$$[NAME, DATE]$$

BirthdayBook

$$\begin{array}{l} known : \mathbb{P}\, NAME \\ birthday : NAME \pfun DATE \\ \hline known = \mathrm{dom}\, birthday \end{array}$$

InitBirthdayBook

$$\begin{array}{l} BirthdayBook \\ \hline known = \varnothing \end{array}$$

AddBirthday

$$\begin{array}{l} \Delta BirthdayBook \\ name? : NAME \\ date? : DATE \\ \hline name? \notin known \\ birthday' = birthday \cup \{(name?, date?)\} \end{array}$$

RemoveBirthday

$$\begin{array}{l} \Delta BirthdayBook \\ name? : NAME \\ \hline name? \in known \\ birthday' = \{name?\} \ndres birthday \end{array}$$

FindBirthday

$$\begin{array}{l} \Xi BirthdayBook \\ name? : NAME \\ date! : DATE \\ \hline name? \in known \\ (name?, date!) \in birthday \end{array}$$

The above example in Z Markup Language is as follows.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<ZML xmlns:xsi="http://www.w3.org/2000/10/XMLSchema-instance"
xsi:noNamespaceSchemaLocation="http://nt-appn.comp.nus.edu.sg/fm/zml/zml.xsd">
    <comment>This is a simplified version of the BirthdayBook example in Z
      represented in Z Markup Language.</comment>
    <basicTypeDef>
        <name>NAME</name>
        <name>DATE</name>
    </basicTypeDef>
    <schemaDef>
        <name>BirthdayBook</name>
        <declaration>
            <variable>known</variable>
            <dataType>
                <unarySym>pset</unarySym>
                <type>NAME</type>
            </dataType>
        </declaration>
        <declaration>
            <variable>birthday</variable>
            <dataType>
                <dataType>
                    <type>NAME</type>
                </dataType>
                <binarySym>tfun</binarySym>
                <type>DATE</type>
            </dataType>
        </declaration>
        <predicate>
            <expression>
                <varName>known</varName>
            </expression>
            <relationSym>=</relationSym>
            <expression>
                <prefixExpr>dom</prefixExpr>
                <expression>
                    <varName>birthday</varName>
                </expression>
            </expression>
        </predicate>
    </schemaDef>
    <schemaDef>
        <name>InitBirthdayBook</name>
        <incluList>BirthdayBook</incluList>
        <predicate>
            <expression>
                <varName>known</varName>
```

```
        </expression>
        <relationSym>=</relationSym>
        <expression>
            <singleton>emptyset</singleton>
        </expression>
    </predicate>
</schemaDef>
<schemaDef>
    <name>AddBirthday</name>
    <deltaList>BirthdayBook</deltaList>
    <declaration>
        <variable>name?</variable>
        <dataType>
            <type>NAME</type>
        </dataType>
    </declaration>
    <declaration>
        <variable>date?</variable>
        <dataType>
            <type>DATE</type>
        </dataType>
    </declaration>
    <predicate>
        <expression>
            <varName>name?</varName>
        </expression>
        <relationSym>nem</relationSym>
        <expression>
            <varName>known</varName>
        </expression>
    </predicate>
    <predicate>
        <expression>
            <expression>
                <varName>birthday</varName>
            </expression>
            <postfixExpr>'</postfixExpr>
        </expression>
        <relationSym>=</relationSym>
        <expression>
            <expression>
                <varName>birthday</varName>
            </expression>
            <exprConnSym>uni</exprConnSym>
            <expression>
                <left>{</left>
                <expression>
```

```
                    <left>(</left>
                    <expression>
                        <expression>
                            <varName>name?</varName>
                        </expression>
                        <exprConnSym>,</exprConnSym>
                        <expression>
                            <varName>date?</varName>
                        </expression>
                    </expression>
                    <right>)</right>
                </expression>
                <right>}</right>
            </expression>
        </expression>
    </predicate>
</schemaDef>
<schemaDef>
    <name>RemoveBirthday</name>
    <deltaList>BirthdayBook</deltaList>
    <declaration>
        <variable>name?!</variable>
        <dataType>
            <type>NAME</type>
        </dataType>
    </declaration>
    <predicate>
        <expression>
            <varName>name?</varName>
        </expression>
        <relationSym>mem</relationSym>
        <expression>
            <varName>known</varName>
        </expression>
    </predicate>
    <predicate>
        <expression>
            <expression>
                <varName>birthday</varName>
            </expression>
            <postfixExpr>'</postfixExpr>
        </expression>
        <relationSym>=</relationSym>
        <expression>
            <expression>
                <left>{</left>
                <expression>
```

```
                    <varName>name?</varName>
                </expression>
                <right>}</right>
            </expression>
            <exprConnSym>dsub</exprConnSym>
            <expression>
                <varName>birthday</varName>
            </expression>
        </expression>
    </predicate>
</schemaDef>
<schemaDef>
    <name>FindBirthday</name>
    <xiList>BirthdayBook</xiList>
    <declaration>
        <variable>name?</variable>
        <dataType>
            <type>NAME</type>
        </dataType>
    </declaration>
    <declaration>
        <variable>date!</variable>
        <dataType>
            <type>DATE</type>
        </dataType>
    </declaration>
    <predicate>
        <expression>
            <varName>name?</varName>
        </expression>
        <relationSym>mem</relationSym>
        <expression>
            <varName>known</varName>
        </expression>
    </predicate>
    <predicate>
        <expression>
            <left>(</left>
                    <expression>
                        <expression>
                            <varName>name?</varName>
                        </expression>
                        <exprConnSym>,</exprConnSym>
                        <expression>
                            <varName>date!</varName>
                        </expression>
                    </expression>
```

```
                        <right>)</right>
                </expression>
                <relationSym>mem</relationSym>
                <expression>
                    <varName>birthday</varName>
                </expression>
            </predicate>
        </schemaDef>
    </ZML>
```