CT216 TUTORIAL 1 INTRODUCTION TO Z

`http://www.it.nuigalway.ie/~gettrick/courses/CT216/t1.html`

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1. Develop a Z specification for bank accounts. Include operations to make deposits and withdrawals, open and close an account, and query the balance of an account.

2. Model the booking system for a particular flight. The aeroplane has a limited capacity and the flight should not be overbooked. The operations should include: a passenger booking onto the flight; a passenger cancelling his booking; a query of how many seats are still available; the production of a passenger list. Use the given set [PERSON].

3. A certain brokerage firm specialises in buying and selling companies. At a given time, its portfolio of investments is the set of companies it owns. Based on the State Schema

$$
\begin{array}{|l}
\hline
\textit{Portfolio} \\
\textit{portfolio} : \mathbb{P}\, \textit{COMPANY} \\
\textit{portfolioSize} : \mathbb{Z} \\
\hline
\textit{portfolioSize} = \#\textit{portfolio} \\
\hline
\end{array}
$$

write down schemas for `(i)` buying a company, `(ii)` selling a company, `(iii)` a combined operation where we buy one company and sell a different one.

4. An antique shop buys and sells items. Model the collection of antiques in the shop at a given time, and describe operations to buy and sell antiques, using the basic type [*ANTIQUE*].

5. In the parking example discussed in class, with basic types [*PERSON*, *PARKING_SLOT*] our State Schema had the form

$$
\begin{array}{|l}
\hline
\textit{Parking} \\
\textit{staff} : \mathbb{P}\, \textit{PERSON} \\
\textit{assigned\_to} : \textit{PARKING\_SLOT} \leftrightarrow \textit{PERSON} \\
\textit{available}, \textit{occupied} : \mathbb{P}\, \textit{PARKING\_SLOT} \\
\hline
\mathrm{ran}\ \textit{assigned\_to} \subseteq \textit{staff} \\
\textit{available} \cap \textit{occupied} = \emptyset \\
\hline
\end{array}
$$

Write schema (with appropriate error handling) to `(i)` find all parking slots assigned to a particular person, `(ii)` find all staff that share a particular parking slot.

6. In a certain US city, parking permission requires that the car is registered and has a parking permit. A parking permit is only issued to registered cars. Starting with the specification

$[CAR]$

$STATUS ::= noRegistration \mid registeredCar \mid permitHolder$

$REPORT ::= success \mid alreadyRegistered \mid permitCancelledAlso \mid notRegistered$
$\quad \mid noPermitsLeft \mid permitAlready \mid notPermitHolder$

$permitLimit : \mathbb{N}$

and the State Schema

Reg

$registered, permits : \mathbb{F}\ CAR$

$permits \subseteq registered$
$\#permits \leq permitLimit$

develop schema for each of the following ($\mathbb{F}$ above stands for a **finite subset**):

(a) Registration of a car. Write here 3 schema $RegOK, Success, AlreadyRegistered$ with the overall structure

$$Registration \mathrel{\widehat=} RegOK \land Success \lor AlreadyRegistered$$

(b) Deregistration of a car (4 schema: $DeregOK, Success, DeregPlusPermit, NotRegistered$)

$$DeRegistration \mathrel{\widehat=} DeregOK \land Success \lor DeregPlusPermit \lor NotRegistered$$

(c) Issuing of a permit:

$$Permit \mathrel{\widehat=} PermitOK \land Success \lor NotRegistered \lor PermitAlready \lor NoPermitsLeft$$

(d) Cancelling a permit:

$$CancelPermit \mathrel{\widehat=} CancelPermitOK \land Success \lor NotPermitHolder \lor NotRegistered$$

(e) Enquiring about the status of a car:

$$Enquire \mathrel{\widehat=} (RegisteredOnly \lor PermitHolder \lor Unregistered) \land Success$$