

Post-Evaluation Procedure

- Your evaluation packet is being returned *for review*.
 - Compare your self-evaluation and my adjustment
 - Go over my comments (if applicable)
- You must resubmit it by the class time on Fri., Oct. 3.**
 - If you did not achieve 10 for any component, you are invited to make an individual appointment with me and make another attempt to convince me of your understanding by this deadline.
 - If you have achieved full scores or do not wish to re-do, resubmit the packet immediately.
- You are encouraged to exchange information regarding how to achieve the learning goals and how to convince others/me.

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Animal Kingdom

- Guerrillas consist of George, Don, and John.
- Mammals are those which breast-feed.
- Furby is a Mammal.
- Guerrillas are those who attack by surprise.
- There are more Humans than Guerrillas.
- Humans are Primates.
- Both Humans and Chimps are Primates.
- No Humans are Chimps.
- Non-Humans cannot be Guerrillas.
- Primates which are not Humans.

Commonality among the underlined words?

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B1: Sets

Today

- Formally represent sets and use them to analyze phenomena
 - Set definitions
 - Set relations
 - Set operations
- Take-home exercises MS Word has Math **symbols**
 - North Pole, English, Books

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Section 1

Defining Sets

List notation

– {1, 2, 3, 4}, i.e., “the set *A* contains ...”

Members

Predicate notation

– {*x* | *x* is a positive integer less than 5}

Properties are also called “predicates.”

Variable

Condition that applies to the variable

i.e., “the set *B* is a collection of things (*x*) that satisfy ...”

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Naming Sets

- Pattern: *Name* = *Set definition*
- Examples
 - $A = \{1, 2, 3, 4\}$
 - $B = \{x \mid x \text{ is a positive integer less than } 5\}$
 - $C = \text{the set of integers}$

Common error

- $A = \text{the set of integers}$ Correct
- $B = \{\text{the set of integers}\}$ Wrong

Explanation: The description “The set of natural numbers” is already a set. 1. correctly gives a name to *that* set. But 2. defines a set *B* that *contains* “the set of natural numbers” as a member.

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Properties of Set

- Objects are either **in** (member) or **out** (non-member).
- The members of a set must be **discrete** (not continuous, e.g., *water*).
- Every member of a set must be **distinct** (no repetition of the same object, e.g., $\{1\} = \{1, 1\}$).
- A set can be empty.
- A set may have **infinitely many** members.

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Section Summary

- Set definitions
 - List notation (if finite)
 - Predicate notation (if the defining property is known)
- Properties
 - Either in or out
 - Discrete and distinct
 - Possibly empty or infinite

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Group Exercise

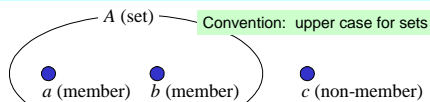
- Identify a set that can be defined with the list notation
 - Define it with the list notation
 - Define it with the predicate notation
- Identify a set that cannot be defined with the list notation
 - Define it with the predicate notation

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Section 2

Membership Relation



Venn diagram

- Between an object and a set
 - Notation:
 - $a \in A$, i.e., “a is a member of A”
 - $c \notin A$, i.e., “c is **not** a member of A”

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Set Identity

- Two sets are identical. \leftrightarrow The two sets have exactly the same members.
 - Ordering does *not* matter
 - Notation (list vs. predicate) does not matter
 - E.g., if $A = \{1, 2, 3, 4\}$ and $B = \{x \mid x \text{ is a positive integer less than } 5\}$, $A = B$

Use of '='



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Cardinality

- The number of elements
 - Notation: $|A|$ for a set A
- Examples
 - If $A = \{1, 2\}$, $|A| = 2$
 - If $A = \{1, 2\}$, $|\{A\}| = 1$
 - $|\text{the set of Santa Claus}| = 0$ (under a certain assumption)

Note: Ignore the cardinality of infinite sets (although it is possible to define such a thing).

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Special Sets

- Exactly one member (cardinality 1): **singleton** (set) Singleton vs. member?
- Absolutely no member (cardinality 0): **empty set**
 - Notation: \emptyset

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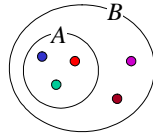
Subset Relation

- A is a subset of B . \Leftrightarrow Every member of A is also a member of B .

– Notation: $A \subseteq B$

Convention:

- Member as a point
- Subset as a circle



Venn diagram

– Negation: $A \not\subseteq B$

Warning: We use $A \subseteq B$ although the text uses $A \subset B$.

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Section Summary

- Set relations [true/false] (cf. functions)
 - Membership: **between objects and sets**
 - Subset: **between two sets**
- Set identity
- Cardinality
- Special sets: singleton, empty set

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Group Exercise

- Some languages of the world are classified into language families, e.g.:
 - Germanic (Ge)
 - Romance (Ro)
 - Slavic (Sl)
 - Indo-European (IE), including Ge, Ro, Sl
- List several languages (assign a symbol, e.g., E for English). Formally represent as many relations between languages as possible.

Use your knowledge

Extend if needed

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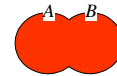
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Section 3

Union and Intersection

- **Union** of sets A and B : $\{x \mid x \in A \text{ or } x \in B\}$

– Notation: $A \cup B$



Venn diagram

- **Intersection** of sets A and B : $\{x \mid x \in A \text{ and } x \in B\}$

– Notation: $A \cap B$

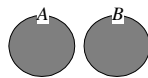


Remind something?

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Disjoint Sets

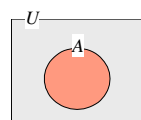


- Sets A and B are disjoint. $\Leftrightarrow A \cap B = \emptyset$

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Complement



- **Universal set**: The set of all the members *under consideration*

– Notation: (often) U

- **Complement** of set A

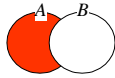
$\Leftrightarrow \{x \mid x \in U \text{ and } x \notin A\}$

– Notation: A'

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'Difference'



- Difference $A - B$: $\{x \mid x \in A \text{ and } x \notin B\}$

Complement vs. Difference?

Section Summary

- Set operations [function: input/output]
 - Union
 - Intersection
 - Disjoint
 - Complement
 - Difference

Cf. Set relations

- Membership
- Subset

Summary Exercise

- Compare informal and formal representations of "sets" with respect to preciseness and conciseness.
- If there were unclear, difficult, and/or confusing points, please list them all.