Task 3: Z Schemas for the Delivery Management

Definitions:

Data Type

[ORDER, DELIVERY_AGENT, STATUS, LOCATION]
STATUS ::= confirmed | preparing | outForDelivery | delivered | cancelled

Axiomatic Descriptions

maxOrders: $\mathbb{N}$
validStatuses: $\mathbb{P}$ STATUS
validStatuses = {confirmed, preparing, outForDelivery, delivered, cancelled}

System State Schema

DeliveryState
assigned: ORDER $\leftrightarrow$ DELIVERY_AGENT
status: ORDER $\rightarrow$ STATUS
location: DELIVERY_AGENT $\rightarrow$ LOCATION

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dom assigned $\subseteq$ dom status
$\forall$ o: ORDER • o $\in$ dom status $\Rightarrow$ status o $\neq$ cancelled

Initialization Schema

InitDeliveryState

DeliveryState

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assigned = $\varnothing$
status = $\varnothing$
location = $\varnothing$

Operation Scheme

1. Order Preparing Operation

SetOrderAsPreparingSuccess

Δ DeliveryState
o?: ORDER

$o? \in \text{dom status} \land \text{status } o? = \text{confirmed}$
$\text{status}' = \text{status} \sqcup \{o? \mapsto \text{preparing}\}$
$\text{assigned}' = \text{assigned}$
$\text{location}' = \text{location}$

SetOrderAsPreparingFailure

Ξ DeliveryState
o?: ORDER

$o? \notin \text{dom status} \lor \text{status } o? \neq \text{confirmed}$

SetOrderAsPreparing

$\text{SetOrderAsPreparing} \triangleq \text{SetOrderAsPreparingSuccess} \lor \text{SetOrderAsPreparingFailure}$

2. Assign Agent Operation

AssignOrderToAgentSuccess

AssignOrderToAgentSuccess
Δ DeliveryState
o?: ORDER
a?: DELIVERY_AGENT

o? ∈ dom status ∧ status o? = preparing
assigned' = assigned ∪ {o? ↦ a?}
status' = status ⊔ {o? ↦ outForDelivery}
location' = location

AssignOrderToAgentFailure

Ξ DeliveryState
o?: ORDER

o? ∉ dom status ∨ status o? ≠ preparing

AssignOrderToAgent

AssignOrderToAgent ≙ AssignOrderToAgentSuccess ∨
AssignOrderToAgentFailure

3. Reassign Delivery Operation

ReassignDeliveryAgentSuccess

Δ DeliveryState
o?: ORDER
a?: DELIVERY_AGENT

o? ∈ dom assigned ∧ status o? = outForDelivery
assigned' = (assigned \ {o? ↦ assigned o?}) ∪ {o? ↦ a?}
status' = status
location' = location

ReassignDeliveryAgentFailure

Ξ DeliveryState
o?: ORDER

o? ∉ dom assigned ∨ status o? ≠ outForDelivery

ReassignDeliveryAgent

ReassignDeliveryAgent ≙ ReassignDeliveryAgentSuccess ∨
ReassignDeliveryAgentFailure

4. Confirm Delivery Operation

ConfirmOrderDeliverySuccess

Δ DeliveryState
o?: ORDER

o? ∈ dom status ∧ status o? = outForDelivery
status' = status ⊔ {o? ↦ delivered}
assigned' = {o: ORDER | o ≠ o? • o ↦ assigned o}
location' = location

ConfirmOrderDeliveryFailure

Ξ DeliveryState
o?: ORDER

o? ∉ dom status ∨ status o? ≠ outForDelivery

ConfirmOrderDelivery

ConfirmOrderDelivery ≙ ConfirmOrderDeliverySuccess ∨
ConfirmOrderDeliveryFailure

5. Cancel Order Operation

CancelActiveOrderSuccess

$$
\begin{aligned}
&\Delta\ \text{DeliveryState} \\
&\quad o?: \text{ORDER} \\
&\hline
&o? \in \text{dom status} \land \text{status } o? \neq \text{delivered} \\
&\quad \text{status}' = \text{status} \sqcup \{o? \mapsto \text{cancelled}\} \\
&\quad \text{assigned}' = \{o: \text{ORDER} \mid o \neq o? \bullet o \mapsto \text{assigned } o\} \\
&\quad \text{location}' = \text{location}
\end{aligned}
$$

CancelActiveOrderFailure

$$
\begin{aligned}
&\Xi\ \text{DeliveryState} \\
&\quad o?: \text{ORDER} \\
&\hline
&o? \notin \text{dom status} \lor \text{status } o? = \text{delivered}
\end{aligned}
$$

CancelActiveOrder

$$
\text{CancelActiveOrder} \triangleq \text{CancelActiveOrderSuccess} \lor \text{CancelActiveOrderFailure}
$$

6. Get Agent Current Location Operation

GetAgentCurrentLocationSuccess

$$
\begin{aligned}
&\Xi\ \text{DeliveryState} \\
&\quad a?: \text{DELIVERY\_AGENT} \\
&\quad loc!: \text{LOCATION} \\
&\hline
&a? \in \text{dom location} \\
&\quad loc! = \text{location } a?
\end{aligned}
$$

GetAgentCurrentLocationFailure

Ξ DeliveryState
a?: DELIVERY_AGENT

a? $\notin$ dom location

GetAgentCurrentLocation

GetAgentCurrentLocation $\triangleq$ GetAgentCurrentLocationSuccess $\vee$ GetAgentCurrentLocationFailure