Technical Overview of OpenModelica and its Development Environment

Adrian Pop

2013-02-04

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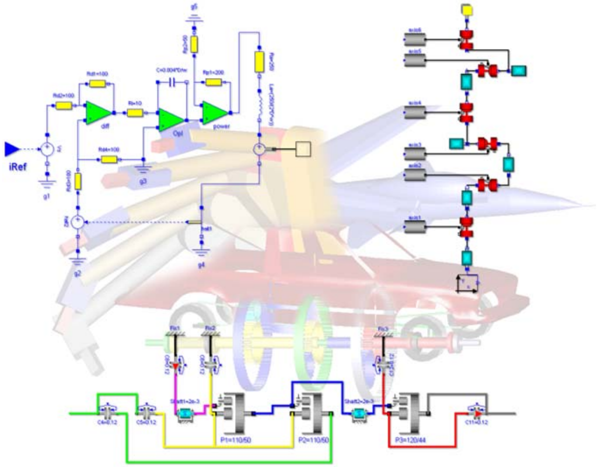
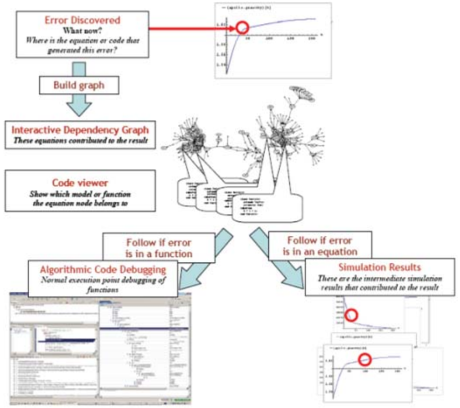
www.OpenModelica.org





Error Discovered
What now?
Where is the equation or code that generated this error?

Build graph

Interactive Dependency Graph
These equations contributed to the result

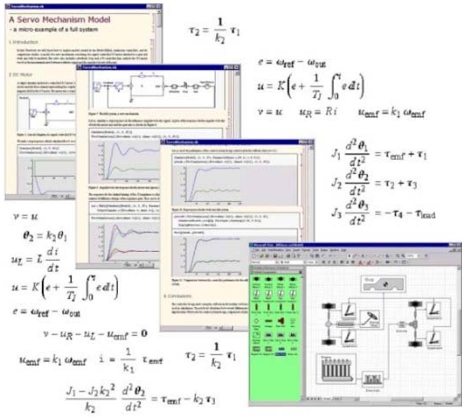
Code viewer
Show which model or function the equation node belongs to

Follow if error is in a function

Algorithmic Code Debugging
Normal execution point debugging of functions

Follow if error is in an equation

Simulation Results
These are the intermediate simulation results that contributed to the result



Outline

- OpenModelica
  - What is OpenModelica?
  - The past and present
- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook,
  - OMEdit, ModelicaML, SimForge
- OpenModelica Development Environment
  - MetaModelica (RML/OMC)
  - The Eclipse Environment (MDT)
- OpenModelica Latest Developments (2012-2013)

What is OpenModelica? (0)

OpenModelica is ... *its developers*

Thank you!

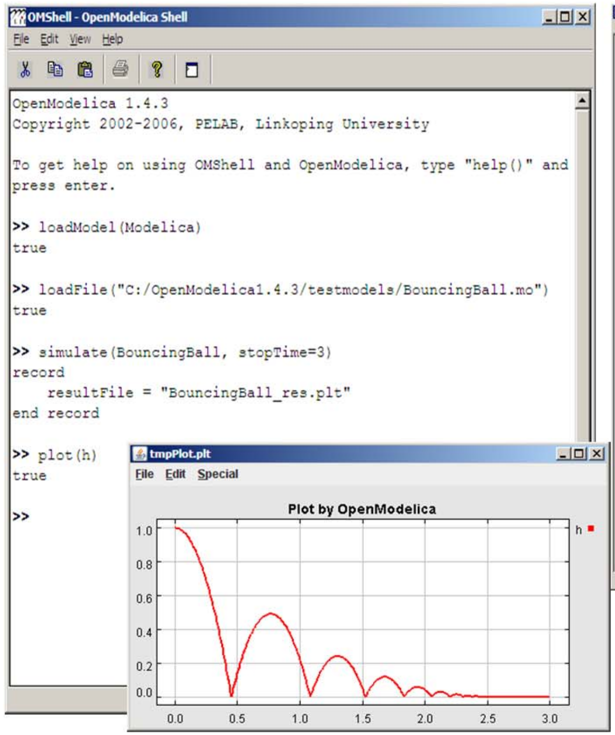
asodja, sjoelund.se, sebco011, lochel, wbraun, niklwors, hubert.thieriot, petar, perost, Frenkel TUD, Unknown, syeas460, adeas31, ppriv, ricli576, haklu, dietmarw, levsa, mahge930, x05andfe, mohsen, nutaro, x02lucpo, florosx, x06hener, x07simbj, stebr461, x08joekl, x08kimja, Dongliang Li, jhare950, x97davka, krsta, edgarlopez, hanke, henjo, wuzhu.chen, fbergero, harka011, tmtuomas, bjozac, AlexeyLebedev, x06klasj, ankar, kajny, vasaie_p, niemisto, donida, hkiel, davbr, otto@mathcore.com, Kaie Kubjas, x06krino, afshe, x06mikbl, leonardo.laguna, petfr, dhedberg, g-karbe, x06henma, abhinnk, azazi, x02danhe, rruusu, x98petro, mater, g-bjoza, x02kajny, g-pavgr, x05andre, vaden, jansilar, ericmeyers, x05simel, andsa, leist, choeger, Ariel.Liebman, frisk, adrpo

Developers (81)

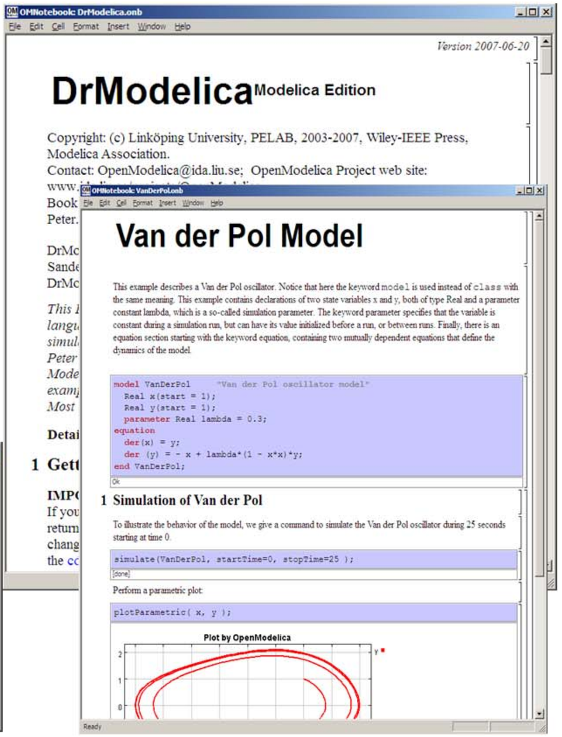
Martin
Per
Adeel
Jens
Willi
Lennart
Alexey
Mahder
Olena
Mohsen
Kristian
Hubert
Niklas
Kaie
Kiel
Peter *
Leonardo
Filippo
Xenofon
Frederico
Edgar
Kaj
Levon
Stefan
Rickard
Bjorn
David
Otto
Eric
...
Adrian

What is OpenModelica? (I)

- Advanced Interactive Modelica compiler (OMC)
  - Supports MLS v. 3.1/MSL v. 3.2.1
- Basic and advanced environments for creating models
  - OMShell – an interactive command handler
  - OMNotebook – a literate programming notebook
  - OMEdit – Open Modelica Connection Editor
  - OMPlot – Open Modelica Plotting
  - OMOptim – Open Modelica Optimization Editor
  - MDT – an advanced textual environment in Eclipse



```
OpenModelica 1.4.3
Copyright 2002-2006, PELAB, Linkoping University

To get help on using OMShell and OpenModelica, type "help()" and
press enter.

>> loadModel(Modelica)
true

>> loadFile("C:/OpenModelica1.4.3/testmodels/BouncingBall.mo")
true

>> simulate(BouncingBall, stopTime=3)
record
    resultFile = "BouncingBall_res.plt"
end record

>> plot(h)
true

>>
```


OMNotebook: DrModelica.onb
File Edit Cell Format Insert Window Help
OMNotebook: VanDerPol.onb
File Edit Cell Format Insert Window Help
Plot by OpenModelica
y
2
1
0
Ready

Version 2007-06-20

DrModelica Modelica Edition

Copyright: (c) Linköping University, PELAB, 2003-2007, Wiley-IEEE Press, Modelica Association.
Contact: OpenModelica@ida.liu.se; OpenModelica Project web site:

Van der Pol Model

This example describes a Van der Pol oscillator. Notice that here the keyword `model` is used instead of `class` with the same meaning. This example contains declarations of two state variables x and y, both of type Real and a parameter constant lambda, which is a so-called simulation parameter. The keyword parameter specifies that the variable is constant during a simulation run, but can have its value initialized before a run, or between runs. Finally, there is an equation section starting with the keyword equation, containing two mutually dependent equations that define the dynamics of the model.

```
model VanDerPol     "Van der Pol oscillator model"
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
equation
  der(x) = y;
  der (y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;
```

```
Ok
```

1 Simulation of Van der Pol

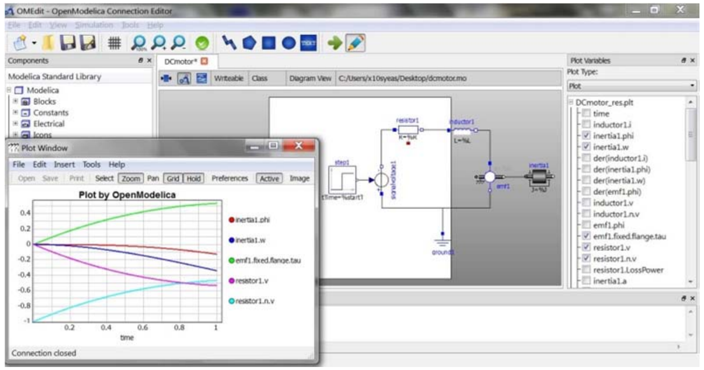
To illustrate the behavior of the model, we give a command to simulate the Van der Pol oscillator during 25 seconds starting at time 0.

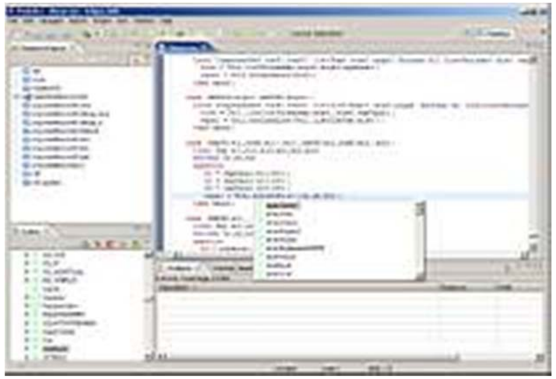
```
simulate(VanDerPol, startTime=0, stopTime=25 );
```

```
[done]
```

Perform a parametric plot:

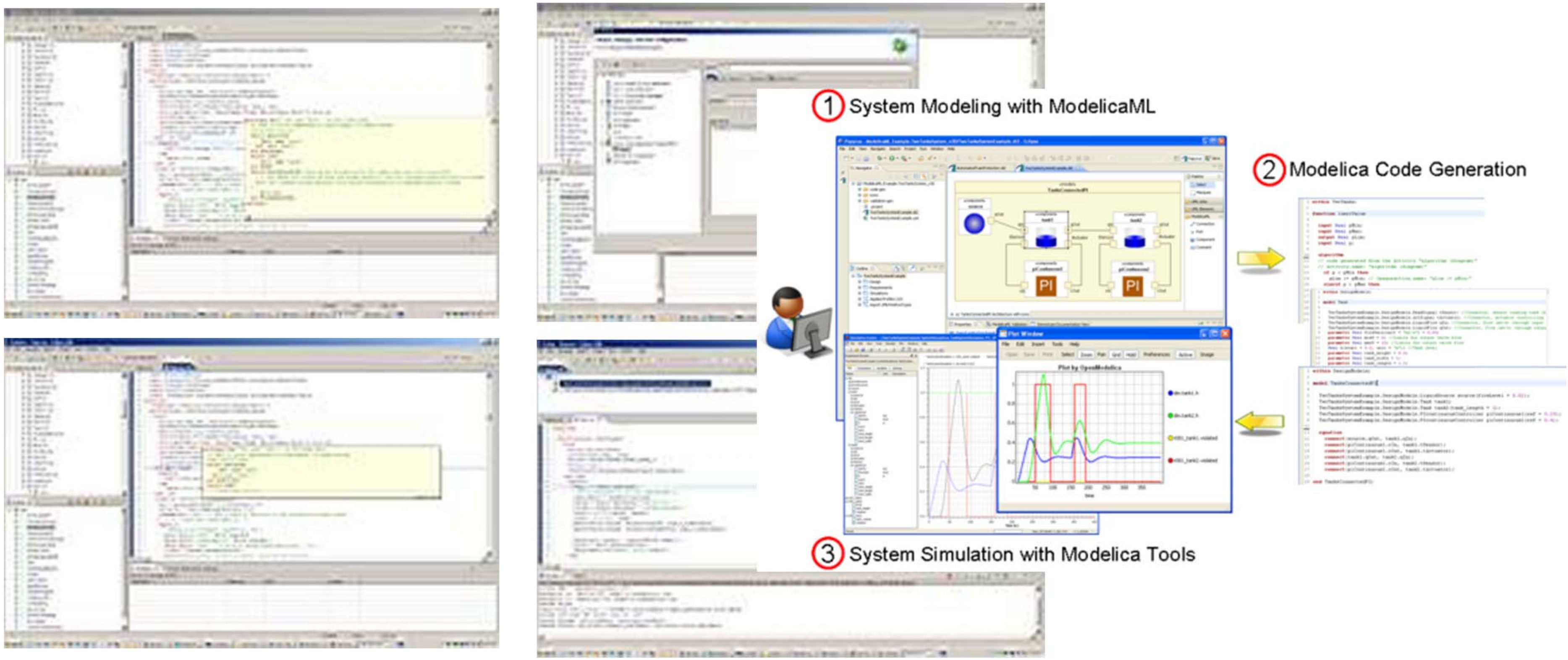
```
plotParametric( x, y );
```





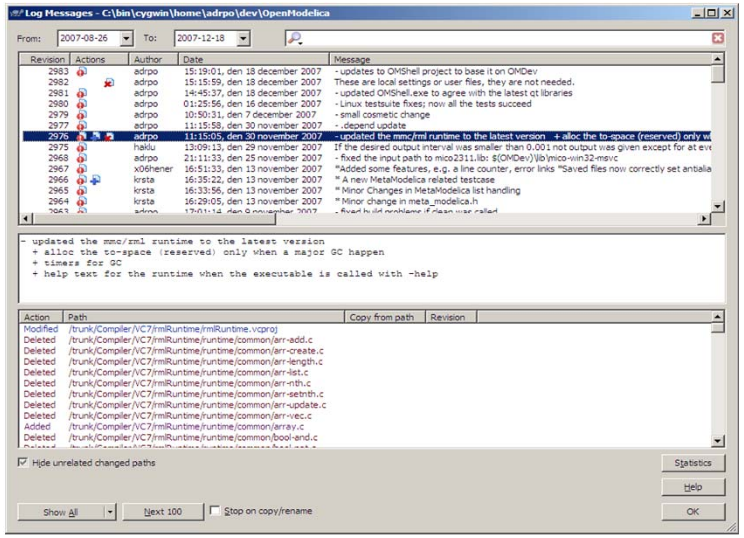
What Is OpenModelica? (II)

- **Advanced Eclipse-based Development Environment**
- **Modelica Development Tooling (MDT) - started in 2005**
  - Code Assistance, Debugging, Outline & a lot more
  - *Used heavily for OpenModelica development*
  - Used in many OpenModelica Development Courses
- **ModelicaML UML/SysML integration**


1 System Modeling with ModelicaML
2 Modelica Code Generation
3 System Simulation with Modelica Tools
PI
PI
Plot by OpenModelica

What is OpenModelica? (III)

- Open-source community services
  - Website and Support Forum
  - Version-controlled source base
  - Trac with bug database
  - Development courses
  - Mailing lists



Log Messages - C:\bin\cygwin\home\adrpo\dev\OpenModelica

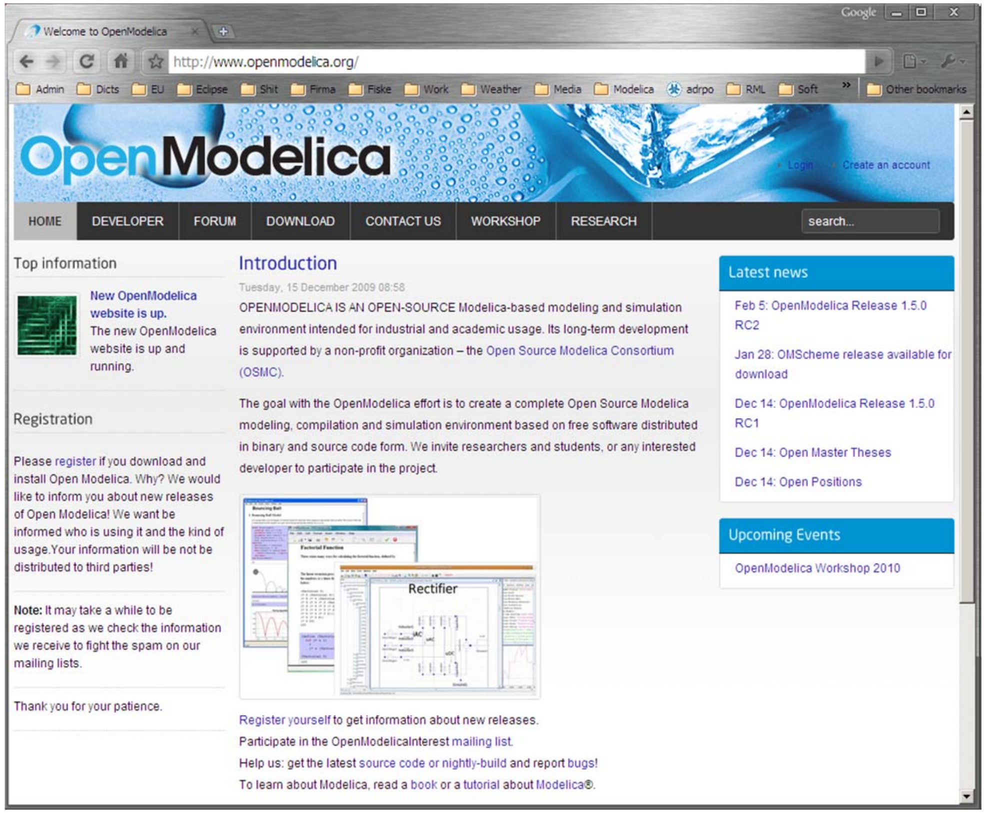
From: 2007-08-26 To: 2007-12-18

Revision	Actions	Author	Date	Message
2983		adrpo	15:19:01, den 18 december 2007	- updates to OMShell project to base it on OMDev
2982		adrpo	15:15:59, den 18 december 2007	These are local settings or user files, they are not needed.
2981		adrpo	14:45:37, den 18 december 2007	- updated OMShell.exe to agree with the latest qt libraries
2980		adrpo	01:25:56, den 16 december 2007	- Linux testsuite fixes; now all the tests succeed
2979		adrpo	10:50:31, den 7 december 2007	- small cosmetic change
2977		adrpo	11:15:58, den 30 november 2007	- .depend update
2976		adrpo	11:15:05, den 30 november 2007	- updated the mmc/rml runtime to the latest version + alloc the to-space (reserved) only w
2975		haklu	13:09:13, den 29 november 2007	If the desired output interval was smaller than 0.001 not output was given except for at eve
2968		adrpo	21:11:33, den 25 november 2007	- fixed the input path to mico2311.lib: $(OMDev)\lib\mico-win32-msvc
2967		x06hener	16:51:33, den 13 november 2007	*Added some features, e.g. a line counter, error links *Saved files now correctly set antialia
2966		krsta	16:35:22, den 13 november 2007	* A new MetaModelica related testcase
2965		krsta	16:33:56, den 13 november 2007	* Minor Changes in MetaModelica list handling
2964		krsta	16:29:05, den 13 november 2007	* Minor change in meta_modelica.h
2963		adrpo	17:01:14, den 9 november 2007	- fixed build problems if clean was called

```
- updated the mmc/rml runtime to the latest version
  + alloc the to-space (reserved) only when a major GC happen
  + timers for GC
  + help text for the runtime when the executable is called with -help
```

Action	Path	Copy from path	Revision
Modified	/trunk/Compiler/VC7/rmlRuntime/rmlRuntime.vcproj		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-add.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-create.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-length.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-list.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-nth.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-setnth.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-update.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/arr-vec.c		
Added	/trunk/Compiler/VC7/rmlRuntime/runtime/common/array.c		
Deleted	/trunk/Compiler/VC7/rmlRuntime/runtime/common/bool-and.c		

☑ Hide unrelated changed paths



Top information

New OpenModelica website is up.

The new OpenModelica website is up and running.

Registration

Please register if you download and install Open Modelica. Why? We would like to inform you about new releases of Open Modelica! We want be informed who is using it and the kind of usage.Your information will be not be distributed to third parties!

Note: It may take a while to be registered as we check the information we receive to fight the spam on our mailing lists.

Thank you for your patience.

Introduction

Tuesday, 15 December 2009 08:58

OPENMODELICA IS AN OPEN-SOURCE Modelica-based modeling and simulation environment intended for industrial and academic usage. Its long-term development is supported by a non-profit organization – the Open Source Modelica Consortium (OSMC).

The goal with the OpenModelica effort is to create a complete Open Source Modelica modeling, compilation and simulation environment based on free software distributed in binary and source code form. We invite researchers and students, or any interested developer to participate in the project.

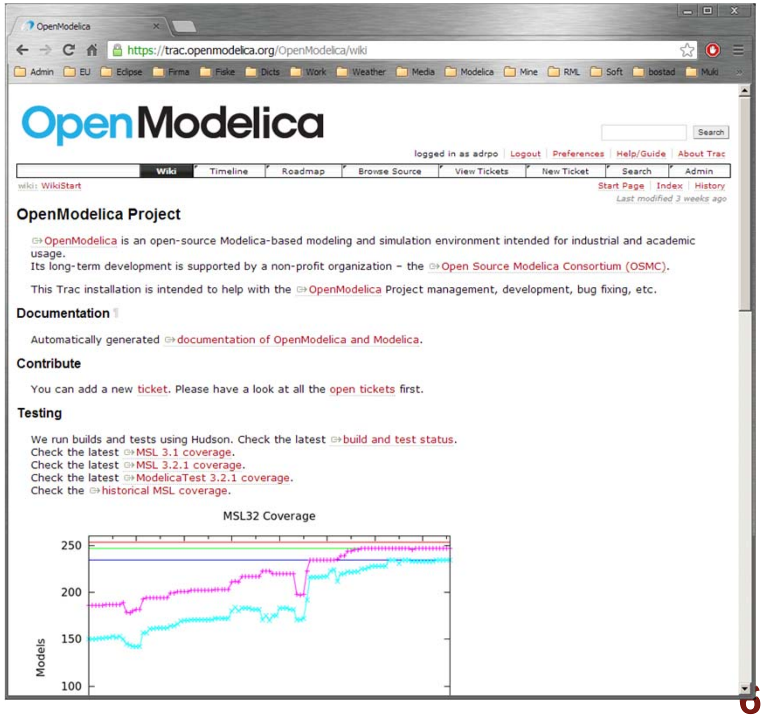
Register yourself to get information about new releases.
Participate in the OpenModelicaInterest mailing list.
Help us: get the latest source code or nightly-build and report bugs!
To learn about Modelica, read a book or a tutorial about Modelica®.

Latest news

- Feb 5: OpenModelica Release 1.5.0 RC2
- Jan 28: OMScheme release available for download
- Dec 14: OpenModelica Release 1.5.0 RC1
- Dec 14: Open Master Theses
- Dec 14: Open Positions

Upcoming Events

- OpenModelica Workshop 2010



OpenModelica Project

OpenModelica is an open-source Modelica-based modeling and simulation environment intended for industrial and academic usage.
Its long-term development is supported by a non-profit organization – the Open Source Modelica Consortium (OSMC).

This Trac installation is intended to help with the OpenModelica Project management, development, bug fixing, etc.

Documentation

Automatically generated documentation of OpenModelica and Modelica.

Contribute

You can add a new ticket. Please have a look at all the open tickets first.

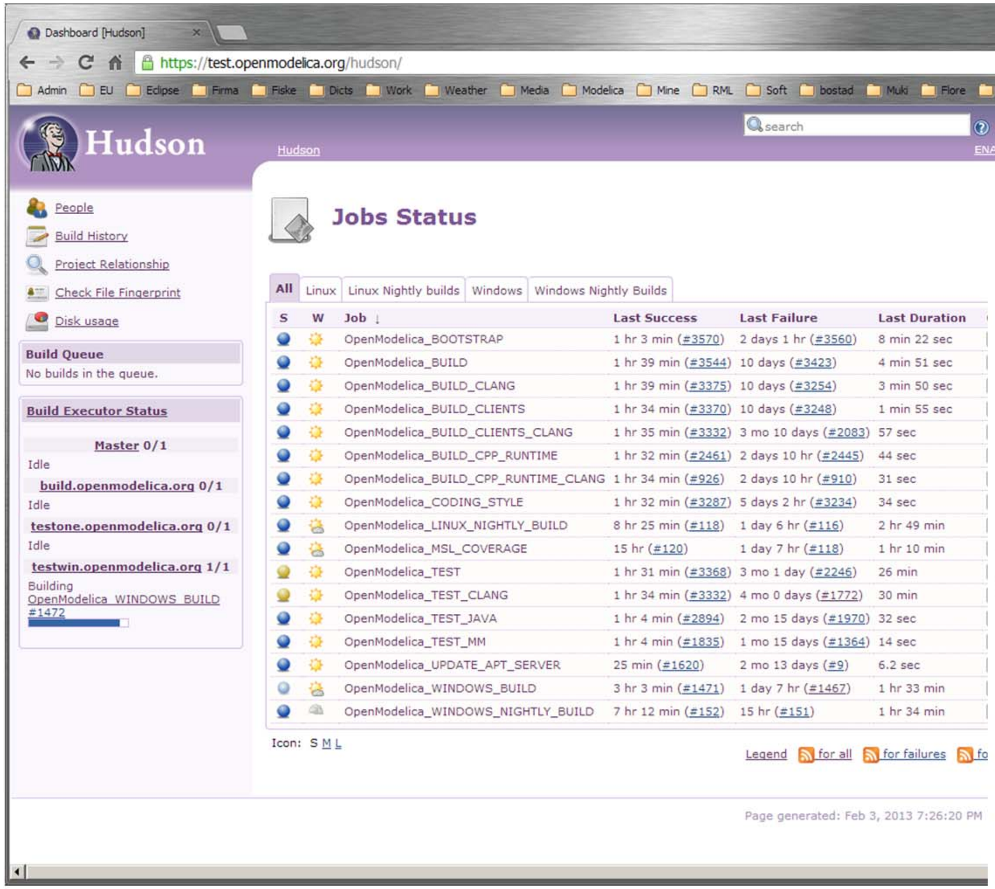
Testing

We run builds and tests using Hudson. Check the latest build and test status.
Check the latest MSL 3.1 coverage.
Check the latest MSL 3.2.1 coverage.
Check the latest ModelicaTest 3.2.1 coverage.
Check the historical MSL coverage.

MSL32 Coverage

What is OpenModelica? (IV)

- Open-source community services
  - Extensive testing (coverage & unit)
  - ~2500 tests ran on each commit via Hudson (3 test servers currently)
    - Linux (GCC & CLANG), Windows (MinGW GCC)
  - Automatic nightly builds for Window & Linux



Dashboard [Hudson]

https://test.openmodelica.org/hudson/

Admin EU Eclipse Firma Fiske Dicts Work Weather Media Modelica Mine RML Soft bostad Muki Flore GCC

Hudson

search | log in | sign up

Hudson | ENABLE AUTO REFRESH

People

Build History

Project Relationship

Check File Fingerprint

Disk usage

Build Queue

No builds in the queue.

Build Executor Status

Master 0/1

Idle

build.openmodelica.org 0/1

Idle

testone.openmodelica.org 0/1

Idle

testwin.openmodelica.org 1/1

Building OpenModelica_WINDOWS_BUILD #1472

Jobs Status

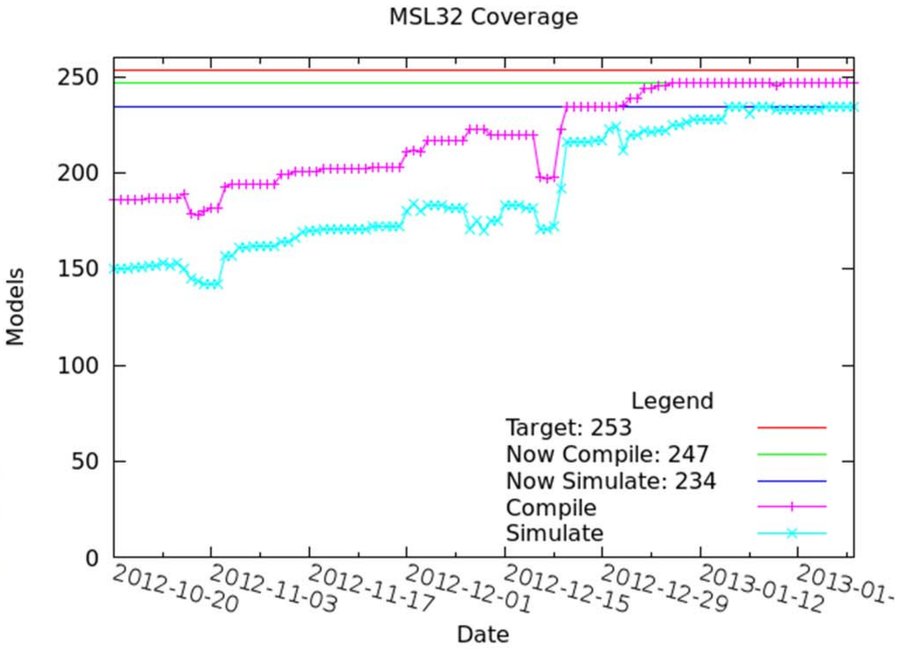
All | Linux | Linux Nightly builds | Windows | Windows Nightly Builds

S	W	Job ↓	Last Success	Last Failure	Last Duration
●	☀	OpenModelica_BOOTSTRAP	1 hr 3 min (#3570)	2 days 1 hr (#3560)	8 min 22 sec
●	☀	OpenModelica_BUILD	1 hr 39 min (#3544)	10 days (#3423)	4 min 51 sec
●	☀	OpenModelica_BUILD_CLANG	1 hr 39 min (#3375)	10 days (#3254)	3 min 50 sec
●	☀	OpenModelica_BUILD_CLIENTS	1 hr 34 min (#3370)	10 days (#3248)	1 min 55 sec
●	☀	OpenModelica_BUILD_CLIENTS_CLANG	1 hr 35 min (#3332)	3 mo 10 days (#2083)	57 sec
●	☀	OpenModelica_BUILD_CPP_RUNTIME	1 hr 32 min (#2461)	2 days 10 hr (#2445)	44 sec
●	☀	OpenModelica_BUILD_CPP_RUNTIME_CLANG	1 hr 34 min (#926)	2 days 10 hr (#910)	31 sec
●	☀	OpenModelica_CODING_STYLE	1 hr 32 min (#3287)	5 days 2 hr (#3234)	34 sec
●	⛅	OpenModelica_LINUX_NIGHTLY_BUILD	8 hr 25 min (#118)	1 day 6 hr (#116)	2 hr 49 min
●	⛅	OpenModelica_MSL_COVERAGE	15 hr (#120)	1 day 7 hr (#118)	1 hr 10 min
●	☀	OpenModelica_TEST	1 hr 31 min (#3368)	3 mo 1 day (#2246)	26 min
●	☀	OpenModelica_TEST_CLANG	1 hr 34 min (#3332)	4 mo 0 days (#1772)	30 min
●	☀	OpenModelica_TEST_JAVA	1 hr 4 min (#2894)	2 mo 15 days (#1970)	32 sec
●	☀	OpenModelica_TEST_MM	1 hr 4 min (#1835)	1 mo 15 days (#1364)	14 sec
●	☀	OpenModelica_UPDATE_APT_SERVER	25 min (#1620)	2 mo 13 days (#9)	6.2 sec
○	⛅	OpenModelica_WINDOWS_BUILD	3 hr 3 min (#1471)	1 day 7 hr (#1467)	1 hr 33 min
●	☁	OpenModelica_WINDOWS_NIGHTLY_BUILD	7 hr 12 min (#152)	15 hr (#151)	1 hr 34 min

Icon: S M L

Legend | for all | for failures | fo

Page generated: Feb 3, 2013 7:26:20 PM



What is OpenModelica? (V)

- An incubator platform for research
  - 5 PhDs since 2004 (Debugging, Parallelization, PDEs Extensions)
  - 25 Master's theses since 2004
  - Both the students and the project benefit
- Master theses at PELAB 2006-2013
  - Refactoring/Parsing and Language extensions
  - UML/SysML view of Modelica code
  - 2D and 3D visualization tools
  - Static and runtime debugging tools
  - Advanced code generation and parallelization of simulation code
  - Bootstrapping and Java Interface
  - Function pointers
  - NVIDIA for Cuda and OpenCL parallel simulation
  - OMEdit – Modelica Connection Editor
  - OMWeb – server based Modelica simulation for teaching
- External Master theses
  - Model based diagnostics at ISY (Dep. Of Electrical Engineering)
  - Monte-Carlo simulation of Satellite Separation Systems at SAAB
  - Interactive Simulations (EADS)
  - Additional Solvers + Event handling (FH-Bielefeld)
  - EADS – ModelicaML
- A Base for commercial and open source products
  - MathCore AB, Bosch Rexroth, InterCAX (MagicDraw SysML), VTT, Equa, Evonik

OpenModelica Roadmap - Past

1997 - started as a master thesis
2003 – first usable internal version
2004 – first external version: OpenModelica 1.1
2005 – more development: OpenModelica 1.3.1

2006 – major milestone

- Translated the whole compiler to MetaModelica
- Integrated Development Environment for the compiler
- OpenModelica website started
- Moved the code repository to Subversion management
- Extended the OpenModelica environment with new tools
- 4 versions released during the year
- External people start using OpenModelica
  - ~ 200 downloads/month
  - first development course at INRIA

OpenModelica Roadmap - Past

2007 – continued development and community involvement

- Improvement in website, support and documentation
- Answered ~1000 questions on the forum
- Portability is highly improved, ported to 4 platforms
  - Linux, Mac, Solaris, Windows (version 1.4.3)
- Improvement of the compiler development tools in Eclipse
- OpenModelica Community starts to react
  - contribute code & report bugs & request enhancements & participate in answering questions in the OpenModelica forum
  - participate at courses and workshops
- New server acquired for better community services
- Increased usage: ~600 downloads/month
- Open Modelica Consortium created in December 4
  - 4 months of work
  - 9 organizations as members already (3 Universities, 6 Companies)
  - discussions are ongoing with other 6 companies

OpenModelica Roadmap - Past

2008 – Further work on the compiler

- Release 1.4.4 and 1.4.5
  - Linux, Mac, Solaris, Windows
- New Solver Interface
- Refactoring
- Dynamic loading of functions
- Merging of MathCore front-end code
- 744 commits in Subversion
- Other things I don’t remember

OpenModelica Roadmap – Past

2009

- Work mainly happened in OSMC (partially on a non-public branch)
- Front-end
  - Refactoring (OSMC)
  - Enumerations (OSMC)
  - Java Interface and Bootstrapping (Martin Sjölund)
  - MultiBody flattening (OSMC)
  - Constraint connection graph breaking (VTT + OSMC)
  - Support for Modelica 3.x and 3.x annotations (OSMC)
- Back-end
  - Tearing in the back-end (Jens Frenkel)
  - Template Code Generation and CSharp backend (Pavol Privitzer, Charles University Prague)
  - Interactive Simulations (EADS)
  - C++ Code generation (Bosch Rexroth)
  - Java Interface and Bootstrapping (Martin Sjölund)
  - Additional Solvers + Events (Willi Braun, FH-Bielefeld)
- General
  - New ModelicaML + SysML prototype (EADS)
  - 1144 commits in subversion (Since 2009 to February 8, 2010)
  - Bug fixes (OSMC)
  - Release 1.5.0 and 1.5.0-RC_X (Linux, Mac, Solaris, Windows)
- More things I don’t remember

OpenModelica Roadmap – Past

2010 – 2011

- Support for Modelica Standard Library 3.1 (Media & Fluid in works)
- Front-end
  - MultiBody flattening (OSMC)
  - Support for Modelica 3.x and 3.x annotations (OSMC)
  - Performance Enhancements
  - Stream connectors
  - Media & Fluid work is on the way
- Back-end
  - Back-end redesign (Jens, Willi, Martin, Per, Adrian, Kristian, Filippo)
  - Tearing in the back-end (Jens Frenkel)
  - Template Code Generation and CSharp backend (Pavol Privitzer, Charles University Prague)
  - Interactive Simulations (EADS)
  - C++ Code generation (Bosch Rexroth)
  - Additional Solvers + Events + Linearization (Willi Braun, FH-Bielefeld)
- General
  - OMEdit – new connection editor
  - Bootstrapping OMC (90% finished)
  - 2550 commits in subversion from 2010 to Feb. 7, 2011 (double than 2009-2010)
  - Bug fixes ~300+ (OSMC)
  - Release 1.6.0 (Linux, Mac, Windows)
  - Downloads Windows (~16434) , Linux (~8301), Mac (~2816)
- More things I don’t remember

OpenModelica Roadmap – Past & Present

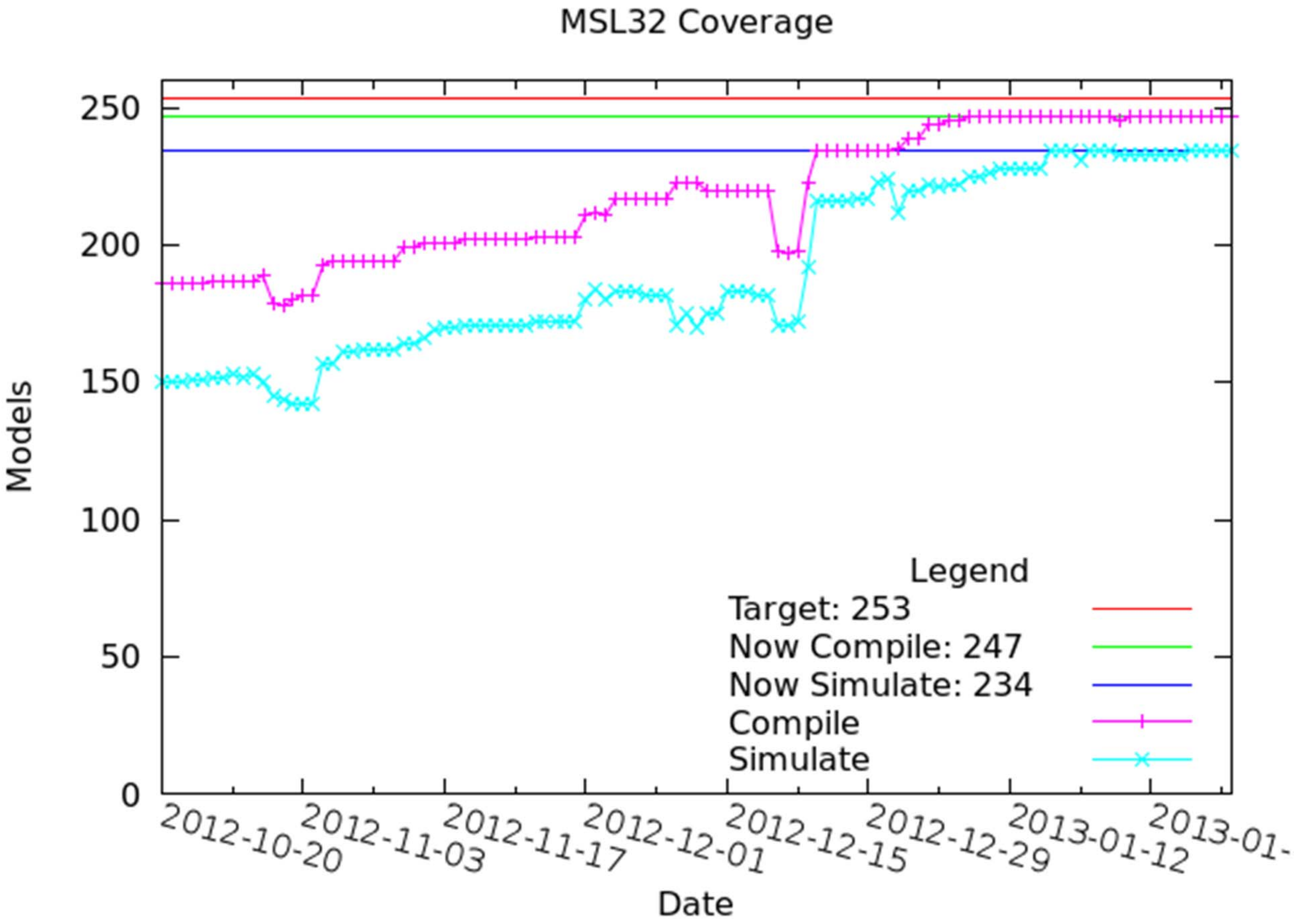
2012 – 2013

- Support for Modelica Standard Library 3.2.1 including Media & Fluid

- Front-end
  - Performance Enhancements
  - Media & Fluid work
  - Operator overloading
  - New instantiation module started
- Back-end
  - Modular back-end with more optimization modules (Jens, Willi, Martin)
  - New simulation runtime redesign (Willi, Lennart, Jens, Martin, Adrian)
  - C++ Code generation (Bosch Rexroth)
  - FMI export & import
  - Initialization, Jacobians (Lennart Lochel, Willi Braun, FH-Bielefeld)
  - Support for parallelization (Martin)
  - Parallel extensions in functions
- General
  - Uncertainties support (OpenTURNS connection & Data reconcilation)
  - MDT GDB debugging based on GDB and the bootstrapped compiler
  - OMEdit – improvements
  - Bootstrapping OMC (100% finished) using Boehm GC
  - 3909 commits in subversion from 2012 to Feb. 4, 2013
  - 2000 forum posts (questions and answers)
  - Bug fixes ~247+ (OSMC)
  - Release 1.9.0 (Linux, Mac, Windows)
  - Downloads Windows (~45307) , Linux (~15543), Mac (~5367)
- More things I don't remember

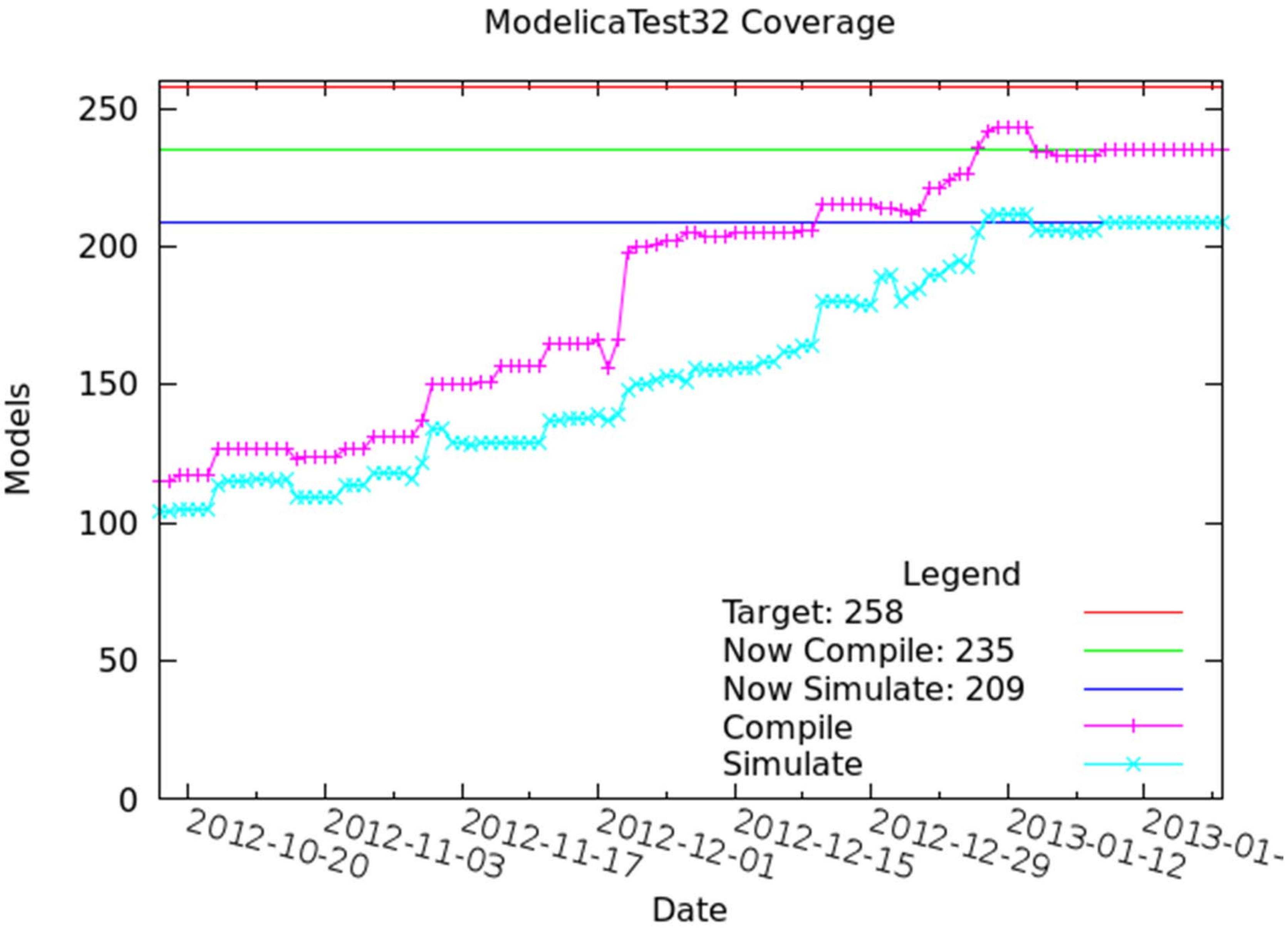
OpenModelica Testing (I)

- 2013-02-03 r15047 - total 253 - build 247 (97%) - sim 234 (92%)

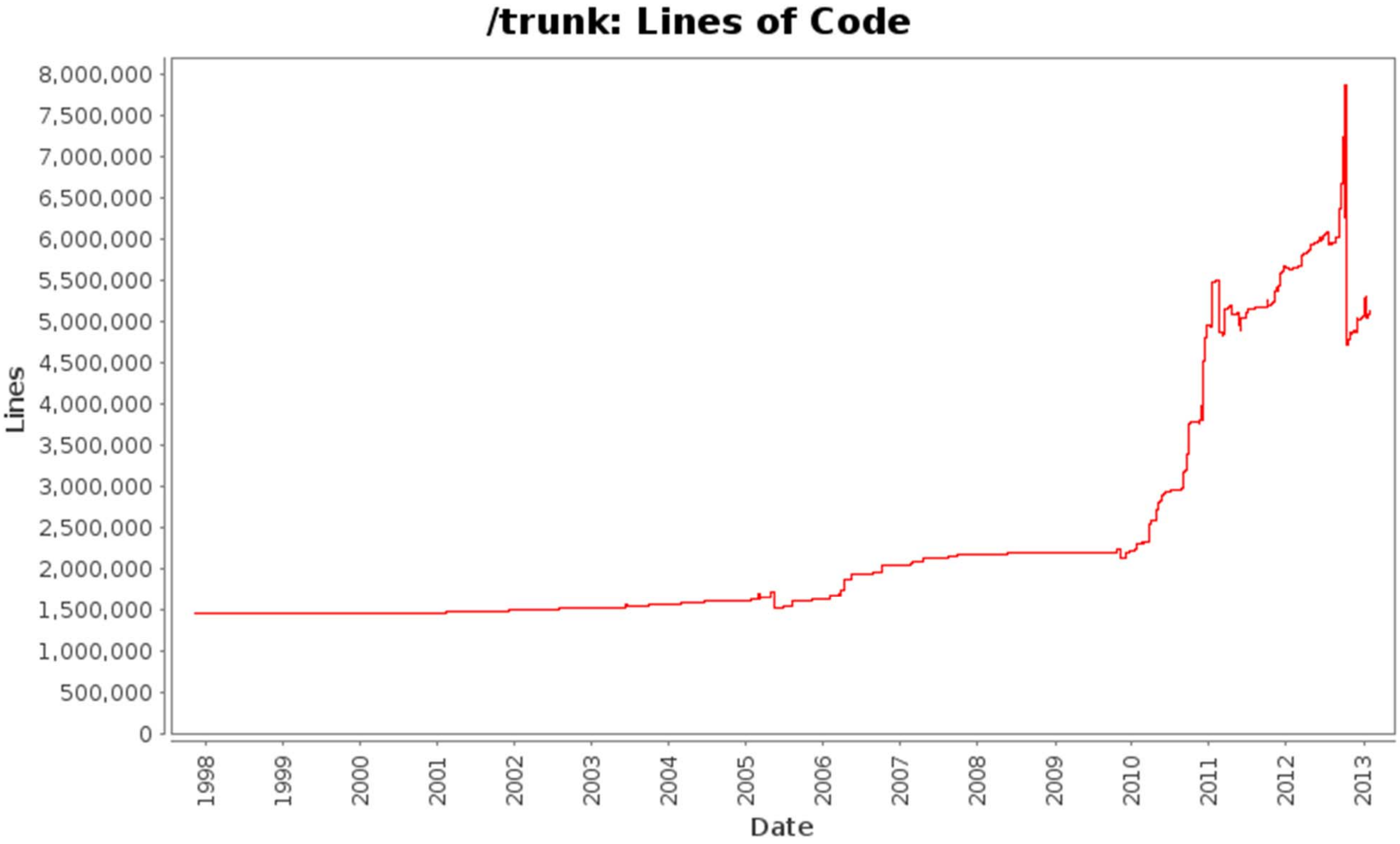


OpenModelica Testing (II)

- 2013-02-03 r15047 - total 258 - build 235 (91%) - sim 209 (81%)

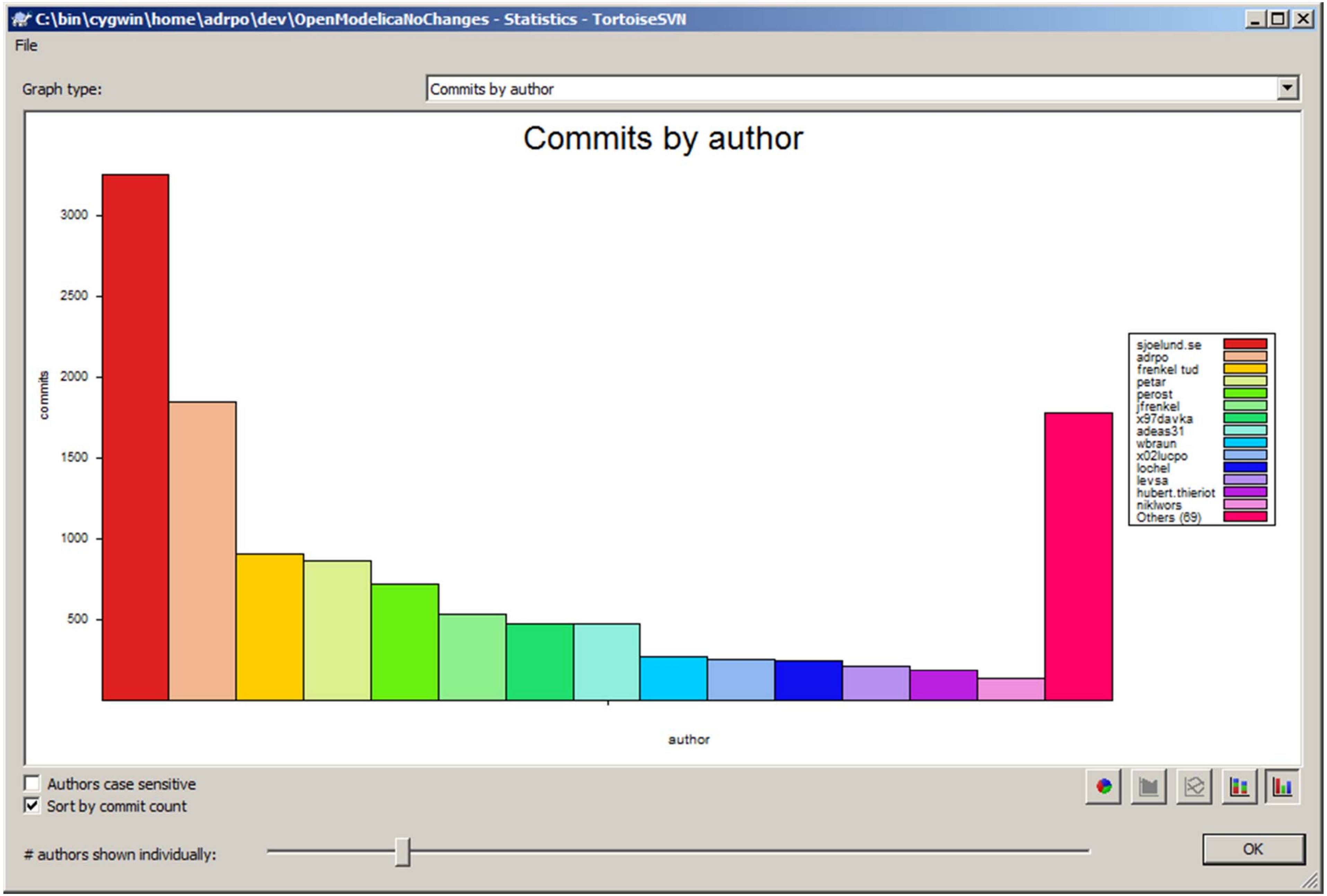


OpenModelica Statistics (I)



- Mature code base (http://build.openmodelica.org/omc/statsvn_trunk/)
- ~ 4500K lines of code and tests, steady increase

OpenModelica Statistics (II)



C:\bin\cygwin\home\adrpo\dev\OpenModelicaNoChanges - Statistics - TortoiseSVN

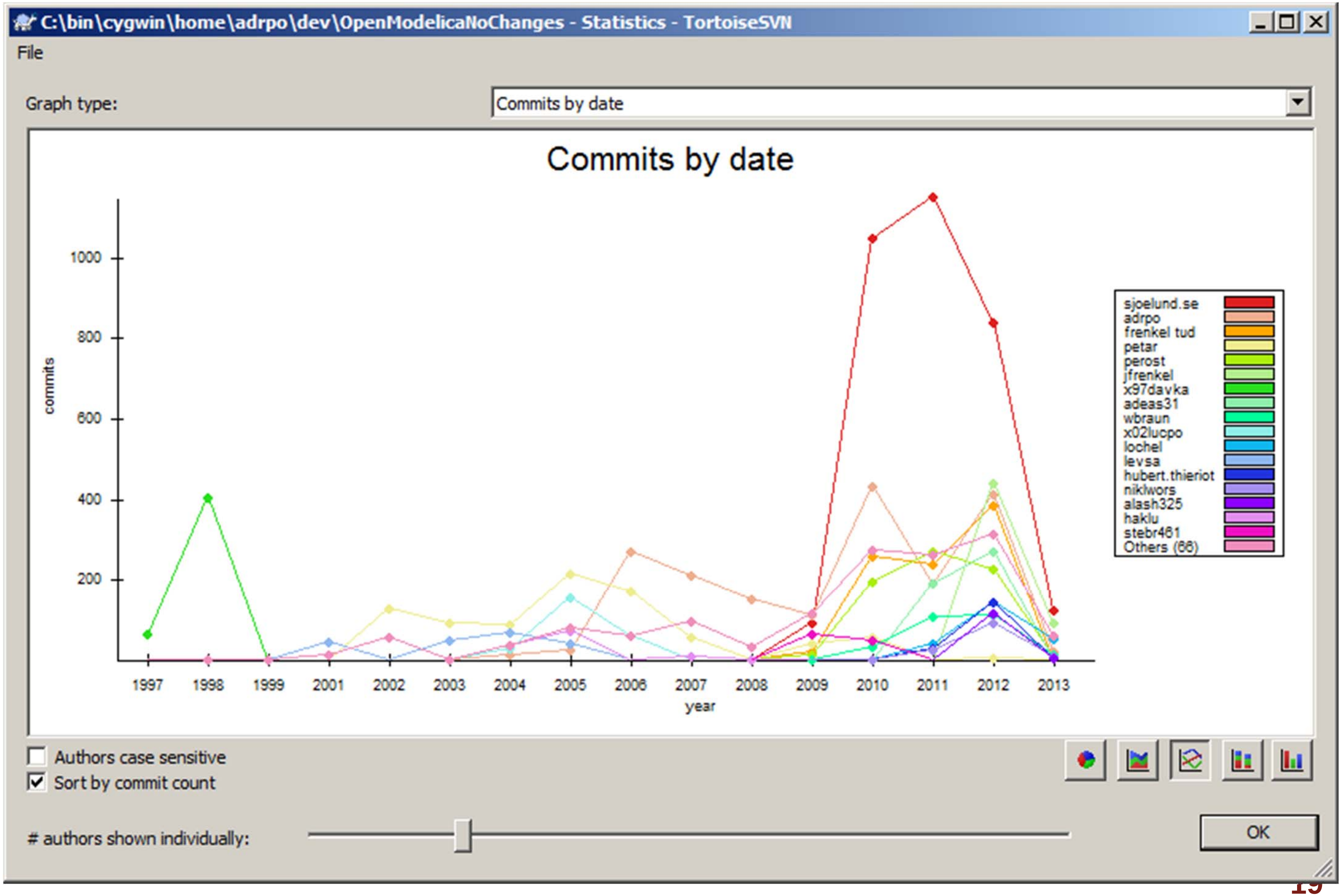
Graph type: Commits by author

☐ Authors case sensitive

☑ Sort by commit count

authors shown individually:

OpenModelica Statistics (III)



C:\bin\cygwin\home\adrpo\dev\OpenModelicaNoChanges - Statistics - TortoiseSVN

File

Graph type: Commits by date

□ Authors case sensitive

☑ Sort by commit count

authors shown individually:

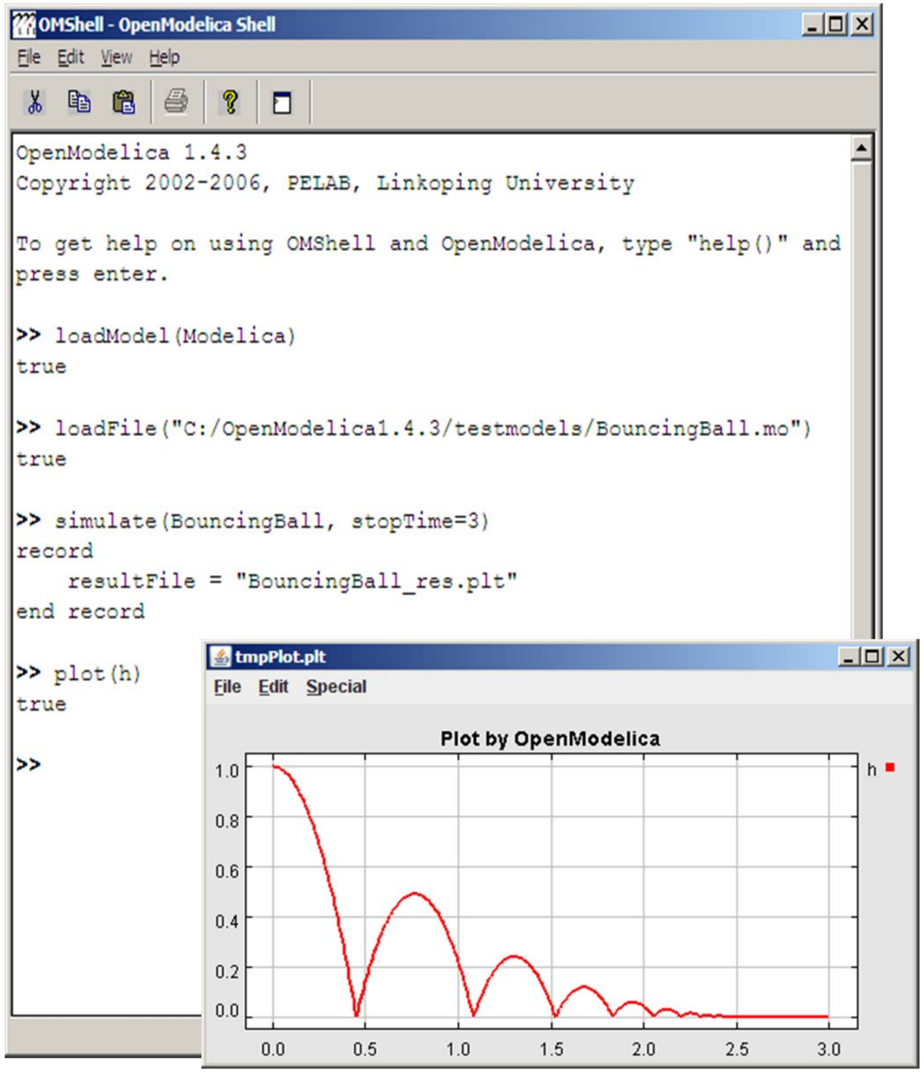
OK

Outline

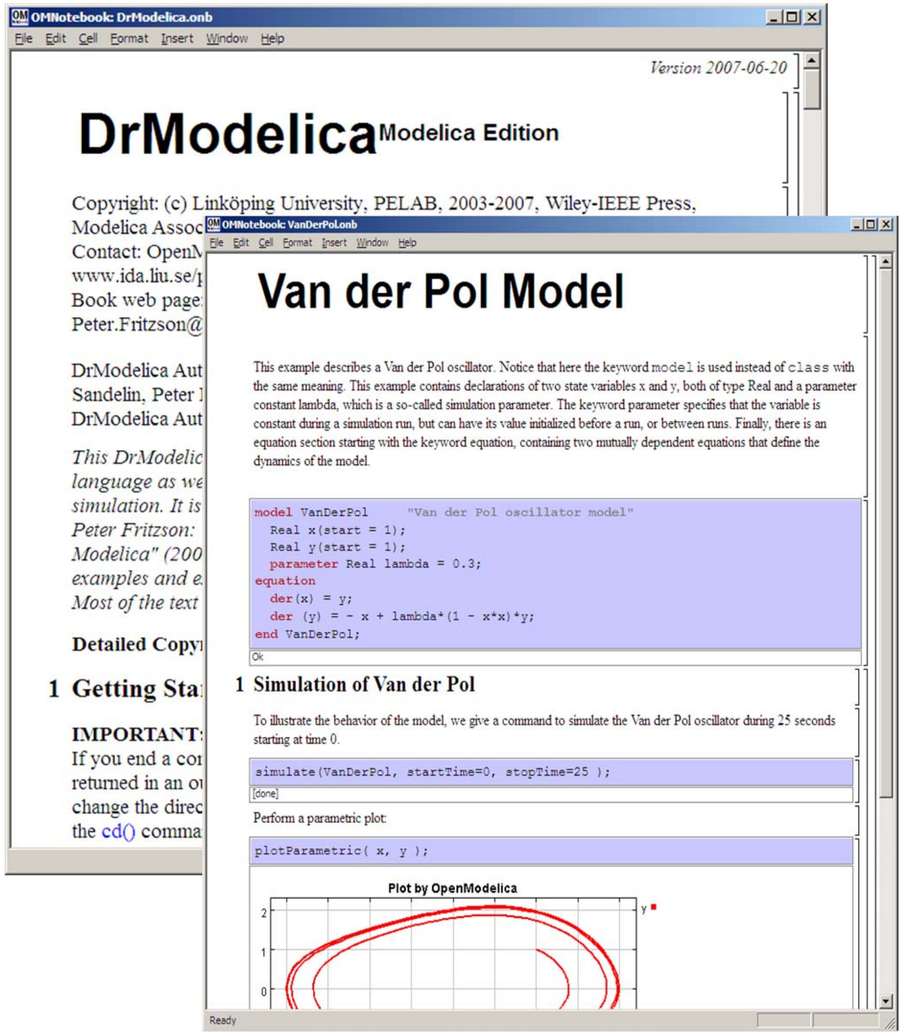
- OpenModelica
  - What is OpenModelica?
  - The past and present
- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook,
  - OMEdit, ModelicaML, SimForge
- OpenModelica Development Environment
  - MetaModelica (RML/OMC)
  - The Eclipse Environment
- OpenModelica Latest Developments (2011-2012)

OMShell & OMNotebook

- Demo?



```
OpenModelica 1.4.3
Copyright 2002-2006, PELAB, Linkoping University

To get help on using OMShell and OpenModelica, type "help()" and
press enter.

>> loadModel(Modelica)
true

>> loadFile("C:/OpenModelica1.4.3/testmodels/BouncingBall.mo")
true

>> simulate(BouncingBall, stopTime=3)
record
    resultFile = "BouncingBall_res.plt"
end record

>> plot(h)
true

>>
```



OMNotebook: DrModelica.onb
File Edit Cell Format Insert Window Help

Version 2007-06-20

DrModelica Modelica Edition

Copyright: (c) Linköping University, PELAB, 2003-2007, Wiley-IEEE Press,
Modelica Assoc
Contact: OpenM
www.ida.liu.se/p
Book web page:
Peter.Fritzson@

DrModelica Aut
Sandelin, Peter I
DrModelica Aut

This DrModelic
language as we
simulation. It is
Peter Fritzson:
Modelica" (200
examples and e
Most of the text

Detailed Copyr

1 Getting Sta

IMPORTANT:
If you end a cor
returned in an ou
change the direc
the cd() comma

OMNotebook: VanDerPol.onb
File Edit Cell Format Insert Window Help

Van der Pol Model

This example describes a Van der Pol oscillator. Notice that here the keyword `model` is used instead of `class` with the same meaning. This example contains declarations of two state variables x and y, both of type Real and a parameter constant lambda, which is a so-called simulation parameter. The keyword parameter specifies that the variable is constant during a simulation run, but can have its value initialized before a run, or between runs. Finally, there is an equation section starting with the keyword equation, containing two mutually dependent equations that define the dynamics of the model.

```
model VanDerPol     "Van der Pol oscillator model"
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
equation
  der(x) = y;
  der (y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;
```

Ok

1 Simulation of Van der Pol

To illustrate the behavior of the model, we give a command to simulate the Van der Pol oscillator during 25 seconds starting at time 0.

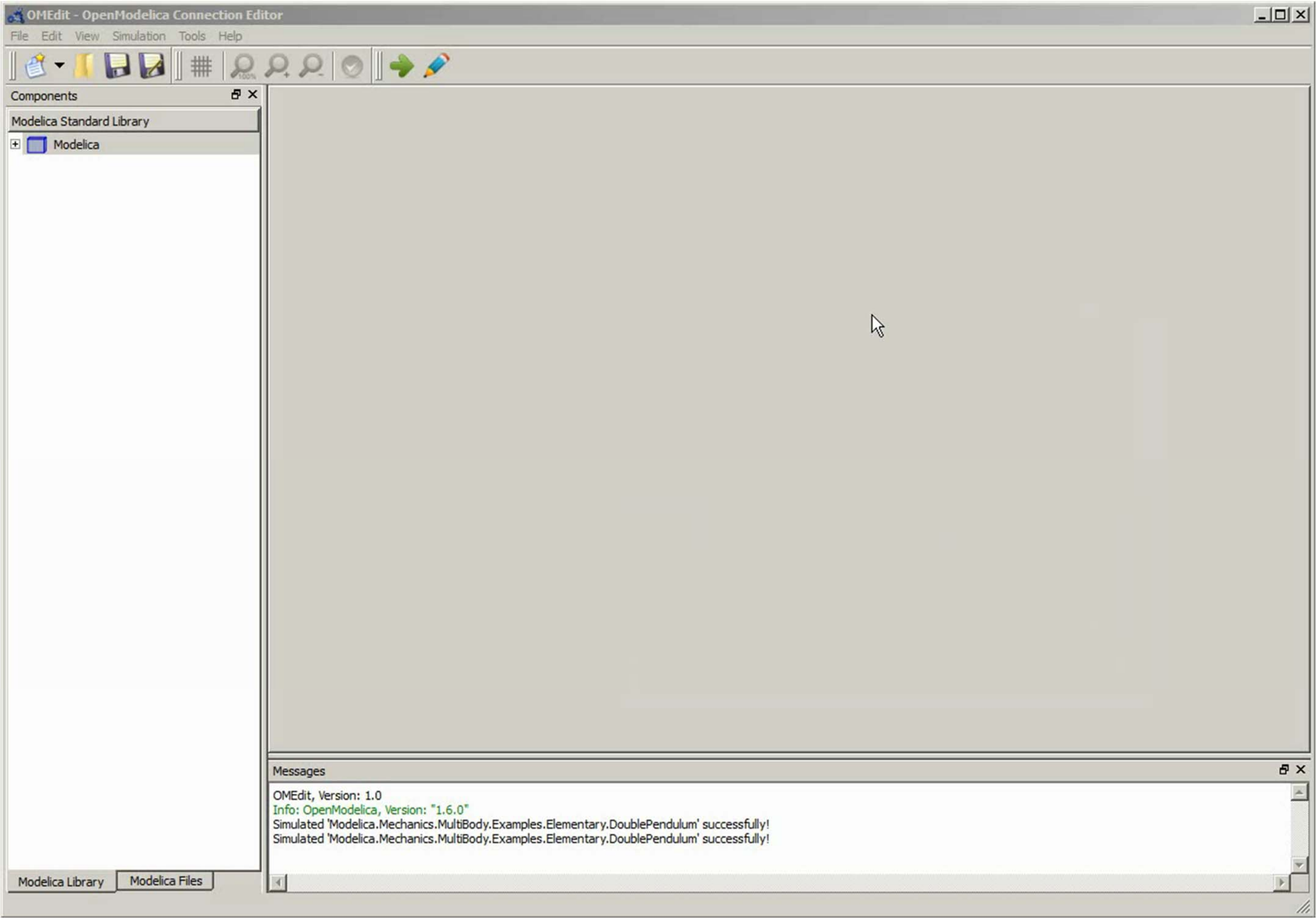
```
simulate(VanDerPol, startTime=0, stopTime=25 );
```

[done]

Perform a parametric plot:

```
plotParametric( x, y );
```

OMEdit - Demo? Maybe a movie!

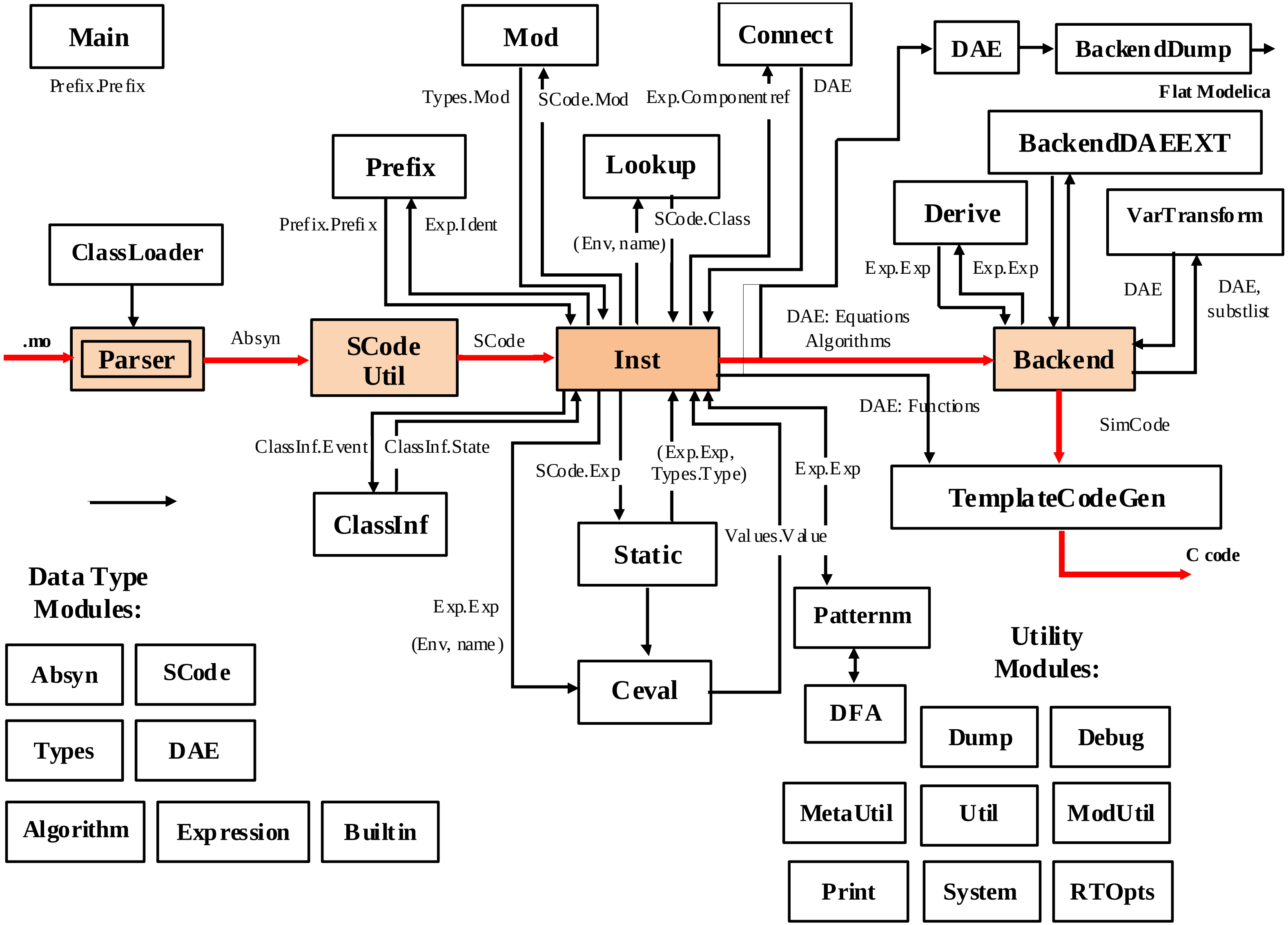


OMEdit - OpenModelica Connection Editor
File Edit View Simulation Tools Help
Components
Modelica Standard Library
Modelica
Messages
Modelica Library
Modelica Files

```
OMEdit, Version: 1.0
Info: OpenModelica, Version: "1.6.0"
Simulated 'Modelica.Mechanics.MultiBody.Examples.Elementary.DoublePendulum' successfully!
Simulated 'Modelica.Mechanics.MultiBody.Examples.Elementary.DoublePendulum' successfully!
```

The OMC Compiler

- Implemented mainly in MetaModelica and C/C++
- The compiler has 230 packages



Modelica->AST->SCode->DAE->C Code

```
// Parse the file and get an AST back
ast = Parse.parse(modelicaFile);


// Elaborate the file
scode = SCode.elaborate(ast);


// flatten the simplified code
(cache, dae1) = Inst.instantiate(Env.emptyCache, scode);


// Call the function that optimizes the DAE
optimizeDae(scode, ast, dae, dae, lastClassName);
```

Outline

- OpenModelica
  - What is OpenModelica?
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- OpenModelica Technical Overview
  - OMC, OMShell, OMNotebook
  - OMEdit, ModelicaML, SimForge
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  - MetaModelica
  - The Eclipse Environment
- OpenModelica Latest Developments (2011-2012)

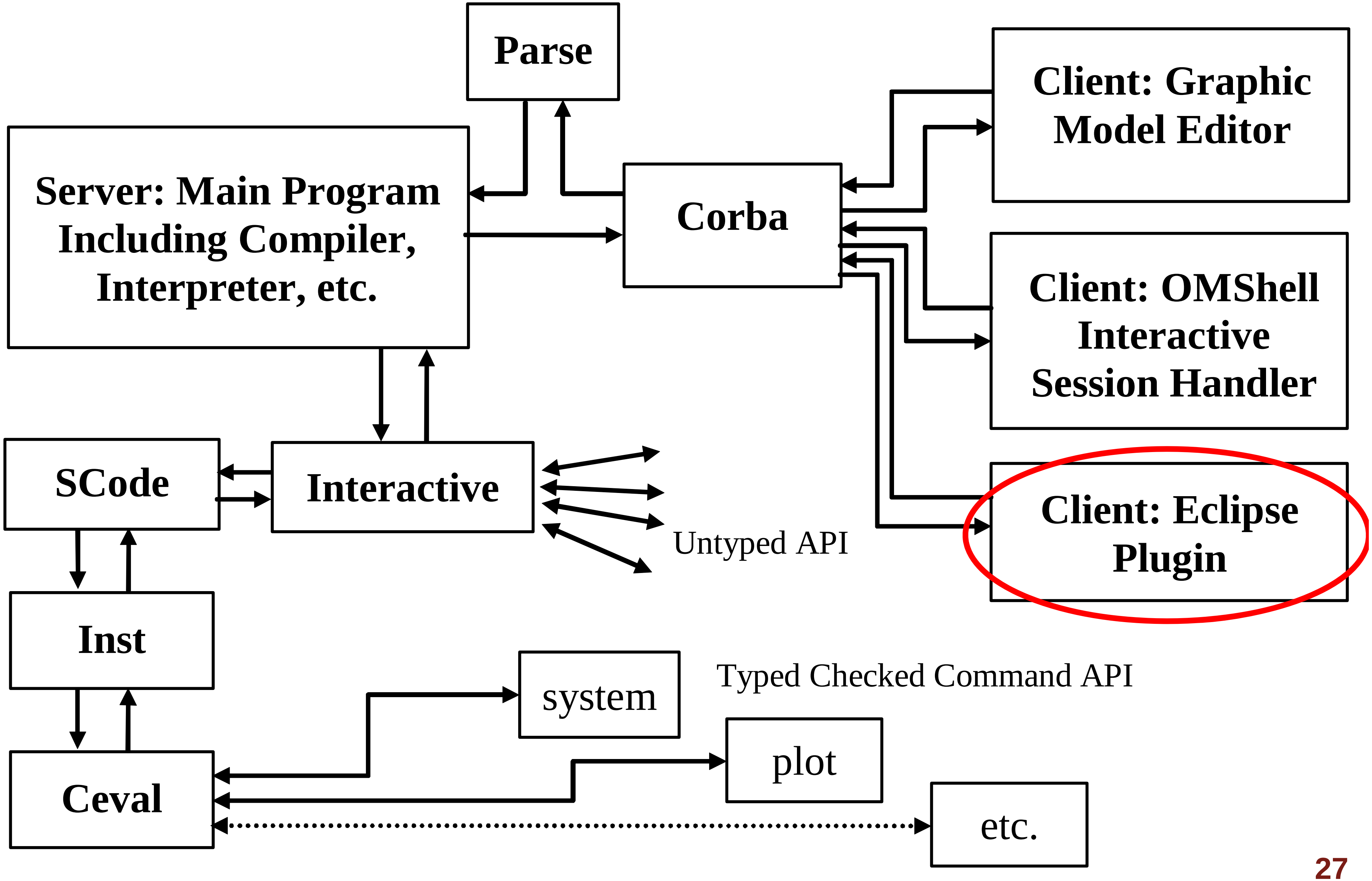
MetaModelica

- OMC
  - Implemented mainly in MetaModelica and C/C++

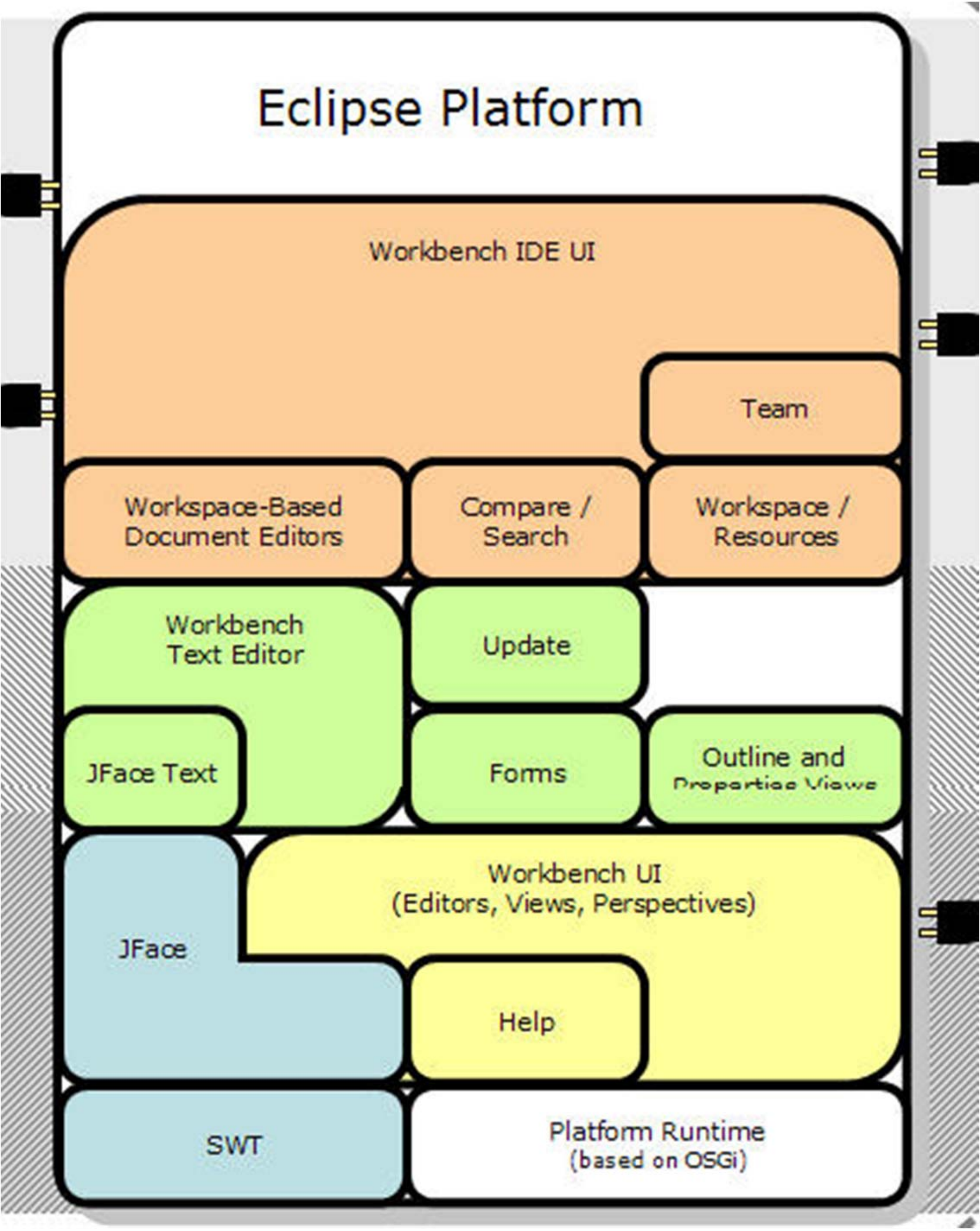
- Modelica
  - classes, models, records, functions, packages
  - behavior is defined by equations or/and functions
  - equations
    - differential algebraic equations and conditional equations

- MetaModelica extensions
  - local equations
  - pattern equations
  - match expressions
  - high-level data structures: lists, tuples, option and uniontypes

OpenModelica Context


Parse
Server: Main Program Including Compiler, Interpreter, etc.
Corba
Client: Graphic Model Editor
Client: OMShell Interactive Session Handler
Client: Eclipse Plugin
SCode
Interactive
Untyped API
Inst
Ceval
system
Typed Checked Command API
plot
etc.

The MDT Eclipse Environment (I)


Eclipse Platform
Workbench IDE UI
Team
Workspace-Based Document Editors
Compare / Search
Workspace / Resources
Workbench Text Editor
Update
JFace Text
Forms
Outline and Properties Views
Workbench UI (Editors, Views, Perspectives)
JFace
Help
SWT
Platform Runtime (based on OSGi)

Modelica Browser

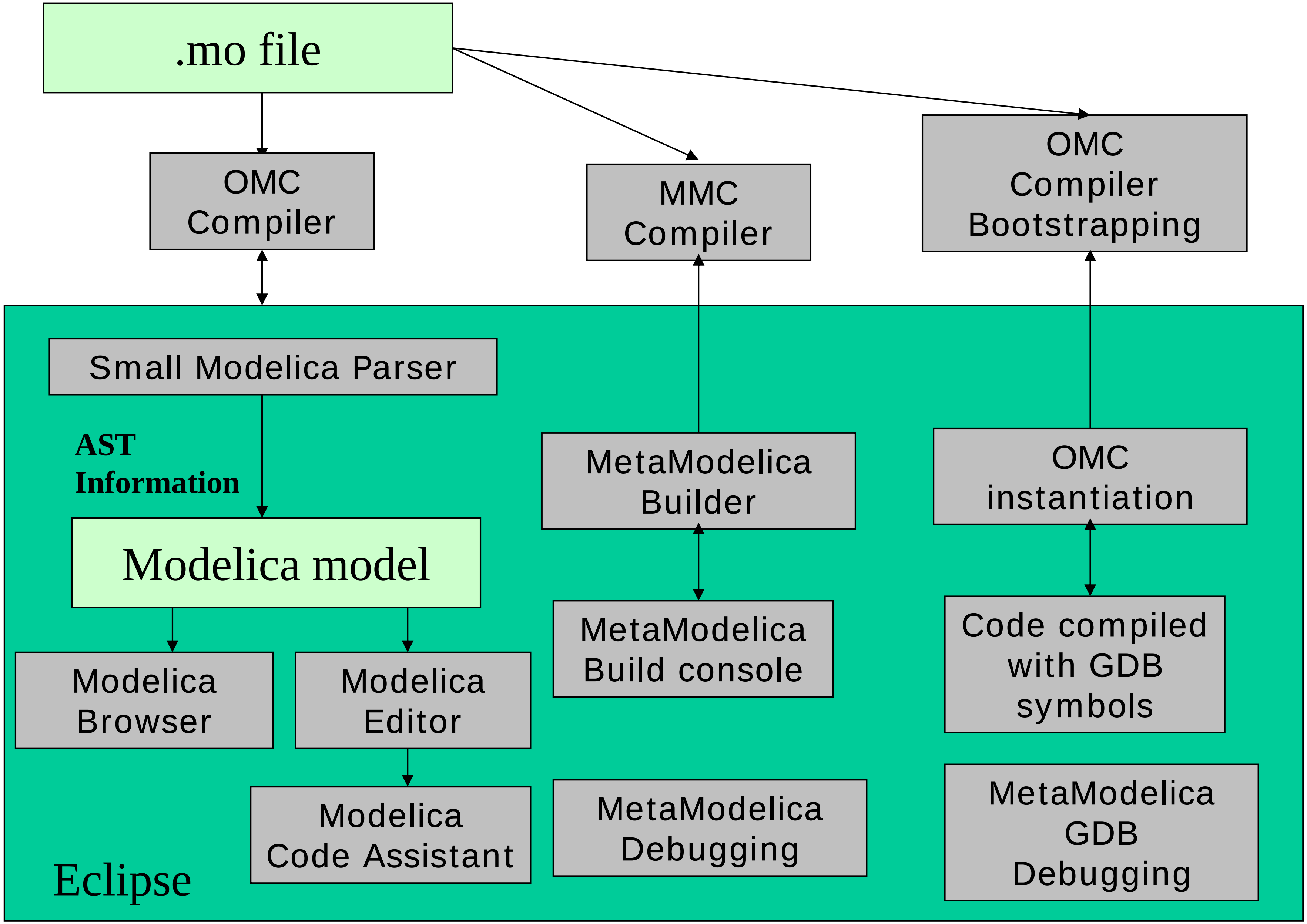
Modelica Editor

Modelica Code Assistant

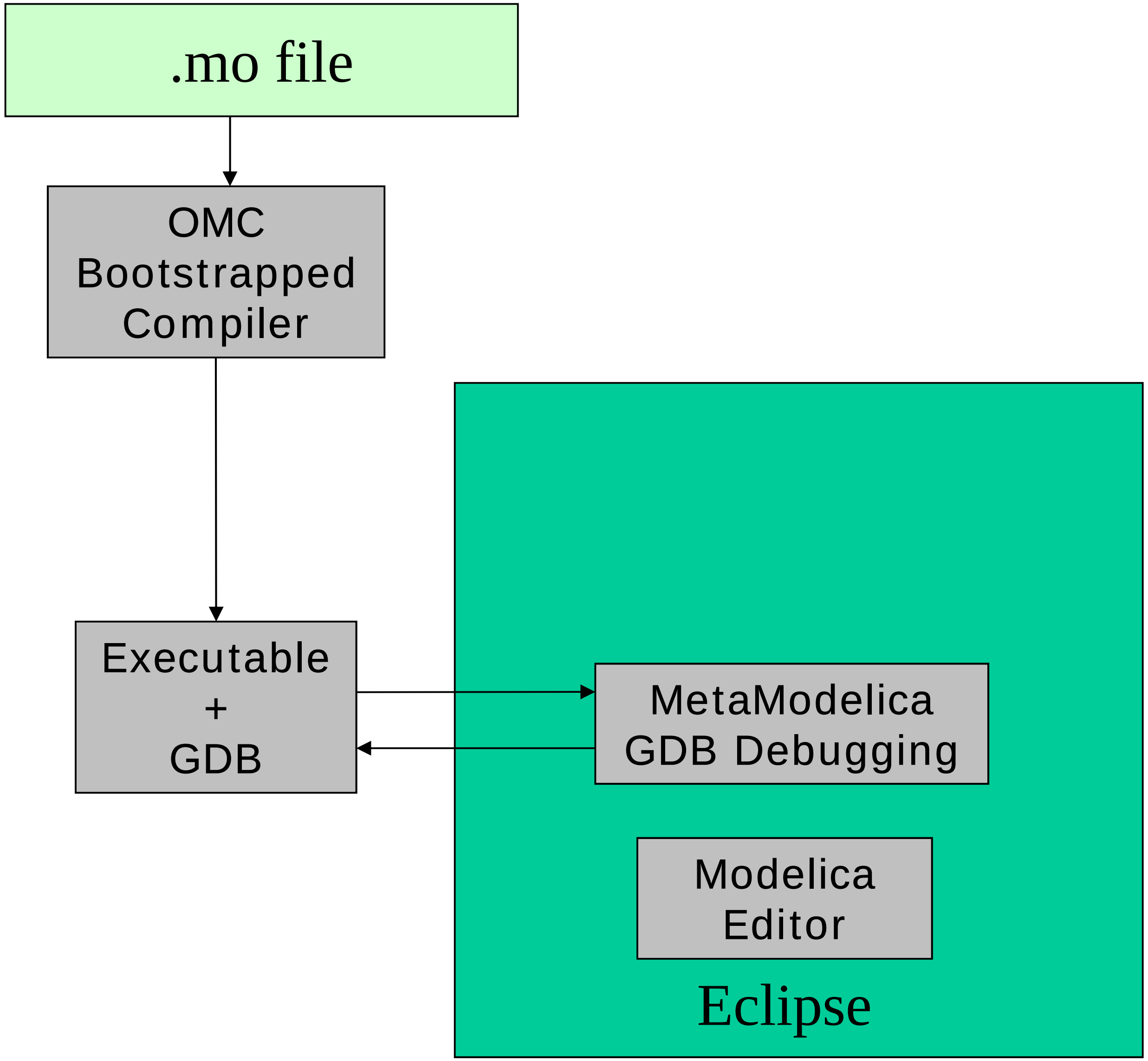
MetaModelica Debugging

Modelica Perspective

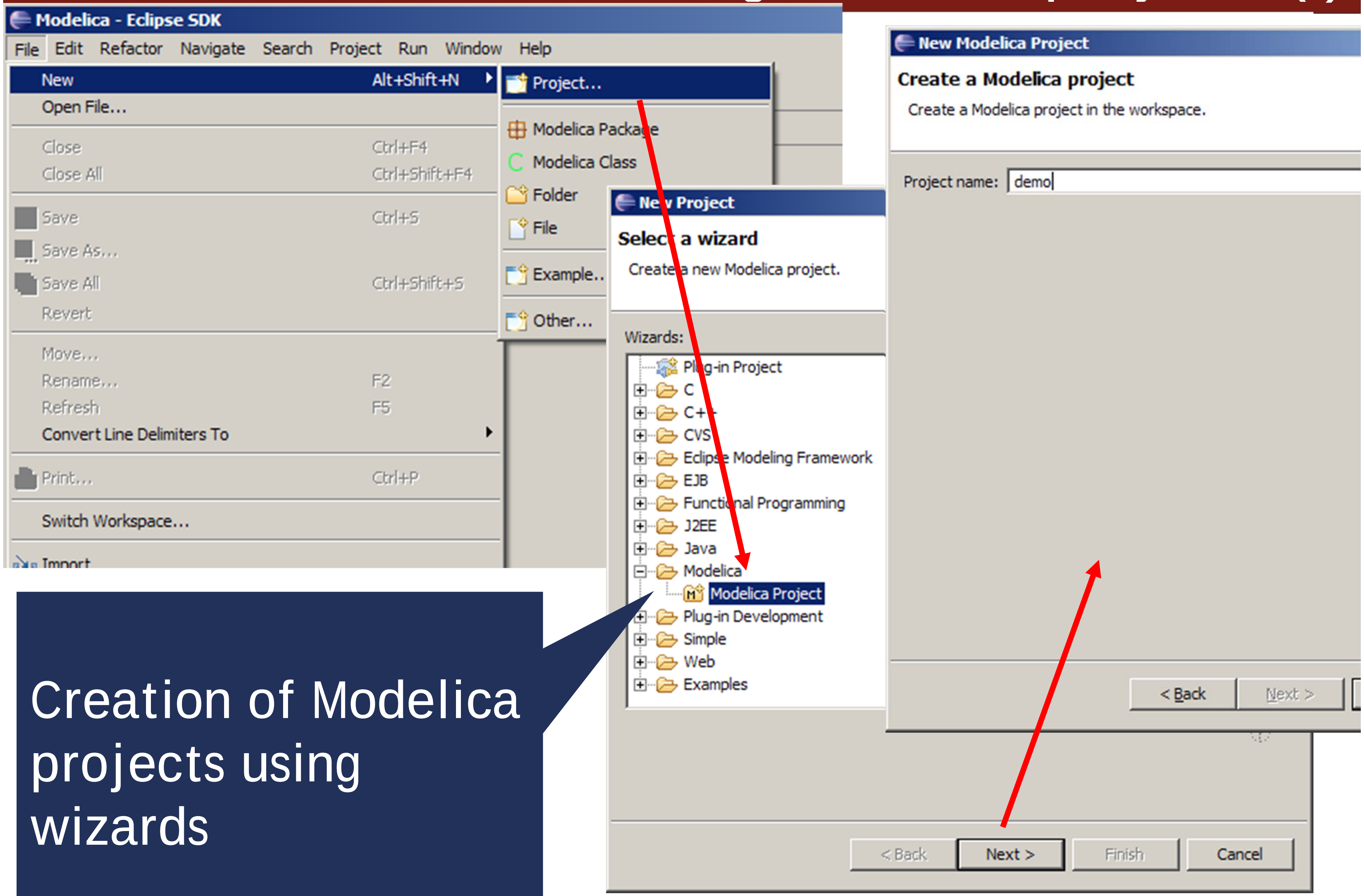
The MDT Eclipse Environment (II)



The MDT Eclipse Environment (III)



Creating Modelica projects (I)



Select a wizard

Create a new Modelica project.

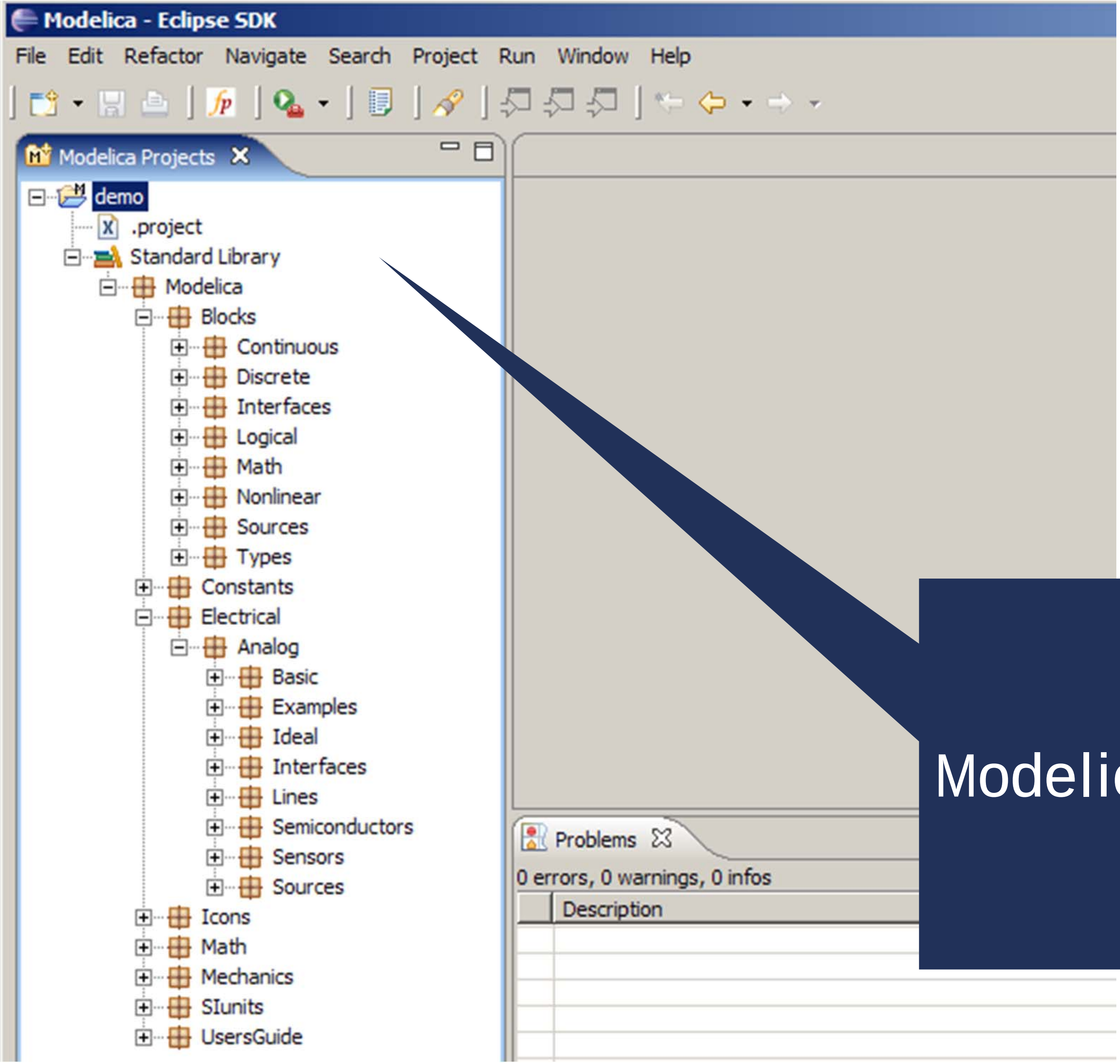
Create a Modelica project

Create a Modelica project in the workspace.

Project name: demo

Creation of Modelica projects using wizards

Creating Modelica projects (II)

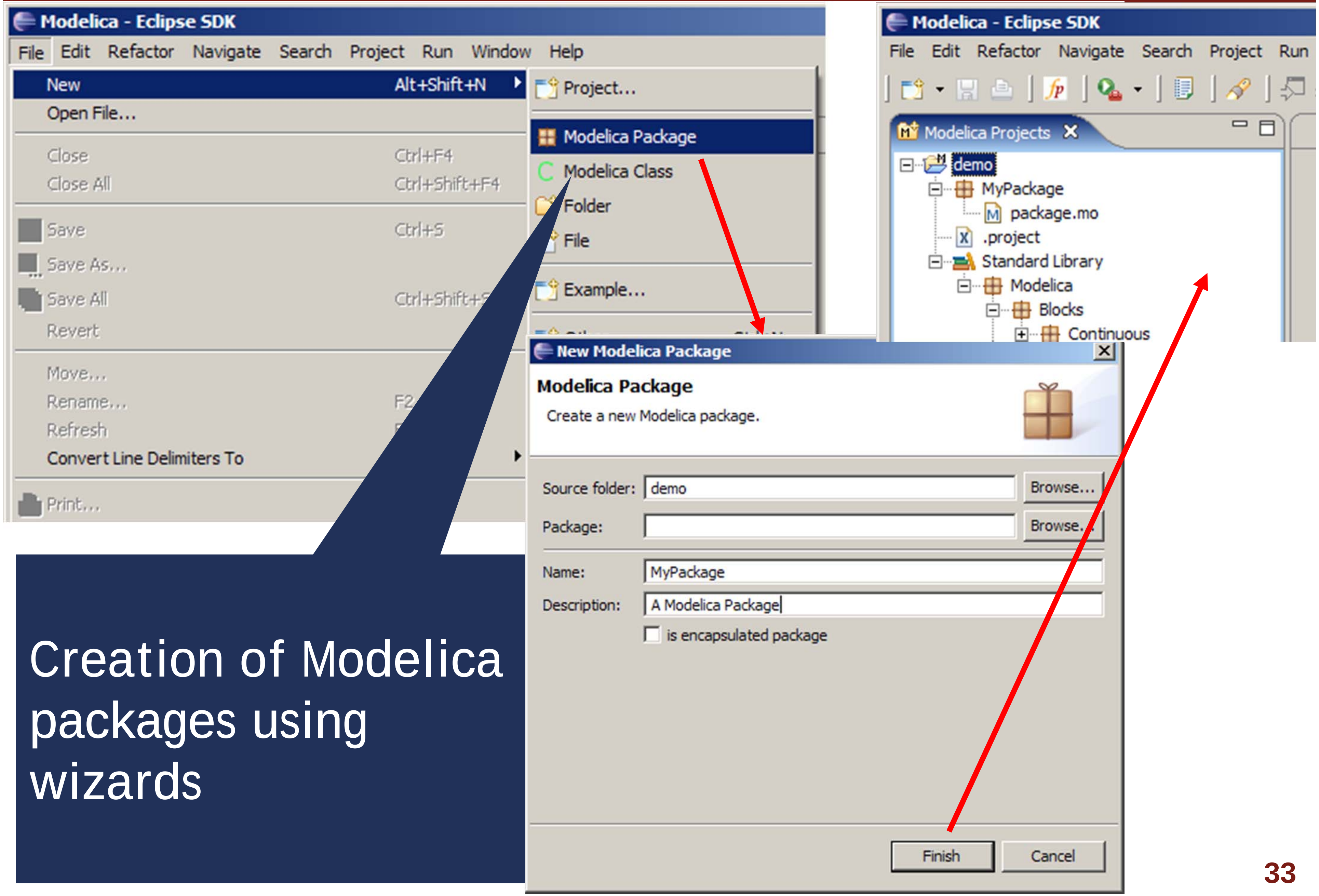


```
demo
    .project
    Standard Library
        Modelica
            Blocks
                Continuous
                Discrete
                Interfaces
                Logical
                Math
                Nonlinear
                Sources
                Types
            Constants
            Electrical
                Analog
                    Basic
                    Examples
                    Ideal
                    Interfaces
                    Lines
                    Semiconductors
                    Sensors
                    Sources
            Icons
            Math
            Mechanics
            SIunits
            UsersGuide
```

0 errors, 0 warnings, 0 infos

Modelica project

Creating Modelica packages



New Modelica Package

Modelica Package

Create a new Modelica package.

Source folder: demo

Package:

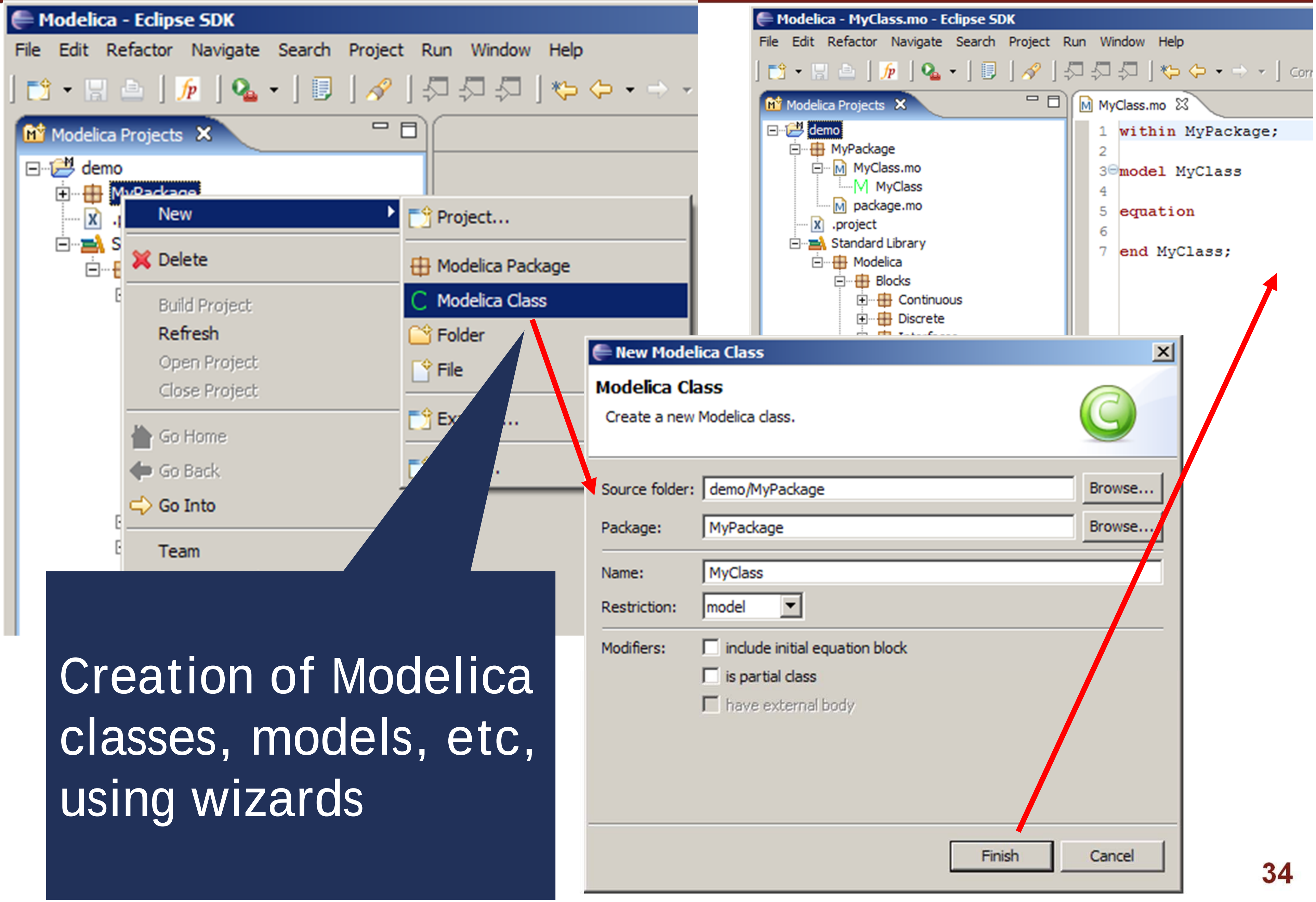
Name: MyPackage

Description: A Modelica Package

☐ is encapsulated package

Creation of Modelica packages using wizards

Creating Modelica classes



Modelica Class

Create a new Modelica class.

Source folder: demo/MyPackage

Package: MyPackage

Name: MyClass

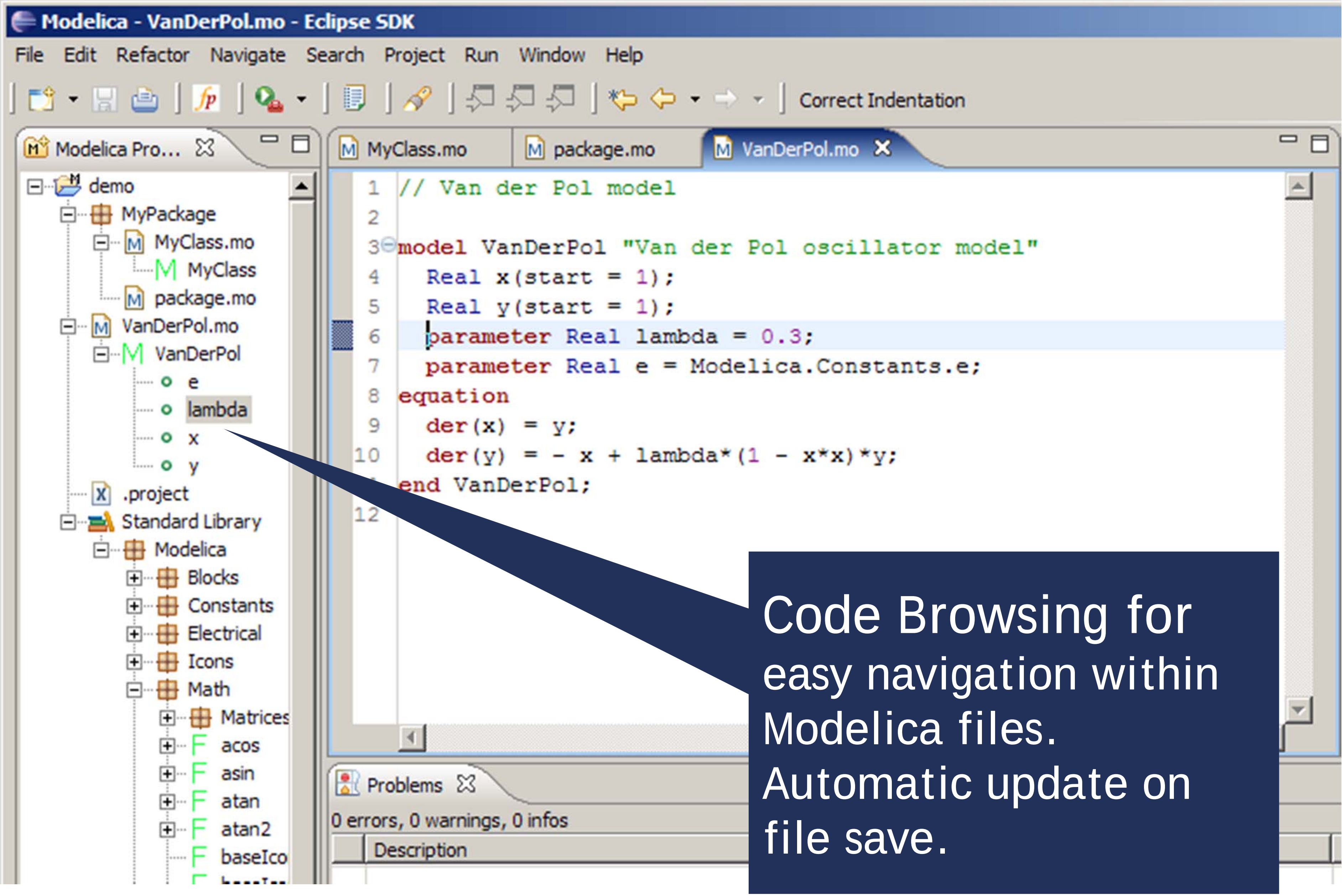
Restriction: model

Modifiers:
- □ include initial equation block
- □ is partial class
- □ have external body

```
within MyPackage;

model MyClass

equation

end MyClass;
```

Creation of Modelica classes, models, etc, using wizards

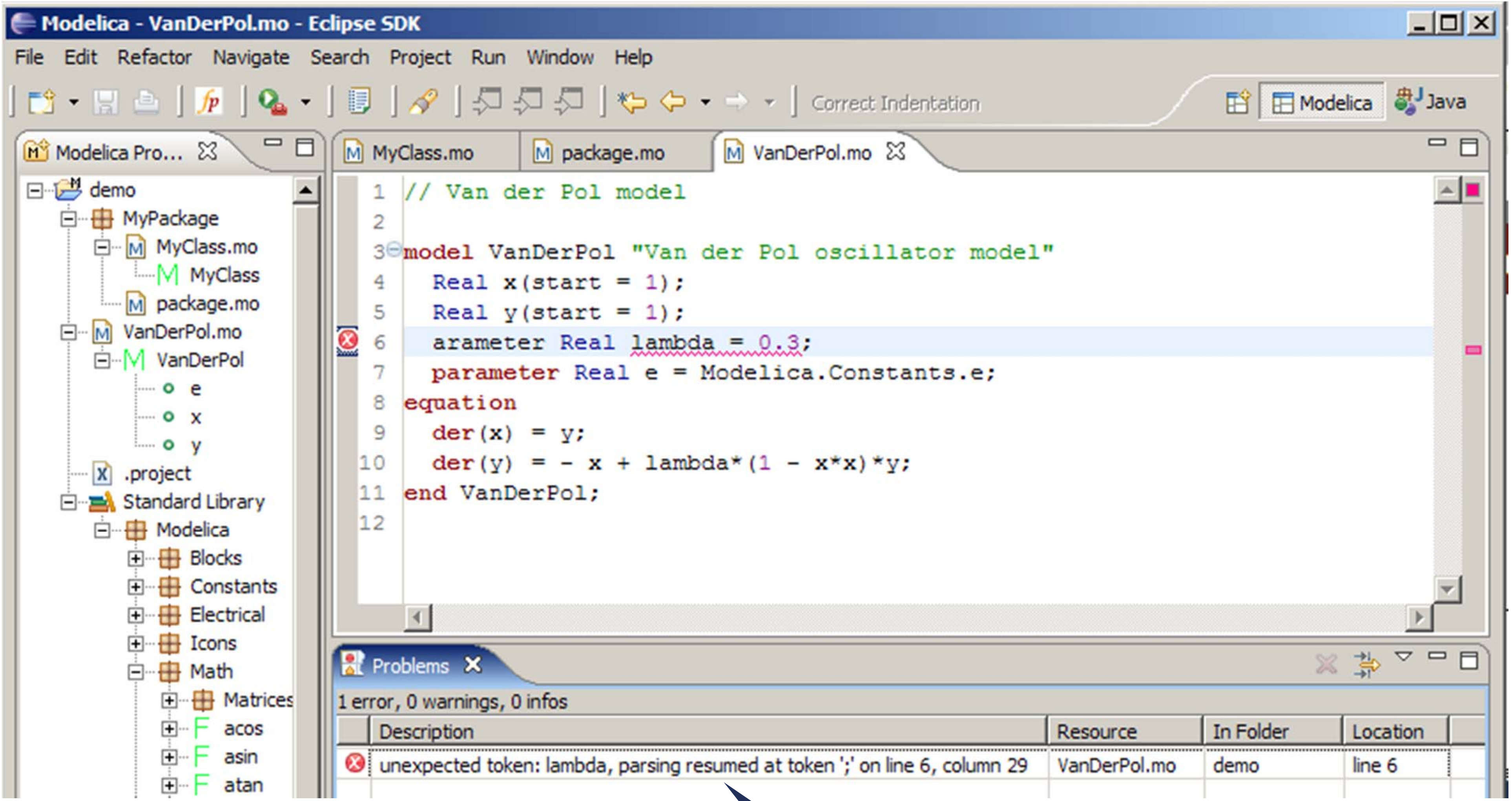
Code browsing



```
// Van der Pol model

model VanDerPol "Van der Pol oscillator model"
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
  parameter Real e = Modelica.Constants.e;
equation
  der(x) = y;
  der(y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;
```

Code Browsing for easy navigation within Modelica files. Automatic update on file save.

Error detection (I)



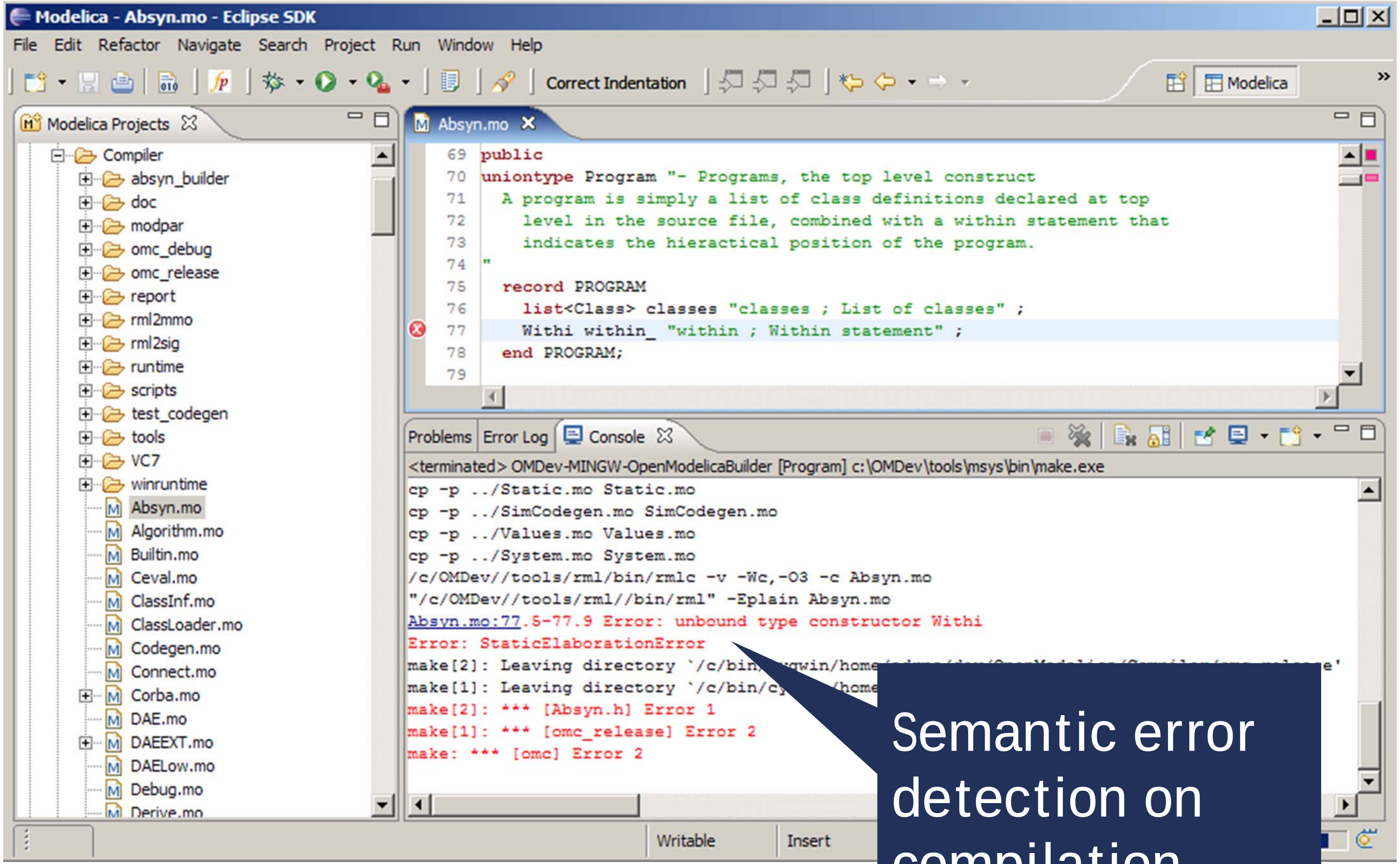
```
// Van der Pol model

model VanDerPol "Van der Pol oscillator model"
  Real x(start = 1);
  Real y(start = 1);
  arameter Real lambda = 0.3;
  parameter Real e = Modelica.Constants.e;
equation
  der(x) = y;
  der(y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;
```

1 error, 0 warnings, 0 infos

Description	Resource	In Folder	Location
unexpected token: lambda, parsing resumed at token ';' on line 6, column 29	VanDerPol.mo	demo	line 6

Parse error detection on file save

Error detection (II)

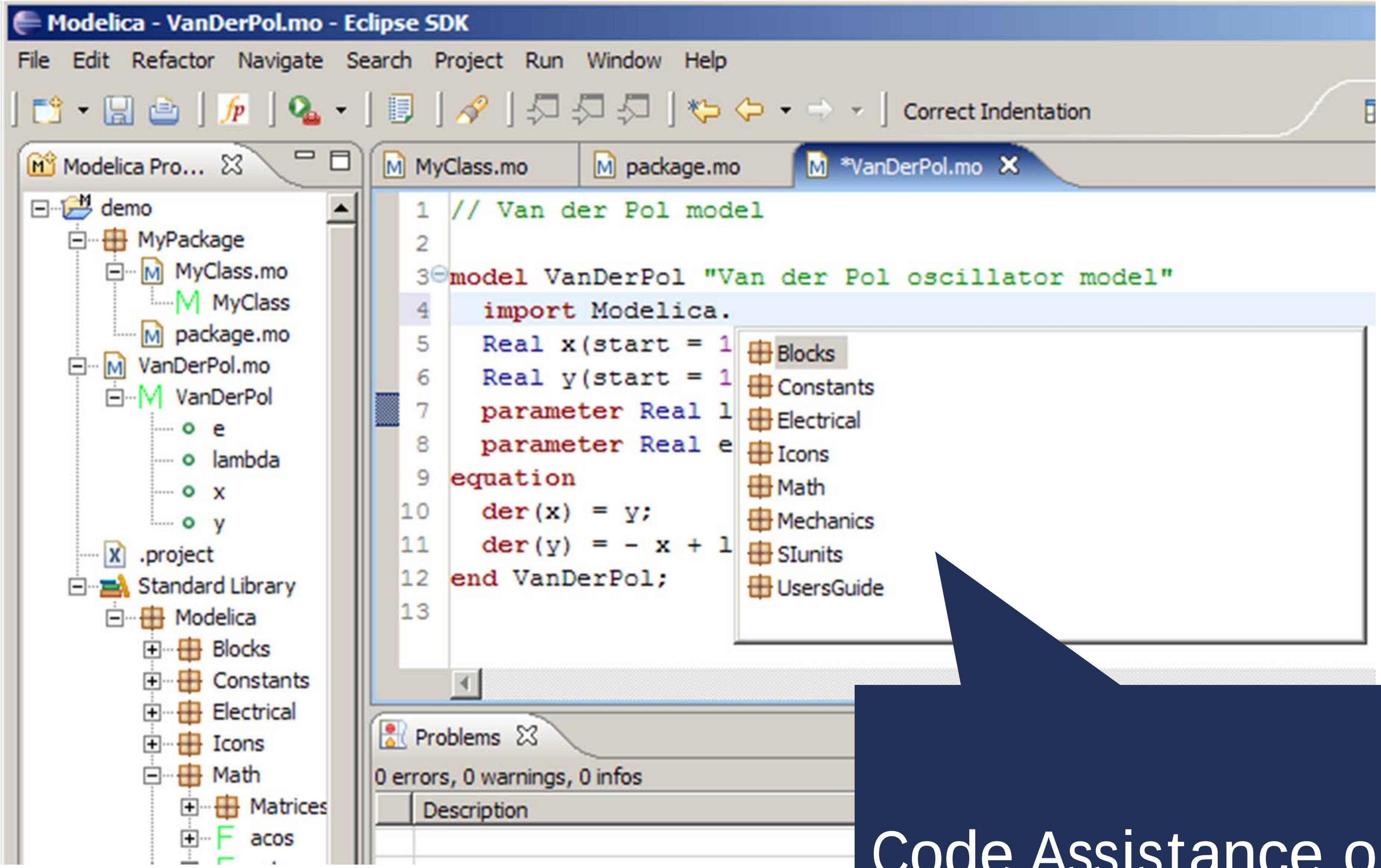


```
69 public
70 uniontype Program "- Programs, the top level construct
71   A program is simply a list of class definitions declared at top
72     level in the source file, combined with a within statement that
73     indicates the hieractical position of the program.
74 "
75   record PROGRAM
76     list<Class> classes "classes ; List of classes" ;
77     Withi within_ "within ; Within statement" ;
78   end PROGRAM;
79
```

```
<terminated> OMDev-MINGW-OpenModelicaBuilder [Program] c:\OMDev\tools\msys\bin\make.exe
cp -p ../Static.mo Static.mo
cp -p ../SimCodegen.mo SimCodegen.mo
cp -p ../Values.mo Values.mo
cp -p ../System.mo System.mo
/c/OMDev//tools/rml/bin/rmlc -v -Wc,-O3 -c Absyn.mo
"/c/OMDev//tools/rml//bin/rml" -Eplain Absyn.mo
Absyn.mo:77.5-77.9 Error: unbound type constructor Withi
Error: StaticElaborationError
make[2]: Leaving directory `/c/bin
make[1]: Leaving directory `/c/bin/c
make[2]: *** [Absyn.h] Error 1
make[1]: *** [omc_release] Error 2
make: *** [omc] Error 2
```

Semantic error detection on compilation

Code assistance (I)

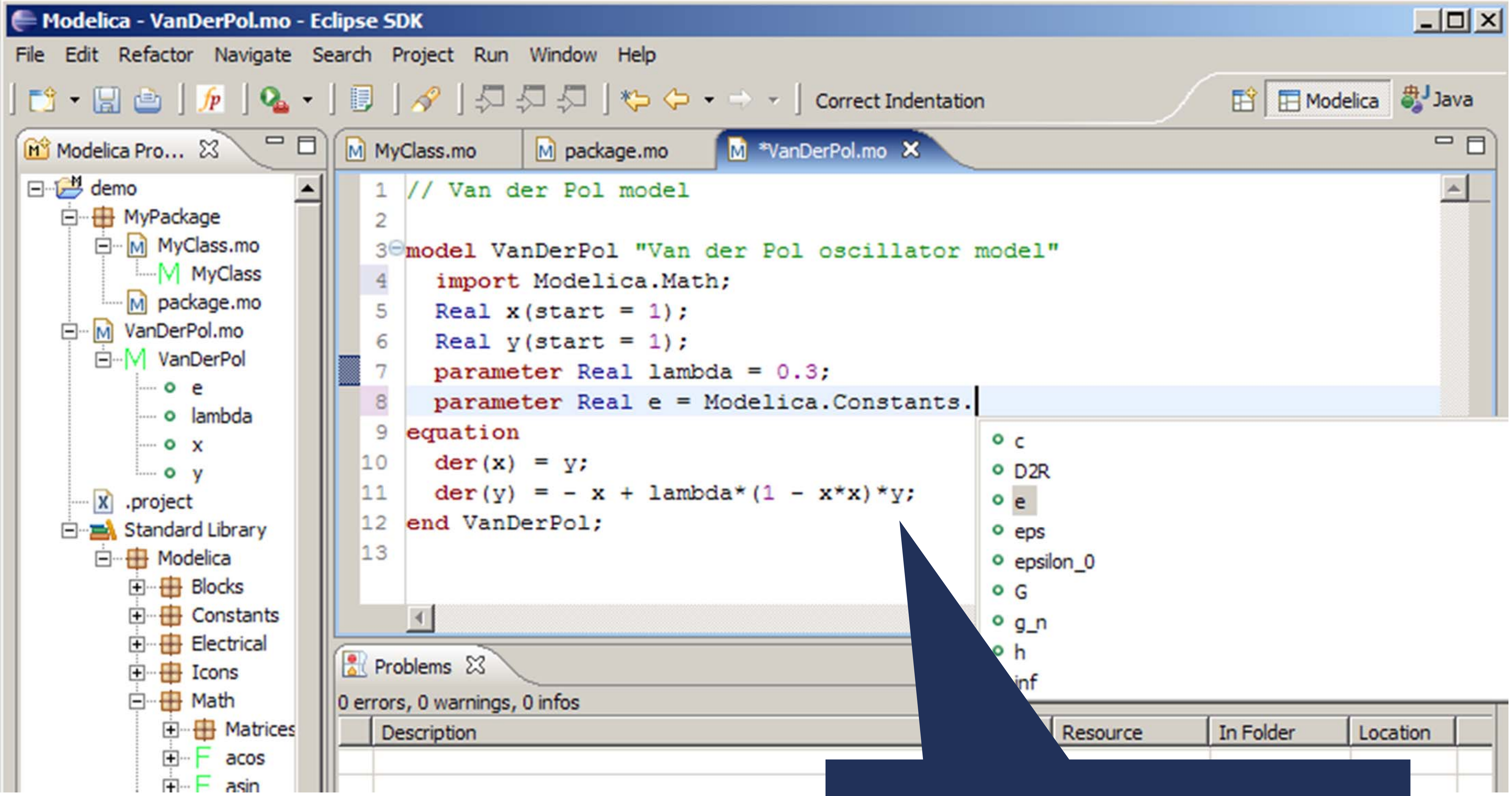


```
// Van der Pol model

model VanDerPol "Van der Pol oscillator model"
  import Modelica.
  Real x(start = 1
  Real y(start = 1
  parameter Real l
  parameter Real e
equation
  der(x) = y;
  der(y) = - x + l
end VanDerPol;
```

0 errors, 0 warnings, 0 infos

Code Assistance on imports

Code assistance (II)

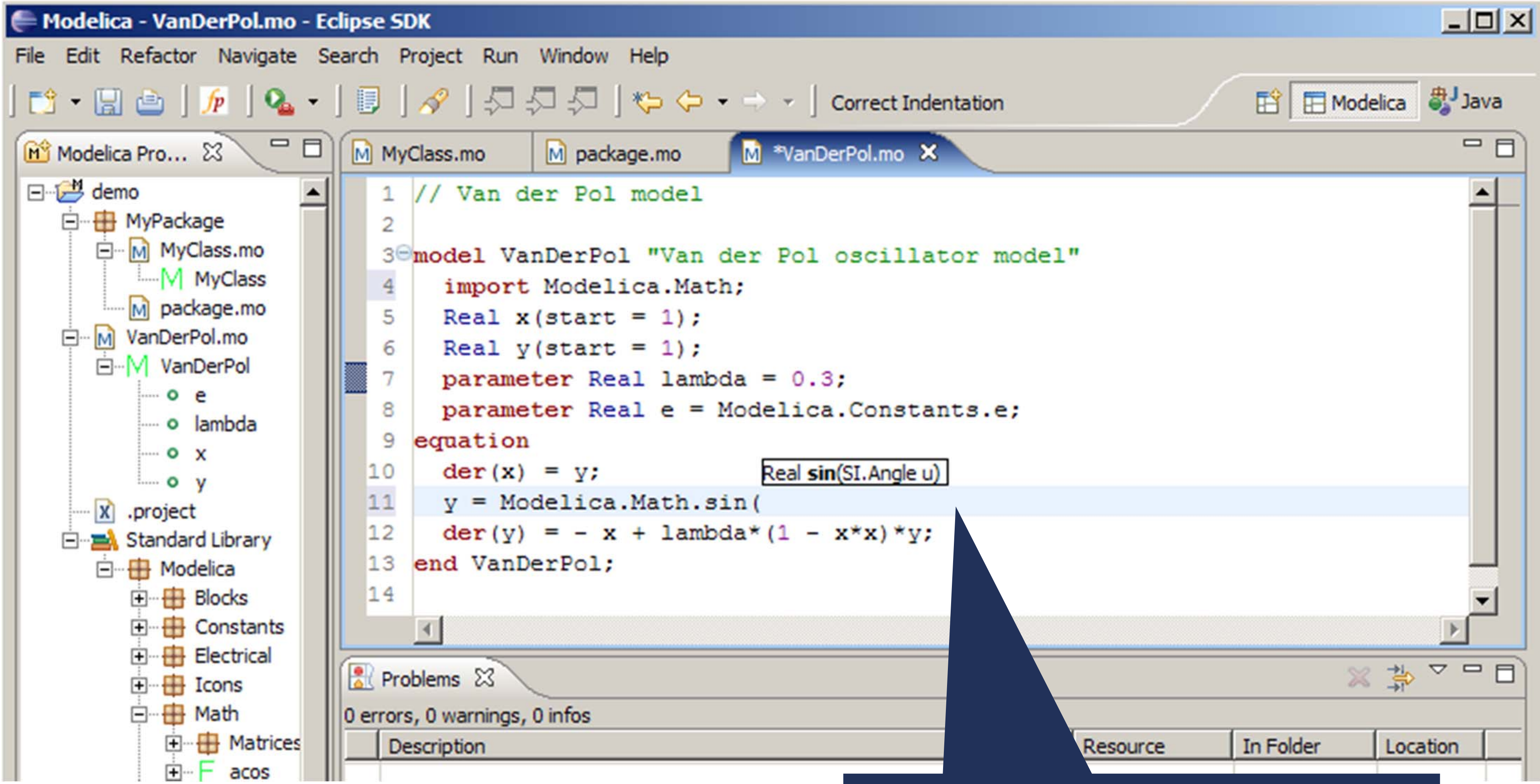


```
// Van der Pol model

model VanDerPol "Van der Pol oscillator model"
  import Modelica.Math;
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
  parameter Real e = Modelica.Constants.
equation
  der(x) = y;
  der(y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;
```

0 errors, 0 warnings, 0 infos

Code Assistance on assignments

Code assistance (III)

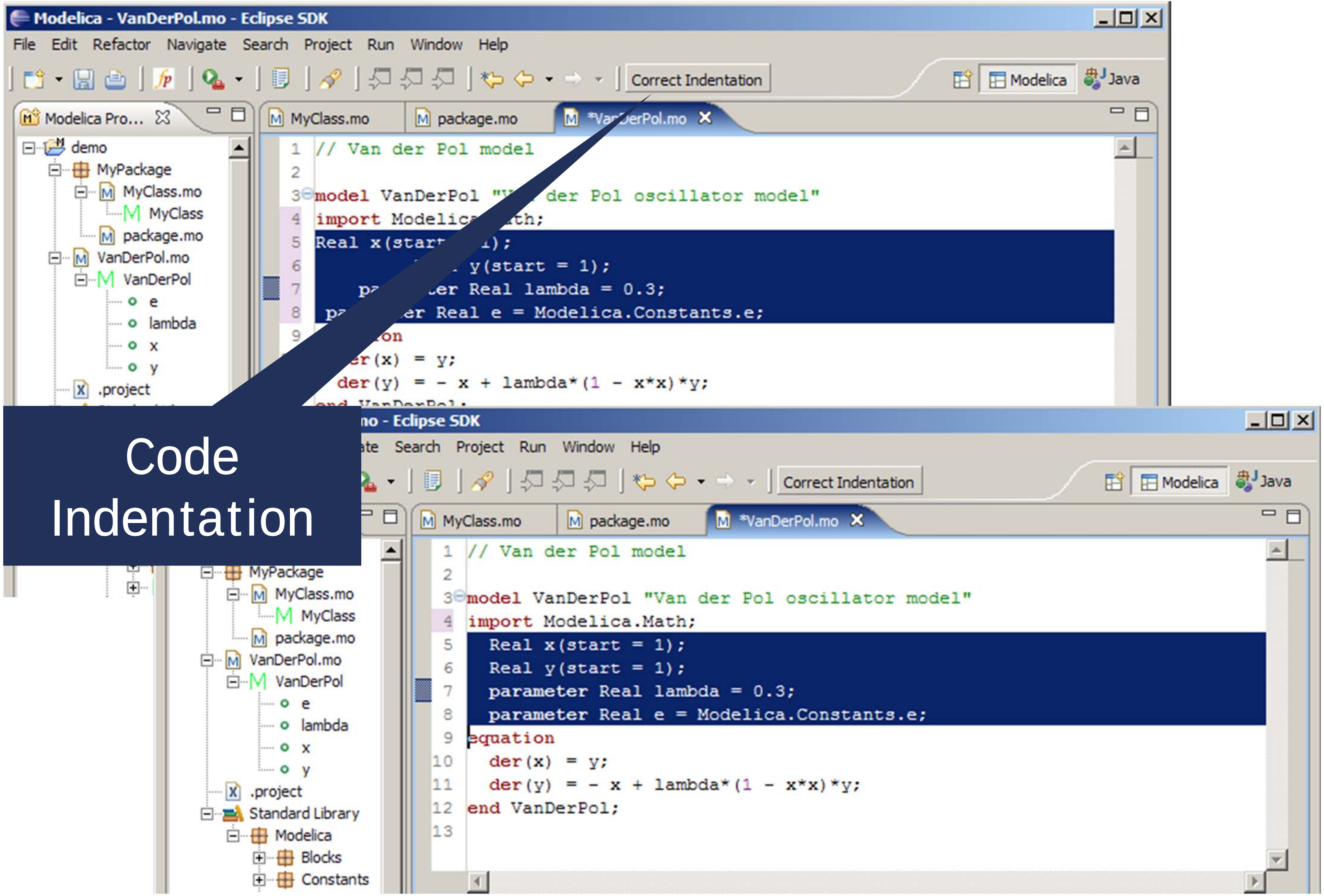


```
// Van der Pol model

model VanDerPol "Van der Pol oscillator model"
  import Modelica.Math;
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
  parameter Real e = Modelica.Constants.e;
equation
  der(x) = y;               Real sin(SI.Angle u)
  y = Modelica.Math.sin(
  der(y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;

```

0 errors, 0 warnings, 0 infos

Code Assistance on function calls

Code indentation

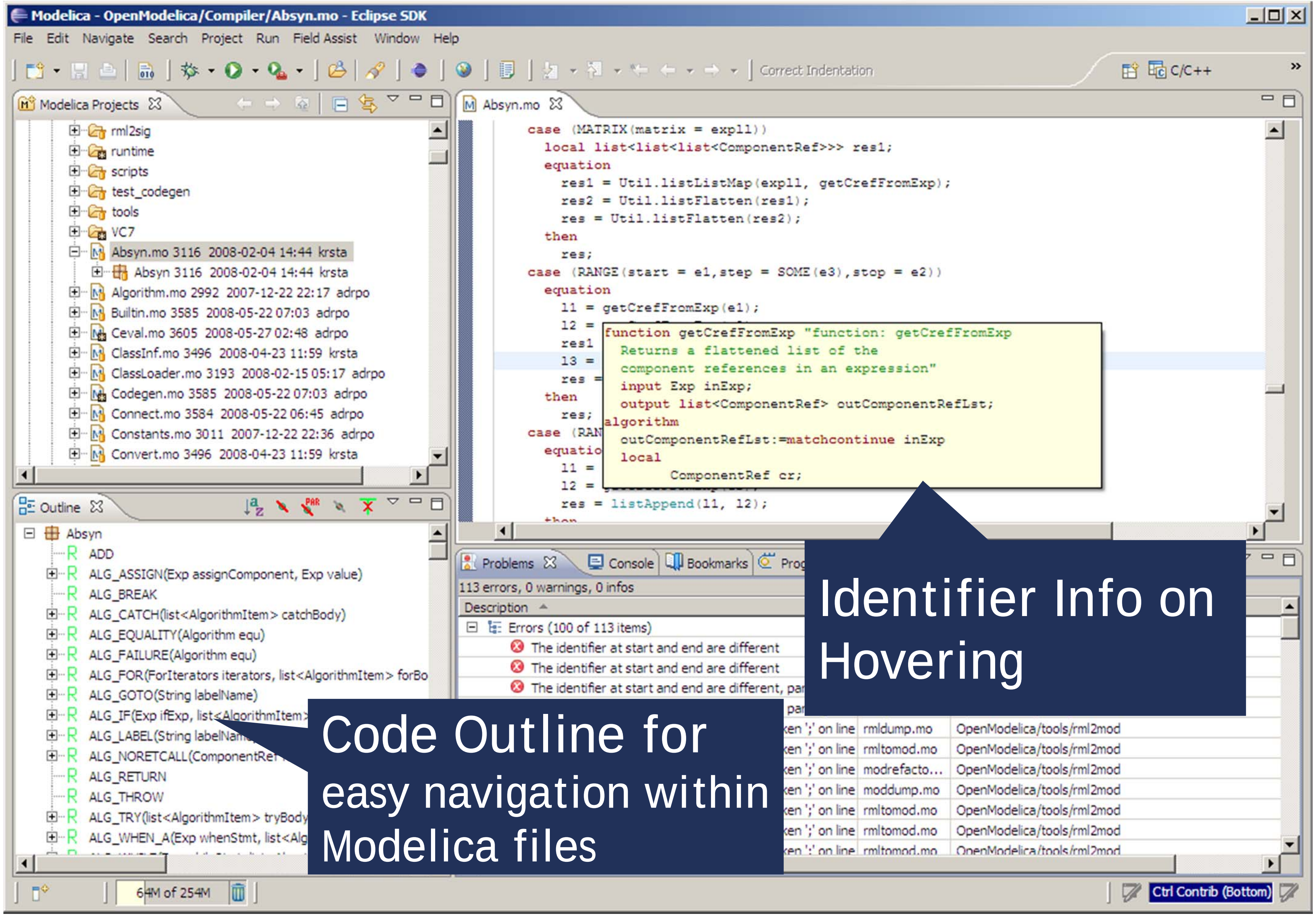


```
// Van der Pol model

model VanDerPol "V    der Pol oscillator model"
import Modelica    th;
Real x(start    1);
           y(start = 1);
    pa    ter Real lambda = 0.3;
 pa    er Real e = Modelica.Constants.e;
        on
   er(x) = y;
  der(y) = - x + lambda*(1 - x*x)*y;
```

Code Indentation

```
// Van der Pol model

model VanDerPol "Van der Pol oscillator model"
import Modelica.Math;
  Real x(start = 1);
  Real y(start = 1);
  parameter Real lambda = 0.3;
  parameter Real e = Modelica.Constants.e;
equation
  der(x) = y;
  der(y) = - x + lambda*(1 - x*x)*y;
end VanDerPol;
```

Code Outline and Hovering Info



Modelica - OpenModelica/Compiler/Absyn.mo - Eclipse SDK

```
rml2sig
runtime
scripts
test_codegen
tools
VC7
Absyn.mo 3116  2008-02-04 14:44  krsta
  Absyn 3116  2008-02-04 14:44  krsta
Algorithm.mo 2992  2007-12-22 22:17  adrpo
Builtin.mo 3585  2008-05-22 07:03  adrpo
Ceval.mo 3605  2008-05-27 02:48  adrpo
ClassInf.mo 3496  2008-04-23 11:59  krsta
ClassLoader.mo 3193  2008-02-15 05:17  adrpo
Codegen.mo 3585  2008-05-22 07:03  adrpo
Connect.mo 3584  2008-05-22 06:45  adrpo
Constants.mo 3011  2007-12-22 22:36  adrpo
Convert.mo 3496  2008-04-23 11:59  krsta
```

```
    case (MATRIX(matrix = expll))
      local list<list<list<ComponentRef>>> res1;
      equation
        res1 = Util.listListMap(expll, getCrefFromExp);
        res2 = Util.listFlatten(res1);
        res = Util.listFlatten(res2);
      then
        res;
    case (RANGE(start = e1,step = SOME(e3),stop = e2))
      equation
        l1 = getCrefFromExp(e1);
        l2 =
        res1
        l3 =
        res =
      then
        res;
    case (RAN
      equatio
        l1 =
        l2 =
        res = listAppend(l1, l2);
```

```
function getCrefFromExp "function: getCrefFromExp
  Returns a flattened list of the
  component references in an expression"
  input Exp inExp;
  output list<ComponentRef> outComponentRefLst;
algorithm
  outComponentRefLst:=matchcontinue inExp
  local
        ComponentRef cr;
```

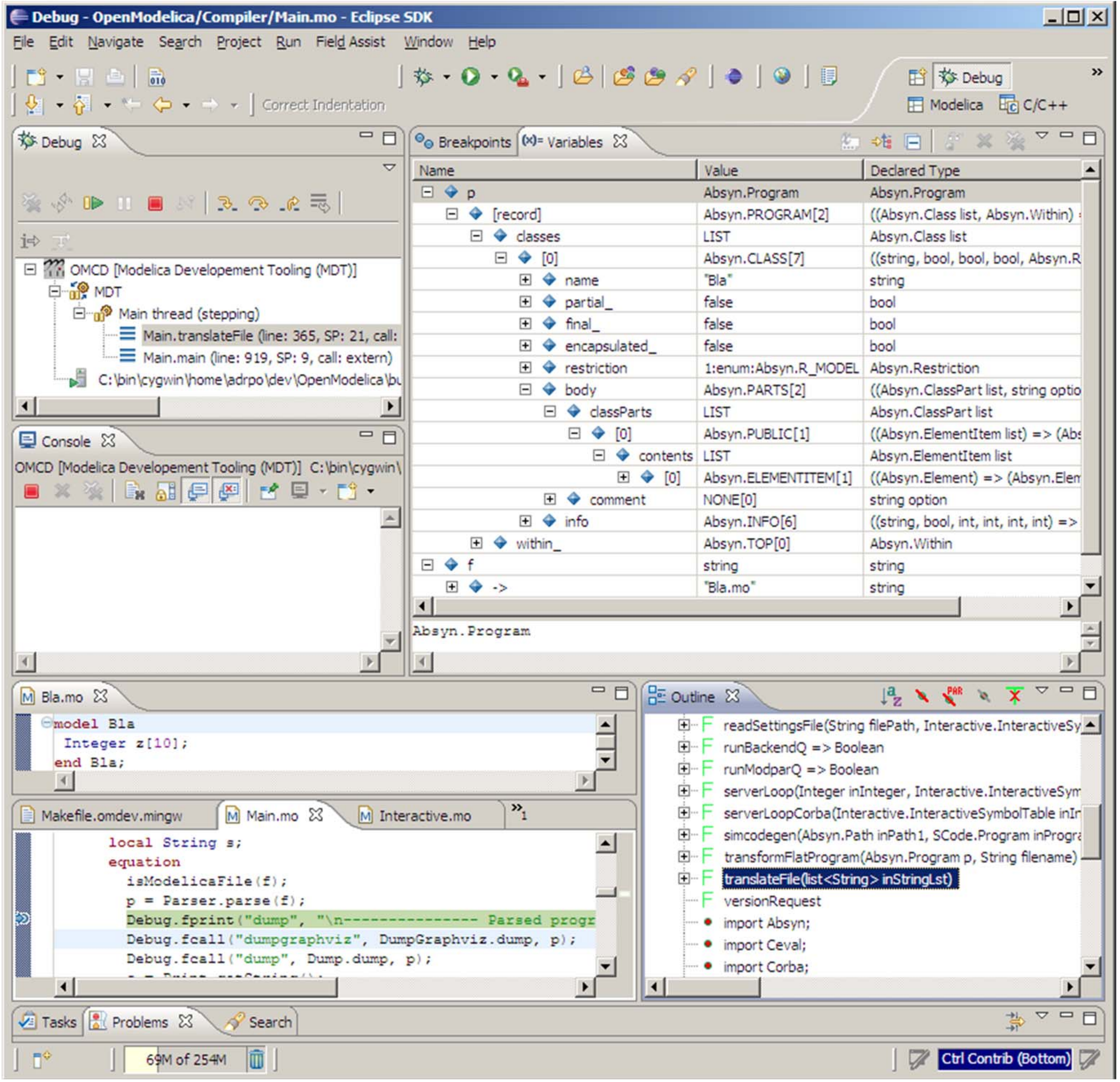
```
Absyn
  R ADD
  R ALG_ASSIGN(Exp assignComponent, Exp value)
  R ALG_BREAK
  R ALG_CATCH(list<AlgorithmItem> catchBody)
  R ALG_EQUALITY(Algorithm equ)
  R ALG_FAILURE(Algorithm equ)
  R ALG_FOR(ForIterators iterators, list<AlgorithmItem> forBo
  R ALG_GOTO(String labelName)
  R ALG_IF(Exp ifExp, list<AlgorithmItem>
  R ALG_LABEL(String labelNam
  R ALG_NORETCALL(ComponentRef
  R ALG_RETURN
  R ALG_THROW
  R ALG_TRY(list<AlgorithmItem> tryBody
  R ALG_WHEN_A(Exp whenStmt, list<Alg
```

```
113 errors, 0 warnings, 0 infos
Description
Errors (100 of 113 items)
  The identifier at start and end are different
  The identifier at start and end are different
  The identifier at start and end are different, par
                                                 par
  ken ';' on line  rmldump.mo      OpenModelica/tools/rml2mod
  ken ';' on line  rmltomod.mo     OpenModelica/tools/rml2mod
  ken ';' on line  modrefacto...   OpenModelica/tools/rml2mod
  ken ';' on line  moddump.mo      OpenModelica/tools/rml2mod
  ken ';' on line  rmltomod.mo     OpenModelica/tools/rml2mod
  ken ';' on line  rmltomod.mo     OpenModelica/tools/rml2mod
  ken ';' on line  rmltomod.mo     OpenModelica/tools/rml2mod
```

Identifier Info on Hovering

Code Outline for easy navigation within Modelica files

Eclipse Debugging Environment



```
OMCD [Modelica Developement Tooling (MDT)]
  MDT
    Main thread (stepping)
      Main.translateFile (line: 365, SP: 21, call:
      Main.main (line: 919, SP: 9, call: extern)
  C:\bin\cygwin\home\adrpo\dev\OpenModelica\bu
```

OMCD [Modelica Developement Tooling (MDT)] C:\bin\cygwin\

Name	Value	Declared Type
p	Absyn.Program	Absyn.Program
[record]	Absyn.PROGRAM[2]	((Absyn.Class list, Absyn.Within)
classes	LIST	Absyn.Class list
[0]	Absyn.CLASS[7]	((string, bool, bool, bool, Absyn.R
name	"Bla"	string
partial_	false	bool
final_	false	bool
encapsulated_	false	bool
restriction	1:enum:Absyn.R_MODEL	Absyn.Restriction
body	Absyn.PARTS[2]	((Absyn.ClassPart list, string optio
classParts	LIST	Absyn.ClassPart list
[0]	Absyn.PUBLIC[1]	((Absyn.ElementItem list) => (Abs
contents	LIST	Absyn.ElementItem list
[0]	Absyn.ELEMENTITEM[1]	((Absyn.Element) => (Absyn.Elem
comment	NONE[0]	string option
info	Absyn.INFO[6]	((string, bool, int, int, int, int) =>
within_	Absyn.TOP[0]	Absyn.Within
f	string	string
->	"Bla.mo"	string

```
Absyn.Program
```

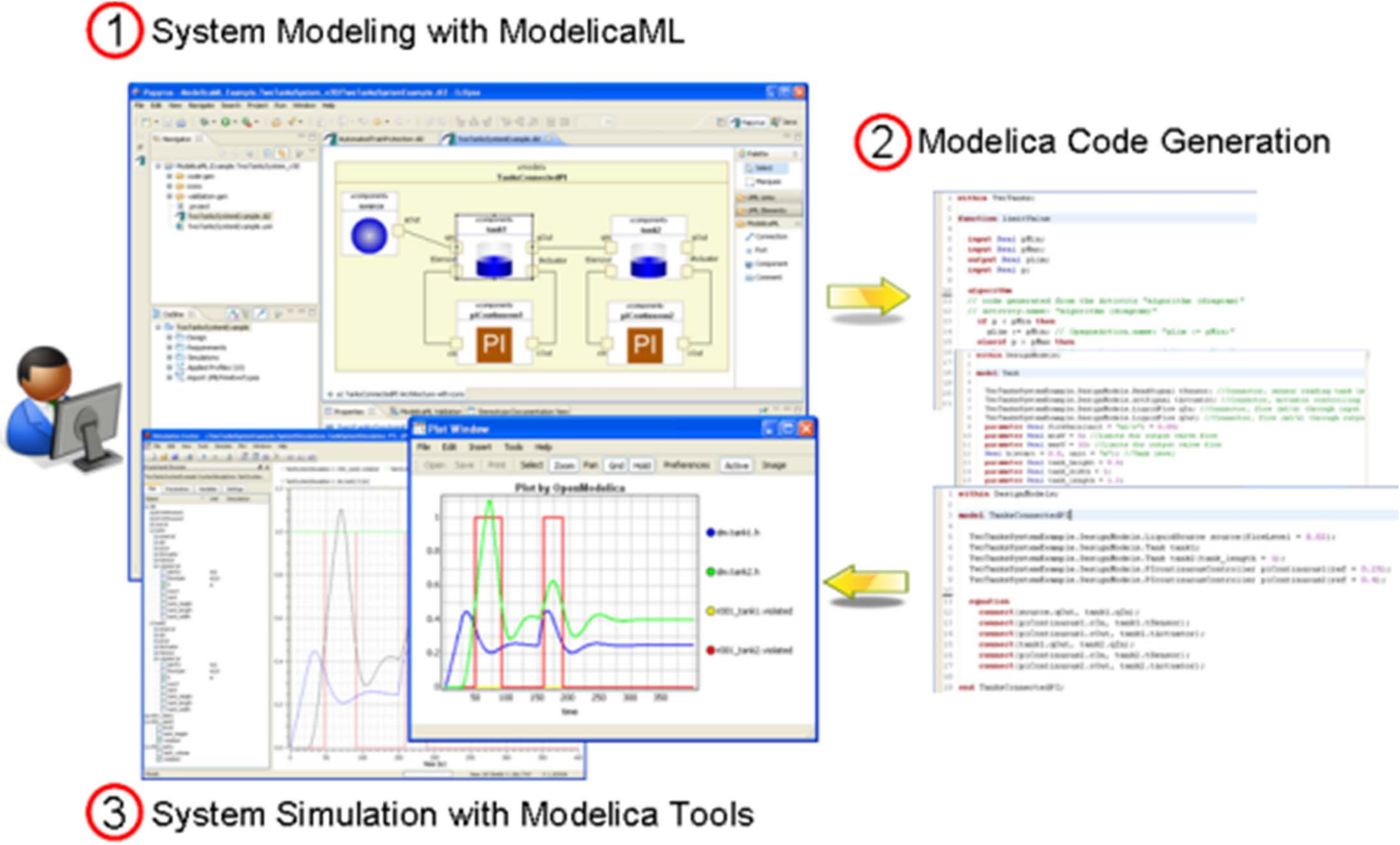
```
model Bla
 Integer z[10];
end Bla;
```

```
      local String s;
      equation
        isModelicaFile(f);
        p = Parser.parse(f);
        Debug.fprint("dump", "\n--------------- Parsed progr
        Debug.fcall("dumpgraphviz", DumpGraphviz.dump, p);
        Debug.fcall("dump", Dump.dump, p);
```

```
F readSettingsFile(String filePath, Interactive.InteractiveSy
F runBackendQ => Boolean
F runModparQ => Boolean
F serverLoop(Integer inInteger, Interactive.InteractiveSym
F serverLoopCorba(Interactive.InteractiveSymbolTable inIr
F simcodegen(Absyn.Path inPath1, SCode.Program inProgra
F transformFlatProgram(Absyn.Program p, String filename)
F translateFile(list<String> inStringLst)
F versionRequest
● import Absyn;
● import Ceval;
● import Corba;
```

- Type information for all variables
- Browsing of complex data structures
- Two Debuggers
  - Code instrumentation
  - GDB based

Eclipse environment for ModelicaML


1 System Modeling with ModelicaML
2 Modelica Code Generation
3 System Simulation with Modelica Tools
Plot Window
Plot by OpenModelica
PI
PI

- Tutorial tomorrow at ModProd 2013!

Outline

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- OpenModelica Latest Developments (2012-2013)

Latest Developments (2012-2013)

2012 – 2013 – Most focus on MSL 3.2.1 support & performance

- Support for Modelica Standard Library 3.2.1 (97% build/92% simulate)

- Front-end
  - New instantiation module (Lookup, Flattening, Connection Handling)
  - Preliminary support for Fluid via the new instantiation module
- Back-end & Simulation Runtime
  - Index Reduction, Matching, Tearing, Dynamic State Selection
  - Initialization, Symbolic Initialization, New methods
  - New NLS solvers, NLS solvers, better event handling, inline solvers
  - Parallelization & Debugging
  - FMI support
  - Several Simulation Runtimes (C, C++, C#, Java, XML, Adevs, QSS, FMU)
- General
  - Uncertainties support (OpenTURNS connection & Data reconcilation)
  - OMEdit – improvements
  - Bootstrapping OMC (100% finished) using Boehm GC
  - 3909 commits in subversion from 2012 to Feb. 4, 2013
  - Bug fixes ~247+ (OSMC)
  - Release 1.9.0 (Linux, Mac, Windows)

Media & Fluid

Media & Fluid is supported since November 2012

- *Continued work to improve the stability and performance*

- The most evil Library is **Media …**
  and its evil father is **Fluid** ☺

- Everything in the Modelica Language Specification is used
  - partial functions in partial packages
  - full packages in partial packages used via the fully qualified path
  - redeclare replaceable model extends x
  - functions using redeclare replaceable function extends used to set constants in partial packages
  - redeclared components that have no replaceable
  - replaceable and redeclare base classes
  - constants with no bindings that *have* to be used in instantiation
  - constant records with components that have no binding
  - large depth of replaceable chains
  - package extension via dot notation on the way to types
- … and then some more that is not even specified

OMC Bootstrapping Status

- The bootstrapped OpenModelica
  - Works and can run the full testsuite
  - Supports very fast debugging via GDB
  - Fully supports Modelica and several new MetaModelica constructs that will make compiler development much easier and modular
  - Comparable in speed with the MMC based one
  - Code generation is much more user friendly (readable)
  - The Boehm Garbage Collector (GC) was integrated
  - Further work is still needed to support native GC

Thank You!
Questions?

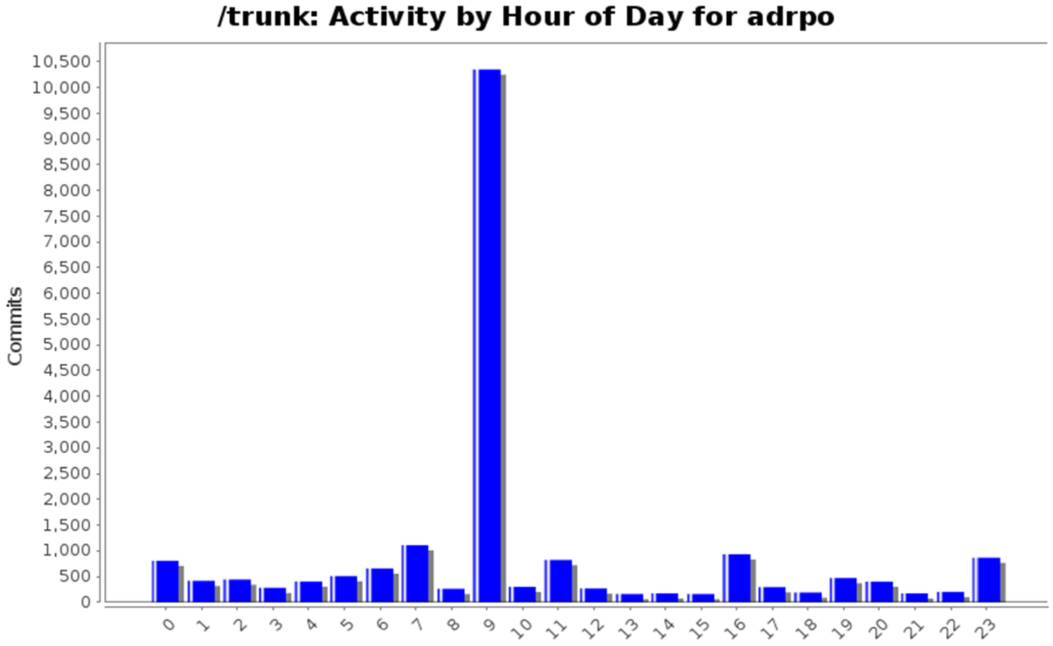
asodja, sjoelund.se, sebco011, lochel, wbraun, niklwors, hubert.thieriot, petar, perost, Frenkel TUD, Unknown, syeas460, adeas31, ppriv, ricli576, haklu, dietmarw, levsa, mahge930, x05andfe, mohsen, nutaro, x02lucpo, florosx, x06hener, x07simbj, stebr461, x08joekl, x08kimja, Dongliang Li, jhare950, x97davka, krsta, edgarlopez, hanke, henjo, wuzhu.chen, fbergero, harka011, tmtuomas, bjozac, AlexeyLebedev, x06klasj, ankar, kajny, vasaie_p, niemisto, donida, hkiel, davbr, otto@mathcore.com, Kaie Kubjas, x06krino, afshe, x06mikbl, leonardo.laguna, petfr, dhedberg, g-karbe, x06henma, abhinnk, azazi, x02danhe, rruusu, x98petro, mater, g-bjoza, x02kajny, g-pavgr, x05andre, vaden, jansilar, ericmeyers, x05simel, andsa, leist, choeger, Ariel.Liebman, frisk, adrpo

OpenModelica Project

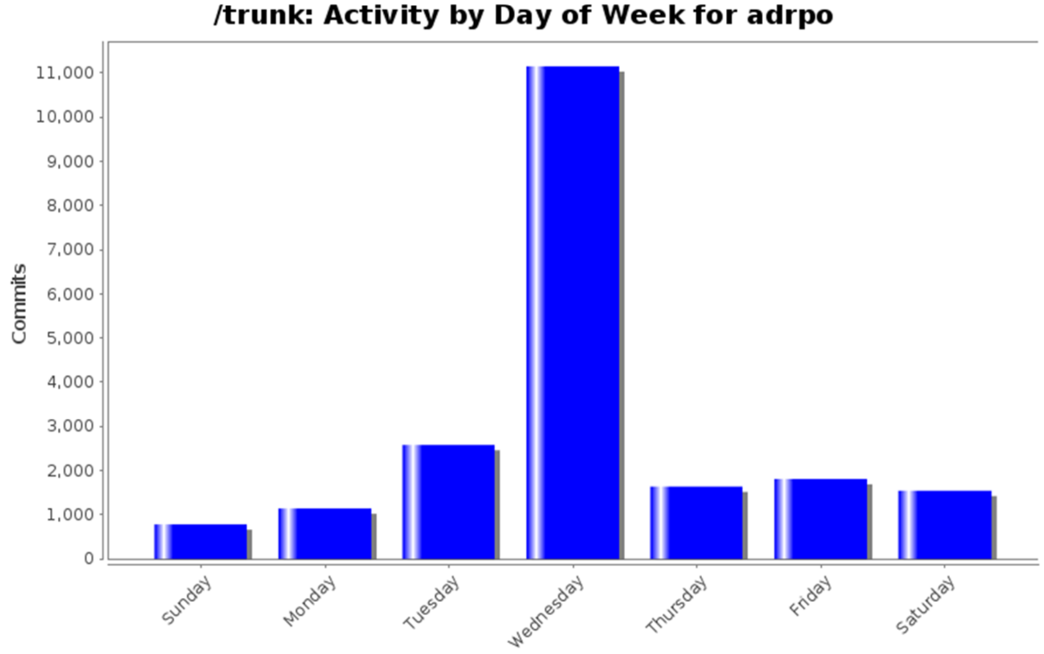
http://www.OpenModelica.org

Funny Facts (I)

- 2011-2012
- adrpo is most productive Wednesdays at 9 o'clock!
- at least 7-8 times more productive ☺
- can I take holidays in the other days?



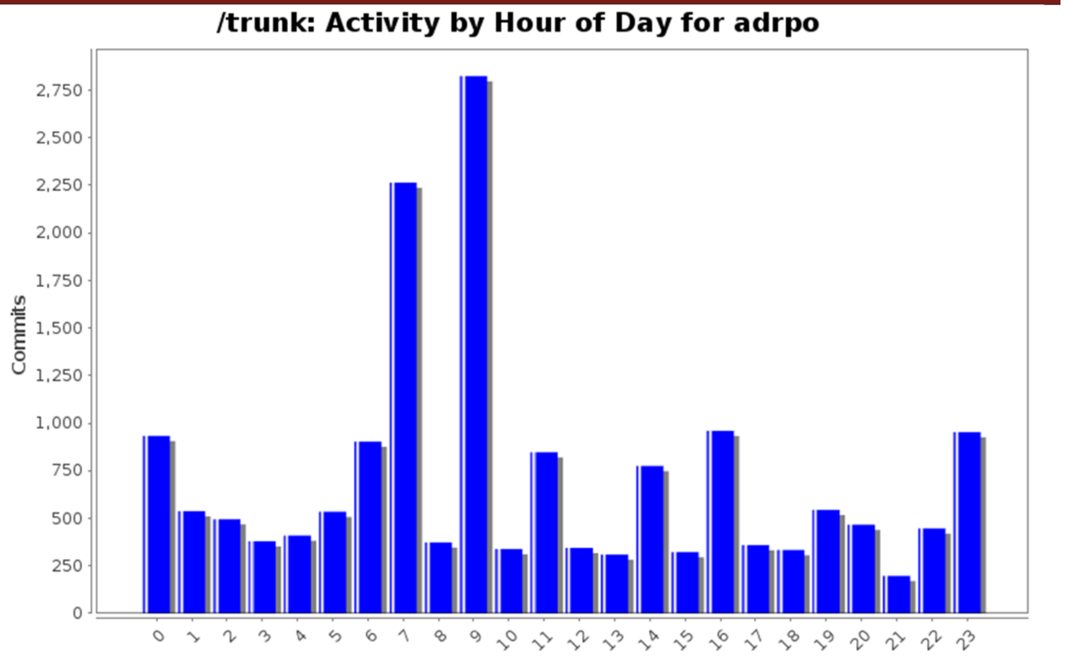
/trunk: Activity by Hour of Day for adrpo



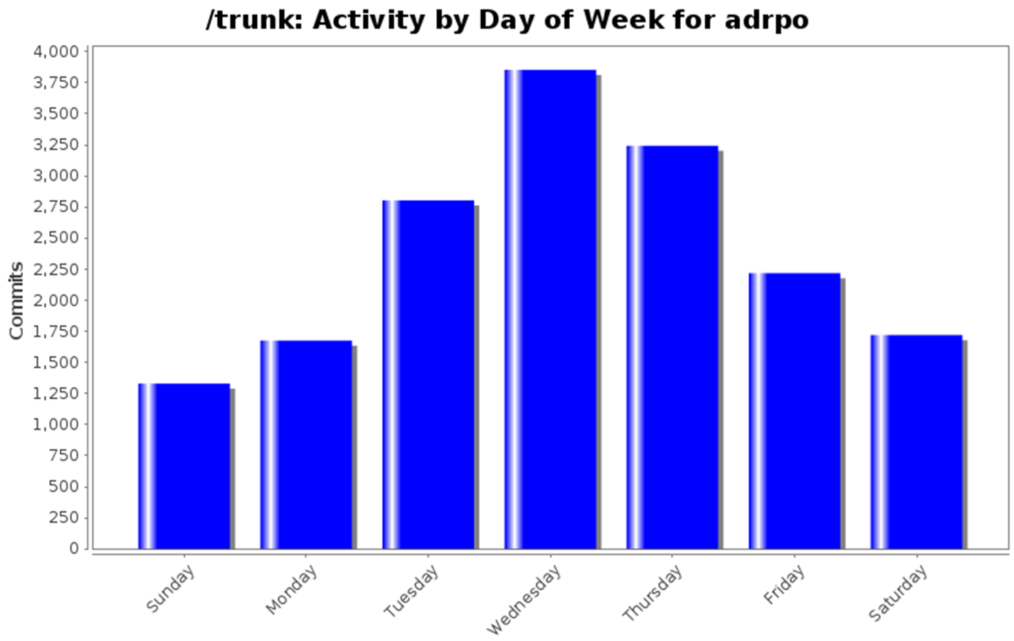
/trunk: Activity by Day of Week for adrpo

Funny Facts (II)

- Things changed 2012-2013
- Gaussian distribution
- More work, more distribution



/trunk: Activity by Hour of Day for adrpo



/trunk: Activity by Day of Week for adrpo