

ATELIER/TUTO EVENT-B/RODIN

INTRODUCTION À LA MÉTHODE EVENT-B ET SES DIFFÉRENTS OUTILS

🎓 TAPAS-ANR meeting

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Idir AIT SADOUNE
idir.aitsadoune@centralesupelec.fr

OUTLINE

- The Event-B method
- The Pro-B animator/model-checker
- The Theory plugin

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USING EVENT-B METHOD

- The use of the **Event-B method** has continued to increase.
 - applied to various applications and domains.
 - railway, automotive, aeronautics, cybersecurity, nuclear-energy, ...
- The **Rodin** platform (an **Eclipse-based IDE**) is intended to support the construction and verification of **Event-B models**.
 - **plugins** for editing, generating proof obligations, proving, animating, model-checking, code generating ...

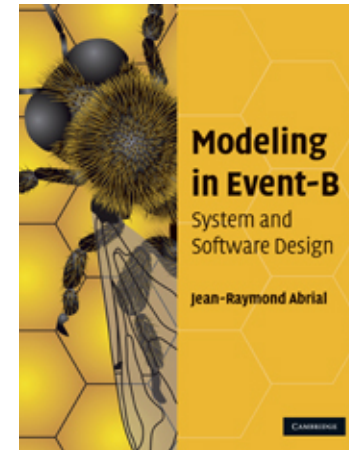


THE RODIN PLATFORM

- The **Rodin Platform** is an **Eclipse-based IDE** for **Event-B** that provides effective support for refinement and mathematical proof.
- The platform is **open source**, contributes to the **Eclipse framework** and is further extendable with **plugins**.
- **Rodin Platform and Plug-in Installation:**
 - Requires **Java 17**
 - Download the Core: **Rodin Platform file** for your platform.
 - Install the **Atelier B Provers plugin** from the Atelier B Provers Update site.

THE EVENT-B METHOD

- The **Event-B method** is an evolution of the **classical B method**.
 - modeling a system by a **set of events** instead of **operations**.
- The **Event-B method** is a **formal method** based on **first-order logic** and **set theory**.
- The **Event-B method** is based on :
 - the notions of **pre-conditions** and **post-conditions** (**Hoare**),
 - the **weakest pre-condition** (**Dijkstra**),
 - and the **calculus of substitution** (**Abrial**).
- The **Event-B method** is adapted to analyse **discrete systems**.
 - offers the possibility of modelling **discrete behaviors**.



THE EVENT-B METHOD

THE STATE OF A MODEL

- A discrete model is first made of a **state**
- The state is represented by some **constants** and **variables**
- Constants are linked by some **properties**
- Variables are linked by some **invariants**
- Properties and invariants are written using **set-theoretic expressions**

THE EVENT-B METHOD

THE EVENTS OF A MODEL (TRANSITIONS)

- A discrete model is also made of a number of **events**
- An event is made of a **guard** and an **action**
- The **guard** denotes the **enabling condition** of the event
- The **action** denotes the way the **state is modified** by the event
- Guards and actions are written using **set-theoretic expressions**

THE EVENT-B METHOD

A MODEL SCHEMATIC VIEW

CONTEXT ctx_1
EXTENDS ctx_2

SETS s
CONSTANTS c

AXIOMS

$A(s, c)$

THEOREMS

$T(s, c)$

END

MACHINE mch_1
REFINES mch_2
SEES ctx_i

VARIABLES v
INVARIANTS

$I(s, c, v)$

THEOREMS

$T(s, c, v)$

EVENTS

$[events_list]$

END

$event \hat{=}$
any x
where
 $G(s, c, v, x)$
then
 $BA(s, c, v, x, v')$
end

THE EVENT-B METHOD

OPERATIONAL INTERPRETATION

```
Initialize;  
while (some events have true guards) {  
    Choose one such event;  
    Modify the state accordingly  
}
```

- An event execution is supposed to **take no time**
- Thus, **no two events can occur simultaneously**
- When all events have false guards, the **discrete system stops**
- When some events have true guards, **one of them** is chosen non-deterministically and **its action modifies the state**
- The previous phase is **repeated** (if possible)

THE EVENT-B METHOD

COMMENTS ON THE OPERATIONAL INTERPRETATION

- Stopping is not necessary: a discrete system may run for ever
- This interpretation is just given here for informal understanding
- The meaning of such a discrete system will be given by the proofs which can be performed on it

BUILDING LARGE COMPUTERIZED SYSTEMS

REFINEMENT

- Refinement allows us to build model **gradually**
- We shall build an **ordered sequence** of more precise models
- Each model is a **refinement** of the one preceding it
- A useful analogy: looking through a **microscope**
- **Spatial** as well as **temporal** extensions
- **Data refinement**

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THANK YOU

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