

Outline

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1 Defining Sets

Set Theory

- Sets are *unordered collections of elements*
- Elements are usually named with lower case letters
- Sets are usually named with capital letters
- Concept of *set membership*
- Example: $barina \in HOLDENS$

Defining Sets

- Two basic ways:
 - enumeration
 - comprehension
- Enumeration: $\{barina, astra, commodore\}$
- Comprehension: $\{x \mid x \in S \wedge P\}$
 - S defines the type of x
 - P is a predicate in x , constraining the set
- Example: $\{x \mid x \in \mathbb{N} \wedge x \leq 10\}$
 - read (*the set of natural numbers*) x such that x at most 10
 - note a) typing, and b) constraint

2 Operations on Sets

New Sets from Old

- Union: $S \cup R$

- Intersection: $S \cap R$
- Powerset: $\mathbb{P}(S)$
- Cartesian Product: $S \times R$

See the B summary for formal definitions of these

3 Relations

Relations

- A relation $S \leftrightarrow R$ is a formal statement of the correspondence between elements of two sets
- Example: $CARS \leftrightarrow PRICE$
- A relation is a set of sets of ordered pairs: $S \leftrightarrow R = \mathbb{P}(S \times R)$
- Note the effect of the powerset: the set of relations $S \leftrightarrow R$ includes the empty set (no relation), the set of all ordered pairs ($S \times R$) (everything related to everything), as well as all subsets in between.
- the set of elements in the left of the ordered pairs is called the *domain*
- the set of elements in the right of the ordered pairs is called the *range*

Relation Examples

- No price information known: $\{\}$
- *barina* costs \$13990: $\{(barina, 13990)\}$
- *astra* costs \$25490: $\{(barina, 13990), (astra, 25490)\}$
- “optioned up” *barina* costs \$25490: $\{(barina, 13990), (barina, 25490), (astra, 25490)\}$
- Note that elements in both domain and range need not be unique.
- $dom(BULLETT4) = \{barina, astra\}$
- $ran(BULLETT4) = \{13990, 25490\}$

4 Functions

Functions

- special case of relations: elements in domain are unique
- not all elements need be in domain: *partial*
- further special cases:
 - all elements in domain: *total*