

A2: Structure Components

Today

- Identify and use structure components
 - Example: North Pole (sets, relations)
 - Example: Barbie Dolls (functions)
 - Practice: Sets, relations, and functions
- Take-home exercises
 - Objects in a room, Set/relation/function

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Section 1

North Pole

- Logic (logical statements)
 1. Reindeer are not Santa Claus.
 2. Reindeer must carry someone/something.
 3. Santa Claus must be carried by reindeer.
 4. Reindeer exists.
- Structure (representation in mind)
 - Santa Claus: none
 - Reindeer: one
 - Carrying: The reindeer carries gifts.

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Set and Relation

- Collection \Rightarrow **Set**
 - Collection of Santa Claus's
 - Collection of reindeer
 - Collection of gifts
 - Collection of objects
- Association between two objects \Rightarrow **Relation**
 - Information about who carries what/whom

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Set

preliminary

- Set = collection
 - Must be able to say whether or not an object is in the set
 - Set consists of **members** (or **elements**)
- Examples
 - Set of students in this class
 - Set of reindeer in Finland
 - Set of natural numbers

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Relation

preliminary

- Relation = association between two objects
 - Must be able to say whether or not an object is *in a particular relation to* another object
- Examples
 - "Sit-next-to" relation: ___ sits next to ___.
 - "Older-than" relation: ___ is older than ___.
 - "Has-same-value" relation: "1 + 1" has the same value as "2"

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North Pole, Revisited

- Structure
 - **Set** of Santa Claus's: **empty**
 - **Set** of reindeer: one (call him *RedNose*)
 - **Set** of gifts: $gift_1, gift_2, gift_3$
 - **Set** of objects: $RedNose, gift_1, gift_2, gift_3$
 - "Carrying" **relation**:
 - *RedNose* carries $gift_1$.
 - *RedNose* carries $gift_2$.
 - *RedNose* carries $gift_3$.

Must be specified for each object

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Section Summary

- Structure components (preliminary)
 - **Set(s)**: about a single object, either in or out of the set
 - **Relation(s)**: about two objects, whether or not the relation hold between the objects

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Foreign Policy

[Final Practice, Spring 2003]

- Suppose that you are the foreign minister of a country whose foreign policy is that “an enemy of an enemy is a friend.” In a UN session, you must defend this policy.
- Then, you insist that every other country is “either with us or against us.”

Group Task: Find “relation(s)” and try to analyze the validity using the relation(s).

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Section 2

Barbie Dolls

- Set of dolls: **Doll1**, **Doll2**
- Set of shirts: **Shirt1**, ..., **Shirt5**
- Set of (pairs of) pants: **Pants1**, ..., **Pants4**
- Relation “wears”: **Doll1** wears **Shirt1**, **Doll1** wears **Pants4**, etc.
- Set of names: **Ken**, **Naomi**, ...
- Relation “is called”: **Doll1** is called **Naomi**, **Doll2** is called **Ken**.

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Properties of Relation

- Relation can be between two different sets
- In general, the object ordering matters
 - “**Doll1** wears **Shirt1**” \neq “**Shirt1** wears **Doll1**”
- In general, one object can be related to multiple objects
 - Both “**Doll1** wears **Shirt1**” and “**Doll1** wears **Pants4**”
- It is also possible to consider a relation between *three or more objects*
 - E.g., “**2** is the average of **1** and **3**”

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Special Relation

preliminary

- Directional: i.e., input \rightarrow output
- For each input, there is some output.
- The output is unique.
- This type of relation is called **function**.
- Function example?
 - Relation between dolls and clothes
 - Relation between dolls and names
 - Relation between names and dolls

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Mathematical Functions

- The notion of function is used heavily in math.
- Examples
 - Absolute value: $|2| = 2$, $|-3| = 3$
 - Square root: $\sqrt{2} = 1.414\dots$ (defined for non-negative real numbers)
- It is also possible to consider a function of more than one inputs
 - E.g., addition: $1 + 2 \Rightarrow 3$

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Section Summary

- Structure components
 - Set(s): about a single object, either in or out of the set
 - Relation(s): about two objects, whether or not the relation hold between the objects
 - **Function(s)**: special case of relation; **directional**, often representing an **operation**
- Structure can be represented as a combination of sets, relations, functions

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Section 3

Sets, Relations, Functions

- Represent the following as a set, relation, or function?
 - Books in a library
 - Marriage
 - ASCII code of a character
 - Current weather
 - Sentences in English
 - Meaning of a sentence (in English)
 - Pronunciation of a sentence (in English)

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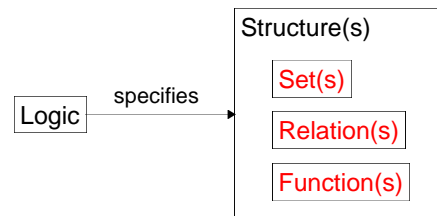
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Game of 'Geography'

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Section Summary



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Summary Exercise

- Explain why we want to use sets, relations, and functions as structure components.
- **Questions/Comments/Suggestions**

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