

SOEN331: Introduction to Formal Methods for Software Engineering

Assignment 4 on algebraic specifications

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Spec: Location;

Sort: Location;

Imports:String, Point

Description: A location contains a description

Operations:

newLocation: $\text{String} \times \text{Point} \rightarrow \text{Location}$;

setDescription: $\text{String} \times \text{Location} \rightarrow \text{Location}$;

getDescription : $\text{Location} \rightarrow \text{String}$;

setPoint : $\text{Point} \times \text{Location} \rightarrow \text{Location}$;

getPoint : $\text{Location} \rightarrow \text{Point}$;

Variables:

newDesc, d: String; newPoint, p: Point;

Axioms:

[A1] $\text{getDescription}(\text{newLocation}(d, p)) = d$;

[A2] $\text{getDescription}(\text{setDescription}(\text{newDesc}, \text{newLocation}(d, p))) = \text{newDesc}$;

[A3] $\text{getDescription}(\text{setPoint}(\text{newPoint}, \text{newLocation}(d, p))) = d$;

[A4] $\text{getPoint}(\text{newLocation}(d, p)) = p$;

[A5] $\text{getPoint}(\text{setPoint}(\text{newPoint}, \text{newLocation}(\text{d}, \text{p}))) = \text{newPoint};$
 [A6] $\text{getPoint}(\text{setDescription}(\text{newDesc}, \text{newLocation}(\text{d}, \text{p}))) = \text{p};$
 [A7] $\text{setDescription}(\text{newDesc}, \text{newLocation}(\text{d}, \text{p})) = \text{newLocation}(\text{newDesc}, \text{p});$
 [A8] $\text{setDescription}(\text{getDescription}(\text{newLocation}(\text{d}, \text{p})), \text{newLocation}(\text{d}, \text{p})) = \text{newLocation}(\text{d}, \text{p});$
 [A9] $\text{setPoint}(\text{newPoint}, \text{newLocation}(\text{d}, \text{p})) = \text{newLocation}(\text{d}, \text{newPoint});$
 [A10] $\text{setPoint}(\text{getPoint}(\text{newLocation}(\text{d}, \text{p})), \text{newLocation}(\text{d}, \text{p})) = \text{newLocation}(\text{d}, \text{p});$

Spec: $\text{Map} (\text{Location});$

Sort: $\text{Map};$

Imports: $\text{String}, \text{Point}, \text{Boolean}, \text{Location};$

Description: A map contains locations

Operations:

$\text{newmap} : \rightarrow \text{Map};$
 $\text{addlocation} : \text{Map} \times \text{Location} \rightarrow \text{Map};$
 $\text{deletelocation} : \text{Map} \times \text{String} \rightarrow \text{Map};$
 $\text{containsdescription} : \text{Map} \times \text{String} \rightarrow \text{Boolean};$
 $\text{containspoint} : \text{Map} \times \text{Point} \rightarrow \text{Boolean};$
 $\text{findlocation} : \text{Map} \times \text{String} \rightarrow \text{Point};$
 $\text{isempty} : \text{Map} \rightarrow \text{Boolean};$
 $\text{clear} : \text{Map} \rightarrow \text{Map};$

Variables:

$\text{d} : \text{String}; \text{p}, \text{q} : \text{Point}; \text{loc} : \text{Location}; \text{map} : \text{Map}$

Axioms:

[A1] $\text{isempty}(\text{newmap}) = \text{true};$
 [A2] $\text{isempty}(\text{clear}(\text{map})) = \text{true};$
 [A3] $\text{containsdescription}(\text{addlocation}(\text{map}, \text{loc}), \text{getDescription}(\text{loc})) = \text{true};$
 [A4] $\text{containsdescription}(\text{map}, \text{d}) \rightarrow \text{findlocation}(\text{addlocation}(\text{map}, \text{newlocation}(\text{d}, \text{q})), \text{d})$
 $= \text{q}$
 [A5] $\text{deletelocation}(\text{addlocation}(\text{addlocation}(\text{newmap}, \text{newLocation}(\text{d}, \text{p})), \text{newLocation}(\text{d}, \text{q})), \text{d})$

→ newmap

[A6]

[A7] findlocation(map, getDescription(loc)) = getPoint(loc)

[A8] findlocation(newmap) = undefined;

[A9] deletelocation(newmap) = undefined;

preconditions:

pre : deletelocation(map, d) = not isempty(map);

pre : findlocation(map, d) = not isempty(map);

end: