

Concordia University  
Department of Computer Science and Software  
Engineering

**SOEN 331 - S and U**  
**Introduction to Formal Methods**  
**for Software Engineering**

**Assignment 2 - Solutions**  
The Object-Z specification language

**Team 19 - Section U**

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# 1 Contact management

## 1.1 State

## 1.2 Class Contacts

<i>Contacts</i>
$\uparrow (MakeNewContact, AddNumber, SearchForNumber, DeleteNumber)$
$numbers : \mathbb{P}PhoneNumberType$ $recorded : PhoneNumberType \leftrightarrow NameType$ $count : \mathbb{N}$
$numbers = dom\ recorded$ $count \geq 0$
<i>INIT</i>
$recorded = \emptyset$ $count = 0$
<i>MakeNewContactOK</i>
$\Delta(recorded, count)$ $number? : PhoneNumberType$ $name? : NameType$
$number? \notin numbers$ $name? \notin ran\ recorded$ $recorded' = recorded \cup \{number? \mapsto name?\}$ $count' = count + 1$
<i>AddNumberOK</i>
$\Delta(recorded)$ $number? : PhoneNumberType$ $name? : NameType$
$count > 0$ $number? \notin numbers$ $name? \in ran\ recorded$ $recorded' = recorded \cup \{number? \mapsto name?\}$
<i>SearchForNumberOK</i>
$\exists Contacts$ $name? : NameType$ $numbers! : \mathbb{P}number$
$count > 0$ $numbers! = \{n : number \mid recorded(n) = name?\}$
...

*Contacts/cont.*

...

*DeleteNumberOK*

$\Delta(\text{recorded}, \text{count})$

$\text{number?} : \text{PhoneNumberType}$

$\text{name} : \text{NameType}$

$\text{count} > 0$

$\text{name} = \text{recorded}(\text{number?})$

$\text{number?} \in \text{numbers}$

$\text{recorded}' = \{\text{number?}\} \triangleleft \text{recorded}$

**if**  $\#(\text{recorded} \triangleright \{\text{name}\}) = 0$  **then**  $\text{count}' = \text{count} - 1$  **else**  $\text{count}' = \text{count}$

*NameUnknown*

$\text{name?} : \text{NameType}$

$\text{response!} : \text{Message}$

$\text{name?} \notin \text{ran recorded}$

$\text{response!} = \text{'Name unknown'}$

*NumberUnknown*

$\text{number?} : \text{PhoneNumberType}$

$\text{response!} : \text{Message}$

$\text{number?} \notin \text{dom recorded}$

$\text{response!} = \text{'Number unknown'}$

*NameExists*

$\text{name?} : \text{NameType}$

$\text{response!} : \text{Message}$

$\text{name?} \in \text{ran recorded}$

$\text{response!} = \text{'Name already exists'}$

*NumberExists*

$\text{number?} : \text{PhoneNumberType}$

$\text{response!} : \text{Message}$

$\text{number?} \in \text{dom recorded}$

$\text{response!} = \text{'Number already exists'}$

*ContactsEmpty*

$\text{response!} : \text{Message}$

$\text{count} = 0$

$\text{response!} = \text{'Contacts is empty'}$

*Success*

$\text{response!} : \text{Message}$

$\text{response!} = \text{'Success'}$

...

*Contacts/cont.*

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...

$$MakeNewContact \hat{=} (MakeNewContactOK \wedge Success) \oplus (NameExists \vee NumberExists)$$

$$AddNumber \hat{=} (AddNumberOK \wedge Success) \oplus (NameUnknown \vee NumberExists \vee ContactsEmpty)$$

$$SearchForNumber \hat{=} (SearchForNumberOK \wedge Success) \oplus (NameUnknown \vee ContactsEmpty)$$

$$DeleteNumber \hat{=} (DeleteNumberOK \wedge Success) \oplus (NumberUnknown \vee ContactsEmpty)$$

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## 1.3 Class Contacts2