Using and Extending

... also Introducing Camille & B-Motion Studio

Jens Bendisposto, UDUS

Event-B – Scheduler/scheduler.bum – Rodin Platform – /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/workspace

Event-B Explor

Scheduler
- Processes
- scheduler

scheduler

```
machine scheduler sees Processes

variables active ready waiting

invariants
  @inv1 active ∈ ℙ(PID)
  @inv2 ready ∈ ℙ(PID)
  @inv3 waiting ∈ ℙ(PID)
  @inv4 ready ∩ waiting = ∅
  @inv5 card(active)≤1
  @inv6 active ∩ (ready ∪ waiting) = ∅
  @inv7 active=∅ ⇒ ready=∅

events
  event INITIALISATION
    then
      @act1 active ≔ ∅
      @act2 ready ≔ ∅
      @act3 waiting ≔ ∅
  end

  event new
    any pp
    where
      @grd1 pp ∈ PID
      @grd2 pp∉active
      @grd3 pp∉ready∪waiting
    then
      @act1 waiting ≔ waiting∪{pp}
  end

  event ready_active
    any rr
```

Outline

- scheduler : sees
  - active
  - ready
  - waiting
  - inv1
  - inv2
  - inv3
  - inv4
  - inv5
  - inv6
  - inv7
  - INITIALISATIO
    - act1
    - act2
    - act3
  - new (pp)
    - grd1
    - grd2
    - grd3
    - act1
  - ready_active
    - grd1
    - grd2
    - act1
    - act2
  - ready (rr)
    - grd1
    - grd2
    - act1
    - act2
  - swap_out

Camille Texteditor

Released for Rodin 1.0

Available through ProB Update Site

Rodin Problems | Properties | Tasks

0 errors, 0 warnings, 0 infos

Description	Resource	Path	Location

0 items selected

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```

Camille Claudel

1864-1943

Rodin's source of inspiration and lover

Outline

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    - grd2
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    - act2
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    - grd1
    - grd2
    - act1
    - act2
  - wap_out

Rodin Problems | Properties | Tasks

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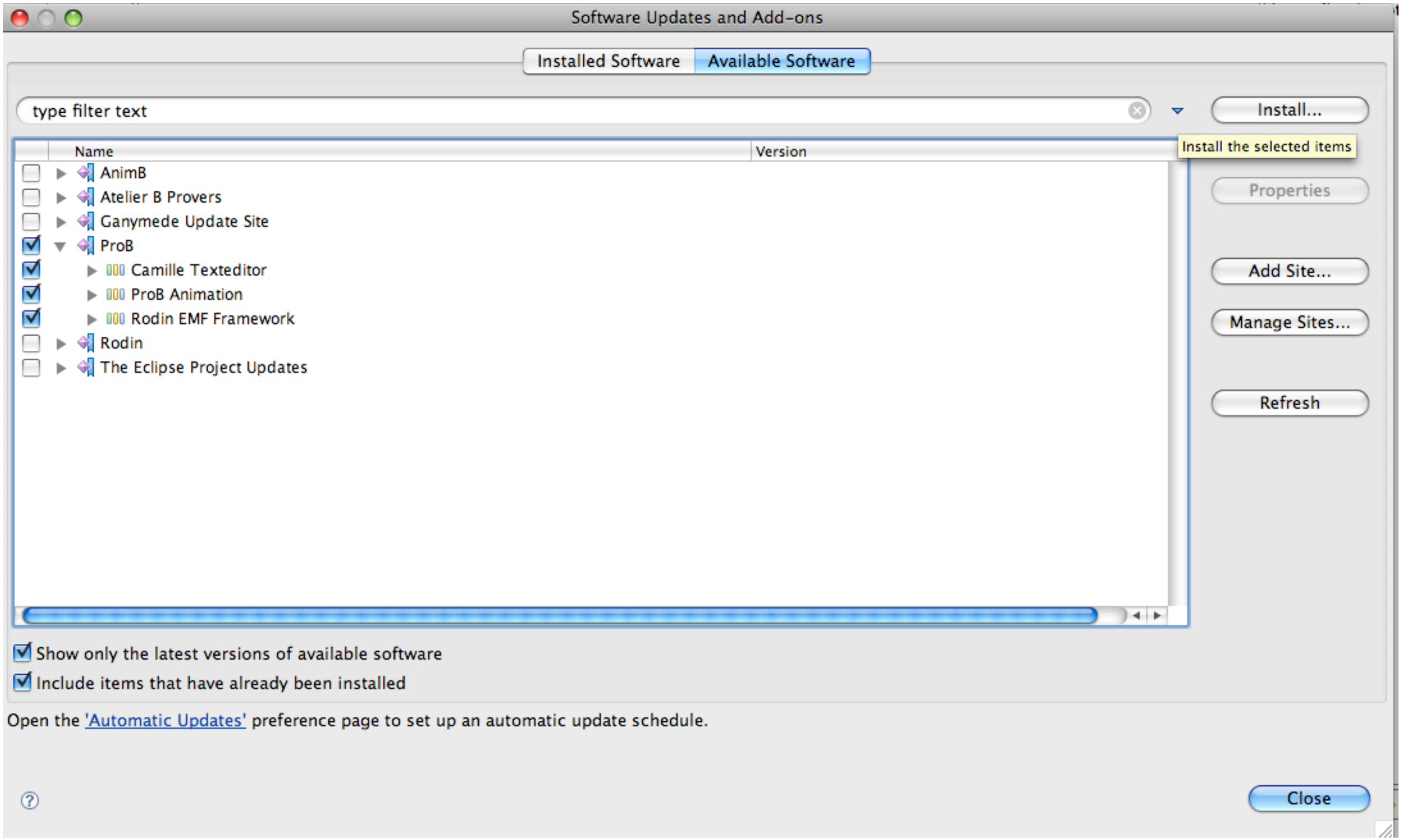
ProB in a Nutshell

- Animator and Model Checker for B, CSP, Z, Promela and **Event-B**
- Available through the Rodin Update Mechanism
- Tcl/Tk Version available from http://www.stups.uni-duesseldorf.de/ProB

Installing ProB



Event-B – Scheduler/scheduler.bum – Rodin Platform – /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/workspace

Event-B Explor

Scheduler
- Processes
- scheduler

Open
Open With
Properties
Rename
Refine
Validate with ProB
Delete
Retry Auto Provers
Recalculate Auto Status
Simplify Proof(s)
Purge Proofs...
Prove Interactively

Animate/Model Check
ProB Open with ProB classic
ProB Export for use in ProB classic

scheduler

```
machine scheduler sees Processes

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        eady ∩ waiting = ∅
        ard(active)≤1
        ctive ∩ (ready ∪ waiting) = ∅
        ctive=∅ ⇒ ready=∅

        t2 ready := ∅
        t3 waiting := ∅

  event new
    any pp
    where
      @grd1 pp ∈ PID
      @grd2 pp∉active
      @grd3 pp∉readyuwaiting
    then
      @act1 waiting := waitingu{pp}
  end

  event ready_active
    any rr
```

Outline

- scheduler : sees
  - active
  - ready
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  - inv1
  - inv2
  - inv3
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    - act1
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    - grd1
    - grd2
    - grd3
    - act1
  - ready_active
    - grd1
    - grd2
    - act1
    - act2
  - ready (rr)
    - grd1
    - grd2
    - act1
    - act2
  - swap_out

Rodin Problems | Properties | Tasks

0 errors, 0 warnings, 0 infos

Description	Resource	Path	Location

1 items selected

ProB – Scheduler/scheduler.bum – Rodin Platform – /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/workspace

Event-B | Rodin Pr

Scheduler
- Processes
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    then
      @act1 waiting ≔ waiting∪{pp}
end
```

State

Name	Value
Variables	
active	
ready	
waiting	

History

Operations	Loops
(root)	

Operations

Operation	Parameter(s)
ready_active	
swap_out	
ready	
swap	
new	
initialise_machine	{}, {}, {}

Evaluate Expression

[Rodin Label] Functor	Value	Predicate / Expression
AXIOMS		
INVARIANT		
THEOREMS		

Predicate / Expression | Value

1 items selected

ProB – Scheduler/scheduler.bum – Rodin Platform – /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/workspace

Event-B | Rodin Pr

Scheduler
- Processes
- scheduler

State

Name	Value	Previous value
Variables		
active	{}	{PID2}
ready	{}	
waiting	{PID1,PID2}	{PID1}

invariant ok

History

Operations	Loops
swap_out()	
swap(PID2)	
ready(PID2)	
ready_active(PID1)	
new(PID2)	
new(PID1)	
initialise_machine({},{},{})	
(root)	

Operations

Operation	Parameter(s)
ready_active	PID1
swap_out	
ready	
swap	
new	

Evaluate Expression

[Rodin Label] Functor	Value	Predicate / Expression
AXIOMS		
INVARIANT		
THEOREMS		

Predicate / Expression | Value

ProB – Simple/count.bum – Rodin Platform – /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/...

Operations

Operation	Parameter(s)
inc	0

0
1
2
3

count

```
machine count

variables x

invariants
  @type x∈ℕ

events
  event INITIALISATION
    then
      @init x := 0
  end

  event inc
    any y
    where
      @grd y∈ℕ
    then
      @inc x := x +y
  end
end
```

State

Name	Value	Previou
Variables		
x	2	

invariant ok

Preferences

type filter text

- General
- Event-B
- Help
- Install/Update
- ProB
  - ProB Classic
- Run/Debug
- Team

ProB

MaxInt, used for expressions such as xx::NAT (2147483647 for 4 byte ints) 3

MinInt, used for expressions such as xx::INT (-2147483648 for 4 byte ints) -1

Size of unspecified deferred sets in SETS section 2

Max Number of Initialisations Computed 4

Max Number of Enablings per Operation Computed 10

Show top-level ANY variable values of Event B Events as operation parameters ☐

Animate operations which are skip or PRE C THEN skip ☑

Convert lazy form back into explicit form for Variables, Constants, Operation Arguments ☑

Lazy expansion of lambdas set comprehensions ☐

Lazy expansion of *Recursive* set Comprehensions and lambdas ☐

Symmetry Mode: off,flood,canon,nauty,hash off

Time out for computing enabled transitions (in ms) 2500

Animate multiple levels of refinement in Event-B (experimental) ☐

Restrict invariant checking to affected clauses. Also remove clauses that are proven (EventB) ☑

Restore Defaults Apply

Cancel OK

ProB – Simple/count.bum – Rodin Platform – /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/...

Operations

Operation	Parameter(s)
inc	0

4
5
6
7

count

```
machine count

variables x

invariants
  @type x∈ℕ

events
  event INITIALISATION
    then
      @init x ≔ 0
  end

  event inc
    any y
    where
      @grd y∈ℕ
    then
      @inc x ≔ x +y
  end
end
```

State

Name	Value	Previou
Variables		
x	0	

invariant ok

State

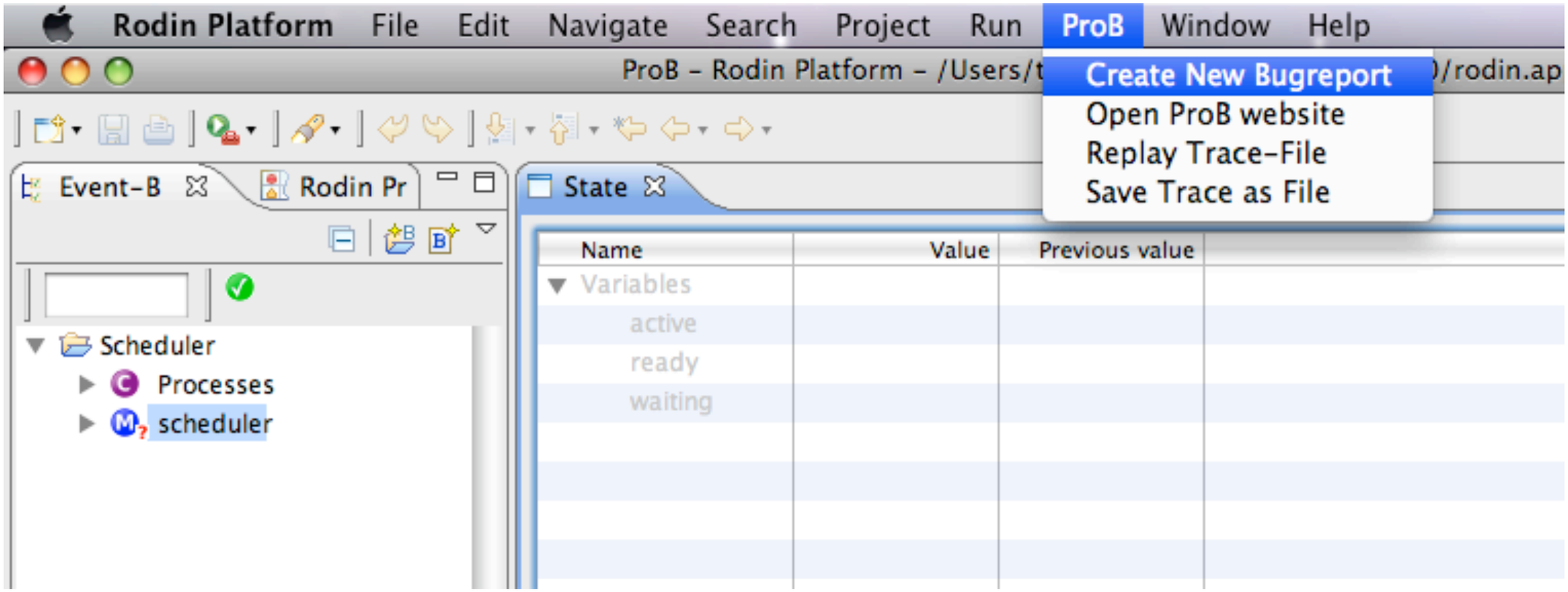
Name	Value	Previous value
ctx0		
discharged	{(e1|->i1),(e2|->i2)}	
initial	{s1}	
label	{((s1|->s2)|->e1),((s1|->s3)|->e2),((s2|->s3)|->e1),((s3|->s4)|->e1)}	
preserve	{s1,s3}	
proofobligations	{(e1|->i1),(e1|->i2),(e2|->i1),(e2|->i2),(e3|->i1),(e3|->i2)}	
trans	{(s1|->s2),(s1|->s3),(s2|->s3),(s3|->s4)}	
truth	{(s1|->i1),(s1|->i2),(s2|->i1),(s3|->i1),(s3|->i2),(s4|->i1)}	
violate	{s2,s4}	
mc2		
inv_broken	{s2}	{}
inv_ok	{}	
open	{s1,s3,s4}	TYPES:STATES
mc1		
inv_broken	{s2}	{}
inv_ok	{}	
open	{s1,s3,s4}	TYPES:STATES
mc0		
inv_broken	{s2}	{}
inv_ok	{}	
open	{s1,s3,s4}	TYPES:STATES

invariant ok

Something is wrong?

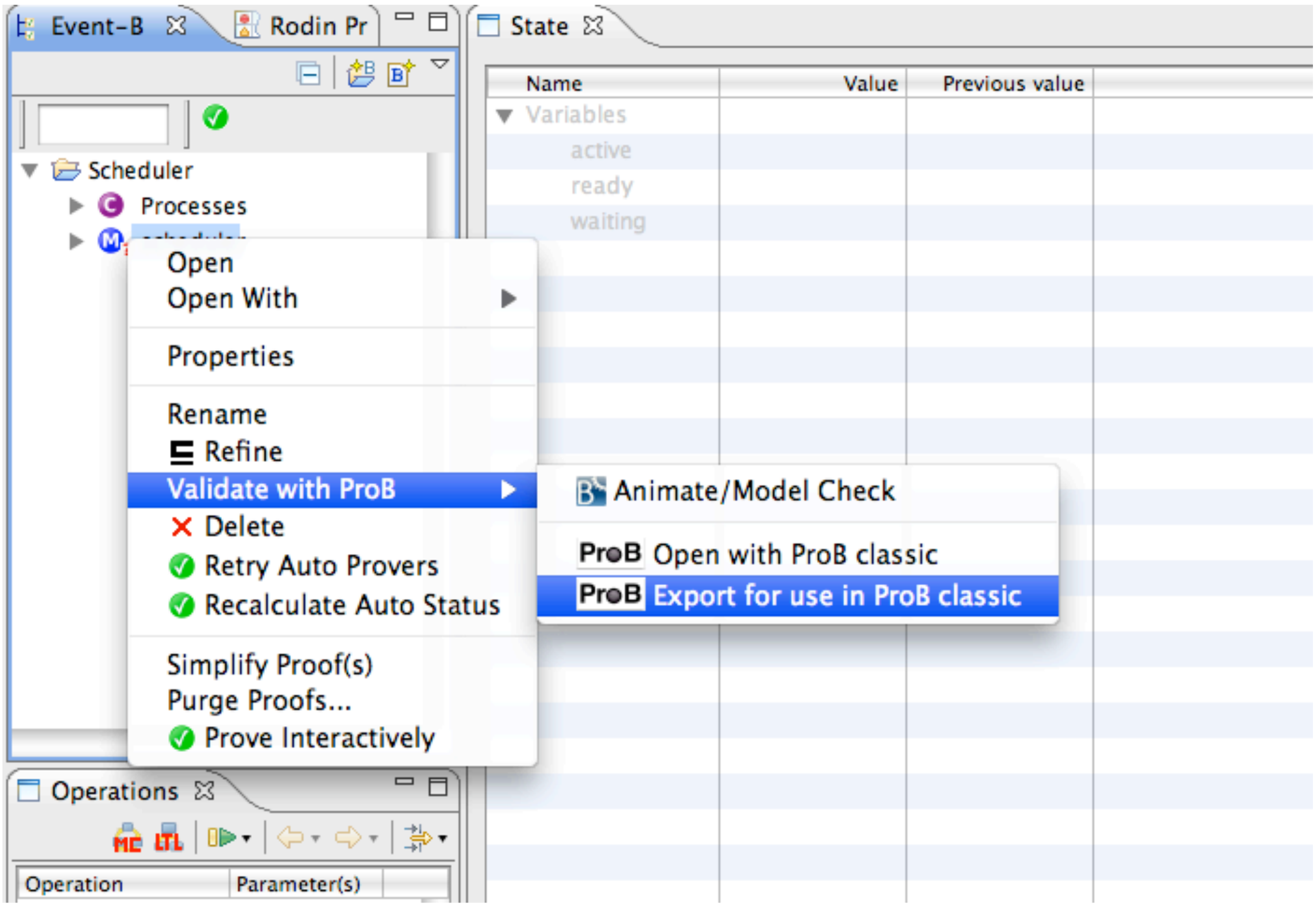
Something is missing?

Important: Let us know!



If possible: Attach Trace

Meanwhile ...


Event-B
Rodin Pr
State
Name
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Previous value
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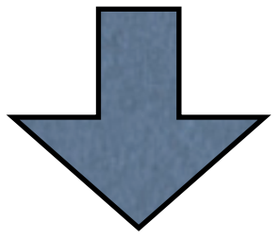
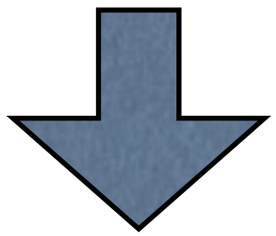
Open with ProB classic
Export for use in ProB classic
Operations
Operation
Parameter(s)

Extending ProB

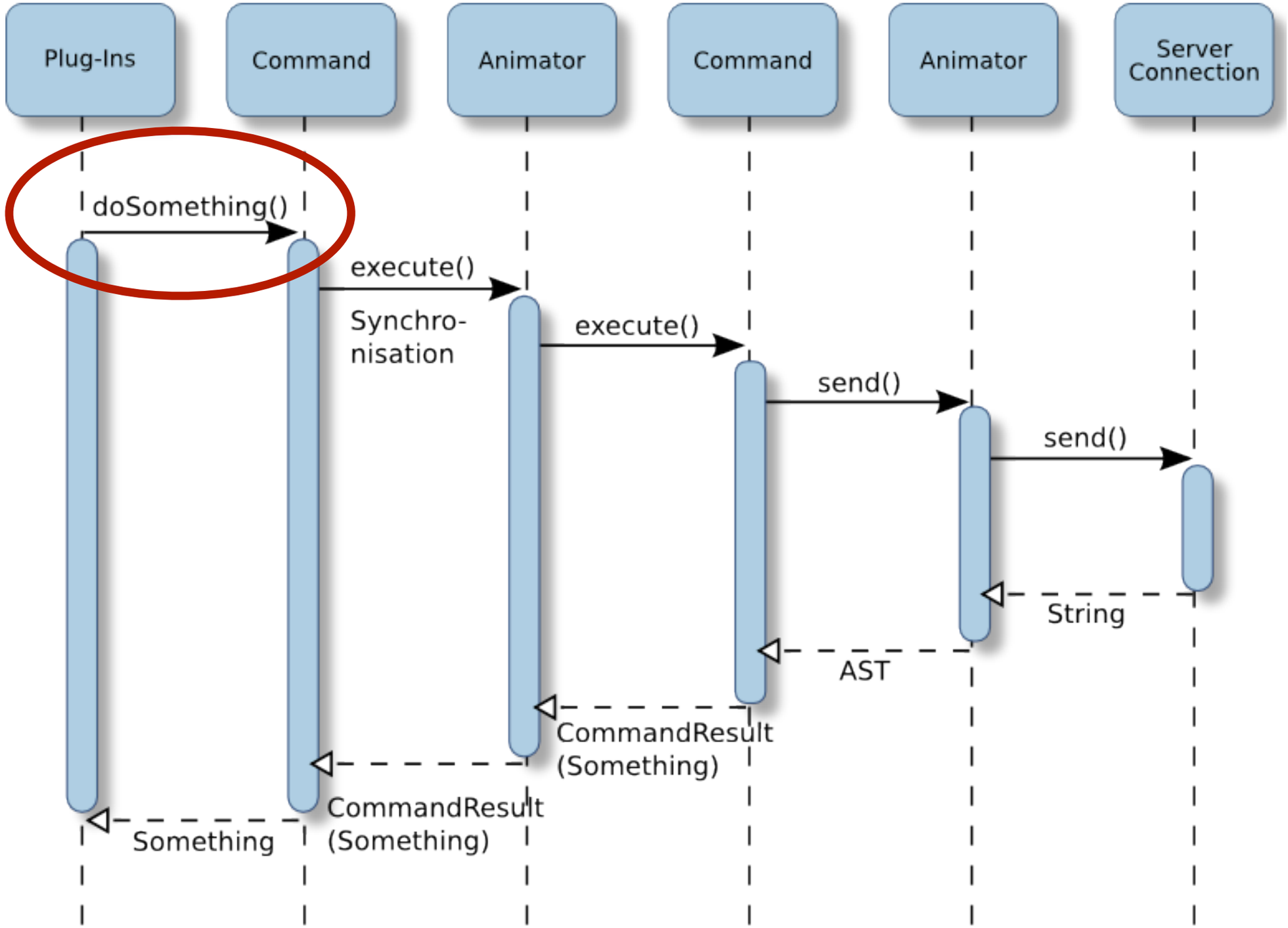
Command

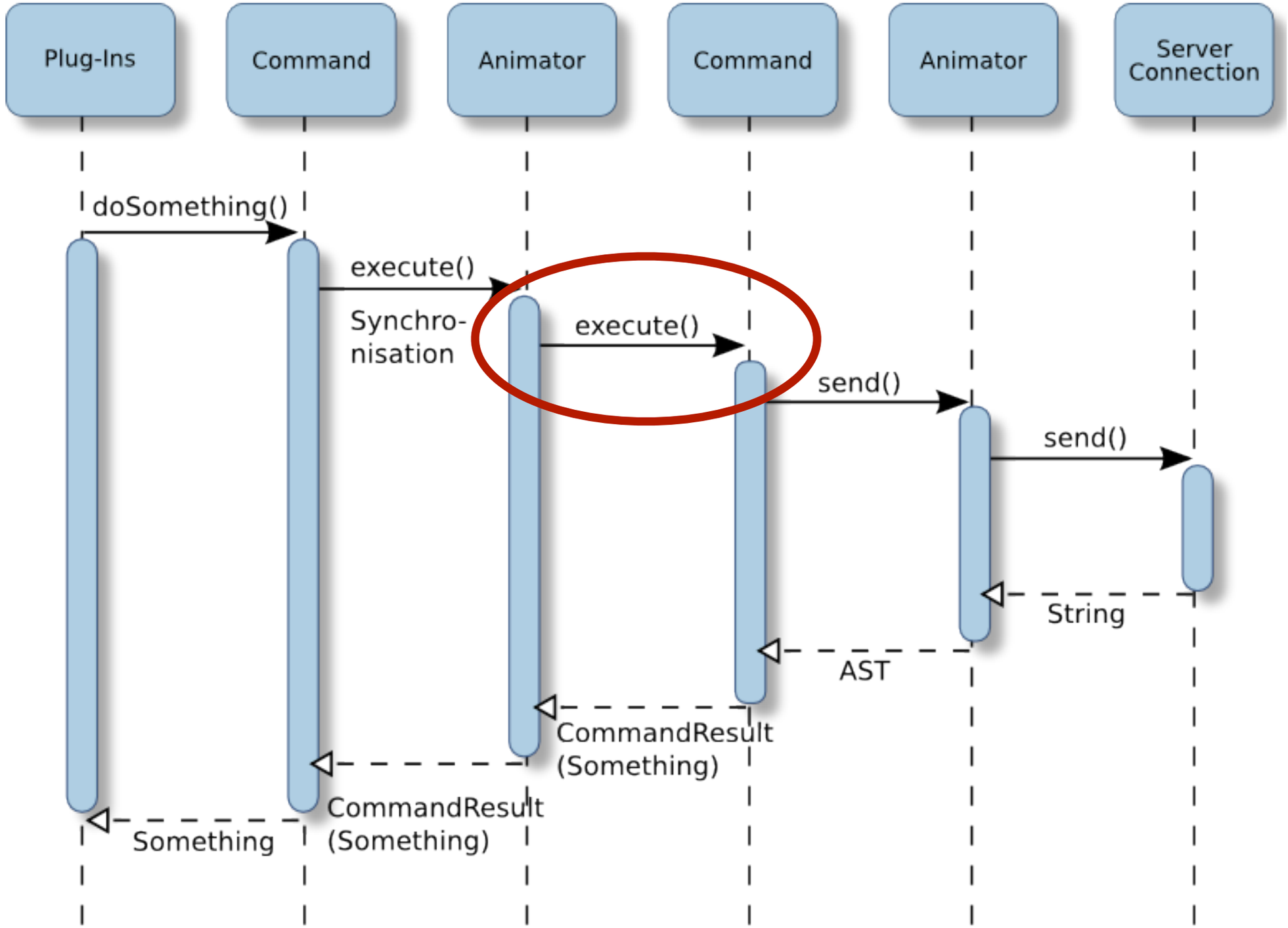


Animator



Result


Plug-Ins
Command
Animator
Command
Animator
Server Connection
doSomething()
execute()
Synchro-
nisation
execute()
send()
send()
String
AST
CommandResult
(Something)
CommandResult
(Something)
Something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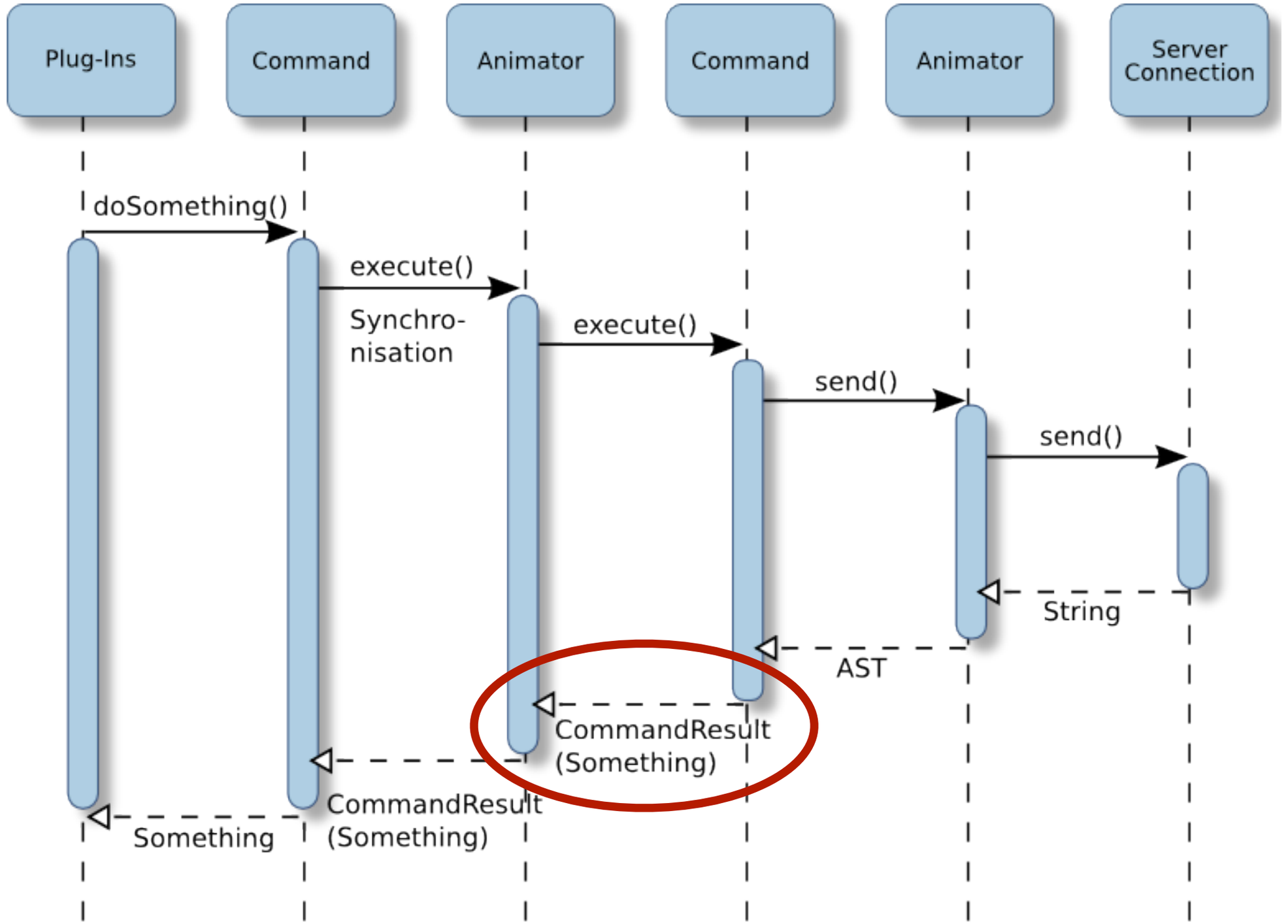
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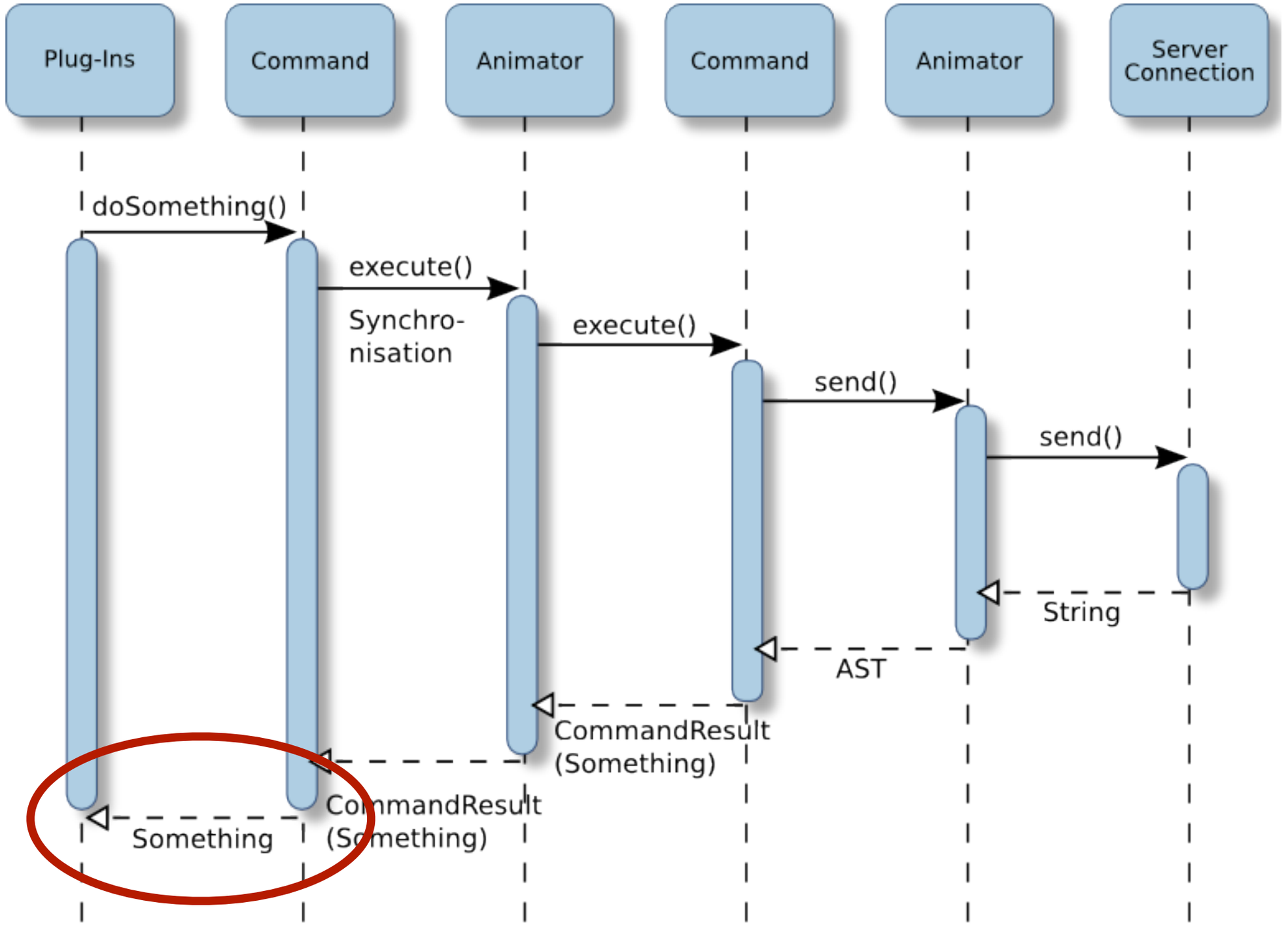
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AST
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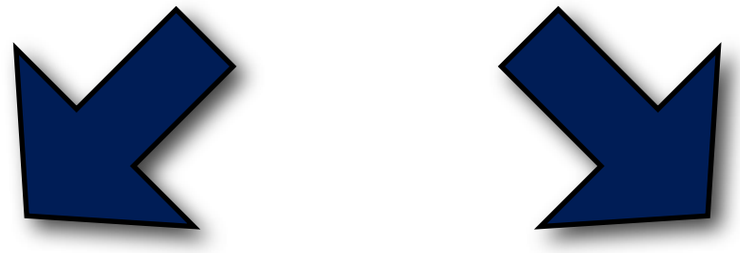
CommandResult
(Something)
Something

Two (basic) Flavours



Basic Commands

- Call Prolog Code
- May need support from UDUS

Composed Commands

- Call other Commands
- May not need support from UDUS

No real difference

- Prolog calls and Command calls can be mixed

Example: Exploring a new State

```
List<Operation> enabledOperations =
GetEnabledOperationsCommand.getOperations(animator, id);

StateValuesResult stateValues =
GetStateValuesCommand.getStateValues(animator, id);

boolean initialised =
CheckInitialisationStatusCommand.isInitialized(animator, id);

boolean invariantKo =
CheckInvariantStatusCommand.isInvariantViolated(animator, id);

boolean maxOperationReached = CheckMaxOperationReachedStatusCommand
            .maxOperationReached(animator, id);

boolean timeoutOccured = CheckTimeoutStatusCommand.isTimeout(
             animator, id);
```

Example: Getting the current State ID

```
final static String COMMAND ="getCurrentStateID(ID).";

public CommandResult<String> execute(final Animator a) throws
ProBException {
      Map<String, PrologTerm> bindings = BindingGenerator
            .createBindingMustNotFail(COMMAND,
                  animator.sendCommand(COMMAND));

      String id = bindings.get("ID").toString();
      return new CommandResultAdapter<String>(id);
   }

public static String getID(final Animator a) throws ProBException {
      GetCurrentStateIdCommand getID =
                        new GetCurrentStateIdCommand();
      return (String) a.execute(getID).unwrap();
}
```

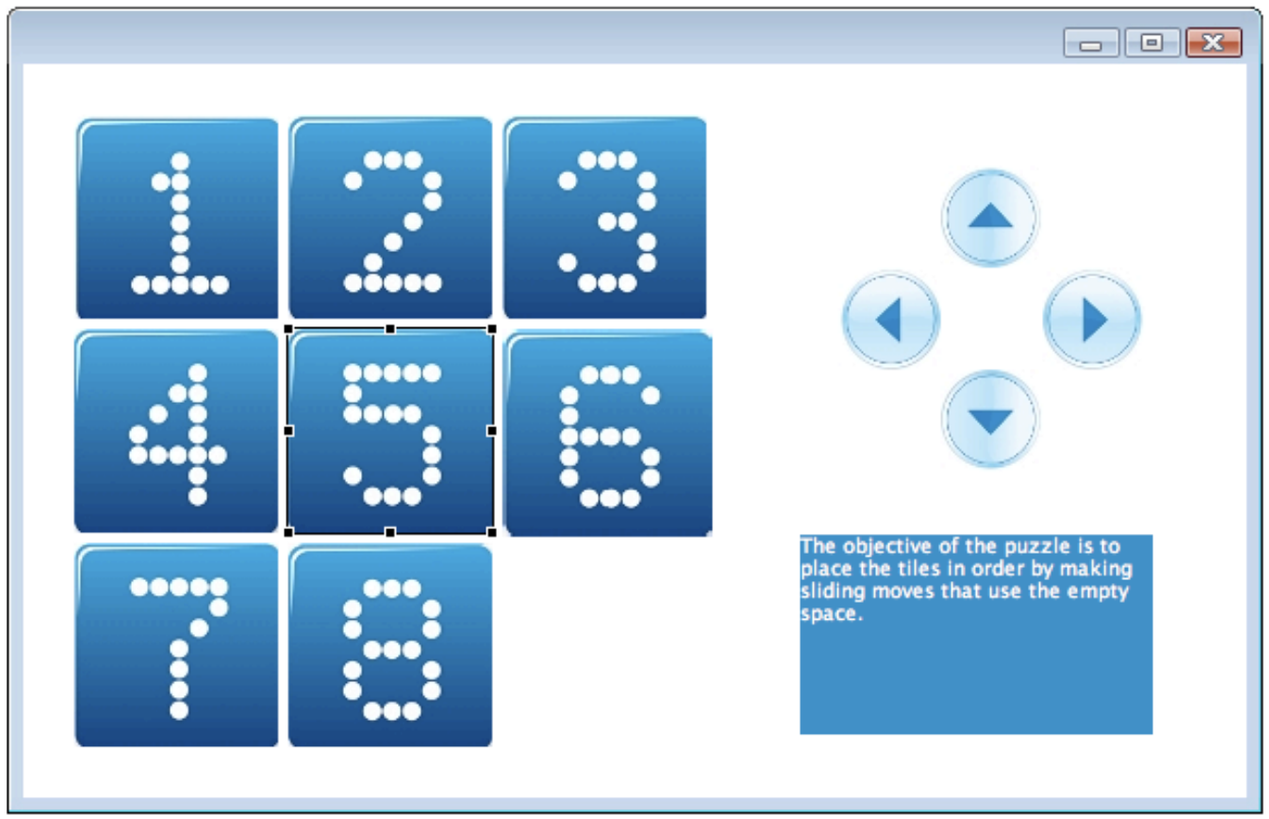
Coming soon

B-Motion Studio - Puzzle8/Visualization.bmso - Rodin Platform - /Users/tech/MyApplications/rodin_1.0/rodin.app/Contents/MacOS/workspace

100%

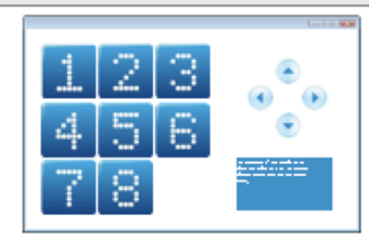
B-Motion Studio Editor

Industry
B-Canister
Main
B-Image
B-Button
B-Composite
B-Text



Outline

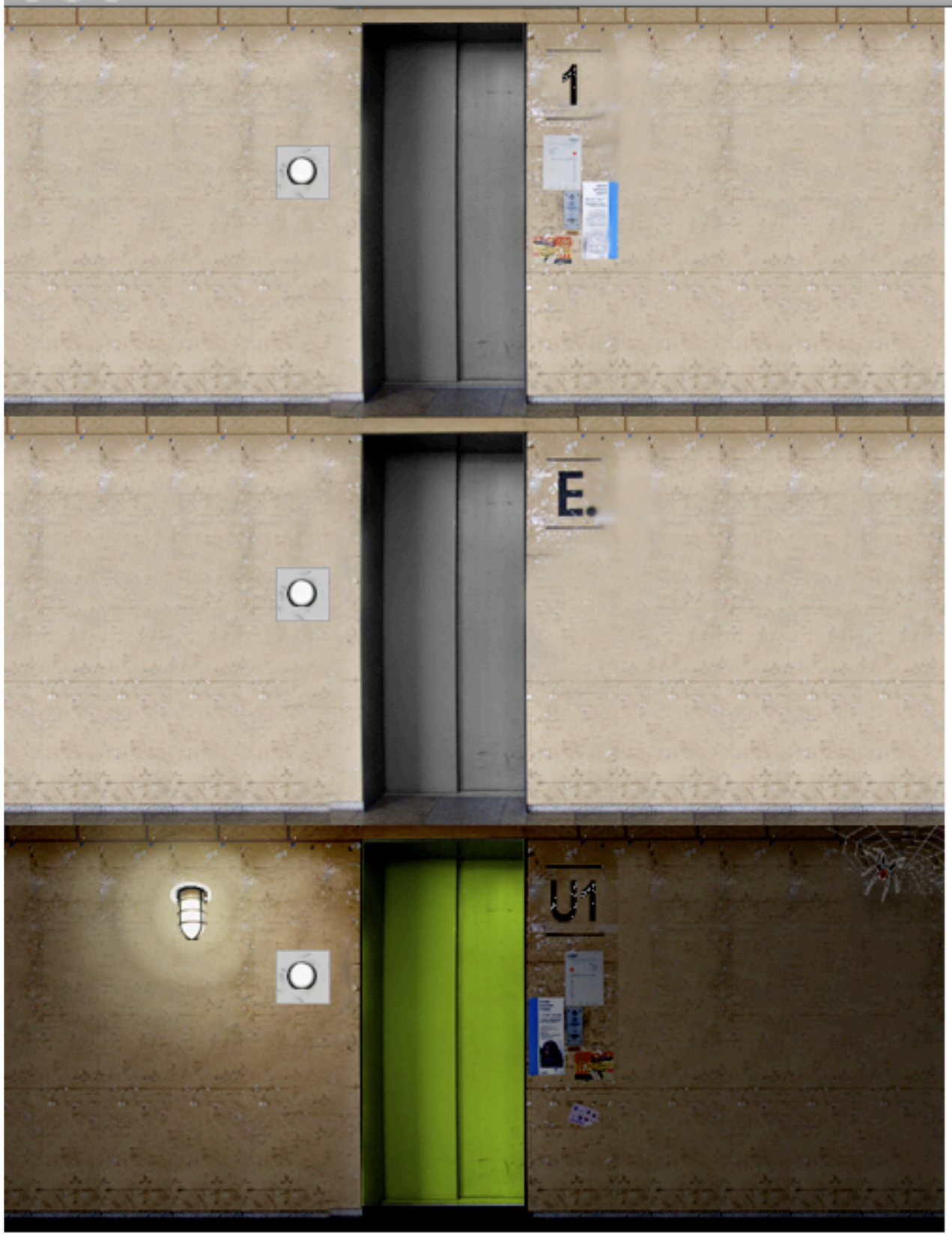
puzzle_4
puzzle_6
puzzle_7
puzzle_8
puzzle_5
bt_down
bt_right
bt_left
bt_up
instruction



Properties

Property	Value
height	100
id	puzzle_5
image	images/5.jpg
width	100
x	130
y	130

Visualization for machine mch.bum



Reverse UP

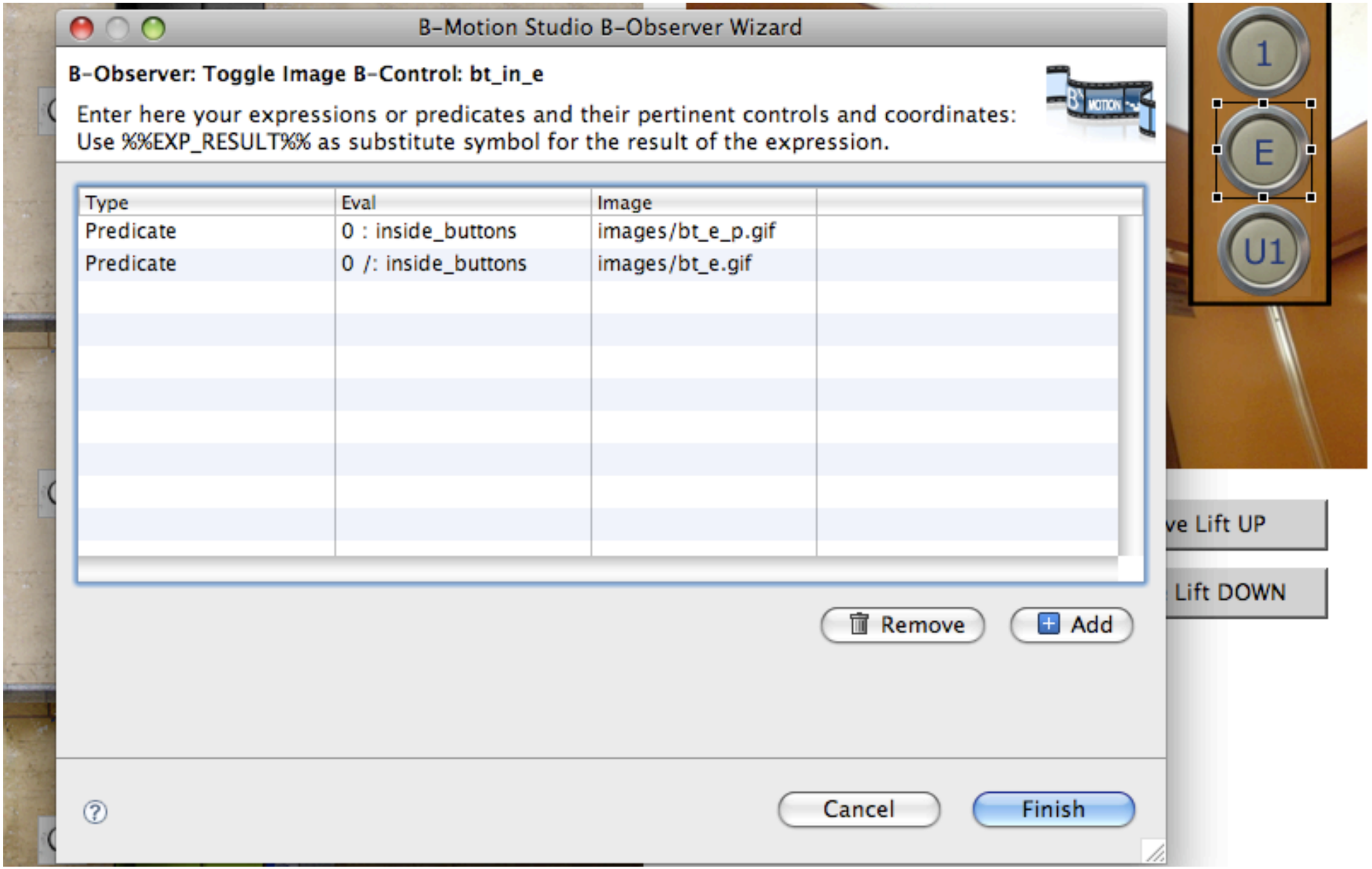
Move Lift UP

Reverse Down

Move Lift DOWN

Open Door

Close Door


B-Motion Studio B-Observer Wizard
B-Observer: Toggle Image B-Control: bt_in_e
Enter here your expressions or predicates and their pertinent controls and coordinates:
Use %%EXP_RESULT%% as substitute symbol for the result of the expression.
Type
Eval
Image
Predicate
0 : inside_buttons
images/bt_e_p.gif
Predicate
0 /: inside_buttons
images/bt_e.gif
Remove
Add
Cancel
Finish
1
E
U1
ve Lift UP
Lift DOWN

Acknowledgements

- Camille Texteditor and EMF Framework: Fabian Fritz, Colin Snook, Alexei Iliasov
- B-Motion Studio: Lukas Ladenberger