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程序代写代做 CS编程辅导



Introduction to Database Systems – Part 2

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Math Concepts

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What are the Math Concepts behind Databases?

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- Set

- Tuple

- Cartesian Product of Sets

- Relation

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Set Notation



Container



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Set Notation



- We need set notation for different formal definitions in this course.

- A **set** is a collection of distinct elements.

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- Two basic properties of sets

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- The elements in a set have no order.

e.g., $\{1, 2, 3\} = \{2, 3, 1\}$

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- Each element can not be in the set more than once.

e.g., $\{\text{Monday}, \text{Monday}, \text{Tuesday}, \text{Wednesday}, \text{Thursday}, \text{Friday}, \text{Friday}\}$ is Not a set. Note that **Multisets** allow to have duplicate elements.

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Set Notation



Two ways of specifying a set

① $\{x_1, \dots, x_n\}$ (i.e., x_1, \dots, x_n are the elements in a set)

- $\{2, 3, 4, 5\}$

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- $\{\text{Sydney, Melbourne, Canberra}\}$

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- $\{\}$ or \emptyset , i.e., the *empty* set.

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② $\{x | \varphi\}$ (i.e., describe the elements that satisfy a property φ)

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- $\{x \mid x \text{ is a student currently enrolled in COMP7240}\}$

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- $\{x \mid x \text{ is an integer and } x > 0\}$



程序代写代做 CS编程辅导 Set Operations



- **Membership:** $x \in A$ if x is in the set A ; $x \notin A$ if x is not in the set A .

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QQ: 749389476 $3 \in \{1,2,3\}$

$2 \in \{1,2\}$ $3 \notin \{1,2\}$
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Set Operations



- **Equality:** If A and B have the same elements, we write $A = B$; otherwise we write $A \neq B$.
 - $\{x \mid x \text{ is an integer and } x < 6\} = \{2, 3, 4, 5\}$

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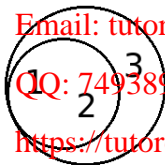
- If one set contains some element that is not in the other set, then they are different.

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$$\{1,2\} \neq \{1,2,3\}$$



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Set Operations



- **Subset:** A is called a subset of B if every element of A is in B and we write $A \subseteq B$;
- **Proper subset:** A is called a proper subset of B if $A \subseteq B$ and A and B are not equal, and we write $A \subset B$.

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$\{1,2\} \subset \{1,2,3\}$



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Set Operations



- **Subset:** A is called a subset of B if every element of A is in B and we write $A \subseteq B$;
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\subseteq means \subset or $=$
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$\{1,2\} \subseteq \{1,2,3\}$
 $\{1,2\} \subset \{1,2,3\}$
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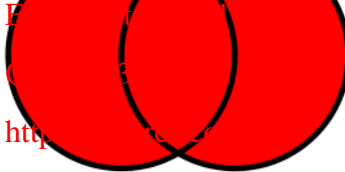
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- **Union:** $A \cup B$ for the union of A and B , containing everything in A and everything in B .
 - $\{3, 4, 5\} \cup \{3, 5, 7, 9\} = \{3, 4, 5, 7, 9\}$.

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- **Intersection:** $A \cap B$ is the set of elements that are in both A and B
 - $\{3, 4, 5\} \cap \{3, 4, 5\} = \{3, 4, 5\}$.

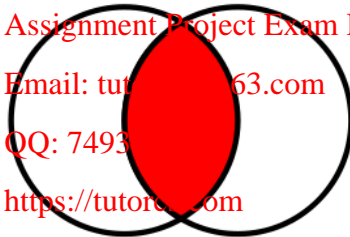
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- **Difference:** $A - B$ is the set of elements from A that are *not* in B
 - $\{3, 4, 5\} - \{3, 4\} = \{5\}$.

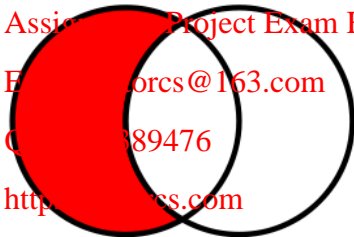
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- Let $A = \{1, 2, 3\}$ and $B = \{true, false\}$.
- Which of the following are correct?

① $\{2\} \in A$

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No! $\{2\} \subset A$ and $2 \in A$

② $true \subset B$

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③ $\{2, 3\} \subseteq A \cup B$

Yes! $A \cup B = \{1, 2, 3, true, false\}$
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④ $2 \in A \cap B$

No! $A \cap B = \{\}$

⑤ $2 \in A - \{1, 3, 5\}$

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Yes! $A - \{1, 3, 5\} = \{2\}$

⑥ $\{1, 4\} \subseteq A - B$

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No! $A - B = \{1, 2, 3\}$

⑦ $\emptyset \cap B = \emptyset$

Yes! $\emptyset = \{\}$, the empty set



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Tuple Notation



Order



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1



2



3



4



5





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Tuple Notation



- A **tuple** is an ordered collection of elements.

- $(1, 2, 3, 4, 5)$
- $(\text{Melbourne}, \text{Sydney}, \text{Canberra})$

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- Two tuples are **equal** if they have the same elements in the same order.

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- $(1, 2, 3) \neq (2, 3, 1)$ (i.e., the order does matter!)

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- The same element can be in a tuple twice.

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- $(\text{Monday}, \text{Monday}, \text{Tuesday}, \text{Wednesday}, \text{Thursday}, \text{Friday}, \text{Friday})$ is a tuple.

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- Ordered pairs are special cases of tuples.



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Cartesian Product of Sets



{2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A}

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程序代写代做 CS编程辅导 Cartesian Product of Sets



{2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A}

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程序代写代做 CS编程辅导 Cartesian Product of Sets



- The Cartesian product takes an ordered list of sets, and returns a set of tuples.

- Cartesian product** $D_1 \times \dots \times D_n$ is the set of all possible combinations of values from the sets D_1, \dots, D_n .

- It contains all the tuples with the first element from the first set, the second element from the second set, ...

- For example, $A \times B = \{(a, b) \mid a \in A \text{ and } b \in B\}$.

If $A = \{2, 3\}$ and $B = \{Clubs, Diamonds, Hearts, Spades\}$

Then $A \times B = \{(2, Clubs), (2, Diamonds), (2, Hearts), (2, Spades), (3, Clubs), (3, Diamonds), (3, Hearts), (3, Spades)\}$.

$(2, Clubs) \in A \times B$, $(Spades, 3) \notin A \times B$, $(4, Hearts) \notin A \times B$

$\{(3, Clubs), (3, Diamonds), (3, Hearts), (3, Spades)\} \subseteq A \times B$

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Relation Notation



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Relation Notation



{2, 3, 4, 5, 6, 7, 8, 9, 10, J, Q, K, A}

{♠, ♦, ♣, ♥}

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FOUR OF A KIND



FULL HOUSE



FLUSH



STRAIGHT



THREE OF A KIND



TWO PAIRS



ONE PAIR



HIGH HAND



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- A **relation** is a subset of the Cartesian product of sets.

• Example

- Let $X = \{\text{Canberra, Paris, Tokyo, Kyoto}\}$, and $Y = \{\text{Australia, France, Japan}\}$
- Let $R = \{(a, b) \mid a \in X, b \in Y \text{ and } a \text{ is a city in } b\}$.
- It is easy to see that R is a relation
 - $R \subseteq X \times Y$.
 - $(\text{Canberra, Australia}) \in R, (\text{Paris, France}) \in R$
but $(\text{Tokyo, France}) \notin R, (\text{France, Japan}) \notin R$

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- A **relation** is a subset of the Cartesian product of sets.
- **Example**

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- Let $\mathbb{Z} = \{\dots, -1, 0, 1, 2, \dots\}$, the set of all integers

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- Let $R = \{(x, y) \mid x \in \mathbb{Z}, y \in \mathbb{Z} \text{ and } x < y\}$.

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- It is easy to see that R is a relation.

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- $R \subseteq \mathbb{Z} \times \mathbb{Z}$.

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- $(0, 1) \in R, (-4, -2) \in R$
but $(0, 0) \notin R, (100, -2) \notin R$.