XEvent-B User Manual

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(for feature version 0.0.6)
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1 Event-B XText Front-end Overview

The Event-B XText Front-end provides new XEvent-B constructs (XMachines and XContexts) which are text files which are automatically translated into the corresponding Rodin Event-B constructs (i.e., Machine and Context) accordingly. Facility for translating from Rodin Event-B components to XEvent-B components can be invoked manually. The overall process can be seen in Figure 1.

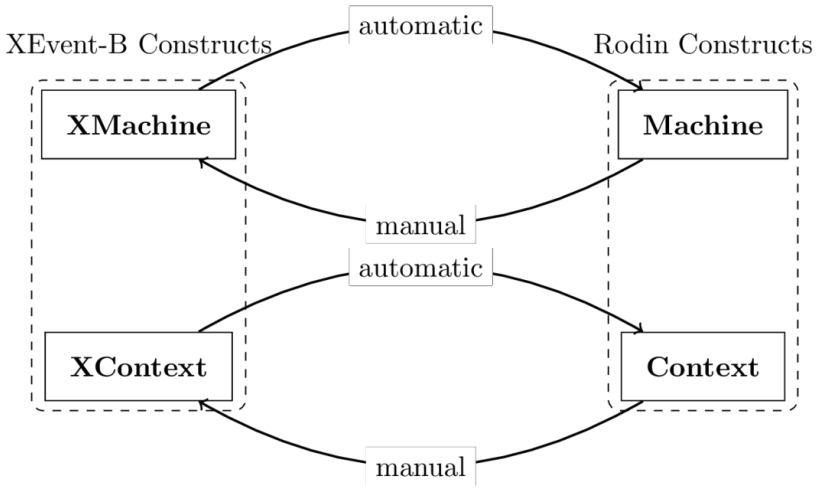

Figure 1: Overview of XEvent-B and Rodin Event-B Constructs

2 Getting Started

2.1 Installation

2.1.1 Setup

- Before installing the Event-B XText Front-end feature, you need to add the XText update site (`http://download.eclipse.org/modeling/tmf/xtext/updates/composite/releases/`) as an additional software site (see Figure 2).

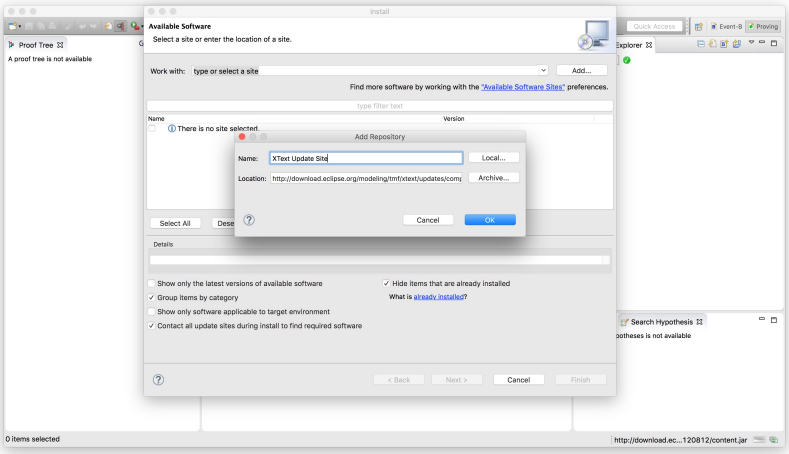

Figure 2: Adding XText Update Site

- The Event-B XText front-end feature is available from the main Rodin update site (under "Modelling Extensions" category). There are two versions of the feature, *eXtended Event-B (XEvent-B)* providing facilities for working with Event-B XText Front-end, and the *eXtended Event-B (XEvent-B) (SDK)* is the feature including source code for software developers (see Figure 3).

2.1.2 Release Notes

0.0.6

- Renamed plug-ins and features to XEvent-B (instead of Event-B XText).
- XEvent-B Branding (0.0.2): Renamed from Event-B XText Branding.
- XEvent-B Documentations (0.0.2): Renamed from Event-B XText Documentations.
- XEvent-B Cheatsheets (0.0.2): Renamed from Event-B XText Cheatsheets.
- XEvent-B Common (0.0.3): Renamed from Event-B XText Common.

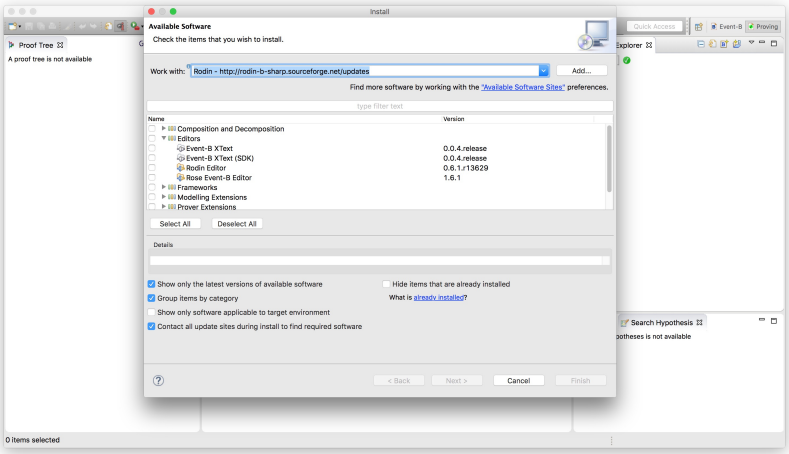

Figure 3: Adding XText Update Site

- XEvent-B UI (0.0.2): Renamed from Event-B XText UI.
- XEvent-B XContext (0.0.4): Renamed from Event-B XText Context.
- XEvent-B XContext IDE (0.0.3): Renamed from Event-B XText Context IDE.
- XEvent-B XContext UI (0.0.3): Renamed from Event-B Context UI.
- XEvent-B XMachine (0.0.4): Renamed from Event-B XText Machine.
  - Support Machine Inclusion and Event Synchronisation.
- XEvent-B XMachine IDE (0.0.3): Renamed from Event-B XText Machine IDE.
- XEvent-B XMachine UI (0.0.3): Renamed from Event-B XText Machine UI.

0.0.5

- Event-B XText Documentations (0.0.1): Documentation plug-in (Initial version).

0.0.4

- Updated plug-in dependency for the feature

0.0.3

- Event-B XText Context (0.0.3):
  - Issue #3: Single-line comment after the element, multi-line comment before the element

- Event-B XText Context IDE (0.0.2): Regenerated
- Event-B XText ContextUI IDE (0.0.2): Regenerated
- Event-B XText Machine (0.0.3):
  - Issue #3: Single-line comment after the element, multi-line comment before the element.
  - Issue #5: Event terminator using 'end' keyword instead of ';'
- Event-B XText Machine IDE (0.0.2) Regenerated
- Event-B XText Machine UI IDE (0.0.2) Regenerated

0.0.2

- Event-B XText Common (0.0.2):
  - Added transient value service for XContext and XMachine.
- Event-B XText Context (0.0.2):
  - Added formatter (used for auto-indentation).
- Event-B XText Machine (0.0.2):
  - Added formatter (used for auto-indentation).
- Event-B XText UI (0.0.1): Initial version
  - Added context menu for converting machines and contexts to XText.

0.0.1 Initial version contains the following plug-ins:

- Event-B XText Branding (0.0.1) Initial version: Branding information
- Event-B XText Common (0.0.1) Initial version: Common facilities
- Event-B XText Context (0.0.1) Initial version: Core support for Event-B contexts
- Event-B XText Context IDE (0.0.1) Initial version: IDE for Event-B contexts
- Event-B XText Context UI (0.0.1) Initial version: UI for Event-B contexts
- Event-B XText Machine (0.0.1) Initial version: Core support for Event-B machines
- Event-B XText Machine IDE (0.0.1) Initial version: IDE for Event-B machines
- Event-B XText Machine UI (0.0.1) Initial version: UI for Event-B machines

2.1.3 IMPORTANT

- Currently, Event-B XText front-end **not only** supports "standard" Event-B machines and contexts, but also supports "*Machine Inclusion*" and "*Event Synchronisation*".
- Since the XContexts and XMachines are compiled to the Rodin files, the corresponding Rodin contexts and machines will be **OVER-WRITTEN**. Any changes in the Rodin files will not be lost.
- **DO NOT USE** the Event-B XText Front-end if you use modelling plug-ins such as *iUML-B* state-machines and class-diagrams, as the additional modelling elements will be over-written.
- Windows users **must** change the workspace text file encoding to **UTF-8**. This can be updated under the Rodin Preferences: General/Workspace then in the "*Text file encoding*" section, select Other: UTF-8.

2.1.4 Known Issues

- Converting to XText: Currently, the "extended" attribute of events are not serialised.
- Machine Inclusion:
  - Currently a machine can be only included if it is in the same project.
  - Including the **same** machine to both the abstract and its refining machine can result in the repetition of invariants.

2.1.5 Configuration

Event-B Explorer By default, XContext files (extension .bucx) and XMachine files (extension .bumx) are not displayed in the *Event-B Explorer*. To enable this, select *Customize view* for *Event-B Explorer* and uncheck the option *All files and folders*.

2.2 Basic Tutorial

This tutorial provides a step-by-step walk-through working with XEvent-B constructs. This tutorial also available as Cheatsheets with the Rodin Platform (`Help/Cheat Sheets/Event-B XText Cheatsheets/Event-B XText Basic Tutorial`).

2.2.1 Task 1. Customise the Event-B Explorer

Introduction The purpose of this task is to customise the Event-B Explorer so that XEvent-B constructs are visible.

Step 1. Disable the filter on "All files and folders" Select "Customize View" of Event-B Explorer View. Make sure that "All files and folders" from the dialog is **Unchecked**.

Conclusion Since the filter on "All files and folders" is now disabled, there might be other files and folders than XEvent-B constructs will also be visible in the Event-B Explorer.

2.2.2 Task 2. Create an Event-B Project

Introduction The purpose of this task is to create an Event-B project for the XEvent-B constructs.

Step 1. Create a new Event-B Project Create a new Event-B Project named "Club" using the *New Event-B Project* wizard (see Figure 4).

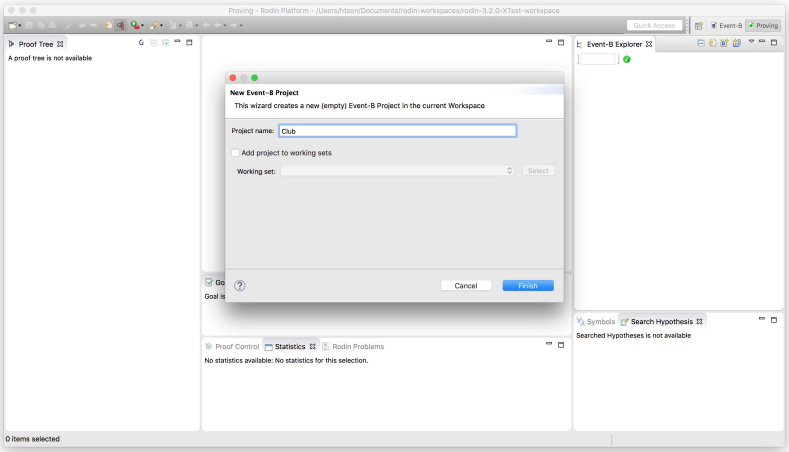

Figure 4: Create Event-B Project called "Club"

Conclusion By now, the project "Club" should be visible in the Event-B Explorer.

2.2.3 Task 3. Create a simple XContext coursesCtx.bucx

Introduction The purpose of this task is to create a simple XContext within the newly created project.

Step 1. Create a new XContext coursesCtx.bucx Create a new XContext named "coursesCtx.bucx" using the *New File wizard* (see Figure 5). **Important**: A pop-up dialog will be displayed asking to convert the "Club" project to XText project, please answer **Yes** (see Figure 6).

Step 2. Set the content of courseCtx.bucx Set the content of "coursesCtx.bucx" as follows.

```
context coursesCtx

sets CRS

constants m

axioms

  @axm0_1: "finite(CRS)"
```

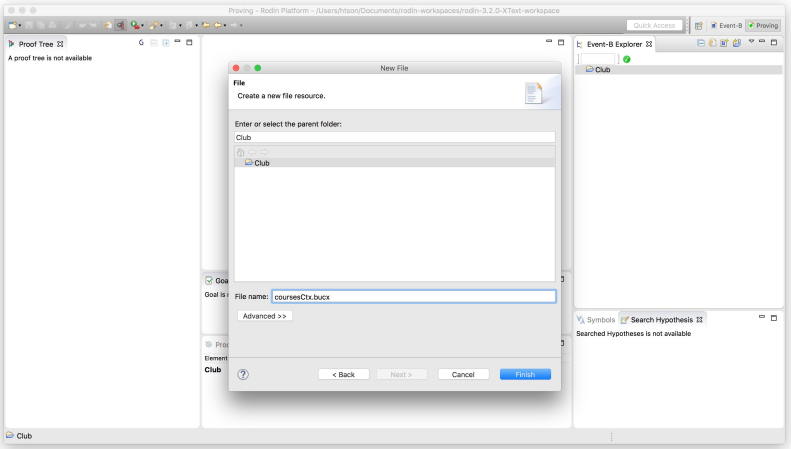

Figure 5: Create an XContext called “coursesCtx.bucx”

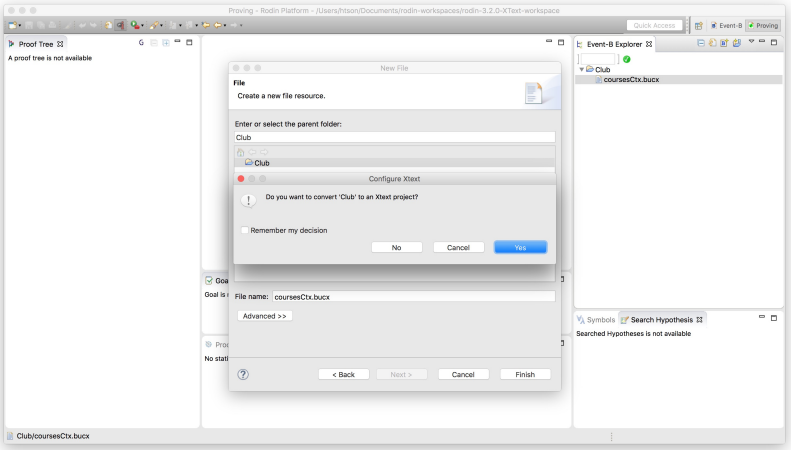

Figure 6: Convert “Club” to XText project

```
@axm0_2: "m ∈ ℕ1"

@thm0_1: "0 < m" theorem

end
```

Important: In order to typeset Event-B mathematical symbol, e.g., $\mathbb{N}_1$, one can use content assist. For example, typing `NAT` and invoking content assist (e.g., on Mac OS `Ctrl+Space`), a dropdown list will appear with options for typesetting $\mathbb{N}_1$ and $\mathbb{N}_1$ (See Figure 7.

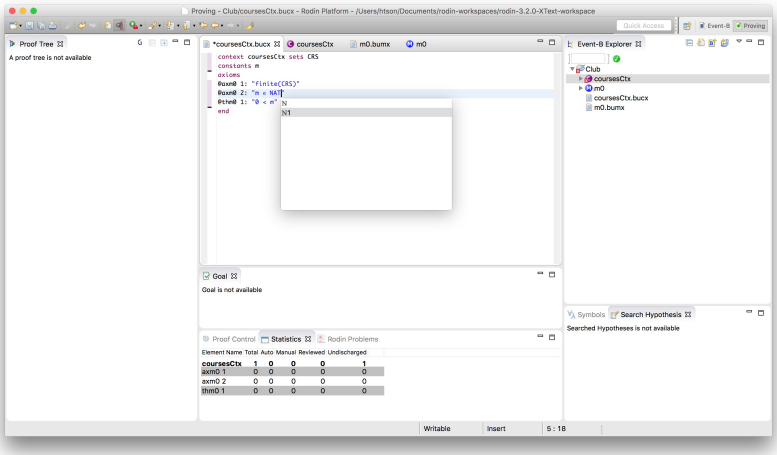

Figure 7: Type-setting $\mathbb{N}_1$ using Content Assist

Step 3. Auto-format the code Automatically format the content of "coursesCtx.bucx" using short-cut (e.g., on Mac OS: `Cmd+Shift+F`).

Step 4. Save the file Save the file "coursesCtx.bucx".

Conclusion By now, the XContext "coursesCtx.bucx" and the corresponding Rodin Context "coursesCtx" should be visible in the Event-B Explorer (see Figure 8).

2.2.4 Task 4. Create a simple XMachine m0.bumx

Introduction The purpose of this task is to create a simple XMachine within the newly created project.

Step 1. Create a new XMachine m0.bumx Create a new XMachine named "m0.bumx" using the New File wizard (see Figure 9. The newly created file should be opened automatically in an XMachine editor.

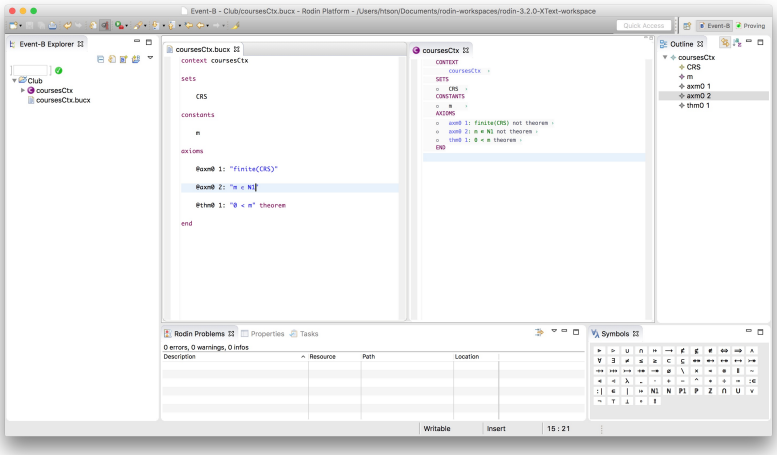

Figure 8: The final XContext coursesCtx.bucx

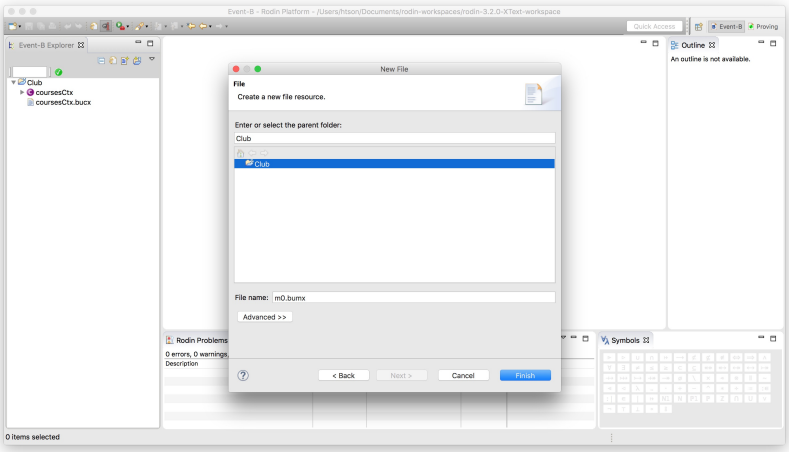

Figure 9: Type-setting $\mathbb{N}_1$ using Content Assist

Step 2. Set the content of m0.bumx Set the content of "m0.bumx" as follows.

machine m0

variables crs

invariants

@inv0_1: "$crs \in \mathbb{P}(CRS)$"

@thm0_2: "finite(crs)" **theorem**

@inv0_2: "card(crs) $\leq m$"

@DLF: "(card(crs) $\neq m$) $\vee$ ($\exists\ cs \cdot cs \subseteq crs \wedge cs \neq \varnothing$)"

events

INITIALISATION

begin

@act0_1: "$crs := \varnothing$"

end

OpenCourses

when

@grd0_1: "card(crs) $\neq m$"

@thm0_3: "$crs \neq CRS$" **theorem**

then

@act0_1: "$crs :| crs \subset crs' \wedge$ card(crs') $\leq m$"

end

CloseCourses **anticipated**

any cs **where**

@grd0_1: "$cs \subseteq crs$"

@grd0_2: "$cs \neq \varnothing$"

then

```
@act0_1: "crs := crs \ cs"
```

```
end
```

```
end
```

Step 3. Auto-format the code Automatically format the content of "m0.bumx" by using short-cut (e.g., on Mac OS: Cmd+Shift+F).

Step 4. Save the file Save the file "m0.bumx".

Step 5. Add missing "sees" clause In the compiled Rodin Machine m0, there are several errors, due to the fact that **m0** refers to the sets and constants of the context courseCtx. **Add the missing "sees" clause** after the "machine" clause

```
sees courseCtx
```

(Note: One can use *Content Assist* after typing the "sees" keyword to select the context, see Figure 10).

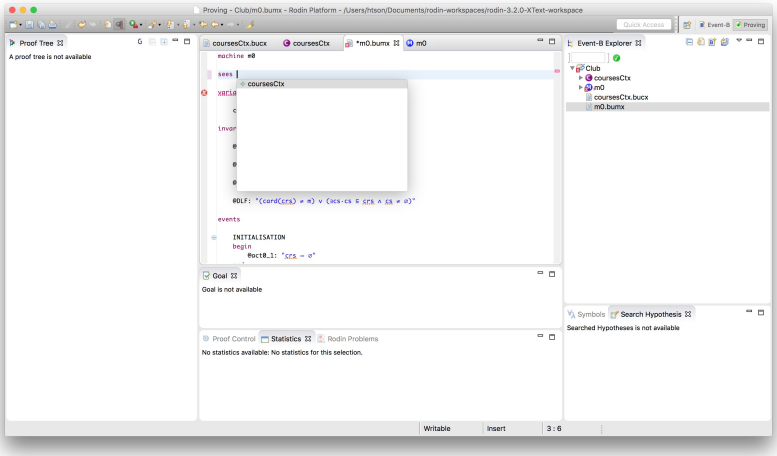

Figure 10: Content Assist for adding Sees clause

Step 6. Save the file again Save the file "m0.bumx" again.

Conclusion By now, the XMachine "m0.bumx" and the corresponding Rodin Machine "m0" (without any error) should be visible in the Event-B Explorer (see Figure 11.

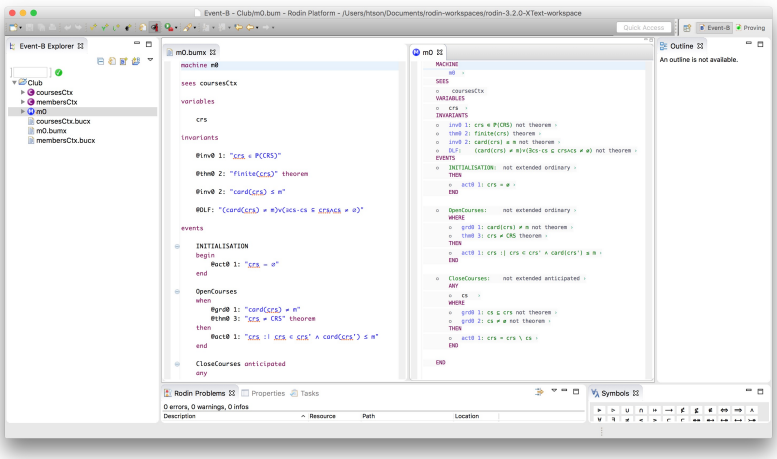

Figure 11: XMachine m0.bucx

2.2.5 Task 5. Create extended XContexts

Introduction The purpose of this task is to create some more extended XContexts within the "Club" project.

Task 5.1. Create a simple XContext membersCtx.bucx Introduction The purpose of this sub-task is to create a simple XContext "membersCtx.bucx" within the "Club" project.

Step 1. Create a new XContext membersCtx.bucx Create a new XContext named "membersCtx.bucx" using the *New File* wizard (see Figure 12.

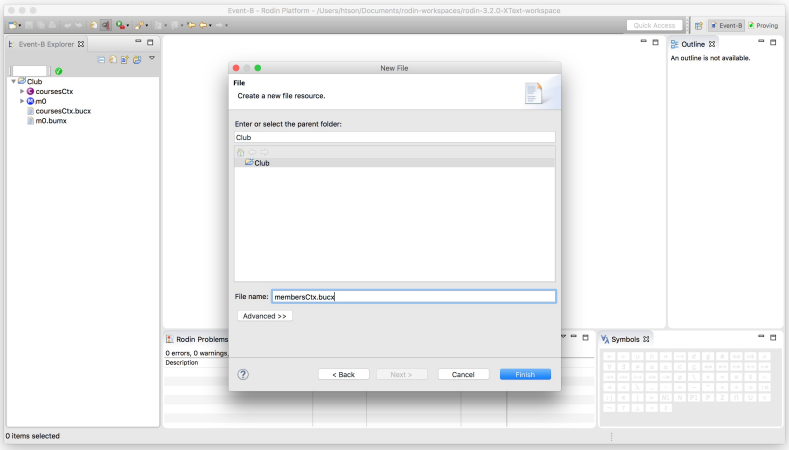

Figure 12: Create membersCtx.bucx

Step 2. Set the content of membersCtx.bucx **Set the content of "membersCtx.bucx" as follows**.

```
context memebersCtx

sets MEM

axioms

    @axm0_1: "finite(MEM)"

end
```

Step 3. Auto-format the code **Automatically format the content of "membersCtx.bucx"** by using short-cut (e.g., on Mac OS: Cmd+Shift+F).

Step 4. Save the file ¡b¿Save the file **"membersCtx.bucx"**.

Conclusion By now, the XContext "membersCtx.bucx" and the corresponding Rodin Context "membersCtx" should be visible in the Event-B Explorer (see Figure 13.

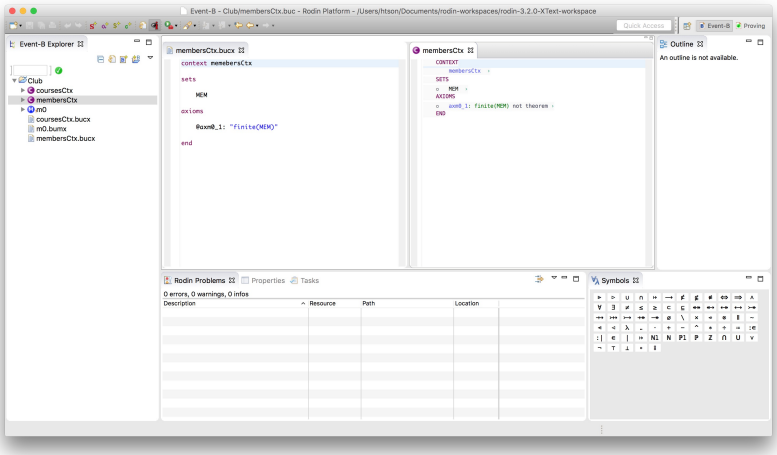

Figure 13: XContext membersCtx.bucx

Task 5.2. Create an extended XContext participantsCtx.bucx **Introduction** The purpose of this sub-task is to create an extended XContext "participantsCtx.bucx" within the "Club" project.

Step 1. Create a new XContext participantsCtx.bucx **Create a new XContext** named "participantsCtx.bucx" using the *New File wizard* (see Figure 14.

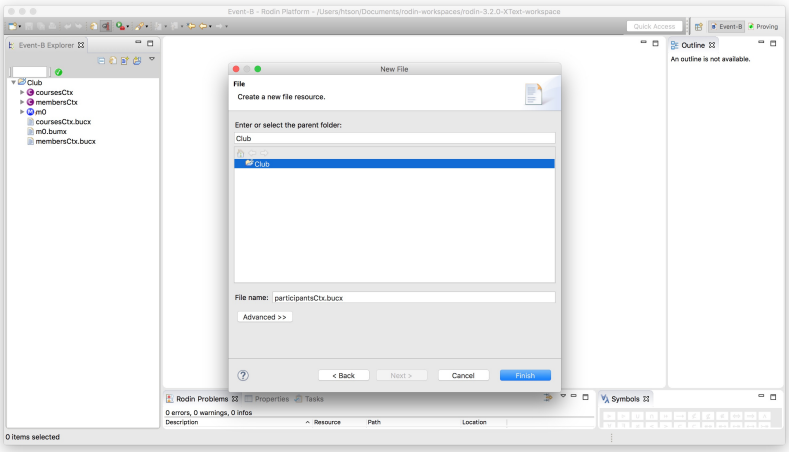

Figure 14: Create participantsCtx.bucx

Step 2. Set the content of participantsCtx.bucx **Set the content of "participantsCtx.bucx" as follows**.

```
context participantsCtx

extends membersCtx

constants PRTCPT

axioms

    @axm1_2: "PRTCPT ∈ ℙ(MEM)"

    @thm1_1: "finite(PRTCPT)" theorem

end
```

Step 3. Auto-format the code **Automatically format the content of "participantsCtx.bucx"** by using short-cut (e.g., on Mac OS: Cmd+Shift+F).

Step 4. Save the file **Save the file "participantsCtx.bucx"**.

Conclusion By now, the XContext "participantsCtx.bucx" and the corresponding Rodin Context "participantsCtx" should be visible in the Event-B Explorer (see Figure 15).

Task 5.3. Create an extended XContext instructorsCtx.bucx **Introduction** The purpose of this sub-task is to create an extended XContext "instructorsCtx.bucx" within the "Club" project.

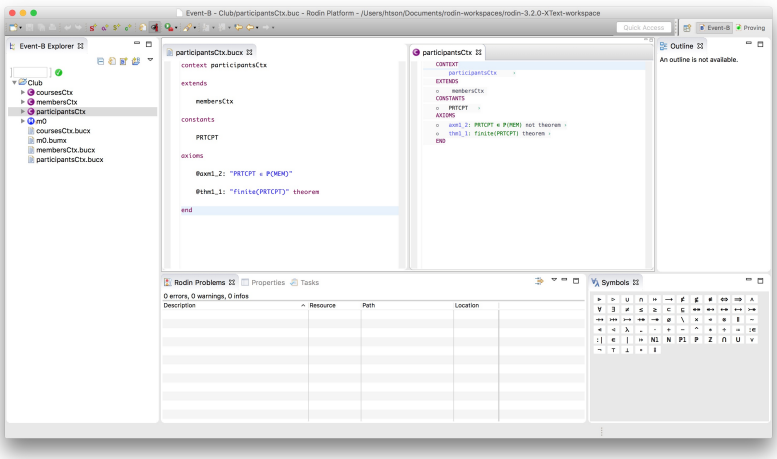

Figure 15: XContext participantsCtx.bucx

Step 1. Create a new XContext instructorsCtx.bucx **Create a new XContext** named "instructorsCtx.bucx" using the *New File wizard* (see Figure 16.

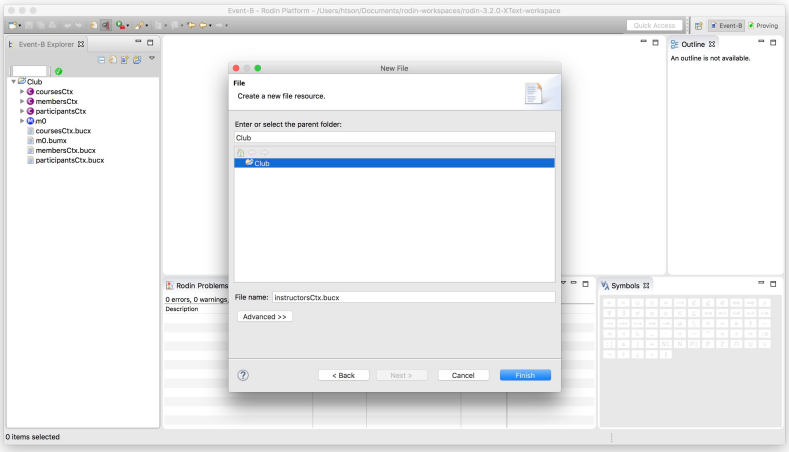

Figure 16: Create instructorsCtx.bucx

Step 2. Set the content of instructorsCtx.bucx **Set the content of "instructorsCtx.bucx" as follows**.

```
context instructorsCtx

extends membersCtx coursesCtx

constants INSTR instrs
```

axioms

`@axm1_3:` "$INSTR \in \mathbb{P}(MEM)$"

`@axm1_4:` "$instrs \in CRS \rightarrow INSTR$"

end

Step 3. Auto-format the code Automatically format the content of "intructorsCtx.bucx" by using short-cut (e.g., on Mac OS: Cmd+Shift+F).

Step 4. Save the file Save the file "instructorsCtx.bucx".

Conclusion By now, the XContext "instructorsCtx.bucx" and the corresponding Rodin Context "instructorsCtx" should be visible in the Event-B Explorer (see Figure.

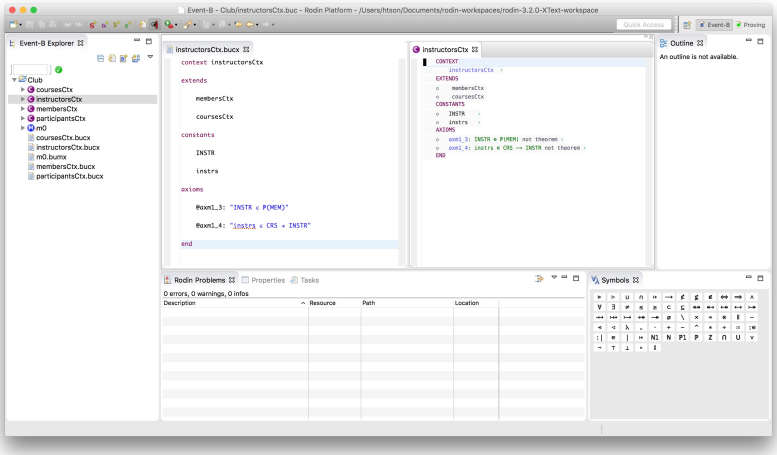

Figure 17: XContext instructorsCtx.bucx

2.2.6 Task 6. Create refined XMachines

Introduction The purpose of this task is to create some more refined XMachines within the "Club" project.

Task 6.1. Create a refined XMachine m1.bumx Introduction The purpose of this sub-task is to create a refined XMachine "m1.bumx" within the "Club" project.

Step 1. Create a new XMachine m1.bumx Create a new XMachine named "m1.bumx" using the *New File wizard* (see Figure 18. The newly created file should be opened automatically in an XMachine editor.

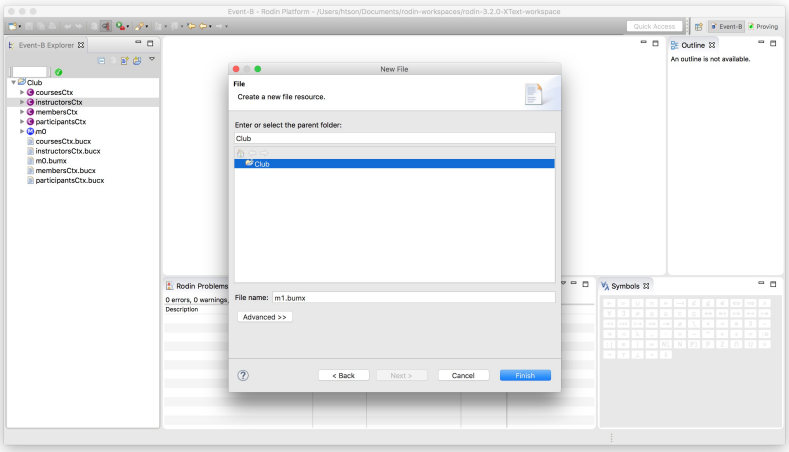

Figure 18: Create m1.bumx

Step 2. Set the content of m1.bumx Set the content of "m1.bumx" as follows.

machine m1

refines m0

sees instructorsCtx participantsCtx

variables crs prtcpts

invariants

@inv1_1: "$prtcpts \in crs \leftrightarrow PRTCPT$"

@inv1_2: "$\forall c \cdot c \quad crs \Rightarrow instrs(c) \notin prtcpts[\{c\}]$"

variant "$(crs \times PRTCPT) \setminus prtcpts$"

events

INITIALISATION **extended**

begin

@act1_2: "$prtcpts := \varnothing$"

end

OpenCourses **extended**

```
refines OpenCourses

when

    @thm1_2: "dom(prtcpts) ⊆ crs" theorem

end

CloseCourses extended anticipated

refines CloseCourses

begin

    @act1_2: "prtcpts := cs ⩤ prtcpts"

end

Register convergent

any p c where

    @grd1_1: "p ∈ PRTCPT"

    @grd1_2: "c ∈ crs"

    @grd1_3: "p ≠ instrs(c)"

    @grd1_4: "c ↦ p ≠ prtcpts"

then

    @act1_1: "prtcpts := prtcpts ∪ {c ↦ p}"

end

end
```

Step 3. Auto-format the code Automatically format the content of "m1.bumx" by using short-cut (e.g., on Mac OS: Cmd+Shift+F).

Step 4. Save the file Save the file "m1.bumx".

Conclusion By now, the XMachine "m1.bucx" and the corresponding Rodin Machine "m1" should be visible in the Event-B Explorer (see Figure 19.

Task 6.2. Create a refined XMachine m2.bumx Introduction The purpose of this sub-task is to create a refined XMachine "m2.bumx" within the "Club" project.

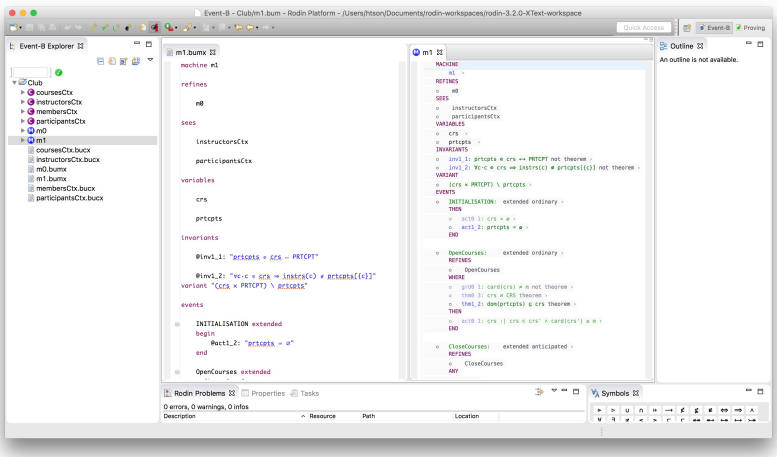

Figure 19: XMachine m1.bumx

Step 1. Create a new XMachine m2.bumx Create a new XMachine named "m2.bumx" using the *New File wizard* (see Figure 20. The newly created file should be opened automatically in an XMachine editor.

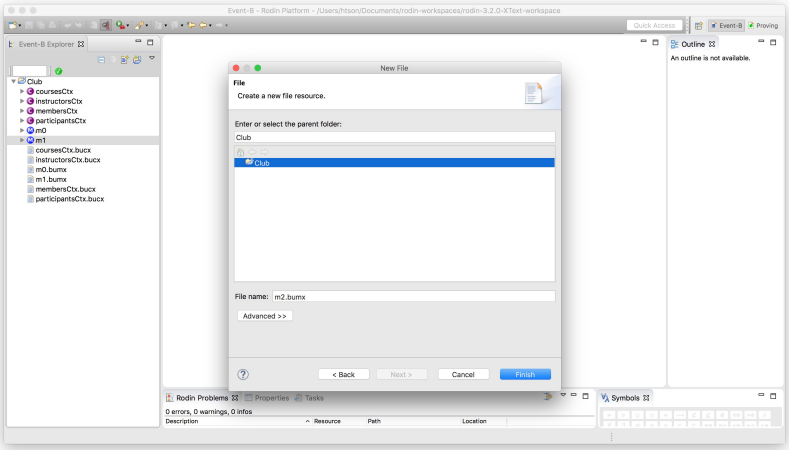

Figure 20: Create m2.bumx

Step 2. Set the content of m2.bumx Set the content of "m2.bumx" as follows.

```
machine m2

refines m1

sees instructorsCtx participantsCtx
```

variables atnds

invariants

@inv2_1: "$atnds \in CRS \pfun \mathbb{P}(PRTCPT)$"

@inv2_2: "$crs = \mathrm{dom}(atnds)$"

@inv2_3: "$\forall\ c \cdot c \in crs \Rightarrow prtcpts[\{c\}] = atnds(c)$"

@thm2_1: "$\mathrm{finite}(atnds)$" **theorem**

variant "$\mathrm{card}(atnds)$"

events

INITIALISATION

begin

@act2_1: "$atnds := \varnothing$"

end

OpenCourse

refines OpenCourses

any c **where**

@grd2_1: "$c \notin \mathrm{dom}(atnds)$"

@grd2_2: "$\mathrm{card}(atnds) \neq m$"

@thm2_2: "$\mathrm{card}(crs) \neq m$" **theorem**

with

@crs': "$crs' = crs \cup \{c\}$"

then

@act2_1: "$atnds(c) := \varnothing$"

end

CloseCourse **convergent**

refines CloseCourses

```
        any c where
            @grd2_1: "c ∈ dom(atnds)"
        with
            @cs: "cs = {c}"
        then
            @act1_2: "atnds := {c} ⩤ atnds"
        end
         Register convergent
        refines Register
        any p c where
            @grd2_1: "p ∈ PRTCPT"
            @grd2_2: "p ≠ instrs(c)"
            @grd2_3: "c ∈ dom(atnds)"
            @grd2_4: "p ∉ atnds(c)"
            @thm2_3: "atnds(c) = prtcpts[{c}]" theorem
        then
            @act2_1: "atnds(c) := atnds(c) {p}"
        end
    end
```

Step 3. Auto-format the code Automatically format the content of "m2.bumx" by using short-cut (e.g., on Mac OS: Cmd+Shift+F).

Step 4. Save the file Save the file "m2.bumx".

Conclusion By now, the XMachine "m2.bucx" and the corresponding Rodin Machine "m2" should be visible in the Event-B Explorer (see Figure 21.

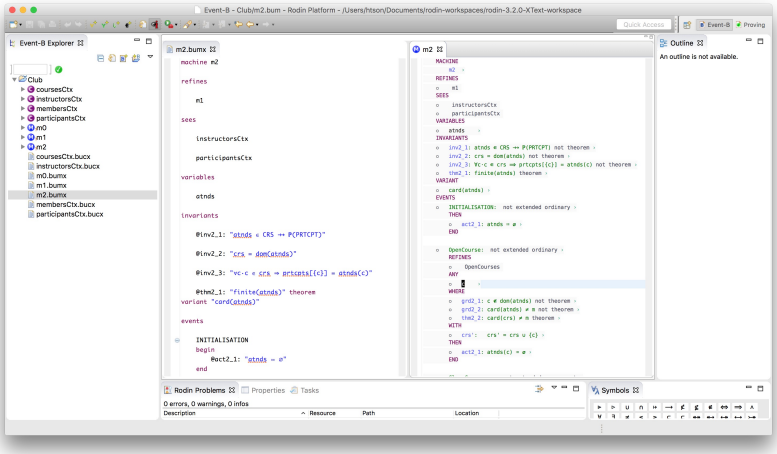

Figure 21: XMachine m2.bumx

2.3 Advanced Tutorial

This tutorial provides a step-by-step walk-through working with *machine inclusion* using XEvent-B. Following the same steps as in Section 2.2 to create machines and contexts, we can create a machine that can include other machines and can update the included machines variables via *event synchronisation*.

We illustrate the application of machine inclusion using XEvent-B by modelling a small example of "controlling cars on a bridge", which is based on Chapter 2 of "*Modeling in Event-B: System and Software Engineering*" book.

2.3.1 Task 1. Create the reusable model

Introduction The purpose of this task is to create the model that will be reused by other models using machine inclusion.

Step 1. Create a new Project with XMachine Sensor_m0_SNSR.bumx Following the same steps as in Sections 2.2.2 and 2.2.4 for creating project and machines.

Step 2. Set the content of Sensor_m0_SNSR.bumx Set the content of "Sensor_m0_SNSR.bumx" as follows.

machine `Sensor_m0_SNSR`

variables `SNSR`

invariants

`@thm0_1: "`$SNSR \in BOOL$`"` **theorem**

events

INITIALISATION

begin

@act1: "$SNSR := FALSE$"

end

SNSR_on

when

@grd1: "$SNSR = FALSE$"

then

@act1: "$SNSR := TRUE$"

end

SNSR_off

when

@grd1: "$SNSR = TRUE$"

then

@act1: "$SNSR := FALSE$"

end

end

Step 3. Auto-format and Save the file "Sensor_m0_SNSR.bumx"

Conclusion By now, the XMachine "Sensor_m0_SNSR.bumx" and the corresponding Rodin Machine "Sensor_m0_SNSR" should be visible in the Event-B Explorer.

2.3.2 Task 2. Model the abstract level of cars on a bridge

Introduction The purpose of this task is to create the abstract model of the "cars on a bridge" example. At this level, we have not applied machine inclusion, but it is possible to apply machine inclusion right from the abstract level.

Step 1. Create the Context Car_c0_limit.bucx Following the same steps as in Section 2.2.3 for creating a simple context. Currently we do **not** support cross referencing across different projects, so you **must** add the

context and machine to the same project created in task 1 for "Sensor_m0_SNSR.bumx". **Set the content of "Car_c0_limit.bucx" as follows and save the file**.

context Car_c0_limit

constants D

axioms

@axm1: "$D \in \mathbb{N}1$"

end

Step 2. Create the Machine Car_m0_cars.bumx Set the content of "Car_m0_cars.bumx" as follows and save the file.

machine Car_m0_cars

sees Car_c0_limit

variables A B C

invariants

@inv0_1: "$A \in \mathbb{N}$"

@inv0_2: "$B \in \mathbb{N}$"

@inv0_3: "$C \in \mathbb{N}$"

@inv0_4: "$A = 0 \lor C = 0$"

@inv0_5: "$A + B + C \leq D$"

@thm0_1: "$B \leq D$" **theorem**

events

INITIALISATION

begin

@act1: "$A := 0$"

@act2: "$B := 0$"

@act3: "$C := 0$"

end

ML_out

when

@grd1: "$C = 0$"

@grd2: "$A + B \neq D$"

then

@act1: "$A := A + 1$"

end

ML_in

when

@grd1: "$C \neq 0$"

then

@act1: "$C := C - 1$"

end

IL_in

when

@grd1: "$A \neq 0$"

then

@act1: "$A := A - 1$"

@act2: "$B := B + 1$"

end

IL_out

when

@grd1: "$B \neq 0$"

@grd2: "$A = 0$"

then

@act1: "$B := B - 1$"

@act2: "$C := C + 1$"

end

end

Conclusion Saving the XContext and XMachine files will generate the corresponding Rodin files. Now in the same project you have the context "Car_c0_limit" and the machines: "Sensor_m0_SNSR" and "Car_m0_cars". Ideally the reusable models should be in a different project, but this is **not** supported **yet** in the current release, that is why we require all models to be in the same project.

2.3.3 Task 3. Model an XMachine using machine inclusion

Introduction In this task we define the XMachine "Car_m1_SNSR.bumx" which is a refinement of the machine "Car_m0_cars" and includes two instances of "Sensor_m0_SNSR". The keywords in red are **not** part of the standard Event-B syntax, they correspond to machine inclusion and event synchronisation.

Step 1. Create the file "Car_m1_SNSR.bumx" Add the file to the same project and set its contents as follows.

machine Car_m1_SNSR

includes Sensor_m0_SNSR as ML_out IL_out

refines Car_m0_cars

sees Car_c0_limit

variables A B C

invariants

@inv1_1: "$IL\_out\_SNSR = TRUE \Rightarrow B \neq 0$"

events

INITIALISATION extended

synchronises ML_out.INITIALISATION

synchronises IL_out.INITIALISATION

refines INITIALISATION

end

ML_out **extended**

synchronises ML_out.SNSR_off

refines ML_out

end

ML_in **extended**

refines ML_in

end

IL_in **extended**

refines IL_in

when

@inv0_2copy: "$B \in \mathbb{N}$" **theorem**

end

IL_out

synchronises IL_out.SNSR_off

refines IL_out

when

@grd2: "$A = 0$"

then

@act1: "$B := B - 1$"

@act2: "$C := C + 1$"

end

ML_out_ARR

synchronises ML_out.SNSR_on

end

```
        IL_out_ARR

        synchronises IL_out.SNSR_on

        when

            @grd2: "B ≠ 0"

        end

    end
```

Step 2. Auto-format the file "Car_m1_SNSR.bumx" and Save it.

Conclusion After saving the file a standard Event-B machine "Car_m1_SNSR" will be generated. The generated machine (Figure 22) is flattened to include the variables and invariants of the included machine "Sensor_m0_SNSR" which are renamed according to the chosen prefixes (ML_out, IL_out). In addition to the guards and actions of the synchronised events. When synchronising an event you can add the prefix of the required machine followed by the synchronised event name (e.g., IL_out.SNSR_on where "IL_out" is one of the included machine prefixes and "SNSR_on" is the synchronised event). It is also possible to include more than one machine and synchronise with more than one event.

3 Concepts

3.1 XText Projects

Each project containing XEvent-B constructs must be set to be XText project. An XText project has an associated XContext and XMachine builders that can compile XEvent-B source files into Rodin files as they are changed. The builders can be turn off via the preferences, either workspace-wise or project-wise (see Figure 23.

The XText projects must be organised such that all XEvent-B constructs has the project as the source container.

3.2 XEvent-B Builders

The XEvent-B Builders, i.e., XContext builder and XMachine builder, build XEvent-B constructs, i.e., XContext and XMachine using their own compiler. If they are enabled, the XEvent-B builders are run everytime an individual XEvent-B file is saved. Problems detected by the XEvent-B builders are classified as either warnings or errors. Compile-time errors are always reported as errors by the XEvent-B buiders and in the presence of errors, no new Rodin files are created or updated, i.e., the XEvent-B builders do not produce any new Rodin file content. In the case of machine inclusion and event synchronisation, a flattened machine is generated which includes data from the included machine and the synchronised events, which can be renamed if prefixing is applied.

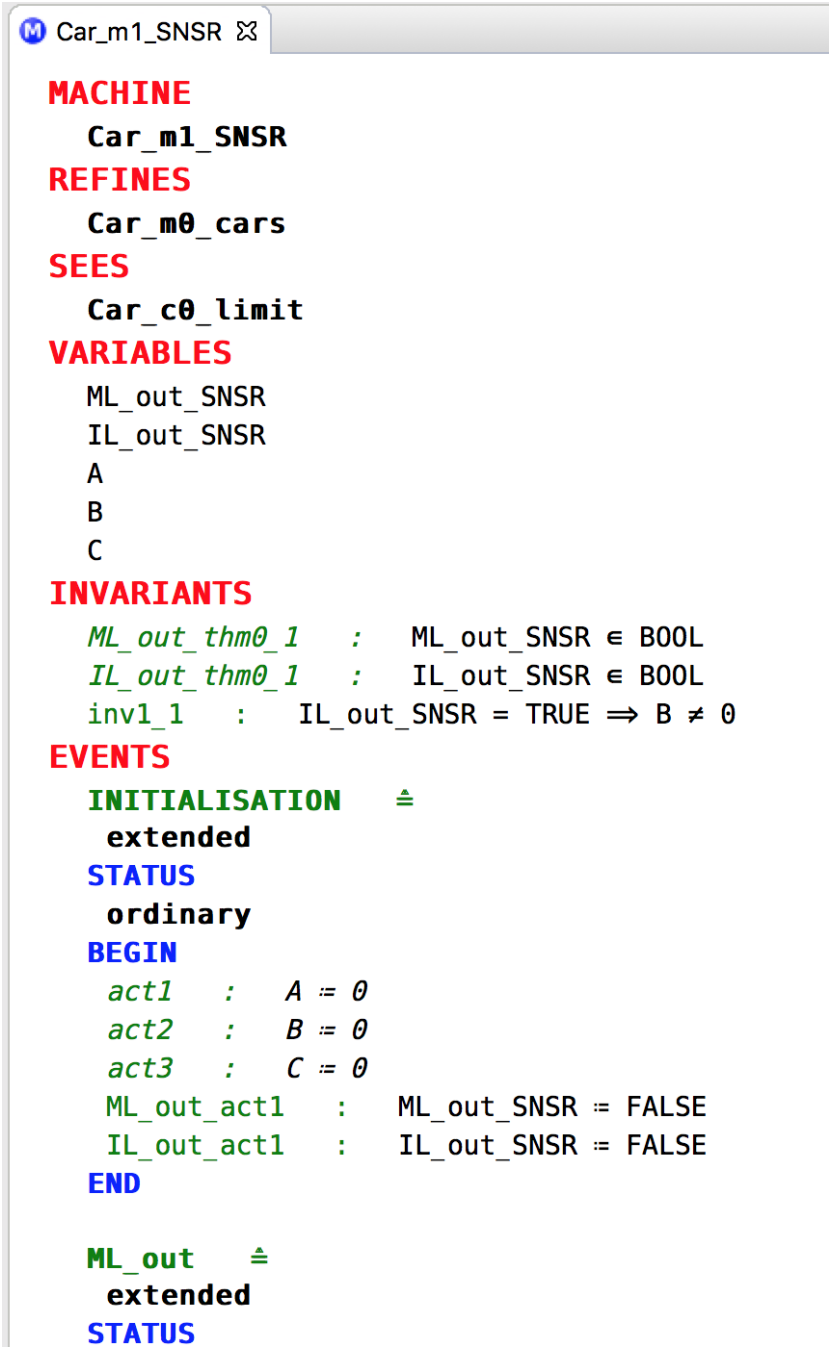

Figure 22: Flattened Machine "Car_m1_SNSR"

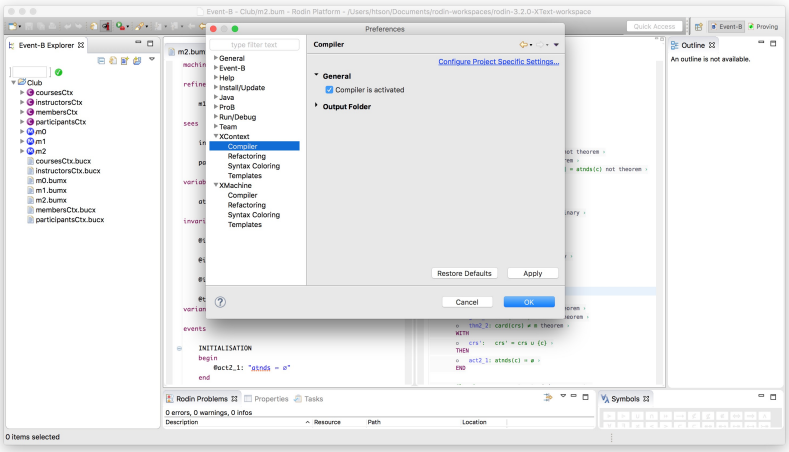

Figure 23: XContext Preference

3.3 Content Assist

Content assist are available for typesetting keywords and Event-B mathematical symbols. The short-cut for invoking content assist is `Ctrl+Space`. Figure 24 shows an example for content assist with keywords. For Event-B mathematical

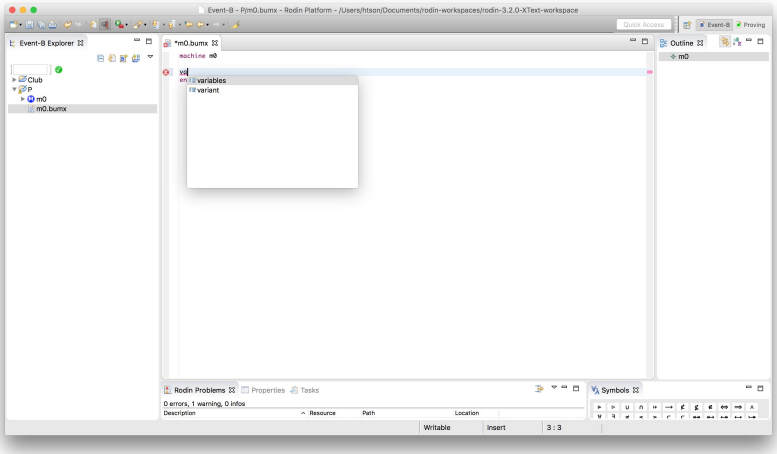

Figure 24: Keyword Content Assist

symbols, the key combination is defined by the Rodin Keyboard plug-in.

4 Tasks

4.1 Creating XEvent-B Files

New XEvent-B files can be create via the *New File wizard* with appropriate file extensions. The file extension for XContext is `bucx` and for XMachine is `bumx`. The syntax of XContext and XMachine can be seen in Section 5.2 and Section 5.3, respectively.

4.2 Typesetting Event-B Mathematical Symbols

Event-B mathematical symbols in predicates, expressions, and assignments are typeset using Content Assist. The definition of the character combinations is defined in the Rodin Keyboard plug-in.

5 Reference

5.1 Common Syntax

```
ML_COMMENT ::= /* STRING */

SL_COMMENT ::= // SL_STRING

ID ::= [^] (LETTER | _) {LETTER | DIGIT | _ }

XLABEL ::= @STRING:
```

5.2 XContext Syntax

```
XCONTEXT ::=

            [ ML_COMMENT | SL_COMMENT ]

            context ID

            [extends ID { ID }]

            [sets XSET {XSET}]

            [constants XCONSTANT { XCONSTANT }]

            [axioms XAXIOM {XAXIOM}]


            end

    XSET ::=
```

```
            XSET_NO_COMMENT |
            XSET_ML_COMMENT |
            XSET_SL_COMMENT
    XSET_NO_COMMENT ::= ID
    XSET_ML_COMMENT ::= ML_COMMENT ID
    XSET_SL_COMMENT ::= ID ML_COMMENT
    XCONSTANT ::=
            XCONSTANT_NO_COMMENT |
            XCONSANT_ML_COMMENT |
            XCONSTANT_SL_COMMENT
    XCONSTANT_NO_COMMENT ::= ID
    XCONSTANT_ML_COMMENT ::= ML_COMMENT ID
    XCONSTANT_SL_COMMENT ::= ID ML_COMMENT
    XAXIOM ::=
            XAXIOM_NO_COMMENT |
            XAXIOM_ML_COMMENT |
            XAXIOM_SL_COMMENT
    XAXIOM_NO_COMMENT ::= XLABEL "XPREDICATE" [theorem ]
    XAXIOM_ML_COMMENT ::= ML_COMMENT XLABEL "XPREDICATE" [theorem ]
    XAXIOM_SL_COMMENT ::= XLABEL "XPREDICATE" [theorem ] SL_COMMENT
```

5.3 XMachine syntax

```
XMACHINE ::= [ ML_COMMENT | SL_COMMENT ]
            machine ID
            [XINCLUDE { XINCLUDE }]
```

```
        [refines ID]
        [sees ID { ID }]
        [variables XVARIABLE {XVARIABLE}]
        [invariants XINVARIANT { XINVARIANT }]
        [variant XVARIANT]
        [events XEVENT { XEVENT }]
        end
XINCLUDE ::=
        includes ID
        [as ID {ID}]
XVARIABLE ::=
        XVARIABLE_NO_COMMENT |
        XVARIABLE_ML_COMMENT |
        XVARIABLE_SL_COMMENT
XVARIABLE_NO_COMMENT ::= ID
XVARIABLE_ML_COMMENT ::= ML_COMMENT ID
XVARIABLE_SL_COMMENT ::= ID SL_COMMENT
XINVARIANT ::=
        XINVARIANT_NO_COMMENT
        XINVARIANT_ML_COMMENT
        XINVARIANT_SL_COMMENT
XINVARIANT_NO_COMMENT ::=
        XLABEL "XPREDICATE" [theorem ]
XINVARIANT_ML_COMMENT ::=
        ML_COMMENT XLABEL "XPREDICATE" [theorem ]
```

```
XINVARIANT_SL_COMMENT ::=
        XLABEL "XPREDICATE" [theorem ] SL_COMMENT
XEVENT ::=
        XEVENT_NO_COMMENT
        XEVENT_ML_COMMENT
        XEVENT_SL_COMMENT
XEVENT_NO_COMMENT ::=
        ID
        ([extended ] & [ordinary | convergent | anticipated ])
        [XSYNC { XSYNC }]
        [refines ID { ID }]
        [
            [with XWITNESS { XWITNESS }]
            begin XACTION { XACTION }
            |
            when XGUARD { XGUARD }
            [with XWITNESS { XWITNESS }]
            [then XACTION { XACTION }]
            |
            any XPARAMETER { XPARAMETER }
            where XGUARD { XGUARD }
            [with XWITNESS { XWITNESS }]
            [then XACTION { XACTION }]
        ]
        end
```

```
XEVENT_ML_COMMENT ::=
        ML_COMMENT
        ID
        ([extended ] & [ordinary | convergent | anticipated ])
        [XSYNC { XSYNC }]
        [refines ID { ID }]
        [
            [with XWITNESS { XWITNESS }]
            begin XACTION { XACTION }
            |
            when XGUARD { XGUARD }
            [with XWITNESS { XWITNESS }]
            [then XACTION { XACTION }]
            |
            any XPARAMETER { XPARAMETER }
            where XGUARD { XGUARD }
            [with XWITNESS { XWITNESS }]
            [then XACTION { XACTION }]
        ]
        end
XEVENT_SL_COMMENT ::=
        ID
        ([extended ] & [ordinary | convergent | anticipated ])
        [XSYNC { XSYNC }]
        [refines ID { ID }]
```

```
        SL_COMMENT
        [
            [with XWITNESS { XWITNESS }]
            begin XACTION { XACTION }
            |
            when XGUARD { XGUARD }
            [with XWITNESS { XWITNESS }]
            [then XACTION { XACTION }]
            |
            any XPARAMETER { XPARAMETER }
            where XGUARD { XGUARD }
            [with XWITNESS { XWITNESS }]
            [then XACTION { XACTION }]
        ]
        end
XSYNC ::=
        synchronises [ID.]ID
XWITNESS ::=
        XWITNESS_NO_COMMENT |
        XWITNESS_ML_COMMENT |
        XWITNESS_SL_COMMENT |
XWITNESS_NO_COMMENT ::= XLABEL "XPREDICATE"
XWITNESS_ML_COMMENT ::= ML_COMMENT XLABEL "XPREDICATE"
XWITNESS_SL_COMMENT ::= XLABEL "XPREDICATE" SL_COMMENT
XPARAMETER ::=
```

```
        XPARAMETER_NO_COMMENT |

        XPARAMETER_ML_COMMENT |

        XPARAMETER_SL_COMMENT

XPARAMETER_NO_COMMENT ::= ID

XPARAMETER_ML_COMMENT ::= ML_COMMENT ID

XPARAMETER_SL_COMMENT ::= ID SL_COMMENT

XGUARD ::=

        XGUARD_NO_COMMENT |

        XGUARD_ML_COMMENT |

        XGUARD_SL_COMMENT

XGUARD_NO_COMMENT ::=

        XLABEL "XPREDICATE" [theorem ]

XGUARD_ML_COMMENT ::=

        ML_COMMENT XLABEL "XPREDICATE" [theorem ]

XGUARD_SL_COMMENT ::=

        XLABEL "XPREDICATE" [theorem ] SL_COMMENT

XACTION ::=

        XACTION_NO_COMMENT |

        XACTION_ML_COMMENT |

        XACTION_SL_COMMENT

XACTION_NO_COMMENT ::= XLABEL "XASSIGNMENT" [theorem ]

XACTION_ML_COMMENT ::= ML_COMMENT XLABEL "XASSIGNMENT"

XACTION_SL_COMMENT ::= XLABEL "XASSIGNMENT" SL_COMMENT
```

5.4 Preferences

5.4.1 XContext Preferences

The following XContext preferences can be set on the the XContext preference page and its sub-pages.

Option	Description	Default
Compiler is activated	**Compiler is activated** or **deactivated**	Activated

Table 1: XContext Compiler Preferences

Compiler

Syntax Coloring

5.4.2 XMachine Preferences

The following XMachine preferences can be set on the XMachine preference page and its sub-pages.

Compiler

Syntax Coloring

5.5 XEvent-B Editors

5.5.1 XEvent-B Content Assist

In the XContext and XMachine editors press `Ctrl+Space` on code to complete. This opens a list of available code completions. Some tips for using code assist are listed in the following paragraph:

- You can use the mouse or the keyboard (Up Arrow, Down Arrow, Page Up, Page Down, Home, End, Enter) to navigate and select lines in the list.
- Clicking or pressing Enter on a selected line in the list inserts the selection into the editor.

5.5.2 XEvent-B Formatter

In the XContent and XMachine editors press `Ctrl+Shift+F` on code to format it. If no selection is set then the entire source is formatted otherwise only the selection will be.

6 Legal

6.1 RODIN Software User Agreement

June 1st, 2006

Option	Description	Default
Comment	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Dark Green White None Platform dependent
Default	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Black White None Platform dependent
Invalid Symbol	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Black White None Platform dependent
Keyword	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Dark Purple White Bold Platform dependent
Number	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Dark Gray White None Platform dependent
Punctuation character	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Black White None Platform dependent
String	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Blue White None Platform dependent
Task Tag	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Light Blue White Bold Platform dependent

Table 2: XContext Syntax Coloring Preferences

Option	Description	Default
Compiler is activated	**Compiler is activated** or **deactivated**	Activated

Table 3: XMachine Compiler Preferences

Option	Description	Default
Comment	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Dark Green White None Platform dependent
Default	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Black White None Platform dependent
Invalid Symbol	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Black White None Platform dependent
Keyword	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Dark Purple White Bold Platform dependent
Number	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Dark Gray White None Platform dependent
Punctuation character	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Black White None Platform dependent
String	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Blue White None Platform dependent
Task Tag	**Color** **Background** **Style** (Italic, Bold, Underline, Strike through) **Font**	Light Blue White Bold Platform dependent

Table 4: XMachine Syntax Coloring Preferences

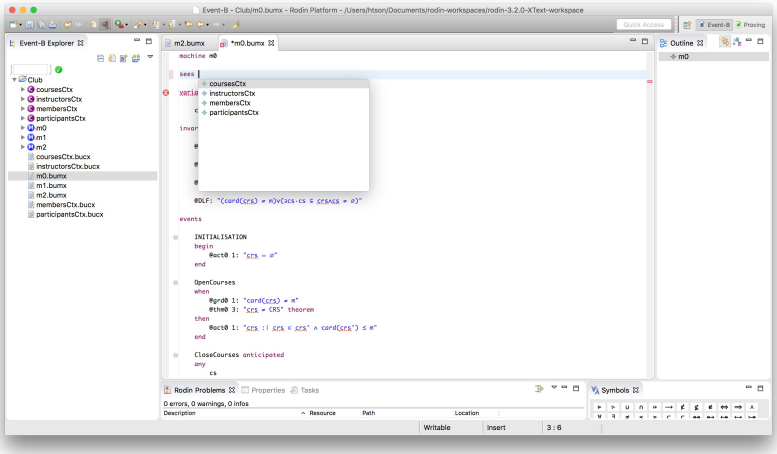

Figure 25: Content Assist for adding Sees clause

6.1.1 Usage Of Content

THE RODIN PROJECT MAKES AVAILABLE SOFTWARE, DOCUMENTATION, INFORMATION AND/OR OTHER MATERIALS FOR OPEN SOURCE PROJECTS (COLLECTIVELY "CONTENT"). USE OF THE CONTENT IS GOVERNED BY THE TERMS AND CONDITIONS OF THIS AGREEMENT AND/OR THE TERMS AND CONDITIONS OF LICENSE AGREEMENTS OR NOTICES INDICATED OR REFERENCED BELOW. BY USING THE CONTENT, YOU AGREE THAT YOUR USE OF THE CONTENT IS GOVERNED BY THIS AGREEMENT AND/OR THE TERMS AND CONDITIONS OF ANY APPLICABLE LICENSE AGREEMENTS OR NOTICES INDICATED OR REFERENCED BELOW. IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS OF THIS AGREEMENT AND THE TERMS AND CONDITIONS OF ANY APPLICABLE LICENSE AGREEMENTS OR NOTICES INDICATED OR REFERENCED BELOW, THEN YOU MAY NOT USE THE CONTENT.

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Content includes, but is not limited to, source code, object code, documentation and other files maintained in the Rodin SourceForge CVS repository ("Repository") in CVS modules ("Modules") and made available as downloadable archives ("Downloads").

- Content may be structured and packaged into modules to facilitate de-

livering, extending, and upgrading the Content. Typical modules may include plug-ins ("Plug-ins"), plug-in fragments ("Fragments"), and features ("Features").

- Each Plug-in or Fragment may be packaged as a sub-directory or JAR (Java^{TM}ARchive) in a directory named "plugins".
- A Feature is a bundle of one or more Plug-ins and/or Fragments and associated material. Each Feature may be packaged as a sub-directory in a directory named "features". Within a Feature, files named "feature.xml" may contain a list of the names and version numbers of the Plug-ins and/or Fragments associated with that Feature.
- Features may also include other Features ("Included Features"). Within a Feature, files named "feature.xml" may contain a list of the names and version numbers of Included Features.

The terms and conditions governing Plug-ins and Fragments should be contained in files named "about.html" ("Abouts"). The terms and conditions governing Features and Included Features should be contained in files named "license.html" ("Feature Licenses"). Abouts and Feature Licenses may be located in any directory of a Download or Module including, but not limited to the following locations:

- The top-level (root) directory
- Plug-in and Fragment directories
- Inside Plug-ins and Fragments packaged as JARs
- Sub-directories of the directory named "src" of certain Plug-ins
- Feature directories

Note: if a Feature made available by the Rodin Project is installed using the Eclipse Update Manager, you must agree to a license ("Feature Update License") during the installation process. If the Feature contains Included Features, the Feature Update License should either provide you with the terms and conditions governing the Included Features or inform you where you can locate them. Feature Update Licenses may be found in the "license" property of files named "feature.properties" found within a Feature. Such Abouts, Feature Licenses, and Feature Update Licenses contain the terms and conditions (or references to such terms and conditions) that govern your use of the associated Content in that directory.

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