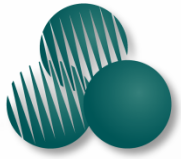

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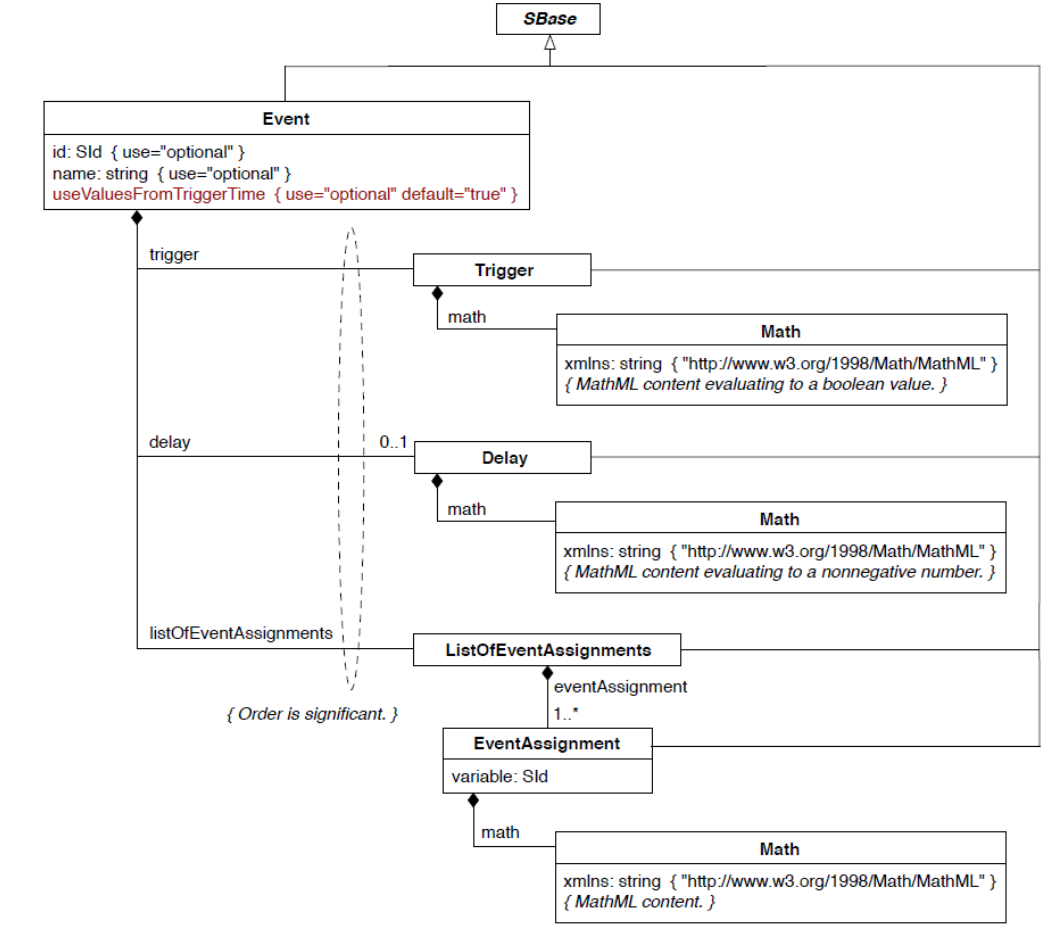
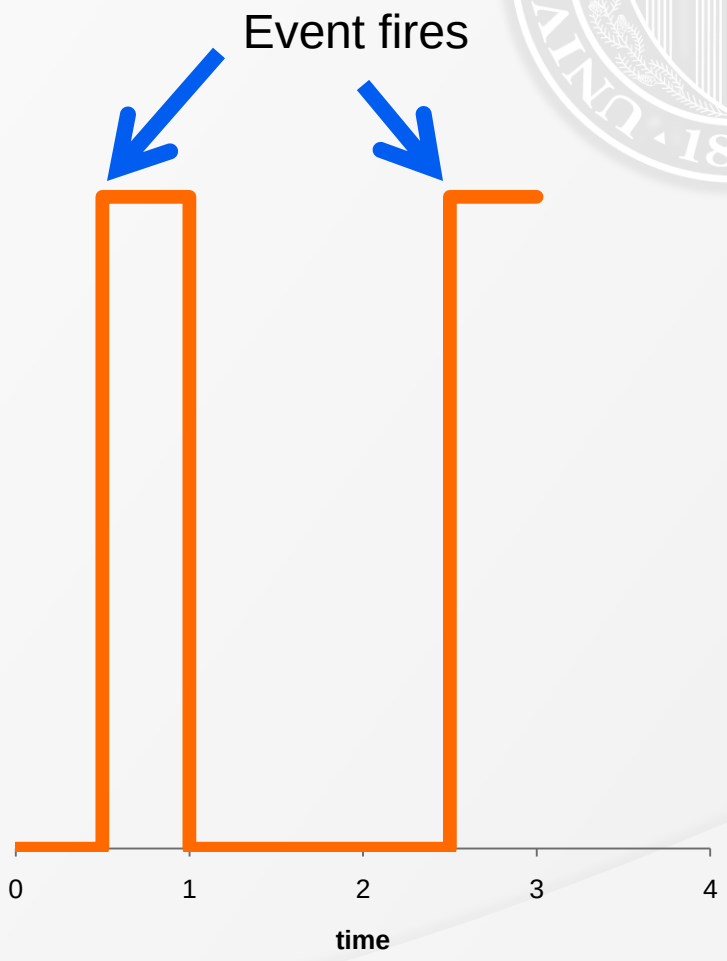
IMPLEMENTING SBML EVENTS

The Spec


SBase
Event
id: SId { use="optional" }
name: string { use="optional" }
useValuesFromTriggerTime { use="optional" default="true" }
trigger
Trigger
math
Math
xmlns: string { "http://www.w3.org/1998/Math/MathML" }
{ MathML content evaluating to a boolean value. }
delay
0..1
Delay
math
Math
xmlns: string { "http://www.w3.org/1998/Math/MathML" }
{ MathML content evaluating to a nonnegative number. }
listOfEventAssignments
ListOfEventAssignments
eventAssignment
1..*
{ Order is significant. }
EventAssignment
variable: SId
math
Math
xmlns: string { "http://www.w3.org/1998/Math/MathML" }
{ MathML content. }

Event fires ...

An event only fires when its Trigger expression makes the transition in value from “false” to “true”. The event will also fire at any future time points when the trigger make this transition; in other words, an event can fire multiple times during a simulation if its trigger condition makes the transition from “false” to “true” more than once



RoadRunner: Event Detection

- Step 1: Transform trigger function such that it is negative as long as it is false, and positive as long as it is true
- Step 2: Apply a root finder (CVode for roadRunner), which will detect whenever 0 is crossed
- Step 3: Only accept results from root finder on rising flank

A word about trigger functions

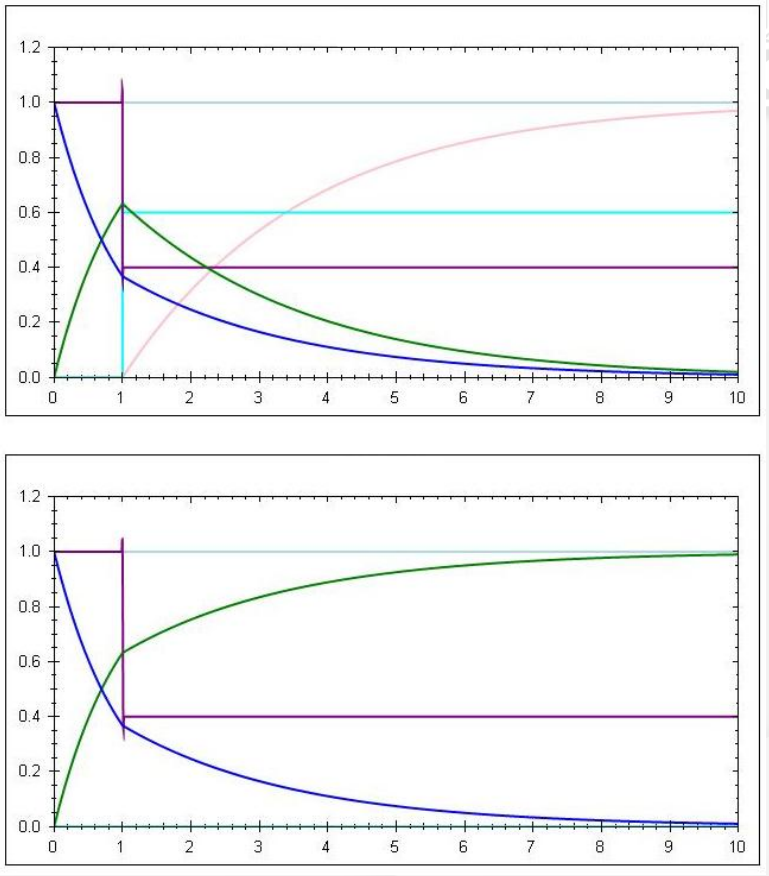
- Root finders will give the same answer for the expressions:
  - t == 1
  - t >= 1
  - t > 1

RoadRunner: BackTracking

- While RoadRunner employs an adaptive step size solver, it will collect output points at fixed intervals (as specified by the user)
- Events will usually hit, in between those intervals
  - ➔ After assignment it is necessary to restart the integrator to solve the remainder of the output interval

Caution: Multiple Assignments

The math element contains a MathML expression that defines the new value of the object identified by the variable. The time at which this expression is evaluated is determined by Event's useValuesFromTriggerTime attribute. If the attribute value is "true" (the default), the expression must be evaluated when the event is fired; more precisely, the values of identifiers occurring in MathML ci attributes in the EventAssignment's math expression are the values they have at the point when the event fired. If, instead, useValuesFromTriggerTime's value is "false", it means the values at execution time should be used; that is, the values of identifiers occurring in MathML ci attributes in the EventAssignment's math expression are the values they have at the point when the event executed.



RoadRunner ToDo List

- Implement delayed Events
  - The idea for a correct implementation is to add new events for each delayed event, that fire and execute with 0 delay precisely after the specified delay. Otherwise the correct delay cannot be guaranteed.
  - adhere to:
    - `useValuesFromTriggerTime = false`

Simulator Comparison

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Systems biology

Comparing simulation results of SBML capable simulators

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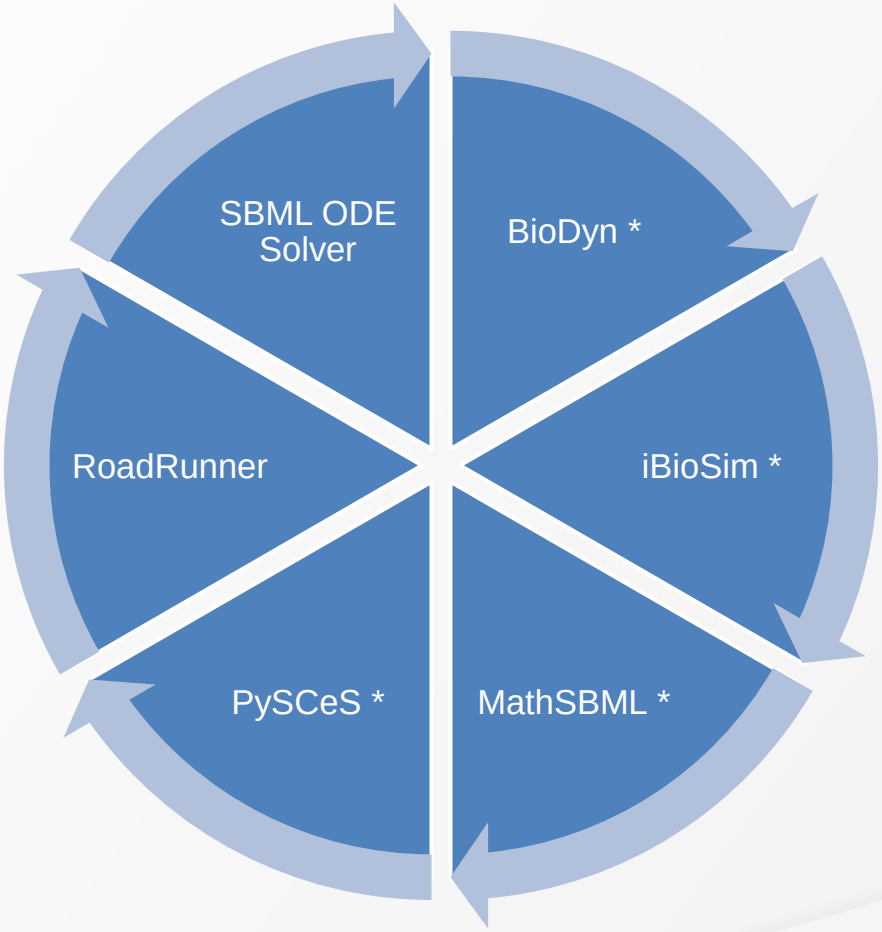
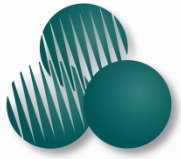
Events are well supported



* Simulator supports delayed events



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Questions

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