Lecture 5 - Sep. 19

Math Review

Set Comprehension Relating Sets vs. Postconditions Power Set (Enumeration, Cardinality)

Announcements/Reminders

- Lab1 due tomorrow (Friday) at <u>noon</u>.
- Lab2 to be released soon afterwards.

Sets: Definitions and Membership





Relating Sets: Exercises



Sets: Exercises

<u>Set membership</u>: Rewrite $e \notin S$ in terms of \in and \neg

Find a common pattern for defining: 1. = (numerical equality) via \leq and \geq) $\chi = \chi \iff \chi \leq \chi \land \chi \leq \chi$ 2. = (set equality) via \subseteq and \supseteq) $\zeta_1 = \zeta_2 \iff \zeta_1 \subseteq \zeta_2 \land \zeta_2 \subseteq \zeta_1$ 2.=(set equality) via ⊆ and ⊇ $S = \{1, 2, 3\}, T = \{2, 3, 1\}, U = \{3, 2\}$.<u>S</u> S ⊆ ④ c <mark>€</mark>) ⊆ ④ c **⑥** c **⑥** c **⑥** $S_1 \setminus S_2 = S_2 \setminus S_1$ Is set difference (\) commutative?

 $\neg (e \in S)$

Bidirectional Subset Relations: Programming

/* Return the set of positive elements from input. */ **HashSet**<Integer> allPositive(**HashSet**<Integer> input)

Formulate the `allPositive` method using a set comprehension.



Bidirectional Subset Relations: **Programming**

/* Return the set of positive elements from input. */
HashSet<Integer> allPositive(HashSet<Integer> input)

all Positive (mput) EV. 1 Is postcond. Just ()

(1) {x X ∈ TAPATA X>05 ⊆ altput

(2) artput S [X XE TOPUT A X>0

Fr. Z Is postand appropriate just 37

Say:

mput

50

12,3,4

artar

72,3,4

- S denotes the subset all positive elements from `input`.

Set `output` denotes the return value from `allPositive`.
 <u>Relate</u> the two sets S and output with set operators.

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<u>Relate</u> the two sets S and output without set operators.

Ex 3. Express postconditions using 4, J, =>, ...

$P(S) = \{ x \mid x \subseteq S \} = \{ ch \text{ member in } R(S) \}$ **Power Set** 1. What's the neuber m Calculate the power set of $\{1, 2, 3\}$. TP(S) that has min card? P(1,2,33)2. What's the member th $= \frac{1}{2} \frac{$ IP(S) that have max rands 2 $S \in P(S)$ 11,23, 17,33, 11,33, card. Z 11,2,35 card. 3 # subsets of rand. Z = (3) card.Z

Given a set S, formulate the cardinality of its power set.



Cardinality of Power Set: Interpreting Formula

- Calculate by considering subsets of various cardinalities.
- Calculate by considering whether a member should be included.
- Want to know: [PCS]



