

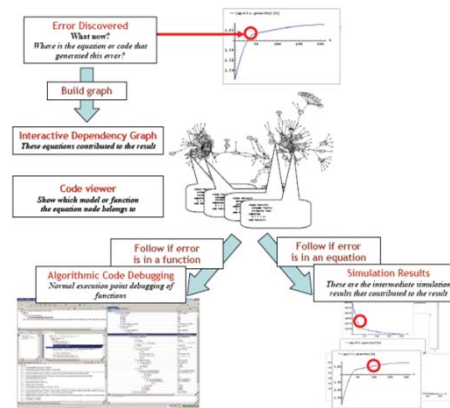
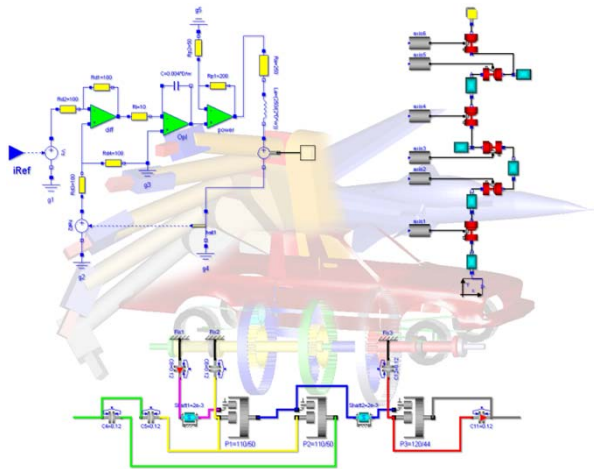
# Technical Overview of OpenModelica and its Development Environment

Adrian Pop

2012-02-06

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 Programming Environment Laboratory  
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 Linköping University

[www.OpenModelica.org](http://www.OpenModelica.org)



$$\tau_2 = \frac{1}{k_2} \tau_1$$

$$e = \omega_{ref} - \omega_{out}$$

$$u = K \left( e + \frac{1}{T_I} \int_0^t e dt \right)$$

$$v = u \quad \omega_R = R \cdot v \quad \omega_{out} = k_1 \omega_{out}$$

$$J_1 \frac{d^2 \theta_1}{dt^2} = \tau_{out} + \tau_1$$

$$J_2 \frac{d^2 \theta_2}{dt^2} = \tau_2 + \tau_3$$

$$J_3 \frac{d^2 \theta_3}{dt^2} = -\tau_4 - T_{load}$$

$$v - \omega_R - \omega_{out} = 0$$

$$\omega_{out} = k_1 \omega_{out} \quad i = \frac{1}{k_1} \tau_{out} \quad \tau_2 = \frac{1}{k_2} \tau_1$$

$$\frac{J_1 - J_2 k_2^2}{k_2} \frac{d^2 \theta_1}{dt^2} = \tau_{out} - k_2 \tau_1$$


- **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 (2011-2012)**

# What is OpenModelica? (0)

OpenModelica is ... *its developers*

*Thank you!*

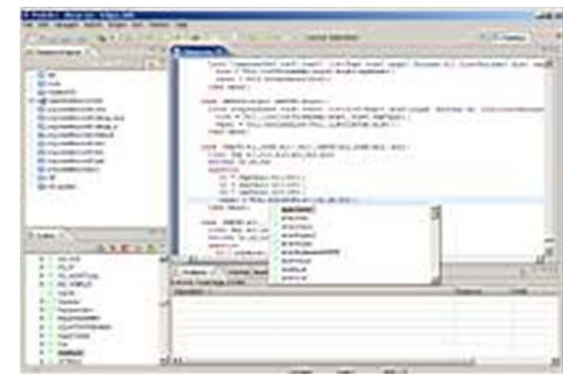
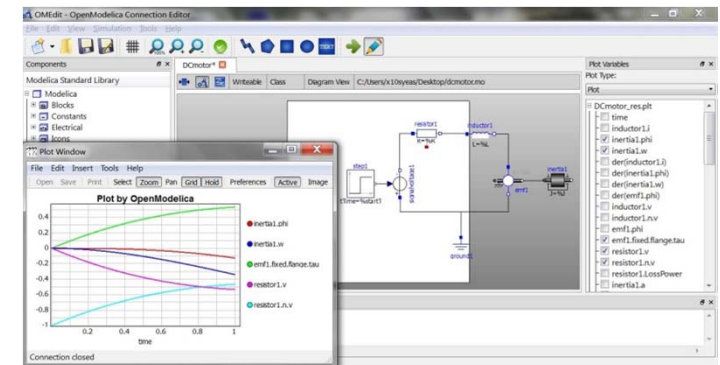
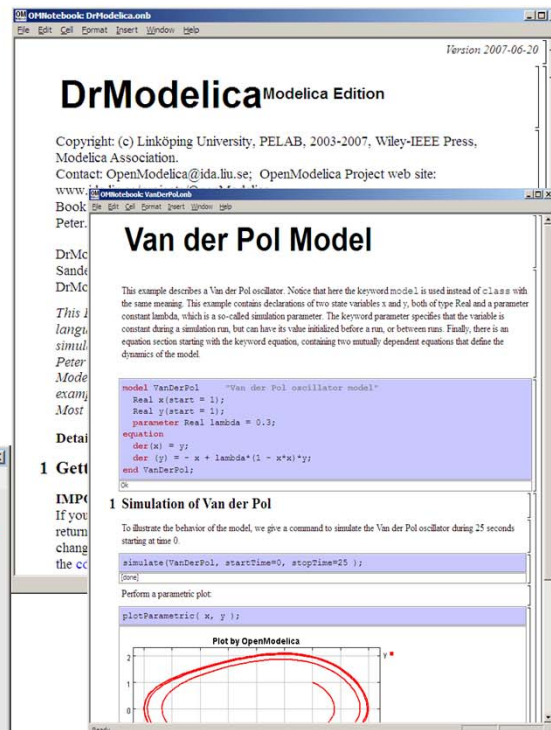
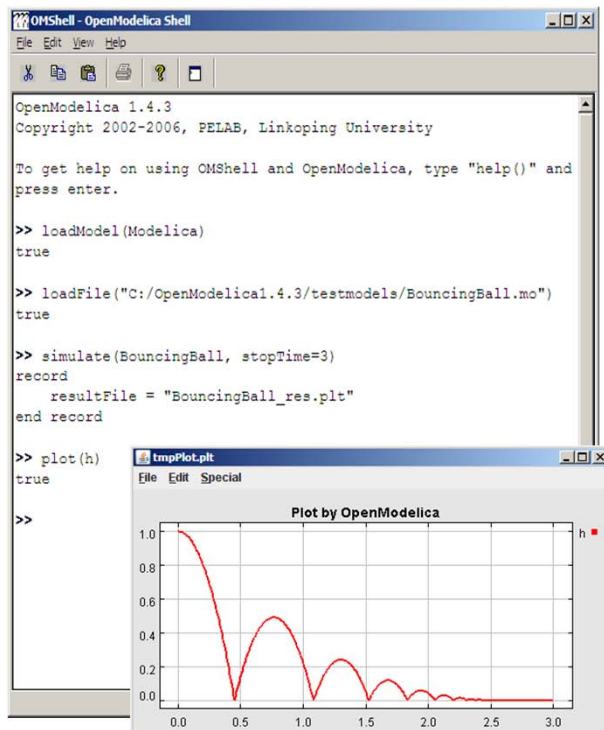
*asodja, sjoelund.se, sebco011, lochel, wbraun, niklwors,  
hubert.thieriot, petar, perost, Frenkel TUD, Unknown,  
syeas460, adeas31, ppriv, ricli576, haklu, dietmarw,  
levsa, mahge930, x05andfe, mohsen, nutaro, x02lucpo,  
floross, x06hener, x07simbj, stebr461, x08joekl,  
x08kimja, Dongliang Li, 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, abhinck, 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

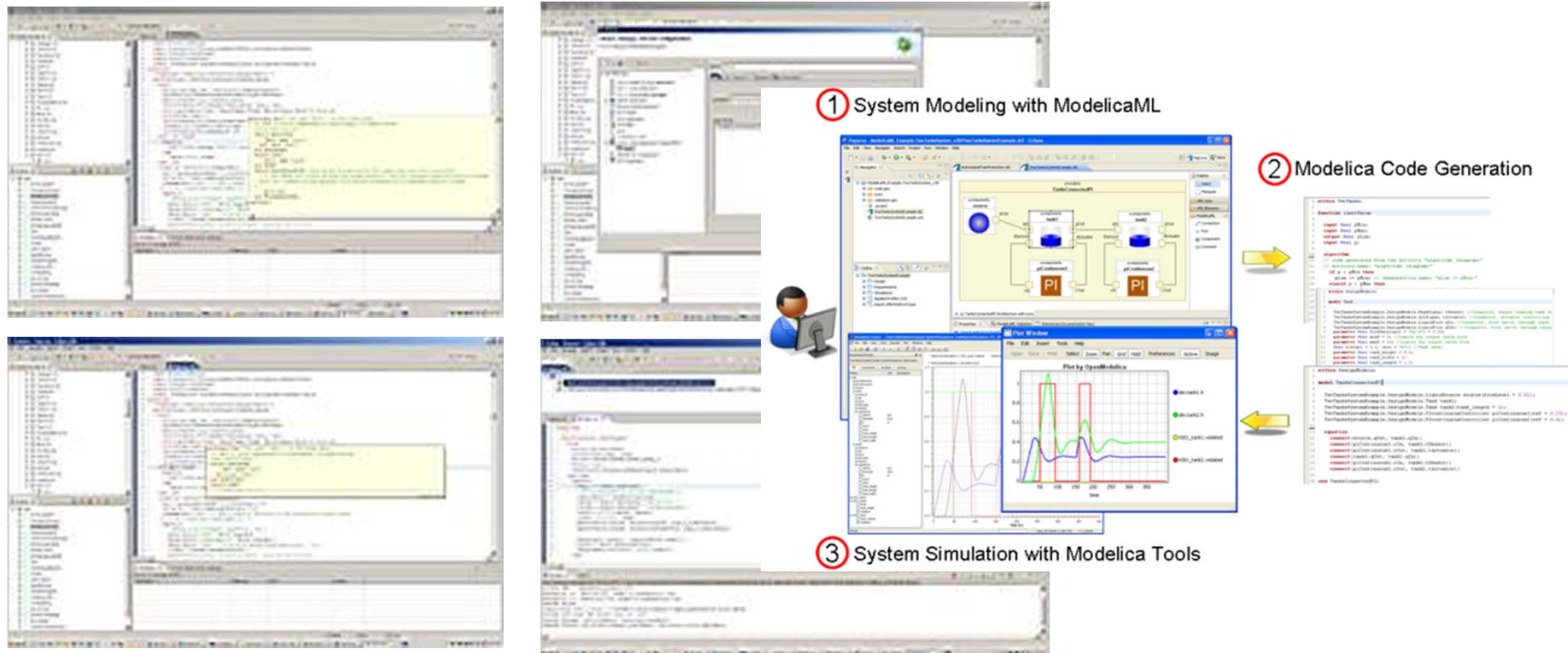
# What is OpenModelica? (I)

- Advanced Interactive Modelica compiler (OMC)
  - Supports MLS v. 3.1/MSL v. 3.2 (without Fluid)
- 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



# 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 (INRIA, PELAB)
- ModelicaML UML/SysML integration





# What is OpenModelica? (III)

- Open-source community services
  - Website and Support Forum
  - Version-controlled source base
  - Bug database (unfortunately)
  - Development courses
  - Mailing lists

Welcome to OpenModelica

http://www.openmodelica.org/

## OpenModelica

HOME DEVELOPER FORUM DOWNLOAD CONTACT US WORKSHOP RESEARCH

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.

### 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

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®.

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

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

Revision	Actions	Author	Date	Message
2983		adrop	15:19:01, den 18 december 2007	- updates to OMShell project to base it on OMDev
2982		adrop	15:15:59, den 18 december 2007	These are local settings or user files, they are not needed.
2981		adrop	14:46:37, den 18 december 2007	- updated OMShell.exe to agree with the latest qt libraries
2980		adrop	01:25:56, den 16 december 2007	- Linux test suite fixes; now all the tests succeed
2979		adrop	10:50:31, den 7 december 2007	- small cosmetic change
2977		adrop	11:15:58, den 30 november 2007	- descend update
2976		adrop	11:15:05, den 30 november 2007	- updated the mmc/zml runtime to the latest version + alloc the to-space (reserved) only when a major GC happen
2975		haku	13:09:13, den 29 november 2007	If the desired output interval was smaller than 0.001 not output was given except for at ev
2968		adrop	21:11:33, den 25 november 2007	- fixed the input path to mico2311.lib: \$(OMDev)\lib\mico-wm32-mvic
2967		adrop	16:51:33, den 13 november 2007	Added some features, e.g. #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		adrop	17:01:14, den 5 november 2007	- fixed build numbers if clean user called

updated the mmc/zml 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
Modified	/trunk/Compiler/C7/mmcRuntime/mmcRuntime.vcproj
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-add.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-create.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-length.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-list.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-nth.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-search.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-update.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-vec.c
Added	/trunk/Compiler/C7/mmcRuntime/runtime/common/arr-vec.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/bool-and.c
Deleted	/trunk/Compiler/C7/mmcRuntime/runtime/common/bool-and.c

Hide unrelated changed paths

Show | Next 100 | Stop on copy/rename

OpenModelica Development Server powered by codeBeamer Enterprise

Logged in as adrop

My Start Projects Wiki Documents Trackers Reports Forums Chats Builds Source Code Members

Projects » OpenModelica » Trackers » Bug

Tracker: Bug

New Issue More actions...

Tracker: Bug (190) Tracker View: Open New Filter: GO more details...

ID	Tracker	Summary	Status	Resolution	Submitter
1163	[1] Bug	parameter fixed = true should be treated as a constant during runtime	--	--	
1162	[1] Bug	Backend: Fixed attribute not working properly for variables	New		
1161	[1] Bug	Weird integer arithmetics	Resolved	FIXED	
1160	[1] Bug	GetComponentAnnotations() and getTheComponentAnnotation() APIs are not working with Modelica standard library 3.	--	--	
1159	[1] Bug	simulation runs old executable when compilation of model fails	Unconfirmed	WORKSFORME	
1158	[1] Bug	mismatch of return values (return + pointer) of external function and result structure	Resolved	FIXED	
1157	[1] Bug	MultiBody: Validating a model with Cylindrical joint returns errors but is built successfully (from MathCore)	--	--	
1156	[1] Bug	The examples in Machines and Multiphase fails to check by MathCore	--	--	
1155	[1] Bug	Wrong Error Variable eAxis is trying to override final variable in class	Resolved	FIXED	
1154	[1] Bug	Linkage of report constructor in modification fails (from MathCore)	Pannoned		

# What is OpenModelica? (IV)

- **An incubator platform for research**
  - 5 PhDs since 2004 (Debugging, Parallelization, PDEs Extensions)
  - 20 Master's theses since 2004
  - Both the students and the project benefit
- **Master theses at PELAB 2006-2012**
  - 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**



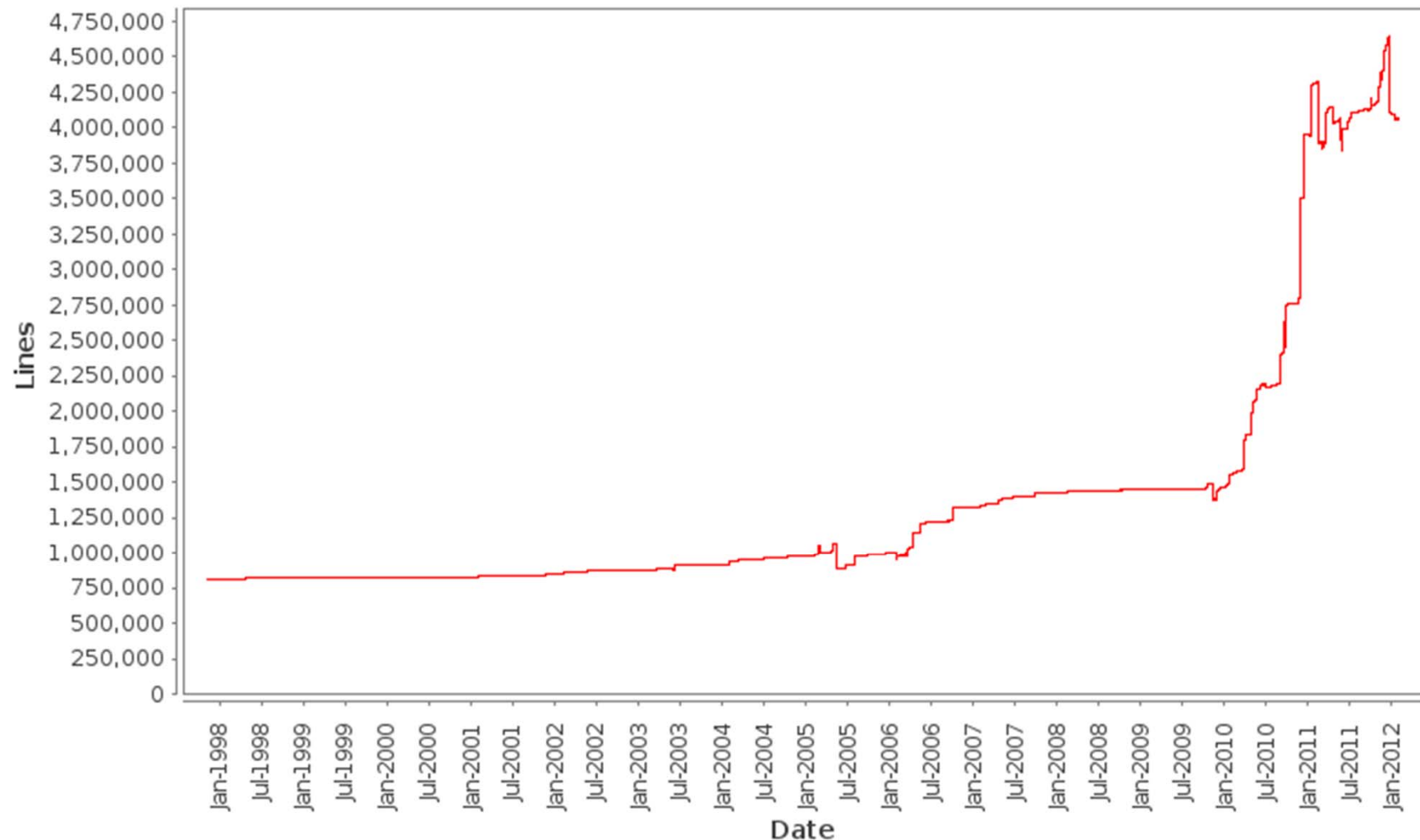
# OpenModelica Roadmap – Past & Present

## 2011 – 2012

- Support for Modelica Standard Library 3.1 (Fluid in works)
- Media & Fluid are now partially supported (more work on the back-end is needed)
- **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**
  - MDT GDB debugging based on GDB and the bootstrapped compiler
  - OMEdit - improvements
  - Bootstrapping OMC (98% finished) GC remaining
  - 2473 commits in subversion from 2011 to Feb. 7, 2012
  - 1037 forum posts (questions and answers)
  - Bug fixes ~190+ (OSMC)
  - Release 1.7.0, 1.8.0, 1.8.1 (Linux, Mac, Windows)
  - Downloads Windows (~31246) , Linux (~10245), Mac (~4543)
- **More things I don't remember**

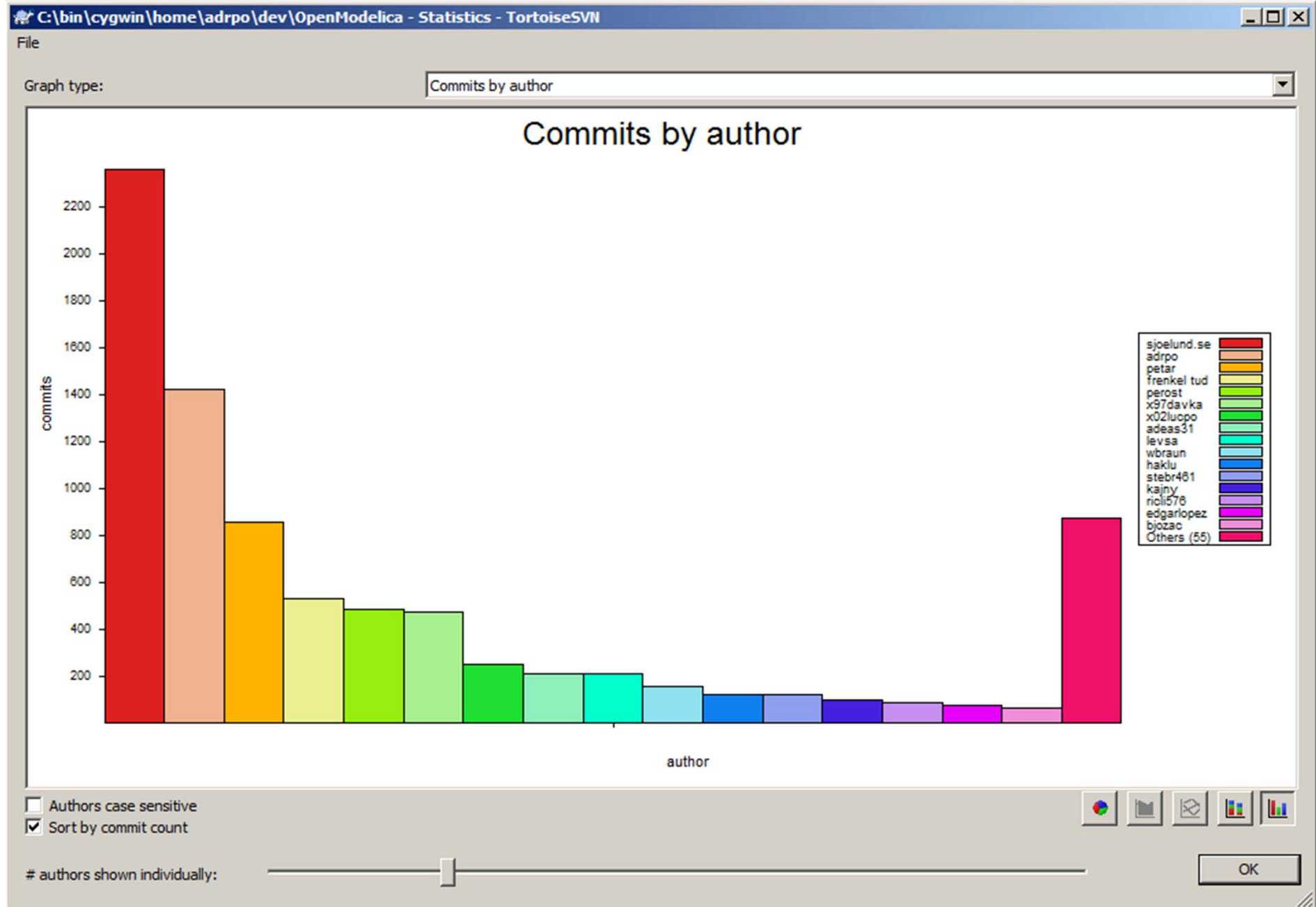
# OpenModelica Statistics (I)

## /trunk: Lines of Code

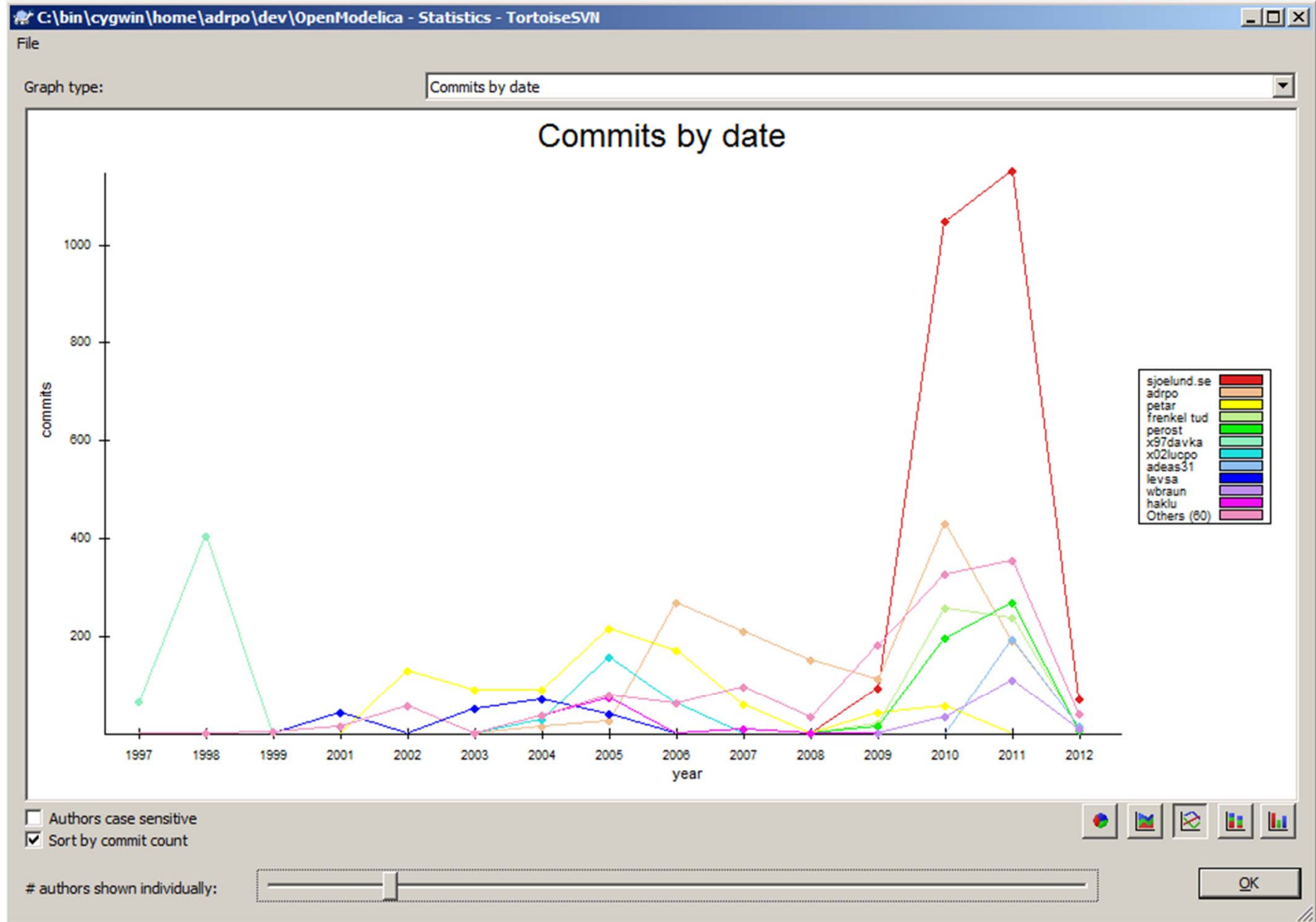


- Mature code base ([http://build.openmodelica.org/omc/statsvn\\_trunk/](http://build.openmodelica.org/omc/statsvn_trunk/))
- ~ 4500K lines of code and tests, steady increase

# OpenModelica Statistics (II)



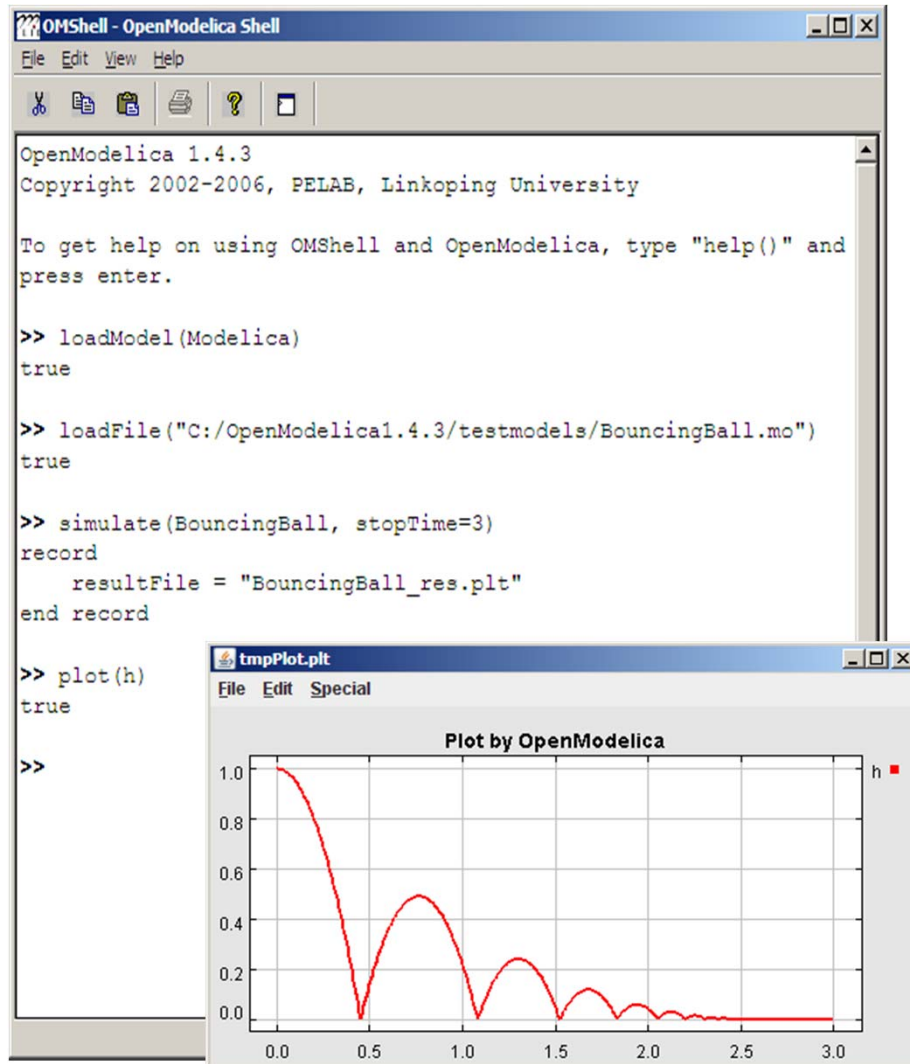
# OpenModelica Statistics (III)





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## ■ Demo?



OMShell - OpenModelica Shell

```
File Edit View Help
```

OpenModelica 1.4.3  
Copyright 2002-2006, PELAB, Linköping 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

>>
```

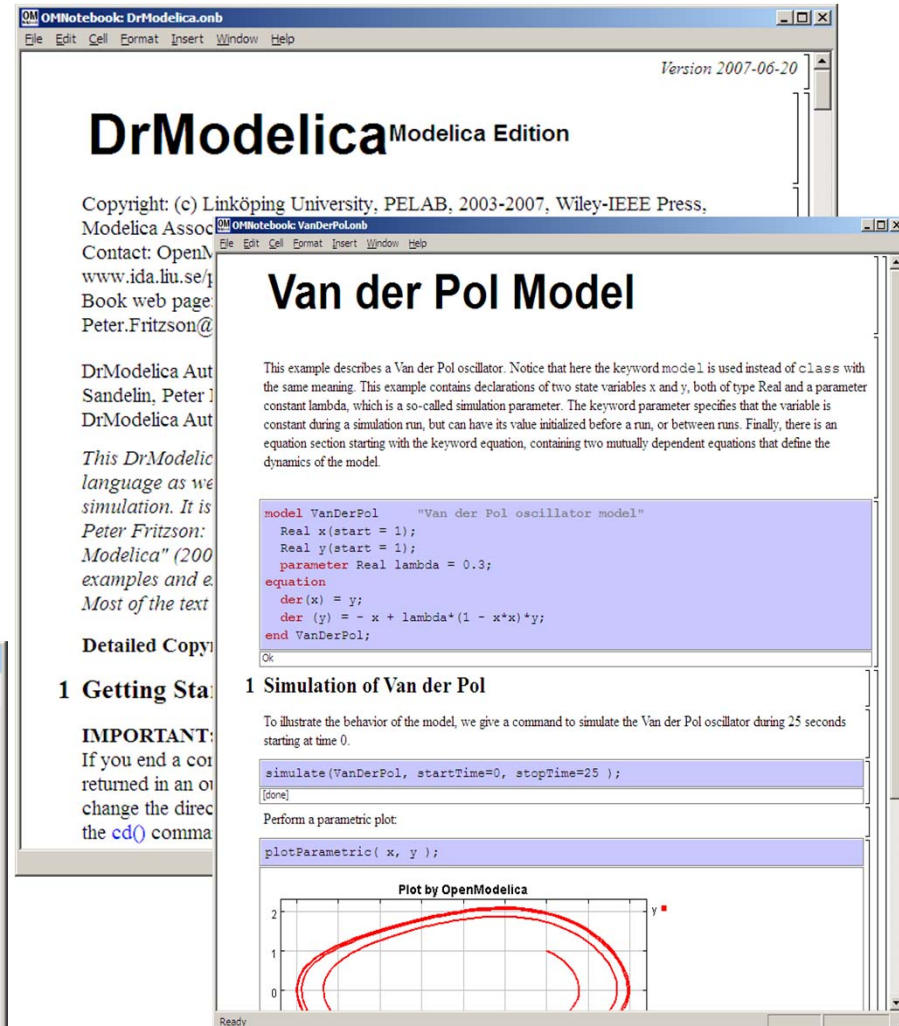
tmpPlot.plt

File Edit Special

Plot by OpenModelica



The plot shows the displacement  $h$  of a bouncing ball over time. The x-axis represents time from 0.0 to 3.0, and the y-axis represents  $h$  from 0.0 to 1.0. The curve starts at  $h=1.0$  at  $t=0$ , reaches  $h=0$  at  $t \approx 0.4$ , and then exhibits damped oscillations, with subsequent peaks at approximately  $t=0.8$ ,  $t=1.2$ , and  $t=1.6$ , before settling near  $h=0$ .



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. [OMNotebook: VanDerPol.m](#)  
Contact: OpenModelica  
[www.ida.liu.se/projects/omnotebook/](http://www.ida.liu.se/projects/omnotebook/)  
Book web page:  
Peter.Fritzson@liu.se

DrModelica Author: Peter Sandelin, Peter Fritzson  
DrModelica Author: Peter Fritzson

*This DrModelica language as we use it is a simulation. It is based on the Modelica language (2003 examples and extensions). Most of the text is from the Modelica language.*

Detailed Copy: [Modelica Language](#)

### 1 Getting Started

**IMPORTANT:** If you end a cell with a return key, the cell is returned in an output window. To change the direction of the output, use the `cd()` command.

### 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:

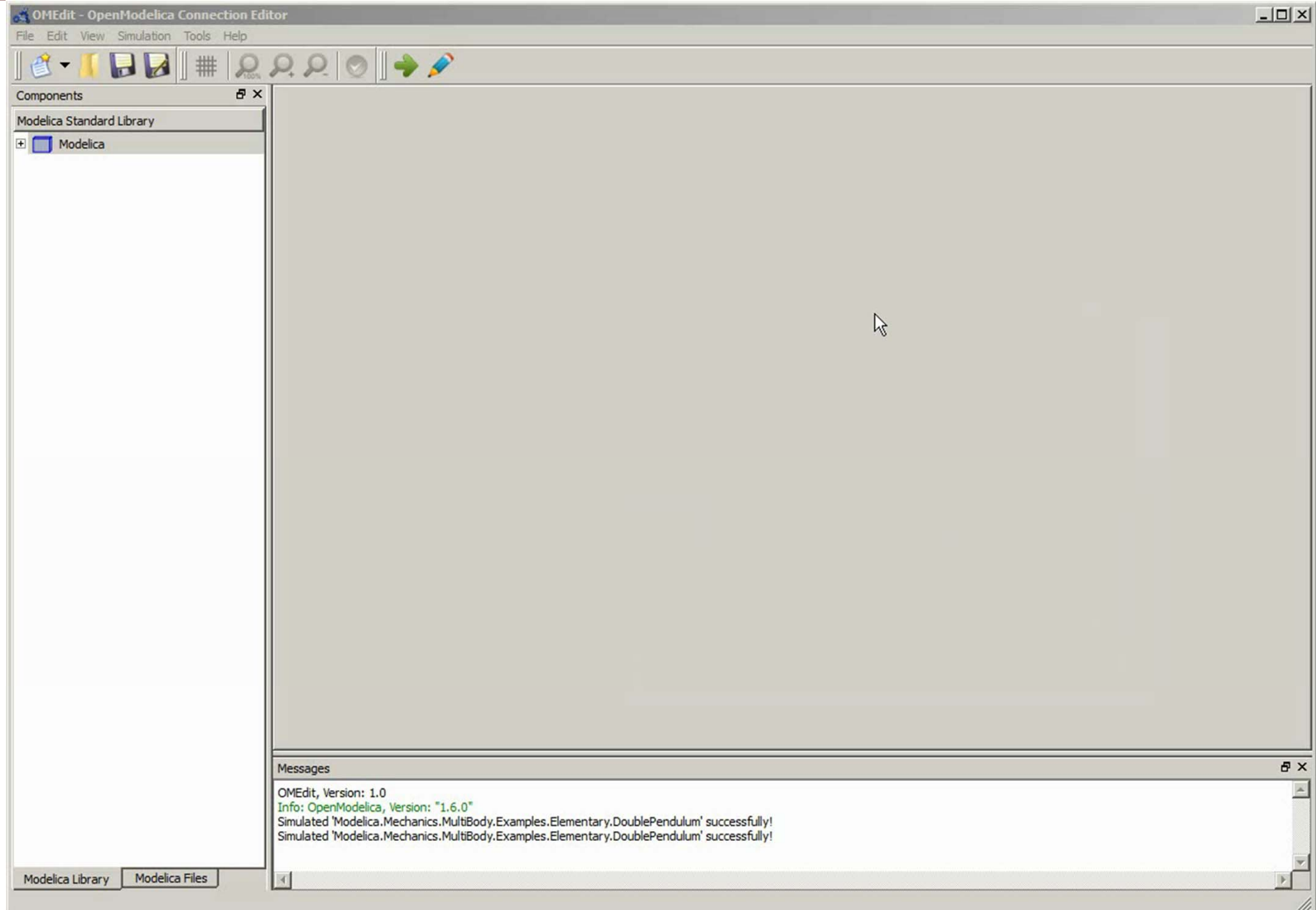
```
plotParametric(x, y);
```

Plot by OpenModelica



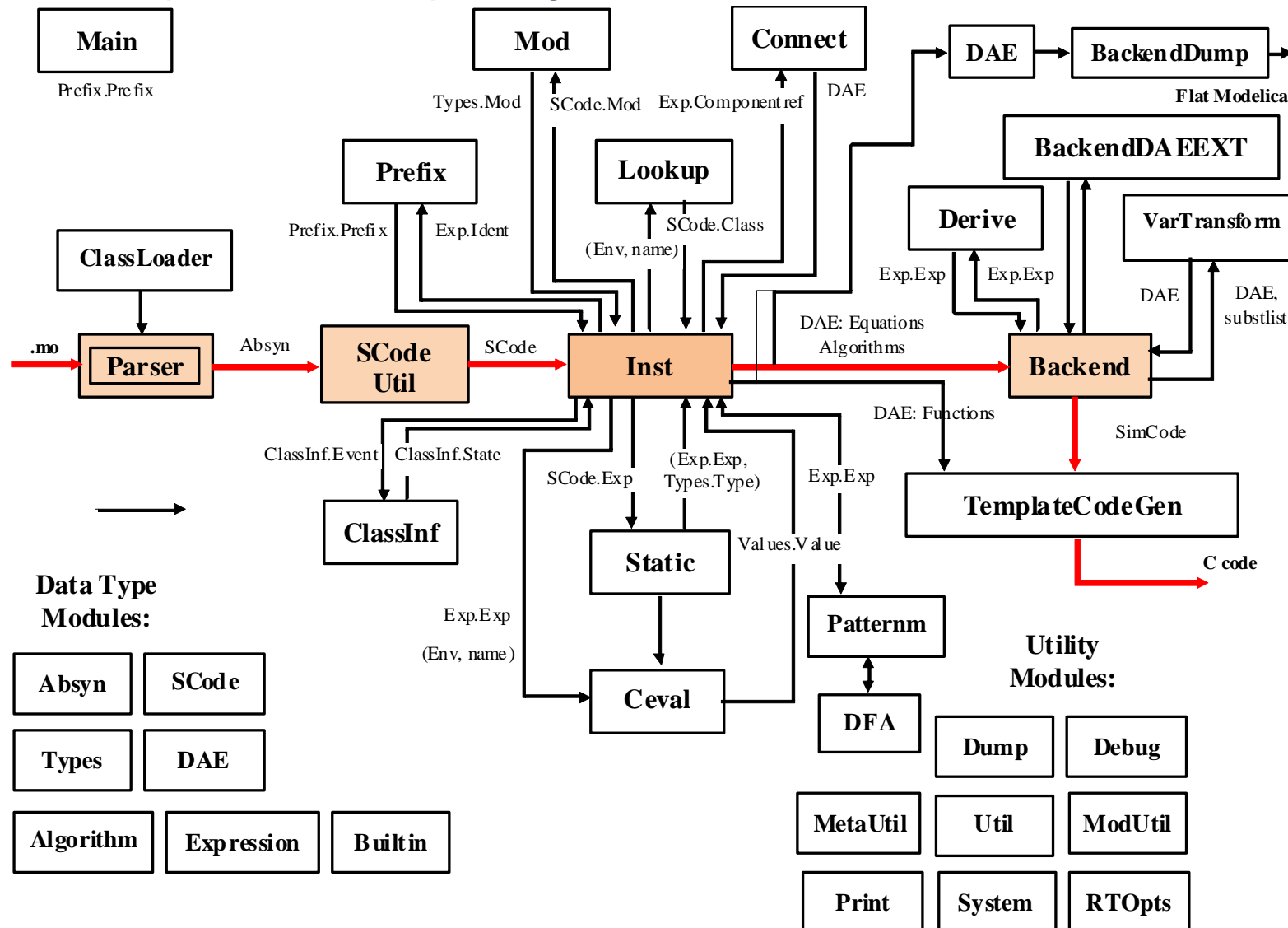
The parametric plot shows the trajectory of the Van der Pol oscillator in the  $(x, y)$  plane. The x-axis ranges from 0 to 2, and the y-axis ranges from 0 to 2. The trajectory starts at  $(1, 1)$  and forms a closed, roughly elliptical loop, indicating periodic behavior.

# OMEdit - Demo? Maybe a movie!



# The OMC Compiler

- Implemented mainly in MetaModelica and C/C++
- The compiler has 156 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);
```

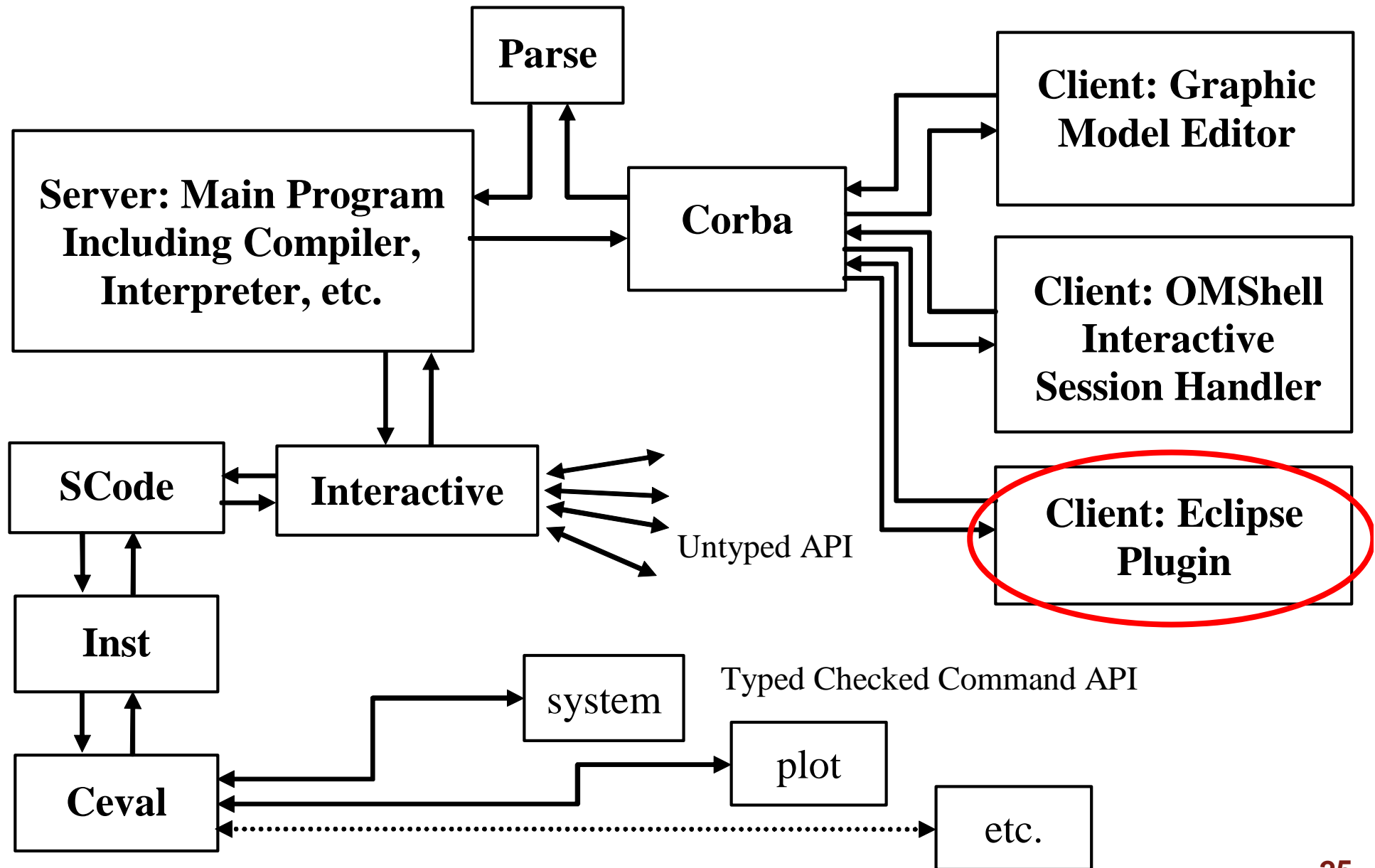
# Simulation Runtime Overview

- **New simulation runtime**
  - Work started in November at OpenModelica development week
  - Mainly C so that it supports FMI better
  - Better initialization
  - Better support for multithreading and parallel execution
  - Better support for Jacobians

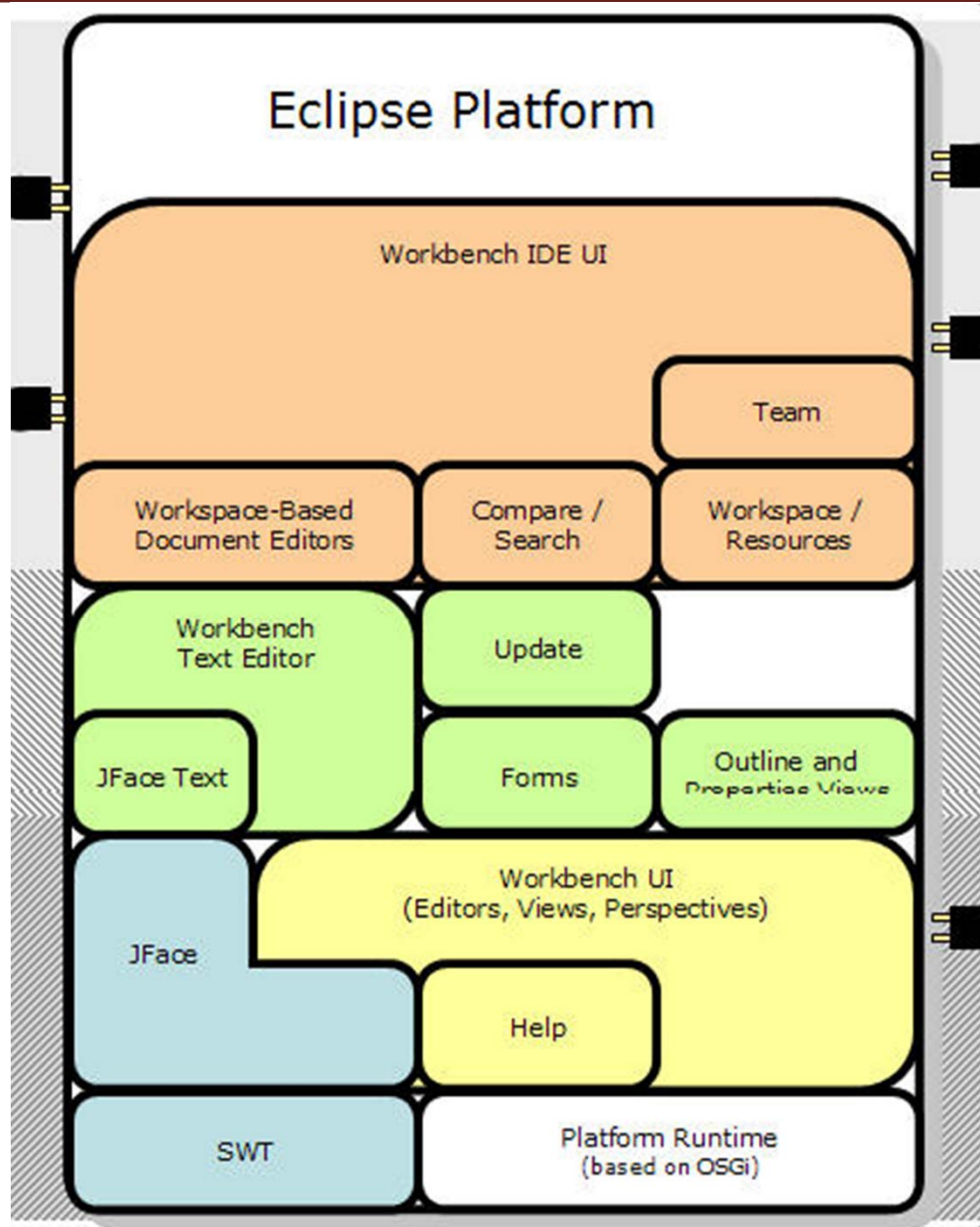
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- **OMC**
  - Implemented mainly in MetaModelica and C/C++
- **Modelica**
  - classes, models, records, functions, packages
  - behavior is defined by equations or/and functions
  - equations
    - differential algebraic equations and conditional equations
- **MetaModelica extensions**
  - local equations
  - pattern equations
  - match expressions
  - high-level data structures: lists, tuples, option and uniontypes

# OpenModelica Context



# The MDT Eclipse Environment (I)



**Modelica Browser**

**Modelica Editor**

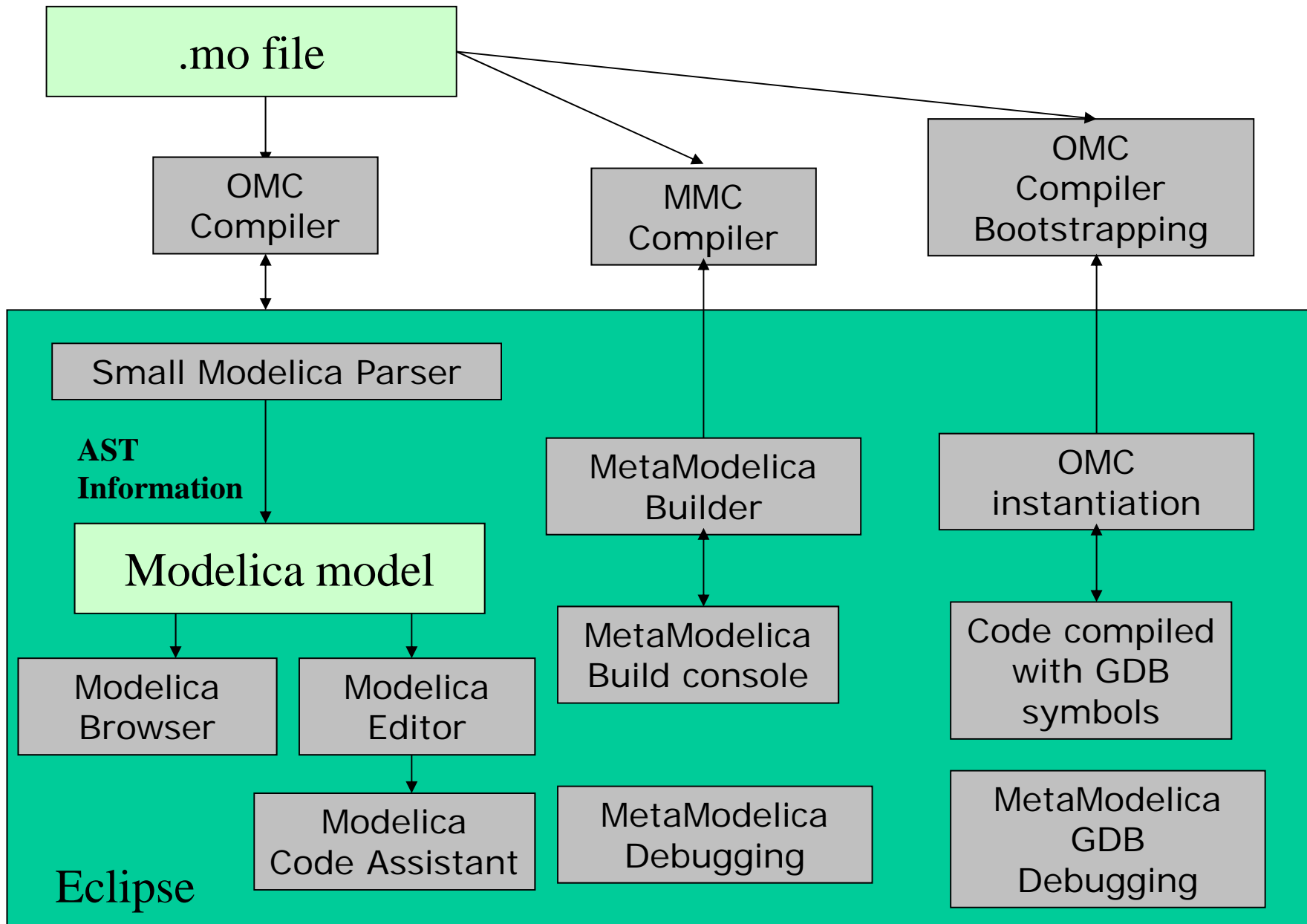
**Modelica Code Assistant**

**MetaModelica Debugging**

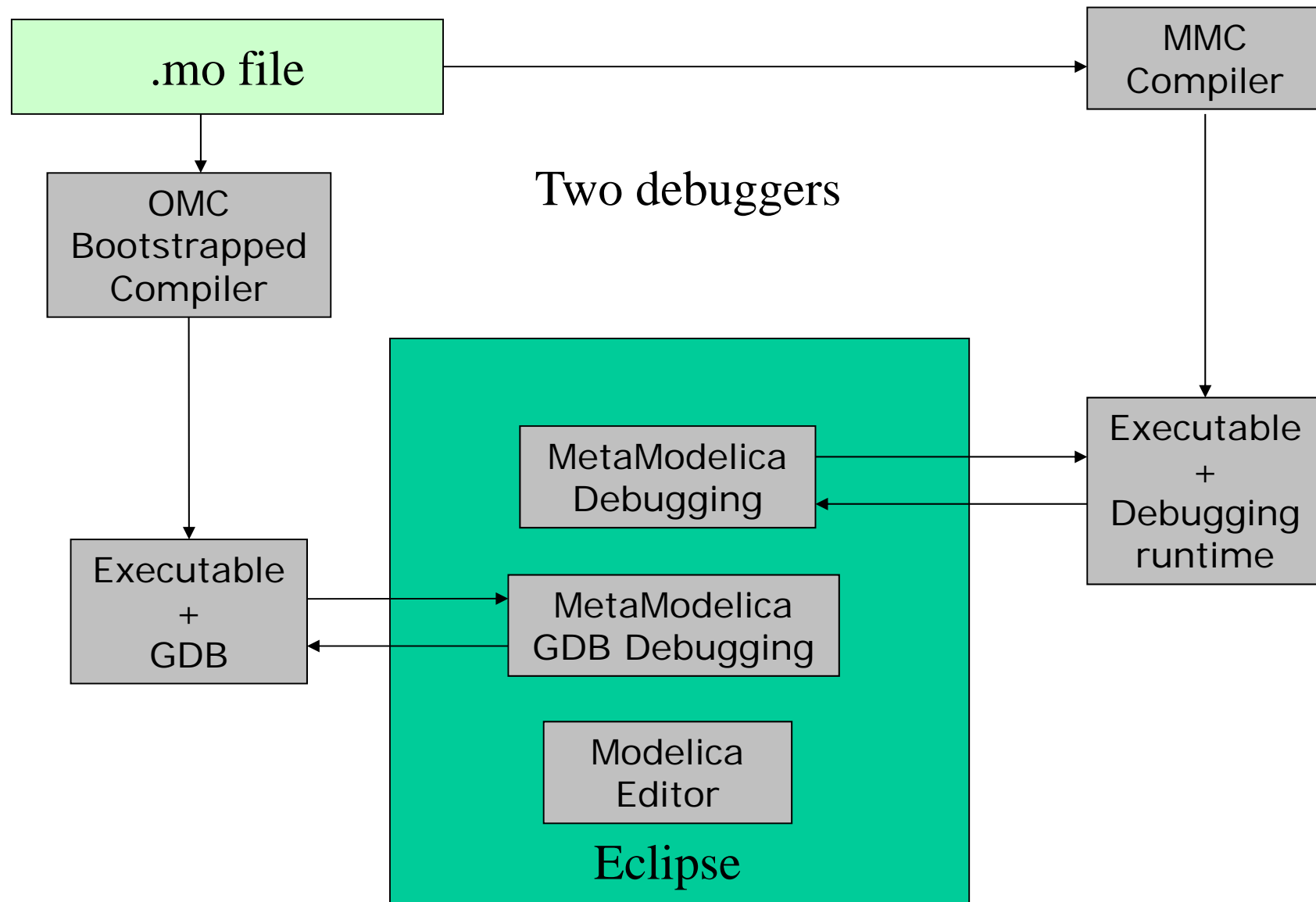
**Modelica Perspective**



# The MDT Eclipse Environment (II)



# The MDT Eclipse Environment (III)



# Creating Modelica projects (I)

The screenshot illustrates the steps to create a Modelica project in Eclipse SDK. The main window shows the 'File' menu with 'New' selected, leading to a 'New Project...' dialog. In this dialog, the 'Modelica' folder is expanded, and the 'Modelica Project' wizard is selected. A red arrow points from the 'Modelica Project' wizard in the 'New Project' dialog to the 'New Modelica Project' wizard in the 'New Modelica Project' dialog. The 'New Modelica Project' dialog shows the 'Project name' field filled with 'demo'. At the bottom of the dialog, there are buttons for '< Back', 'Next >', 'Finish', and 'Cancel'. A second red arrow points from the 'Next >' button in the 'New Modelica Project' dialog to the 'Next >' button in the 'New Project' dialog.

Modelica - Eclipse SDK

File Edit Refactor Navigate Search Project Run Window Help

New Alt+Shift+N Project...

Open File...

Close Ctrl+F4

Close All Ctrl+Shift+F4

Save Ctrl+S

Save As...

Save All Ctrl+Shift+S

Revert

Move...

Rename... F2

Refresh F5

Convert Line Delimiters To

Print... Ctrl+P

Switch Workspace...

Import

Modelica Package

Modelica Class

Folder

File

Example..

Other...

New Project

Select a wizard

Create a new Modelica project.

Wizards:

- Plug-in Project
- C
- C++
- CVS
- Eclipse Modeling Framework
- EJB
- Functional Programming
- J2EE
- Java
- Modelica
  - Modelica Project
- Plug-in Development
- Simple
- Web
- Examples

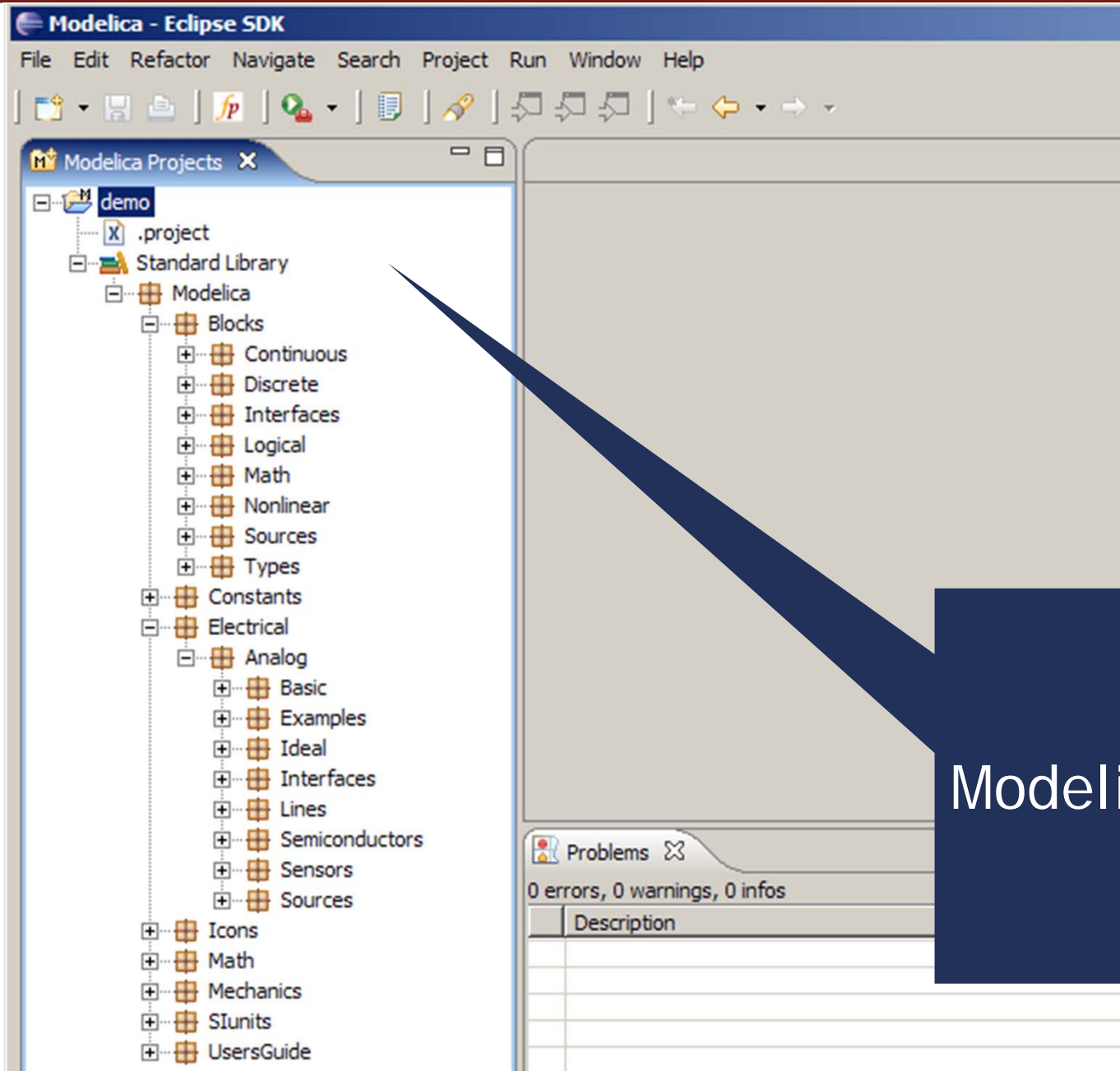
Project name: demo

< Back Next >

< Back Next > Finish Cancel

Creation of Modelica projects using wizards

# Creating Modelica projects (II)



Modelica project

# Creating Modelica packages

The image shows the Eclipse SDK interface for creating a new Modelica package. The 'New Modelica Package' wizard is open, displaying the following fields:

- Source folder: demo
- Package: (empty)
- Name: MyPackage
- Description: A Modelica Package
- is encapsulated package

The 'Finish' button is highlighted with a red arrow. A blue callout box on the left contains the text: "Creation of Modelica packages using wizards".

# Creating Modelica classes

The image shows the Eclipse IDE interface for Modelica. On the left, the 'Modelica Projects' view shows a project named 'demo' with a sub-package 'MyPackage'. A context menu is open over 'MyPackage', and the 'New' option is selected, leading to a submenu where 'Modelica Class' is highlighted. A red arrow points from this menu item to the 'New Modelica Class' wizard dialog box in the foreground. The wizard has the following fields and options:

- Source folder: demo/MyPackage
- Package: MyPackage
- Name: MyClass
- Restriction: model
- Modifiers:  include initial equation block,  is partial class,  have external body

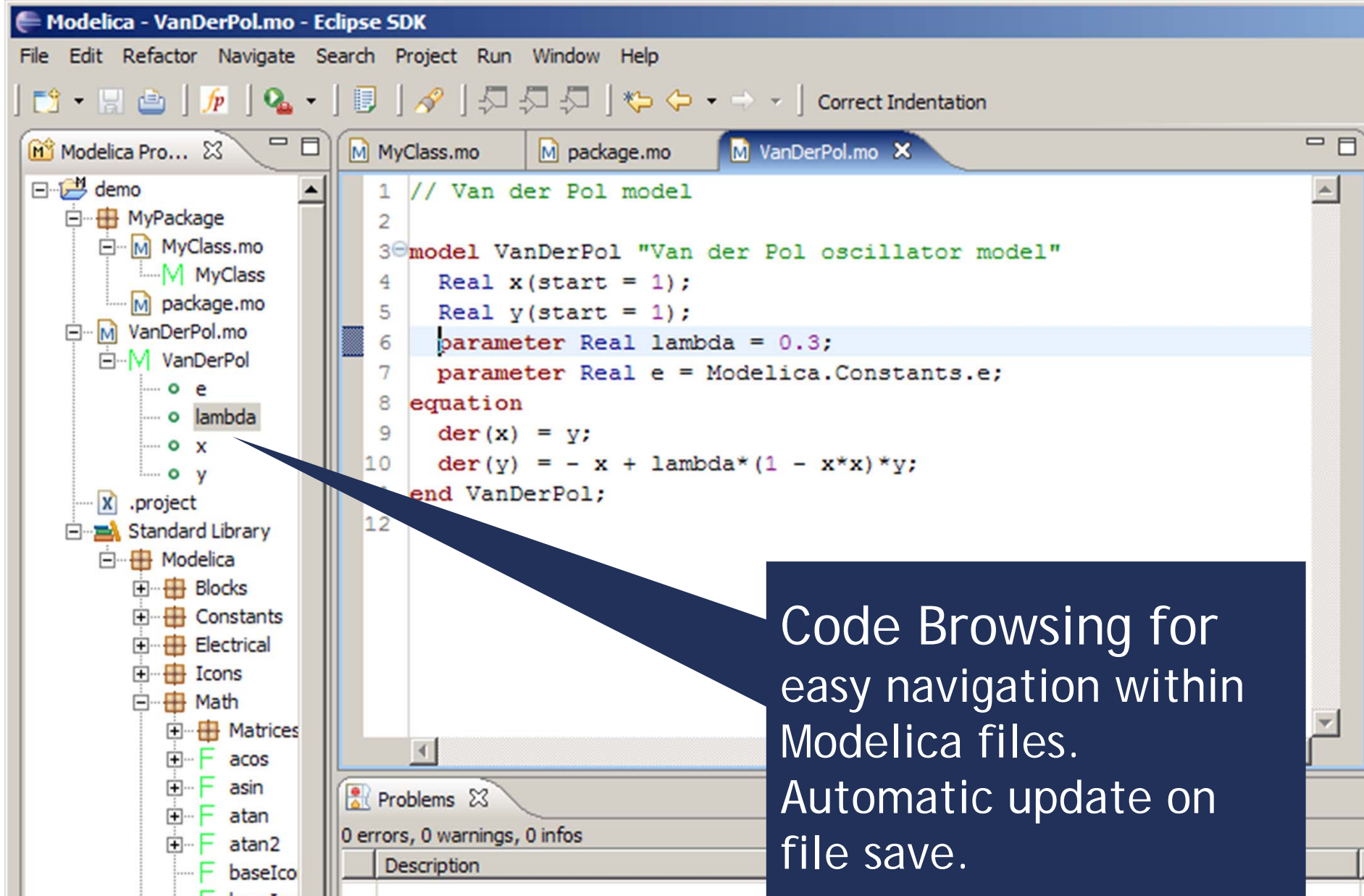
At the bottom of the wizard are 'Finish' and 'Cancel' buttons. A red arrow points from the 'Finish' button to the code editor on the right. The code editor shows the following code:

```
1 within MyPackage;  
2  
3 model MyClass  
4  
5 equation  
6  
7 end MyClass;
```

Creation of Modelica classes, models, etc, using wizards



# Code browsing



The screenshot shows the Eclipse IDE interface with the title bar "Modelica - VanDerPol.mo - Eclipse SDK". The menu bar includes File, Edit, Refactor, Navigate, Search, Project, Run, Window, and Help. The toolbar contains icons for file operations and navigation. The left sidebar shows a project tree for "demo" with folders "MyPackage" and "VanDerPol.mo". Under "VanDerPol.mo", there is a sub-folder "VanDerPol" containing variables "e", "lambda", "x", and "y". The "lambda" variable is selected, and a blue callout box points to it. The main editor window shows the code for "VanDerPol.mo" with the following content:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   Real x(start = 1);
5   Real y(start = 1);
6   parameter Real lambda = 0.3;
7   parameter Real e = Modelica.Constants.e;
8 equation
9   der(x) = y;
10  der(y) = - x + lambda*(1 - x*x)*y;
11 end VanDerPol;
12
```

The "Problems" window at the bottom shows "0 errors, 0 warnings, 0 infos".

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

# Error detection (I)

The screenshot shows the Eclipse IDE with the following components:

- Modelica - VanDerPol.mo - Eclipse SDK** window title.
- Menu bar: File, Edit, Refactor, Navigate, Search, Project, Run, Window, Help.
- Toolbar: Includes icons for file operations and a 'Correct Indentation' button.
- Left sidebar: Project Explorer showing a 'demo' project with 'MyPackage', 'MyClass.mo', 'package.mo', 'VanDerPol.mo', and 'VanDerPol'.
- Editor: Shows the code for 'VanDerPol.mo' with the following content:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   Real x(start = 1);
5   Real y(start = 1);
6   parameter Real lambda = 0.3;
7   parameter Real e = Modelica.Constants.e;
8 equation
9   der(x) = y;
10  der(y) = - x + lambda*(1 - x*x)*y;
11 end VanDerPol;
12
```
- Bottom: Problems view showing 1 error, 0 warnings, 0 infos. The error table is as follows:

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)

The screenshot shows the Eclipse IDE with the 'Modelica - Absyn.mo - Eclipse SDK' window. The left sidebar displays a project tree for 'Modelica Projects' with various subfolders and files. The main editor window shows the source code for 'Absyn.mo'. The code defines a 'Program' type and a 'PROGRAM' record. A red 'X' icon is visible next to line 77, indicating an error. The 'Problems' tab at the bottom shows the error message: 'Absyn.mo:77.5-77.9 Error: unbound type constructor Withi'. The 'Console' tab shows the compilation output, including the error message: 'make[2]: \*\*\* [Absyn.h] Error 1'. A blue callout box with a white arrow points to the error message in the console, containing the text 'Semantic error detection on compilation'.

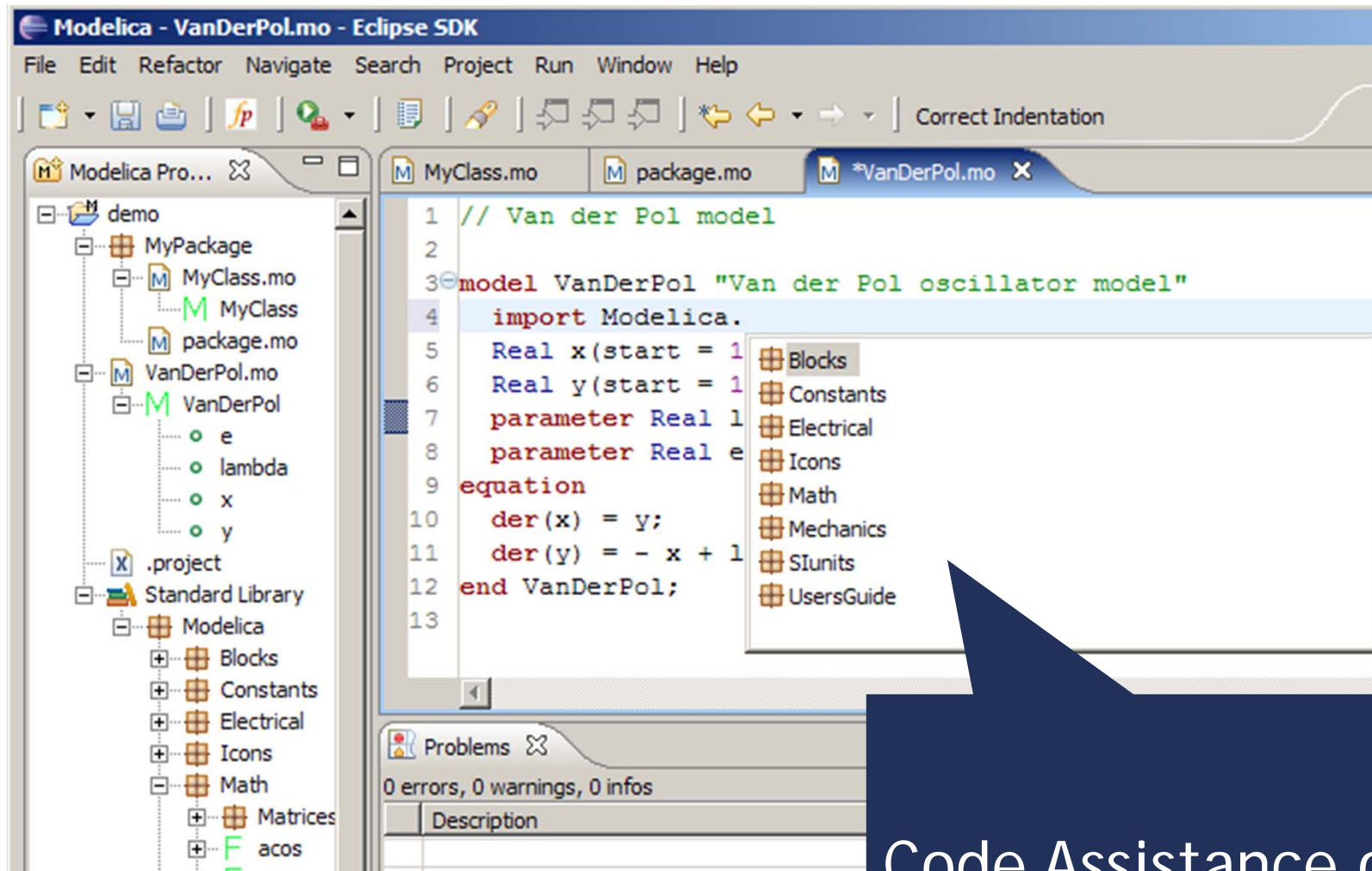
```
69 public
70 uniontype Program "- Programs, the top level construct
71 A program is simply a list of class definitions declared at top
72 level in the source file, combined with a within statement that
73 indicates the hieractical position of the program.
74 "
75 record PROGRAM
76 list<Class> classes "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/mingw/home/.../e'
make[1]: Leaving directory `~/c/bin/cy/.../home
make[2]: *** [Absyn.h] Error 1
make[1]: *** [omc_release] Error 2
make: *** [omc] Error 2
```

Semantic error  
detection on  
compilation



# Code assistance (I)



Code Assistance on imports

# Code assistance (II)

The screenshot shows the Eclipse IDE with the Modelica SDK. The main editor displays the following code:

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4   import Modelica.Math;
5   Real x(start = 1);
6   Real y(start = 1);
7   parameter Real lambda = 0.3;
8   parameter Real e = Modelica.Constants.
9 equation
10  der(x) = y;
11  der(y) = - x + lambda*(1 - x*x)*y;
12 end VanDerPol;
13
```

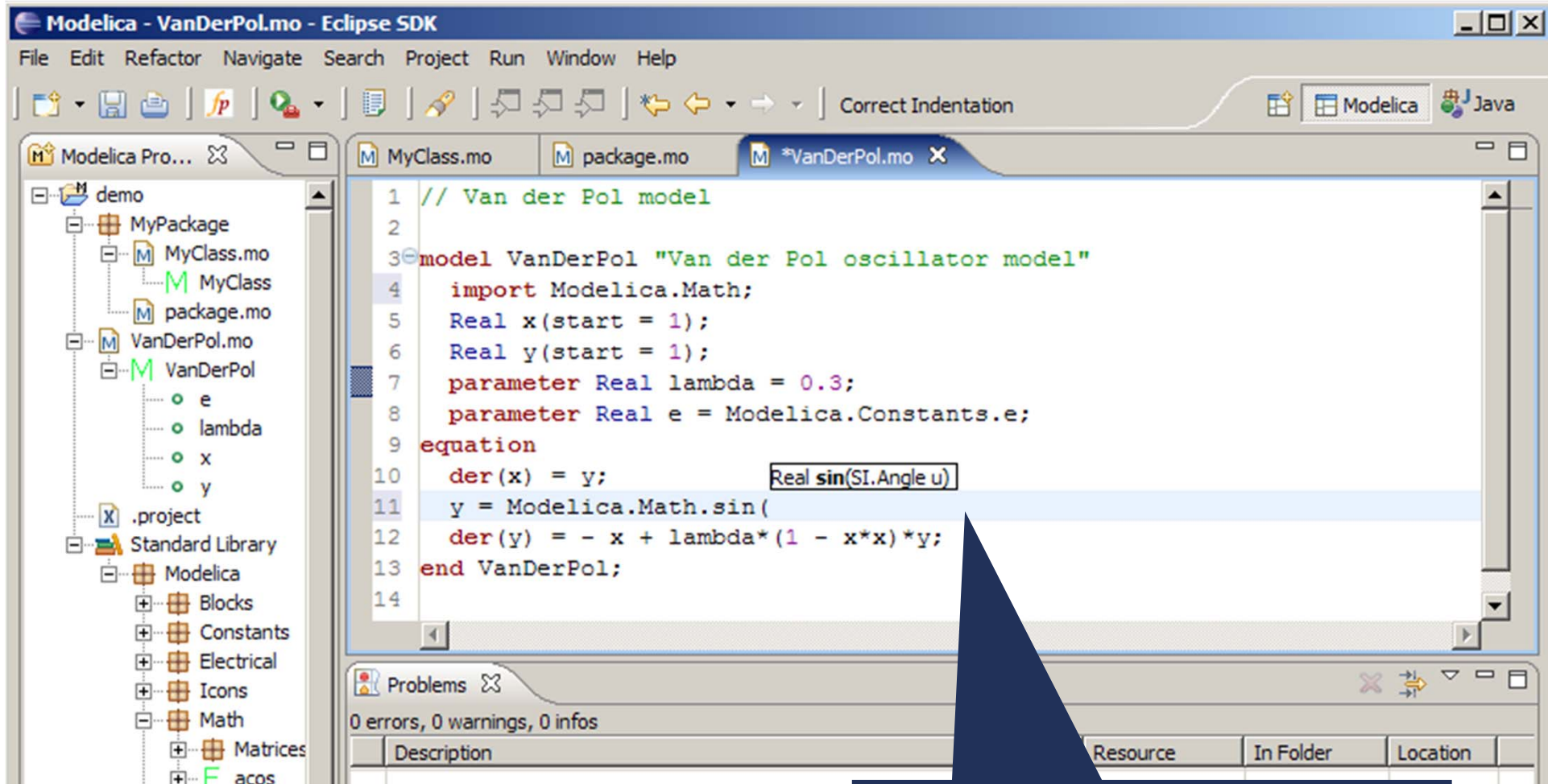
The cursor is positioned at the end of line 8, and a code completion list is shown on the right:

- c
- D2R
- e
- eps
- epsilon\_0
- G
- g\_n
- h
- inf

The Problems view at the bottom shows 0 errors, 0 warnings, and 0 infos.

Code Assistance on assignments

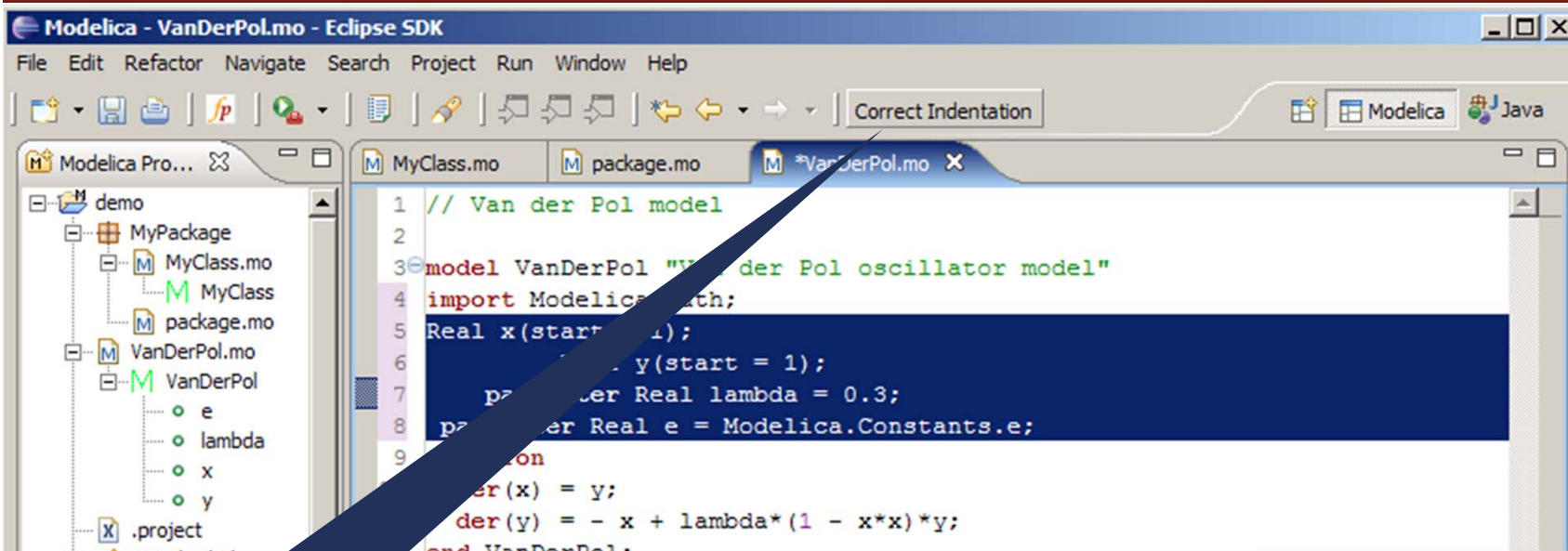
# Code assistance (III)



Code Assistance on  
function calls



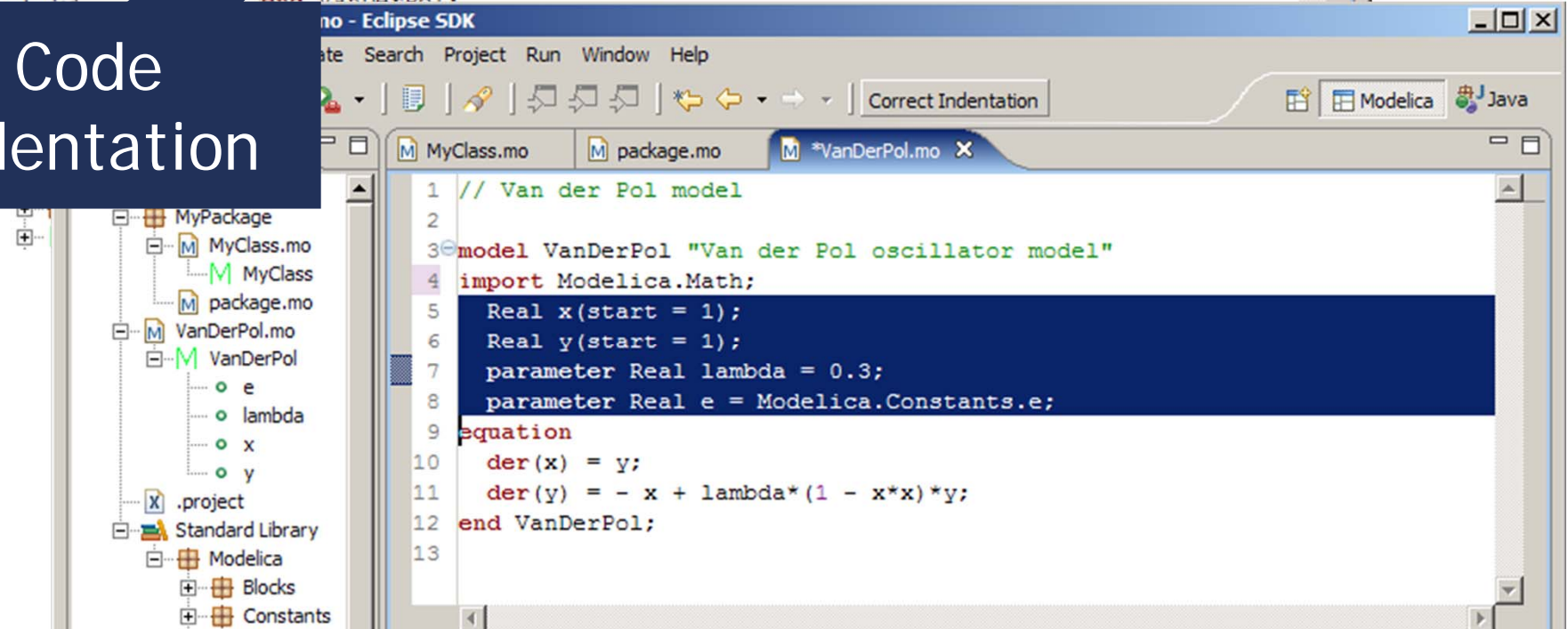
# Code indentation



Modelica - VanDerPol.mo - Eclipse SDK

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4 import Modelica.Math;
5 Real x(start = 1);
6 Real y(start = 1);
7 parameter Real lambda = 0.3;
8 parameter Real e = Modelica.Constants.e;
9 equation
10   der(x) = y;
11   der(y) = - x + lambda*(1 - x*x)*y;
12 end VanDerPol;
```

Code  
Indentation



Modelica - VanDerPol.mo - Eclipse SDK

```
1 // Van der Pol model
2
3 model VanDerPol "Van der Pol oscillator model"
4 import Modelica.Math;
5   Real x(start = 1);
6   Real y(start = 1);
7   parameter Real lambda = 0.3;
8   parameter Real e = Modelica.Constants.e;
9 equation
10   der(x) = y;
11   der(y) = - x + lambda*(1 - x*x)*y;
12 end VanDerPol;
13
```

# Code Outline and Hovering Info

The screenshot displays the Eclipse IDE interface for the Modelica project. The main editor shows the `Absyn.mo` file with the following code:

```
case (MATRIX(matrix = exp11))
  local list<list<list<ComponentRef>>> res1;
  equation
    res1 = Util.listListMap(exp11, 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 =
      function getCrefFromExp "function: getCrefFromExp
        Returns a flattened list of the
        component references in an expression"
        input Exp inExp;
        output list<ComponentRef> outComponentRefLst;
      then
        algorithm
          outComponentRefLst:=matchcontinue inExp
          local
            ComponentRef cr;
            then

```

Annotations in the image include:

- Code Outline for easy navigation within Modelica files:** A callout box points to the Outline view on the left, which lists the code's structure, including `ADD`, `ALG_ASSIGN`, `ALG_BREAK`, `ALG_CATCH`, `ALG_EQUALITY`, `ALG_FAILURE`, `ALG_FOR`, `ALG_GOTO`, `ALG_IF`, `ALG_LABEL`, `ALG_NORETCALL`, `ALG_RETURN`, `ALG_THROW`, `ALG_TRY`, and `ALG_WHEN_A`.
- Identifier Info on Hovering:** A callout box points to the `getCrefFromExp` function definition, which is highlighted in yellow. The tooltip text reads: "function: getCrefFromExp Returns a flattened list of the component references in an expression".

The Problems view at the bottom shows 113 errors, with the first three items being "The identifier at start and end are different".



# Eclipse Debugging Environment

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

The screenshot displays the Eclipse IDE in a debugging state. The top panel shows the 'Debug' toolbar and the 'Breakpoints' and 'Variables' tabs. The 'Variables' tab is active, showing a tree view of the variable 'p' of type 'Absyn.Program'. The tree structure is as follows:

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

The code editor shows the following code for 'Bla.mo':

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

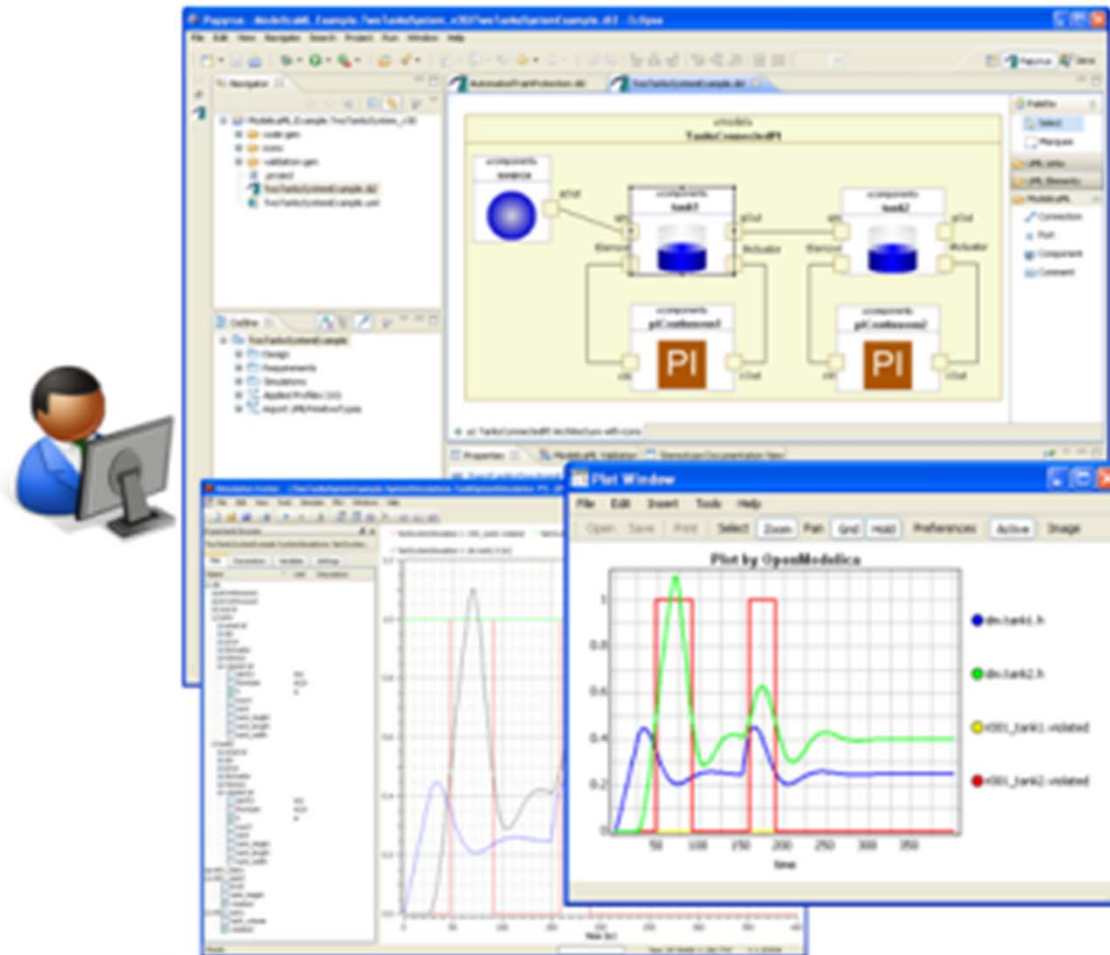
The Outline panel shows the project structure with the following methods:

- readSettingsFile(String filePath, Interactive.InteractiveSym
- runBackendQ => Boolean
- runModparQ => Boolean
- serverLoop(Integer inInteger, Interactive.InteractiveSym
- serverLoopCorba(Interactive.InteractiveSymbolTable inIn
- simcodegen(Absyn.Path inPath1, SCode.Program inProgr
- transformFlatProgram(Absyn.Program p, String filename)
- translateFile(list<String> inStringLst)
- versionRequest

The Console panel shows the output of the program, including the message 'Parsed progr'.

# Eclipse environment for ModelicaML

## ① System Modeling with ModelicaML



## ② Modelica Code Generation

```
1 // Modelica
2 // Example: TankControl
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4 //
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## ③ System Simulation with Modelica Tools

- Tutorial tomorrow at ModProd 2011!

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

# Latest Developments (2011-2012)

2011 - 2012 - Most focus on MSL 3.1 support & performance

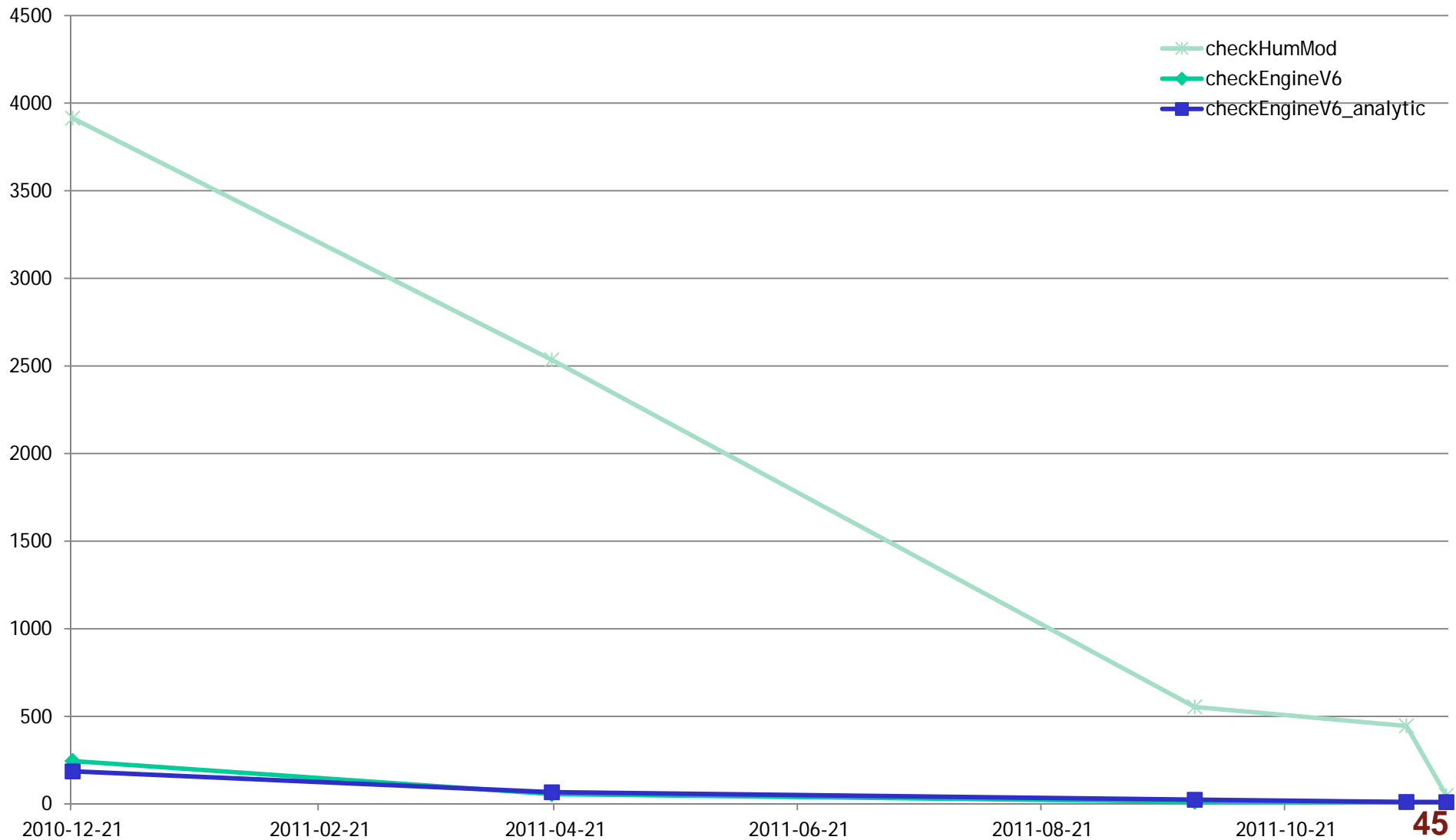
- Support for Modelica Standard Library 3.1
- Media now flattens and we can simulate some of the examples (backend work still)
- Fluid is partially supported and new work has started on a new Inst module
- **Front-end**
  - Performance Enhancements
  - Operator overloading
  - New phases to simplify things (SCode\*)
  - New interactive API
- **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**
  - MDT GDB debugging based on GDB and the bootstrapped compiler
  - OMEdit - improvements
  - Bootstrapping OMC (98% finished) GC speedup remaining
  - 2473 commits in subversion from 2011 to Feb. 7, 2012
  - Bug fixes ~300+ (OSMC)
  - Release 1.7.0, 1.8.0, 1.8.1 (Linux, Mac, Windows)
  - Downloads Windows (~31246) , Linux (~10245), Mac (~4543)



# Latest Developments (2011-2012)

2011 - 2012 - Most focus on MSL 3.1 support & performance

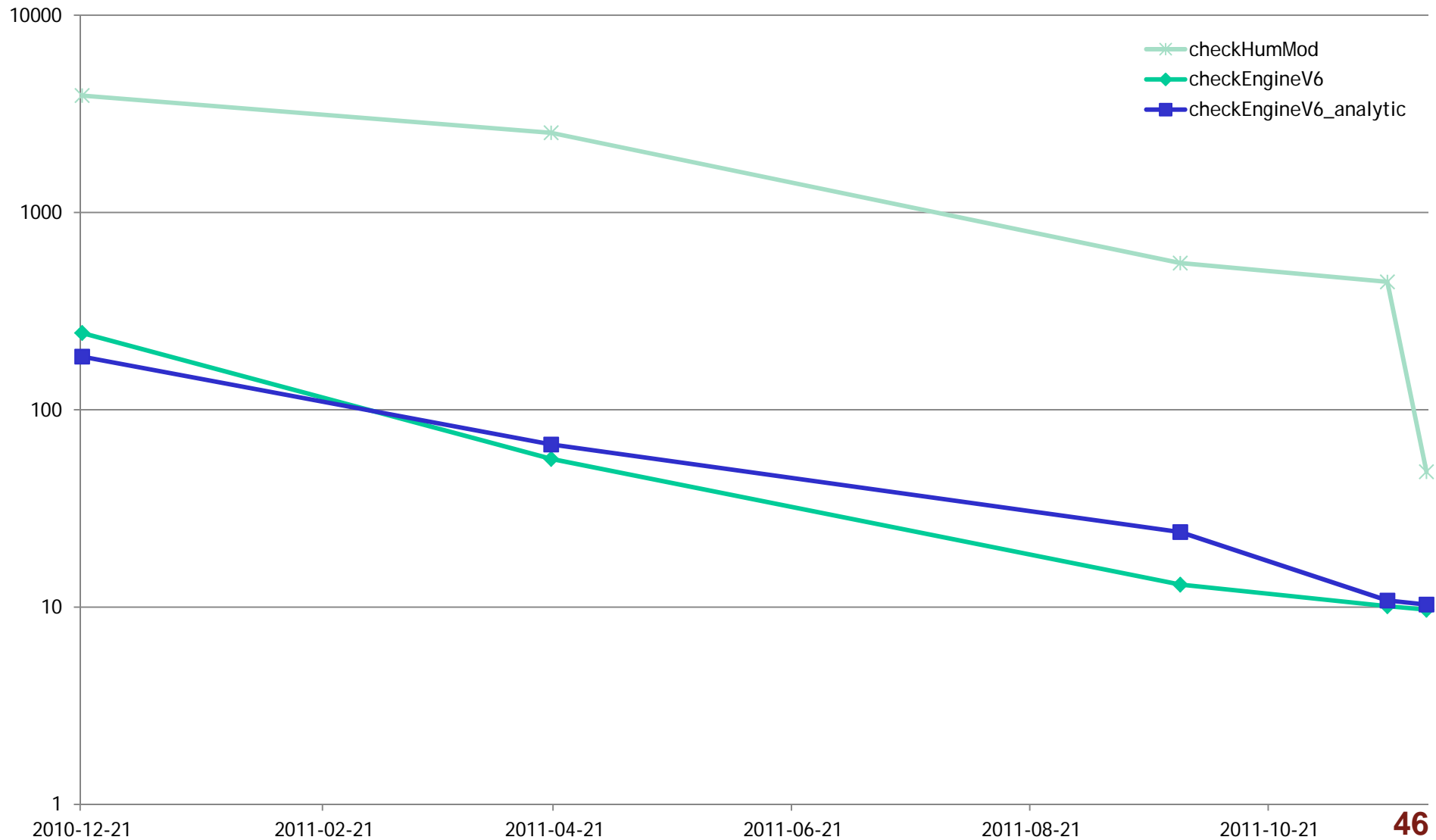
## OpenModelica Performance Benchmarks



# Latest Developments (2011-2012)

2011 - 2012 - Most focus on MSL 3.1 support & performance

## OpenModelica Performance Benchmarks



# Latest Developments (2011-2012)

## Performance measurements for OpenModelica

[Adrian.Pop@liu.se](mailto:Adrian.Pop@liu.se)

Tests done on an HP Elitebook 8440p, Core-i7 (M620) @ 2.67Gz 8GB RAM, SSD, Win 7 64bit

OpenModelica OMC is compiled with MinGW32 GCC 4.4 with -O3

All numbers are in seconds

<https://openmodelica.org/svn/OpenModelica/trunk/doc/performance/benchmarks>

legend

faster
slower
out of memory

OpenModelica				operations			difference		max (MB)	
version	date	revision	test	instantiate	check	equations	instantiate	check	mem	
1.6.0	2010-12-21	7524	HumModOMCTotal	2988	3914	24055	0	0	2355,2	
			RobotR3	10,2	22	4828	0	0		
			EngineV6	34,6	245	12491	0	0		
			EngineV6_analytic	27,5	186	9491	0	0		

Dymola 7.4

check
13,95
4,68
2,6
2,4

version	date	revision	test	instantiate	check	equations	instantiate	check	mem		
1.7.0	2011-04-20	8711	HumModOMCTotal	2391	2535	24055	597	-20%	1379	-35%	675
			RobotR3	9,1	11,5	4828	1,1	-11%	10,5	-48%	
			EngineV6	25,4	56,4	12491	9,2	-27%	188,6	-77%	
			EngineV6_analytic	25,6	66,7	9491	1,9	-7%	119,3	-64%	

version	date	revision	test	instantiate	check	equations	instantiate	check	mem		
1.8.0	2011-09-28	9944	HumModOMCTotal	550	554	24091	1841	-77%	1981	-78%	274
			RobotR3	7,1	7,5	4828	2	-22%	4	-35%	
			EngineV6	12	13	12491	13,4	-53%	43,4	-77%	
			EngineV6_analytic	24	24	9491	1,6	-6%	42,7	-64%	

version	date	revision	test	instantiate	check	equations	instantiate	check	mem		
1.8.0	2011-11-20	10556	HumModOMCTotal	437	445	28083	113	-21%	109	-20%	245
	revisions	3032	RobotR3	6,8	7,1	4828	0,3	-4%	0,4	-5%	
			EngineV6	9,5	10,1	12491	2,5	-21%	2,9	-22%	
			EngineV6_analytic	10,2	10,8	9491	13,8	-58%	13,2	-55%	

more equations due to more correct handling of expandable connectors

version	date	revision	test	instantiate	check	equations	instantiate	check	mem		
1.8.0	2011-11-30	10604	HumModOMCTotal	46,5	48,5	28083	390,5	-89%	396,5	-89%	243
	revisions	48	RobotR3	5,6	6	4828	1,2	-18%	1,1	-15%	
			EngineV6	8,8	9,7	12491	0,7	-7%	0,4	-4%	
			EngineV6_analytic	9,6	10,3	9491	0,6	-6%	0,5	-5%	

- 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

## Action plan to support Media & Fluid

- Simplify flattening (instantiation) by preprocessing phases
  - Remove imports (100%)
  - Apply redeclare and modifiers (100%)
  - Perform dependency analysis (100%)
  - Handle record constants (100%)
  - Instantiate in phases and do type checking after (30%)
- Back-end issues
  - Complex equation support (30%)
  - Other code generation issues
  - Initialization
- Any other unknown issues
- *Hopefully full Media & Fluid flattening in 2012*

# 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)
- **Work in progress**
  - First Garbage Collector (GC) drafts combining mark-and-sweep and generational are working (but not fast enough)
  - Work is on the way to speedup the GC to be able to switch to bootstrapped compilation

# Thank You!

## Questions?

*asodja, sjoelund.se, sebco011, lochel, wbraun, niklwors, hubert.thieriot, petar, perost, Frenkel TUD, Unknown, syeas460, adeas31, ppriv, ricli576, haklu, dietmarw, levsu, mahge930, x05andfe, mohsen, nutaro, x02lucpo, floross, 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*

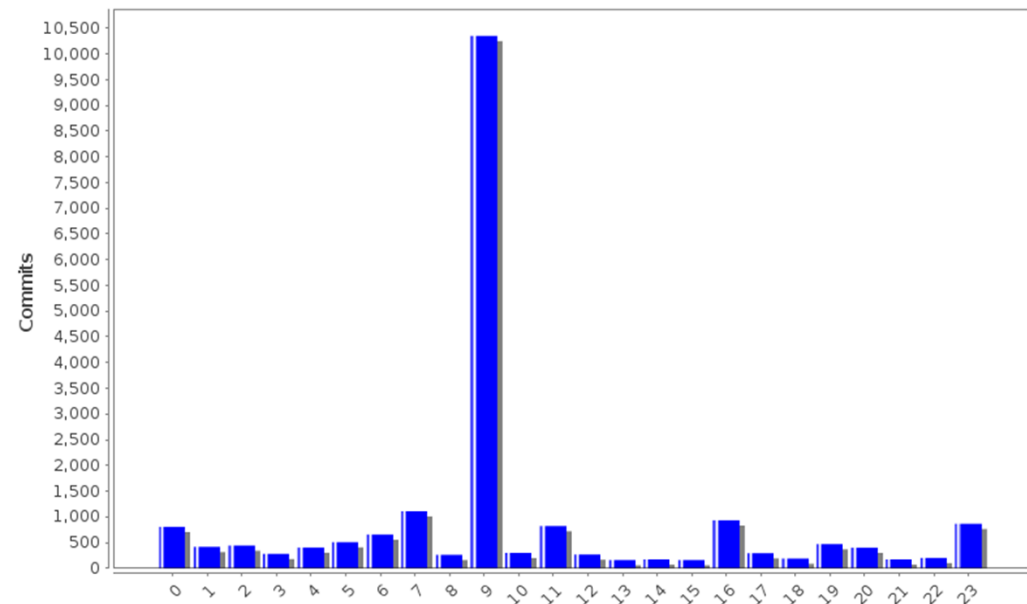
**OpenModelica Project**  
**<http://www.OpenModelica.org>**



# Funny Facts

- 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

