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

Contacts

$\upharpoonright (MakeNewContact, AddNumber, SearchForNumber, DeleteNumber)$

$numbers : \mathbb{P}\,PhoneNumberType$
$recorded : PhoneNumberType \nrightarrow NameType$
$count : \mathbb{N}$

$numbers = dom\ recorded$
$count >= 0$

I_{NIT}

$recorded = \varnothing$
$count = 0$

MakeNewContactOK

$\Delta(recorded, count)$
$number? : PhoneNumberType$
$name? : NameType$

$number? \notin numbers$
$name? \notin ran\ recorded$
$recorded' = recorded \cup \{number? \mapsto name?\}$
$count' = count + 1$

AddNumberOK

$\Delta(recorded)$
$number? : PhoneNumberType$
$name? : NameType$

$count > 0$
$number? \notin numbers$
$name? \in ran\ recorded$
$recorded' = recorded \cup \{number? \mapsto name?\}$

SearchForNumberOK

$\Xi Contacts$
$name? : NameType$
$numbers! : \mathbb{P}\,number$

$count > 0$
$numbers! = \{n : number \mid recorded(n) = name?\}$

...

_____ _Contacts/cont._ _____

...

    _____ _DeleteNumberOK_ _____
    | $\Delta(recorded, count)$
    | $number? : PhoneNumberType$
    | $name : NameType$
    |_____
    | $count > 0$
    | $number? \in numbers$
    | $name = recorded(number?)$
    | $recorded' = \{number?\} \lhd recorded$
    | $\textbf{if}\ \#(recorded \rhd \{name\}) = 0\ \textbf{then}\ count' = count - 1\ \textbf{else}\ count' = count$

    _____ _NameUnknown_ _____
    | $name? : NameType$
    | $response! : Message$
    |_____
    | $name? \notin ran\ recorded$
    | $response! =\ 'Name\ unknown'$

    _____ _NumberUnknown_ _____
    | $number? : PhoneNumberType$
    | $response! : Message$
    |_____
    | $number? \notin dom\ recorded$
    | $response! =\ 'Number\ unknown'$

    _____ _NameExists_ _____
    | $name? : NameType$
    | $response! : Message$
    |_____
    | $name? \in ran\ recorded$
    | $response! =\ 'Name\ already\ exists'$

    _____ _NumberExists_ _____
    | $number? : PhoneNumberType$
    | $response! : Message$
    |_____
    | $number? \in dom\ recorded$
    | $response! =\ 'Number\ already\ exists'$

    _____ _ContactsEmpty_ _____
    | $response! : Message$
    |_____
    | $count =\ 0$
    | $response! =\ 'Contacts\ is\ empty'$

...

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Contacts/cont.

...

  Success

    $response! : Message$

    ———

    $response! = \ 'Success'$

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

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

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

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

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1.3   Class Contacts2

```
┌─ Contacts2 ─────────────────────────────────────────────
│ ↾ (MakeNewContact, AddNumber, SearchForNumber, DeleteNumber,
│   SearchForPerson)
│
│ Contacts
│
│  ┌─ SearchForPersonOK ────────────────────────────────
│  │ ΞContacts2
│  │ number? : PhoneNumberType
│  │ name! : NameType
│  ├──────────────────────────────────────────────────
│  │ number? ∈ numbers
│  │ name! = recorded(number?)
│  └──────────────────────────────────────────────────
│
│ SearchForPerson ≙ (SearchForPersonOK ∧ Success) ⊕ (NumberUnknown ∨ ContactsEmpty)
└─────────────────────────────────────────────────────────
```