This is the BirthdayBook specification, from Spivey [1].

\[ \text{[NAME, DATE]} \]

The BirthdayBook schema defines the state space of the birthday book system.

\[
\text{BirthdayBook}
\begin{align*}
\text{known} &: \mathbb{P} \text{NAME} \\
\text{birthday} &: \text{NAME} \rightarrow \text{DATE} \\
\text{known} &= \text{dom birthday}
\end{align*}
\]

This InitBirthdayBook specifies the initial state of the birthday book system. It does not say explicitly that \( birthday' \) is empty, but that is implicit, because its domain is empty.

\[
\text{InitBirthdayBook}
\begin{align*}
\text{BirthdayBook}' \\
\text{known}' &= \{ \}
\end{align*}
\]

Next we have several operation schemas to define the normal (non-error) behaviour of the system.

\[
\text{AddBirthday}
\begin{align*}
\Delta \text{BirthdayBook} \\
\text{name}? &: \text{NAME} \\
\text{date}? &: \text{DATE} \\
\text{name}? \notin \text{known} \\
\text{birthday}' &= \text{birthday} \cup \{ \text{name}? \mapsto \text{date}? \}
\end{align*}
\]

\[
\text{FindBirthday}
\begin{align*}
\Xi \text{BirthdayBook} \\
\text{name}? &: \text{NAME} \\
\text{date}!: &: \text{DATE} \\
\text{name}? \in \text{known} \\
\text{date}! &= \text{birthday}(\text{name}?)
\end{align*}
\]
Now we strengthen the specification by adding error handling.

\[ \text{REPORT} ::= \text{ok} \mid \text{already\_known} \mid \text{not\_known} \]

First we define auxiliary schemas that capture various success and error cases.

---

**Success**

\[
\text{result}! : \text{REPORT} \\
\text{result}! = \text{ok}
\]

---

**AlreadyKnown**

\[
\exists \text{BirthdayBook} \\
\text{name}? : \text{NAME} \\
\text{result}! : \text{REPORT} \\
\text{name}? \in \text{known} \\
\text{result}! = \text{already\_known}
\]

---

**NotKnown**

\[
\exists \text{BirthdayBook} \\
\text{name}? : \text{NAME} \\
\text{result}! : \text{REPORT} \\
\text{name}? \notin \text{known} \\
\text{result}! = \text{not\_known}
\]

---

Finally, we define robust versions of all the operations by specifying how errors are handled.

\[
\text{RAddBirthday} == (\text{AddBirthday} \land \text{Success}) \lor \text{AlreadyKnown} \\
\text{RFindBirthday} == (\text{FindBirthday} \land \text{Success}) \lor \text{NotKnown} \\
\text{RRemind} == \text{Remind} \land \text{Success}
\]

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References