection C of A and B , written $C = A \cap B$, is the set of elements in both A and B .

$$A \cap B = \{x : x \in A \text{ and } x \in B\}.$$

$$\{1, 2, 3\} \cap \{3, 5, 6\} = \{3\}$$

Difference

If A and B are sets, the difference C of A and B , written $C = A - B$, is the set of elements in A but not in B .

$$A - B = \{x : x \in A \text{ and } x \notin B\}.$$

$$\{1, 2, 3\} - \{3, 5, 6\} = \{1, 2\}$$

Example

$A = \{0, 1\}$ and $B = \{1, 2\}$. What is $(A \times B) \cap (B \times B)$?

$$(A \times B) \cap (B \times B)$$

$$(1, 1) \in A \times B$$

$$(1, 1) \in B \times B$$

$$(1, 2) \in A \times B$$

$$(1, 2) \in B \times B$$

$$\begin{array}{cc} 0, 1 & 0, 2 \\ \hline 1, 1 & 1, 2 \end{array}$$

$$(1, 1) \in (A \times B) \cap (B \times B)$$

$$(1, 2) \in (A \times B) \cap (B \times B)$$

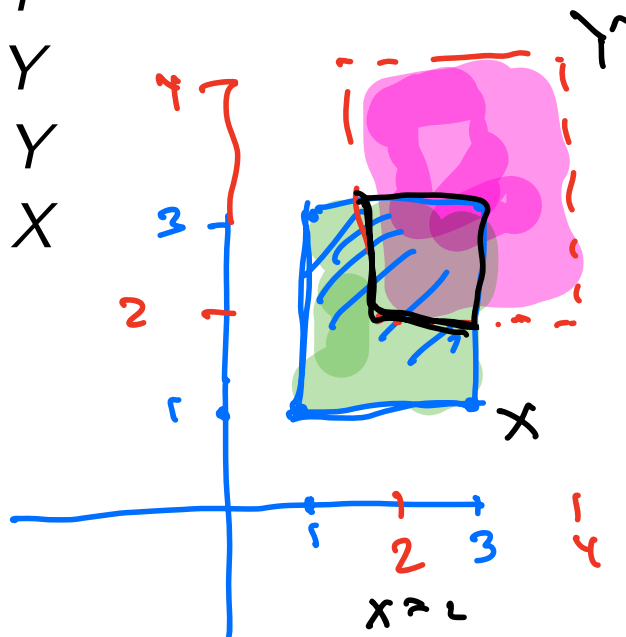
$$\begin{array}{cc} 1, 1 & 1, 2 \\ \hline 2, 1 & 2, 2 \end{array}$$

Example

$$\{x \in \mathbb{R} \mid 1 \leq x \leq 3\}$$

Let $X = [1, 3] \times [1, 3]$ and $Y = [2, 4] \times [2, 4]$ in $\mathbb{R}^2$. Sketch the sets

- ▶ $X \cup Y$
- ▶ $X \cap Y$
- ▶ $X - Y$
- ▶ $Y - X$



$$X = \{(a, b) \mid a \in [1, 3] \text{ and } b \in [1, 3]\}$$

Union = "green" & "pink" (and both)
 intersection $2 \leq x \leq 3$ $2 \leq y \leq 3$ $[2, 3] \times [2, 3]$

$A \times B$

$X - Y$

