



Speaking your language

Václav Pech



MPS



Products

Support

Community

Company



IDEs

- IntelliJ IDEA
- PhpStorm
- PyCharm
- RubyMine
- WebStorm
- AppCode

.NET

- ReSharper
- dotTrace
- dotCover
- dotPeek

Teamware

- TeamCity
- YouTrack

Mobile development

- AppCode
- IntelliJ IDEA Community Edition

Languages



- MPS
- Kotlin

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MPS



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IDEs

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Languages

- MPS
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High thoughts must have high language.

Aristophanes



```
1 <!DOCTYPE html PUBLIC "-//W3C//DTD XHTML
2 <html xmlns="http://www.w3.org/1999/xhtml" la
3 <head>
4 <title>JetBrains :: World's Leading Vendor of
5 <meta name="robots" content="all" />
6 <meta name="copyright" content="JetBrains, In
7 <meta http-equiv="Content-Type" content="text
8 <meta name="verify-v1" content="9EryFSFvvHuIK
9 <meta name="google-site-verification" content:
10 <meta class="local" name="description" conte
```

Language Workbenches

provide

high-level mechanisms for implementing languages

Karel

The image shows a screenshot of a Karel environment. On the left is a grid world window titled "Robot Kaja". The grid is 15x15 cells. Red cells represent walls. The robot is a grey triangle pointing right, located at row 5, column 5. There are two objects labeled "1" at row 3, column 6 and row 5, column 6. The right side of the image shows a code editor window titled "Kajak - [~/MPSProjects/Kajak]". It contains the following code:

```
Script Karel runs as
require Common

turnRight
while not mark do
  traceStep
end
pick

# Routine definitions
routine traceStep means
  drop
  safeStep
end

routine safeStep means
  while wall ahead do
    turnLeft
  end
  step
end

routine turnRight means
  repeat 3 times
    turnLeft
  end
end

routine turnAround means
  turnLeft
  turnLeft
end

end
```

At the bottom of the screenshot, there is a status bar with icons for "4: Run", "Version Control", "9: Changes", and "0: Messages". The bottom right corner shows "Git: master".

MPS IDE support for DSLs

Editor

- Syntax coloring, code-completion, refactoring
- Navigation / Find usages
- Search / Replace
- Error highlighting / Quick fixes

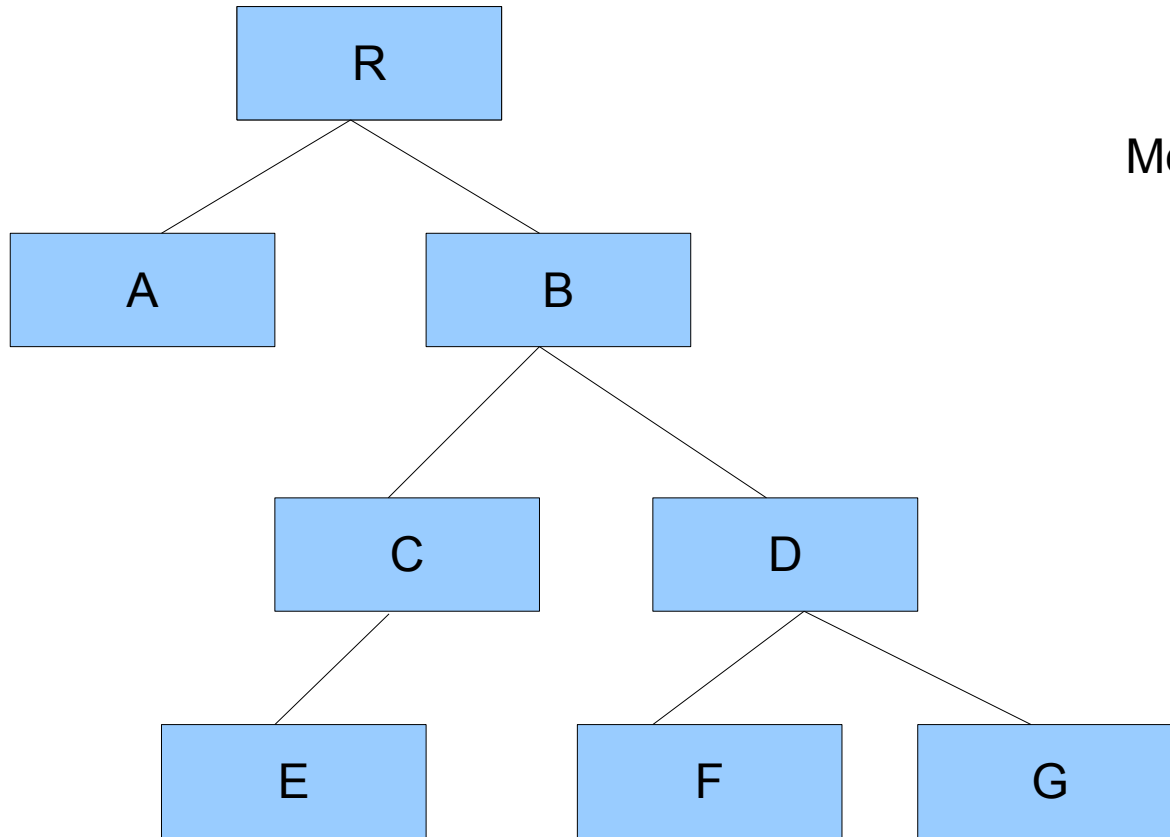
Debugger, Test runner

Version Control Support

Code Analysis

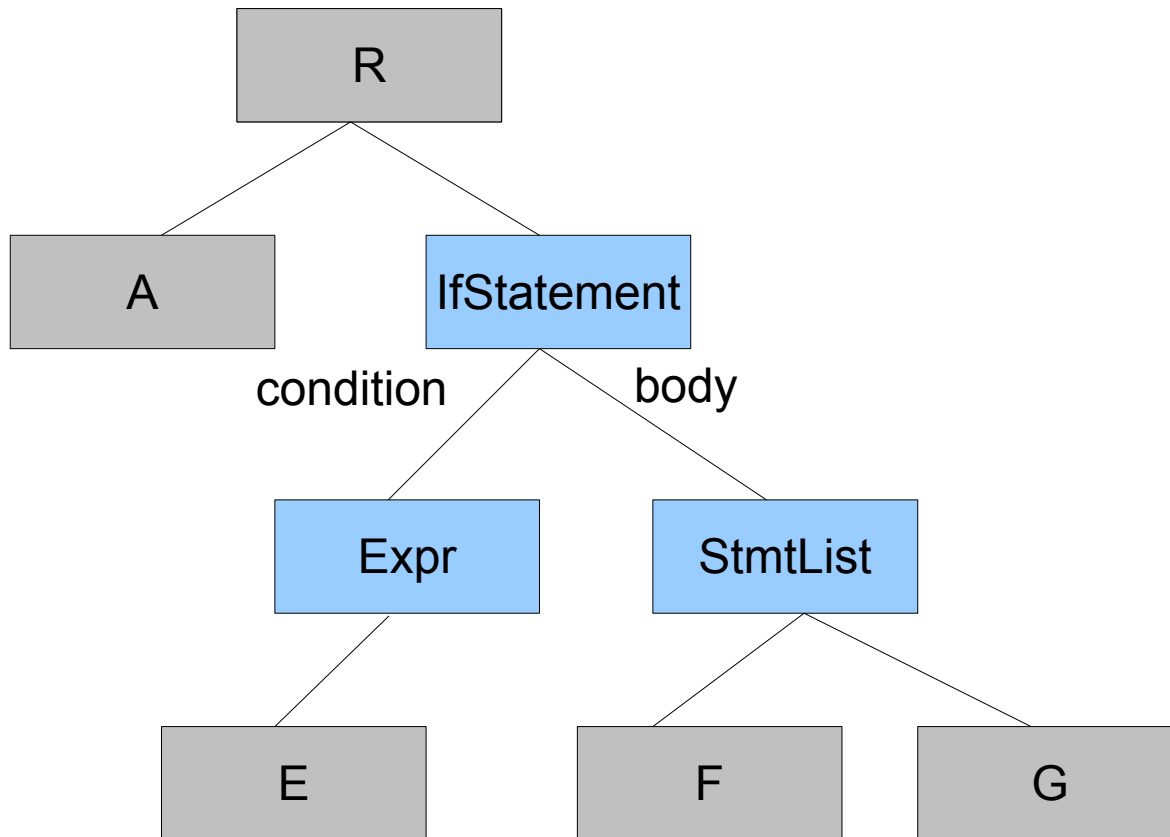
Reporting, Visualization

Programs are trees

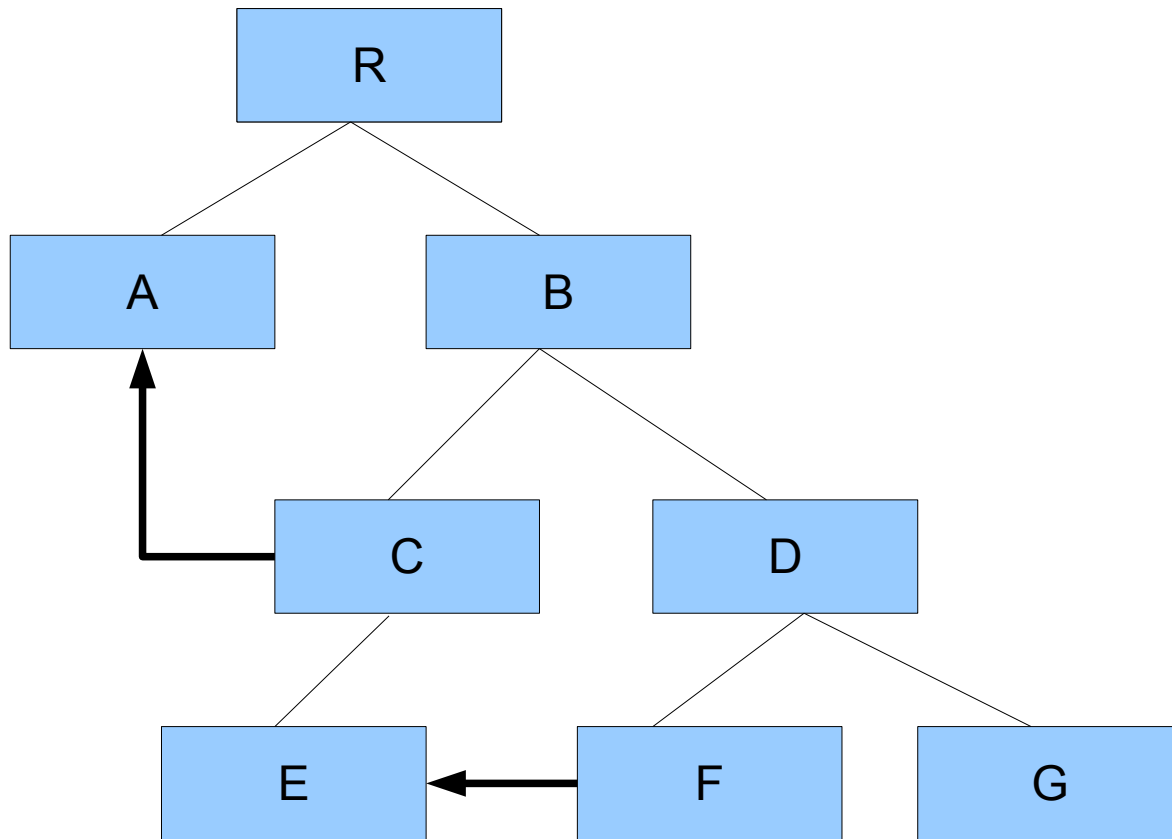


Models composed of nodes

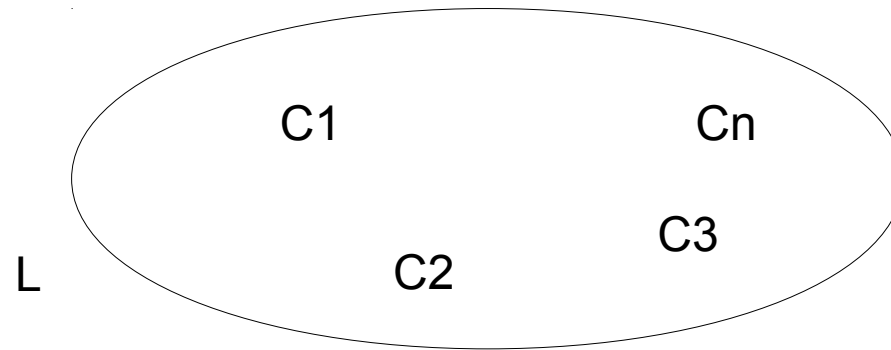
Programs are trees



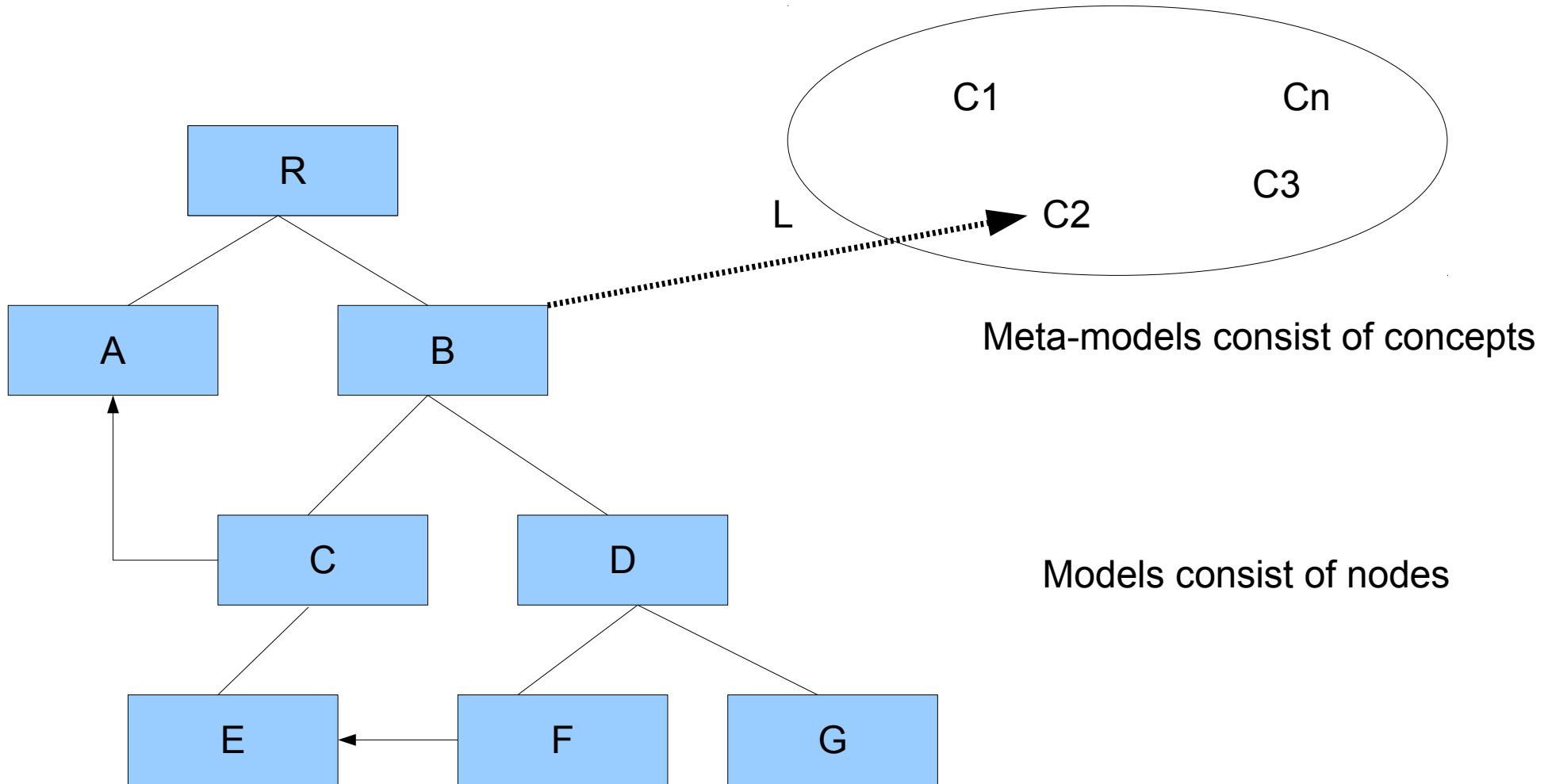
References cross the tree



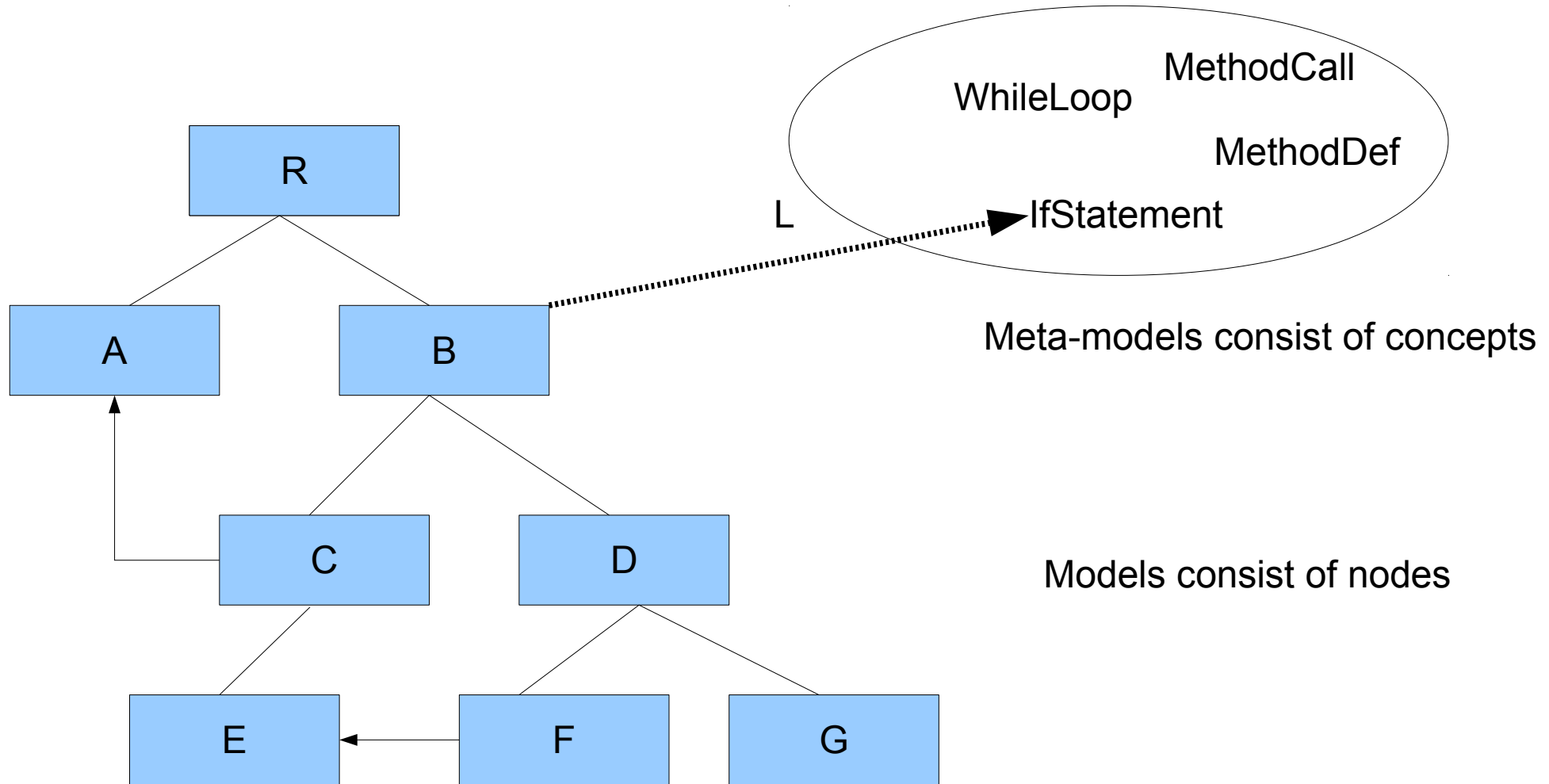
Languages are sets of concepts



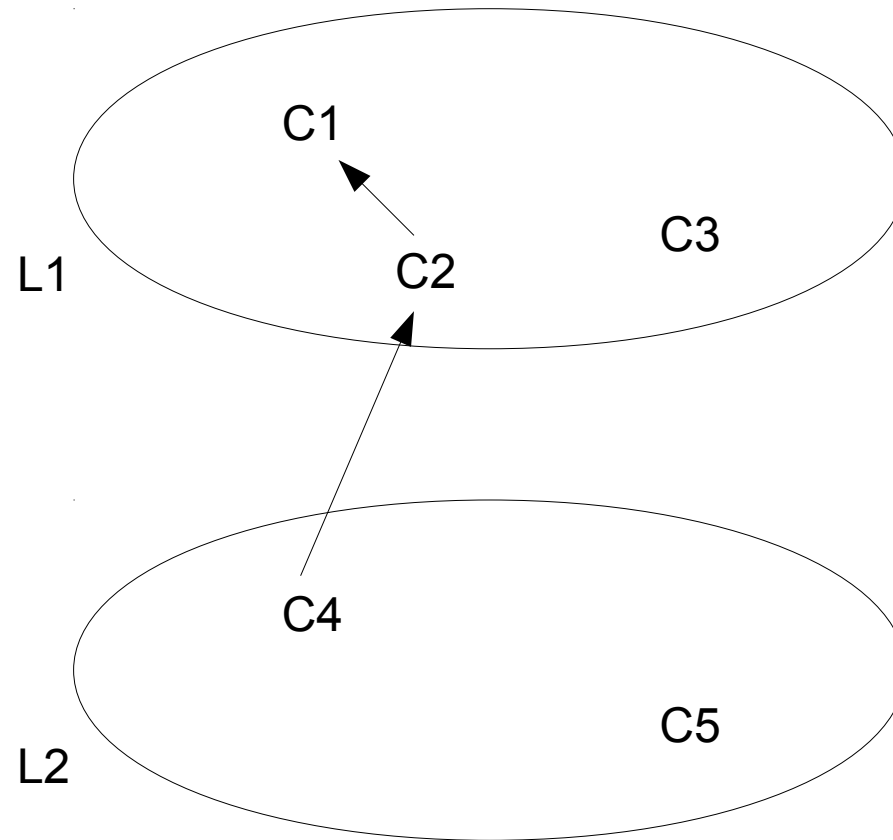
Programs and Languages



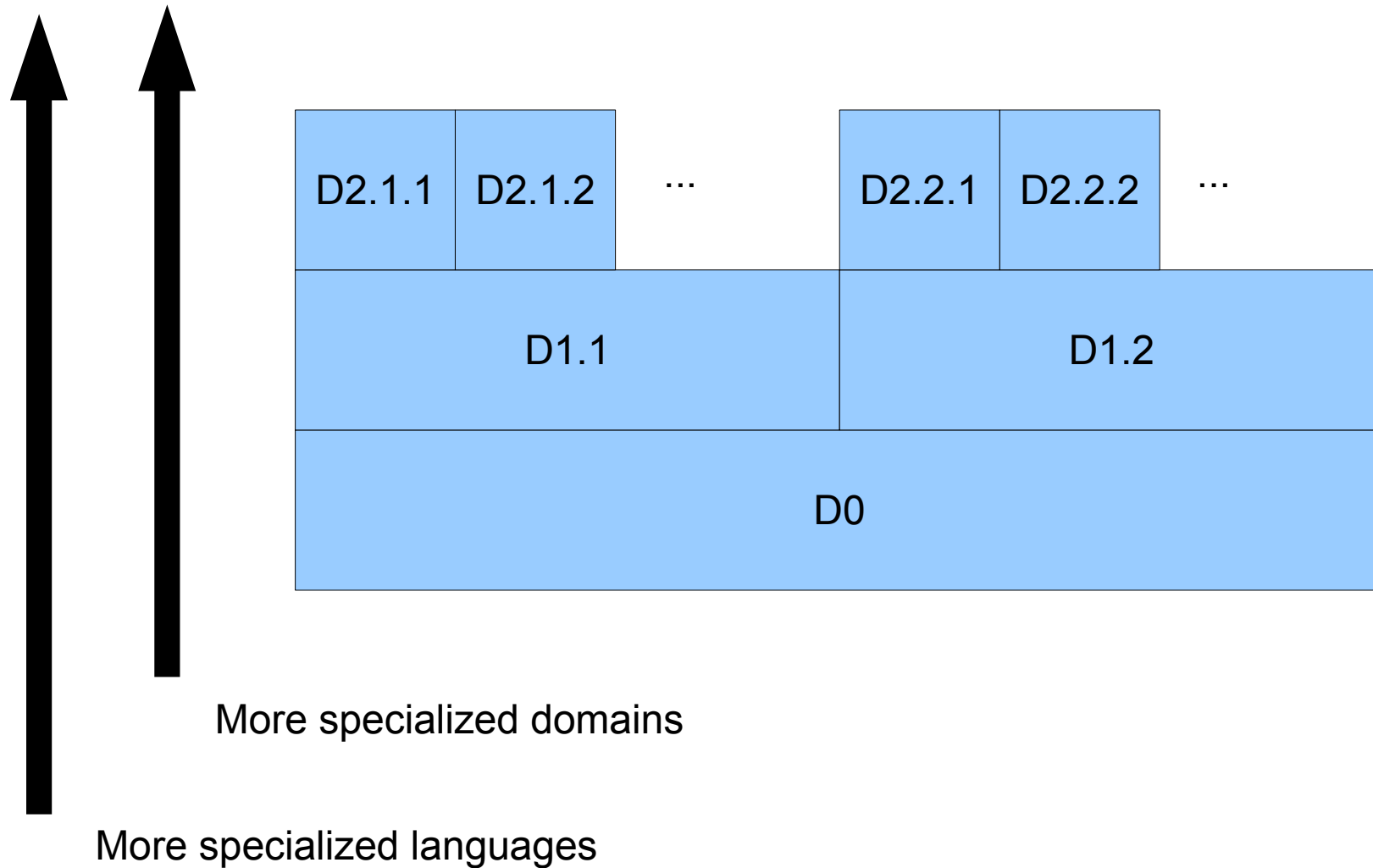
Programs and Languages



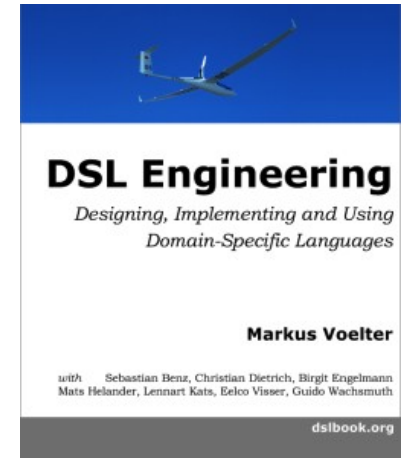
Concept inheritance



Domain Hierarchy

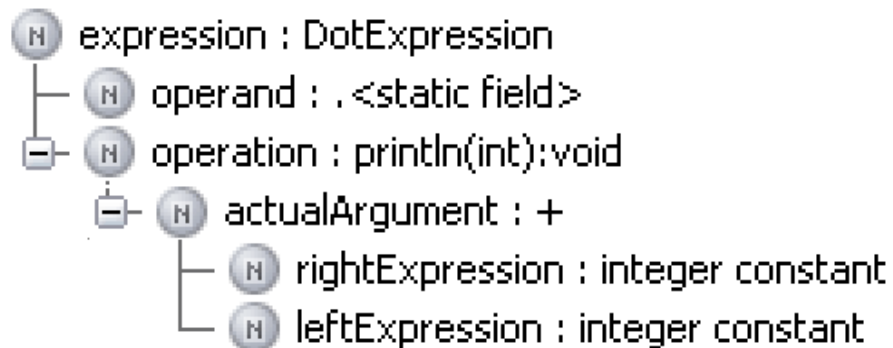


Language modularization



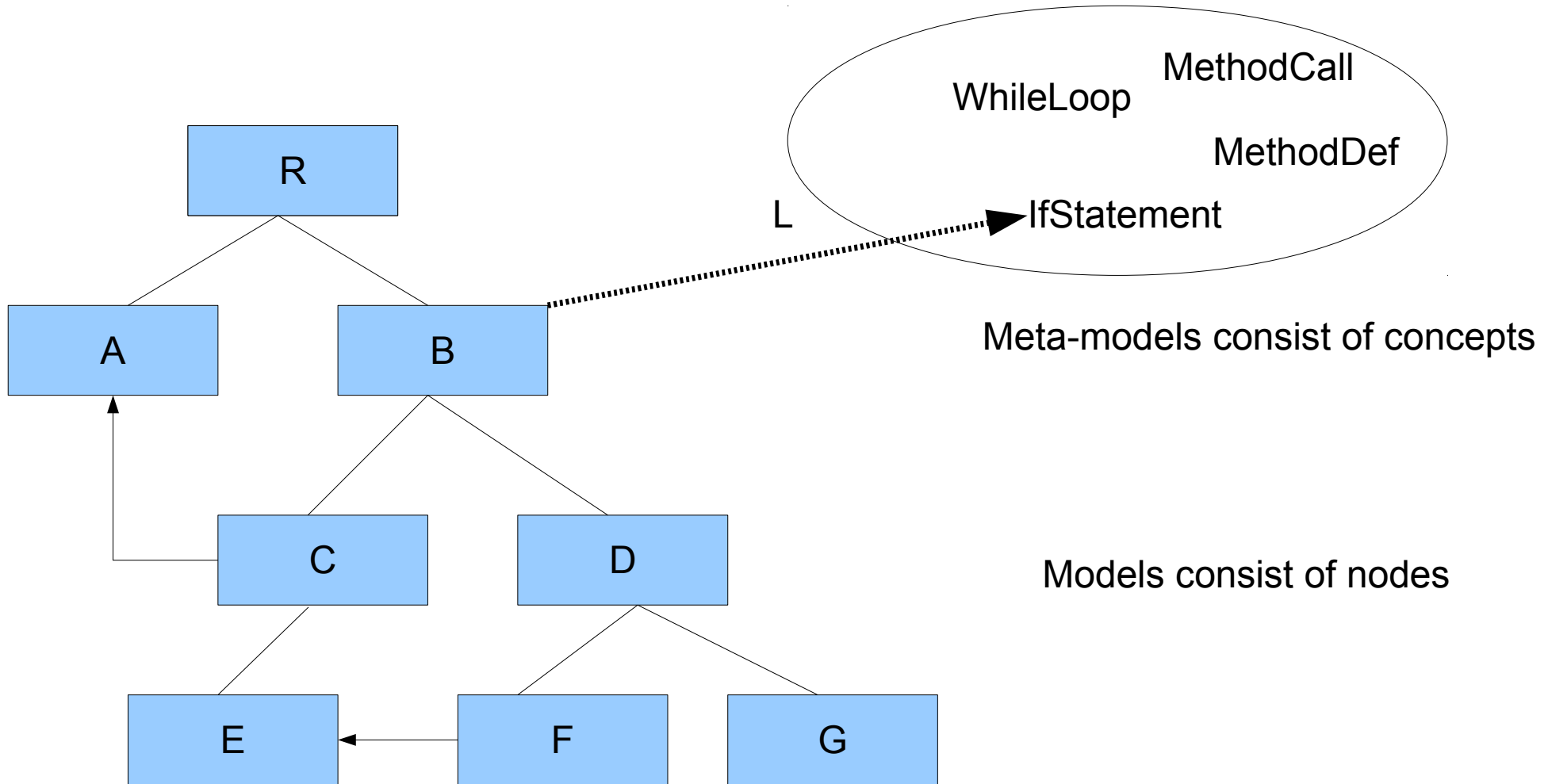
Categorization proposed by Markus Voelter, <http://voelter.de>

MPS Projectional Editor

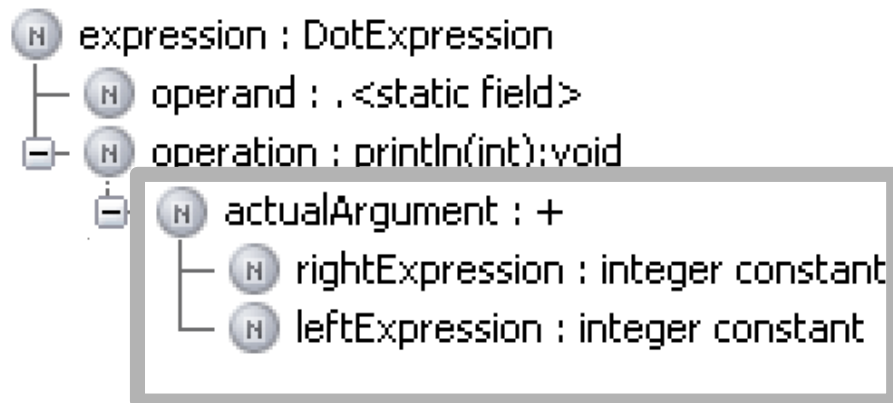


```
<<constructor>>
<<methods>>
public static void main(String[] args) {
    System.out.println(2 + 2);
}
```

Programs and Languages



MPS Projectional Editor



```
<<constructor>>
<<methods>>
public static void main(String[] args) {
    System.out.println(2 + 2);
}
```

Projectional editor

The coding experience is different (better :)

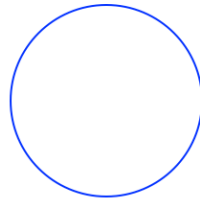
Cooperate with the existing text tool-chain

Instant preview

Interpret the model on-the-fly

Painting MyDrawing

```
circle x: 200 y: 300 radius: 100 color: BLUE
```



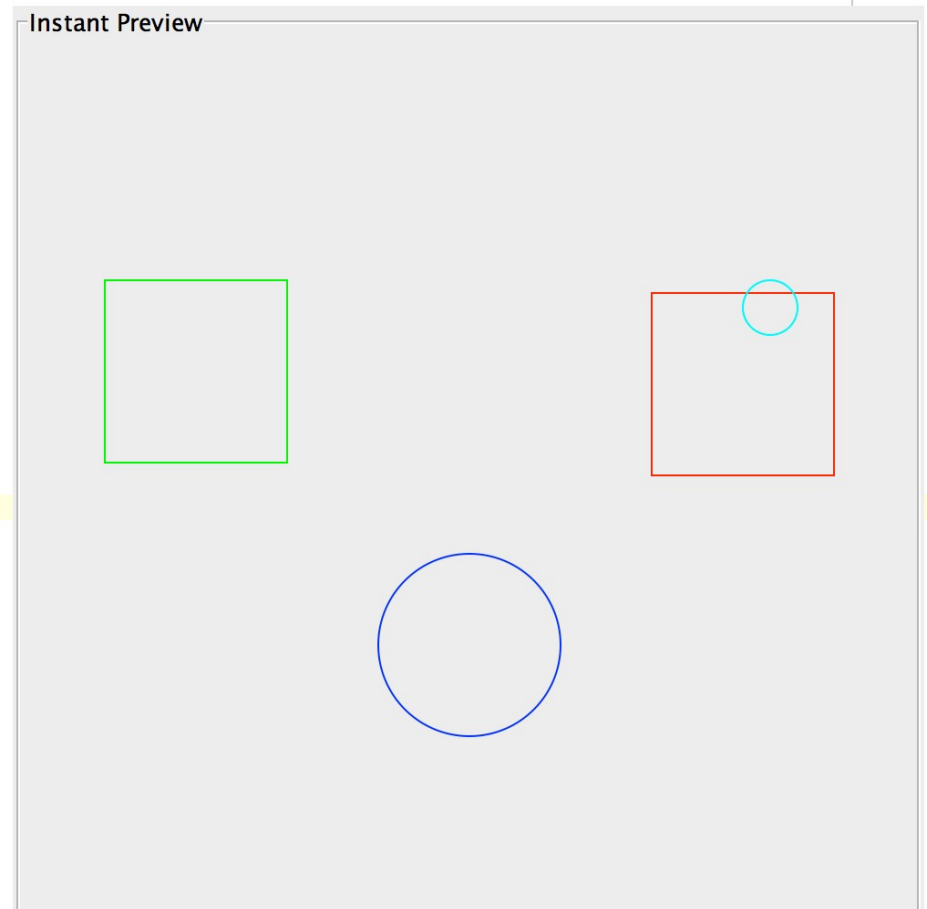
```
square x: 50 y: 150 size: 100 color: GREEN
```



```
square x: 350 y: 157 size: 100 color: RED
```



```
circle x: 400 y: 150 radius: 30 color: CYAN
```



Non-parseable notations

```
public void run(string[] args) {  
    map<string, Object> person = this.createPerson();
```

```
// A decision table gets translated into a series of nested "if" statements  
// A table can be manipulated just like any other expression - try selecting one and invoke e.g. "Extract Method"
```

```
string title = string Default: "Nothing to show here"
```

	<i>isMale</i> (person)	<i>isFemale</i> (person)
<i>isChild</i> (person)	"boy"	"girl"
<i>isAdult</i> (person)	"man"	"woman"

```
System.out.println("The title is: " + title);
```

```
Money discount;
```

```
discount = Money Default: 0 EUR
```

	<i>isMale</i> (person) && 10 EUR > 5 EUR	<i>isFemale</i> (person)
<i>isBaby</i> (person)	100 EUR	100 EUR
<i>isChild</i> (person)	50 EUR	50 EUR
<i>isAdult</i> (person)	5 EUR + this.seasonalBonus()	10 EUR + this.seasonalBonus()
<i>isRetired</i> (person)	20 USD - 10 USD	10 EUR + (person["name"] == "Susan") ? this.seasonalBonus() : 40 EUR

```
System.out.println("Your name: " + person["name"]);
```

```
System.out.println("Your discount: " + discount);
```

Language combinations

```
parallel for (final Money bonus in bonuses) {  
  unless (bonus > 100 EUR) {  
    System.out.println("Processing: " + bonus);  
    @thread safe process(bonus);  
  }  
}
```


Multiple projections

structural **workflow** advancedIssueTracking

```
state Open;  
state WaitingVerification;  
state Closed;
```

```
event Close;  
event Verify;  
event Reopen;
```

```
on event Close  
  Open -> WaitingVerification
```

```
on event Verify  
  WaitingVerification -> Closed
```

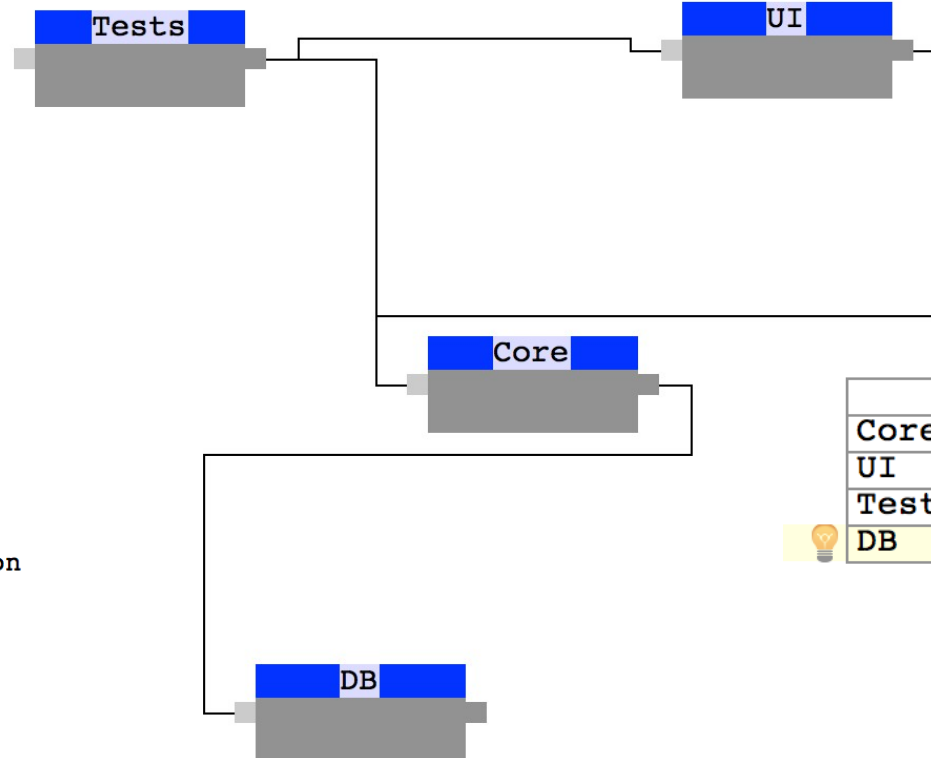
```
on event Reopen  
  WaitingVerification -> Open
```

```
on event Reopen  
  Closed -> Open
```

tabular **workflow** advancedIssueTracking

	event Close;	event Verify;	event Reopen;
state Open;	-> WaitingVerification		
state WaitingVerification;		-> Closed	-> Open
state Closed;			-> Open

Graphical notations




```
name filter: <no filter>
component set My application
  component Core
    depends on DB

  component UI
    depends on Core

  component Tests
    depends on Core
    depends on UI

  component DB
    << ... >>
```



	Core	UI	Tests	DB
Core				+
UI	+			
Tests	+	+		
DB				

Language distribution

Design DSLs in MPS

Use them in

- IntelliJ IDEA
- Standalone IDE (on IntelliJ platform)
- Web

Aspects of language definition

Aspects of language definition

- Abstract syntax
- Concrete syntax (editor)
- Static semantics
 - Constraints
 - Type-system
 - Dataflow
- Execution semantics / Generator
- IDE support

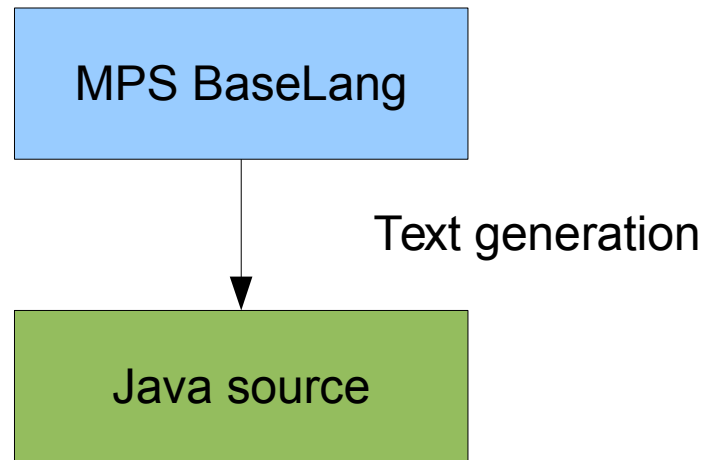
Aspects of language definition

- Abstract syntax
- Concrete syntax (editor)
- Static semantics
 - Constraints
 - Type-system
 - Dataflow
- Execution semantics / Generator
- IDE support

Code generation

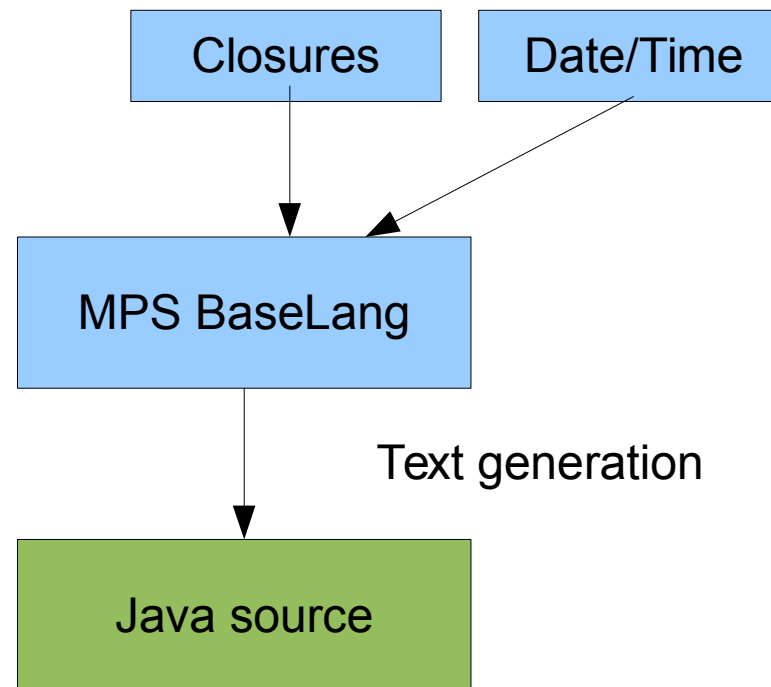
Java source

Code generation

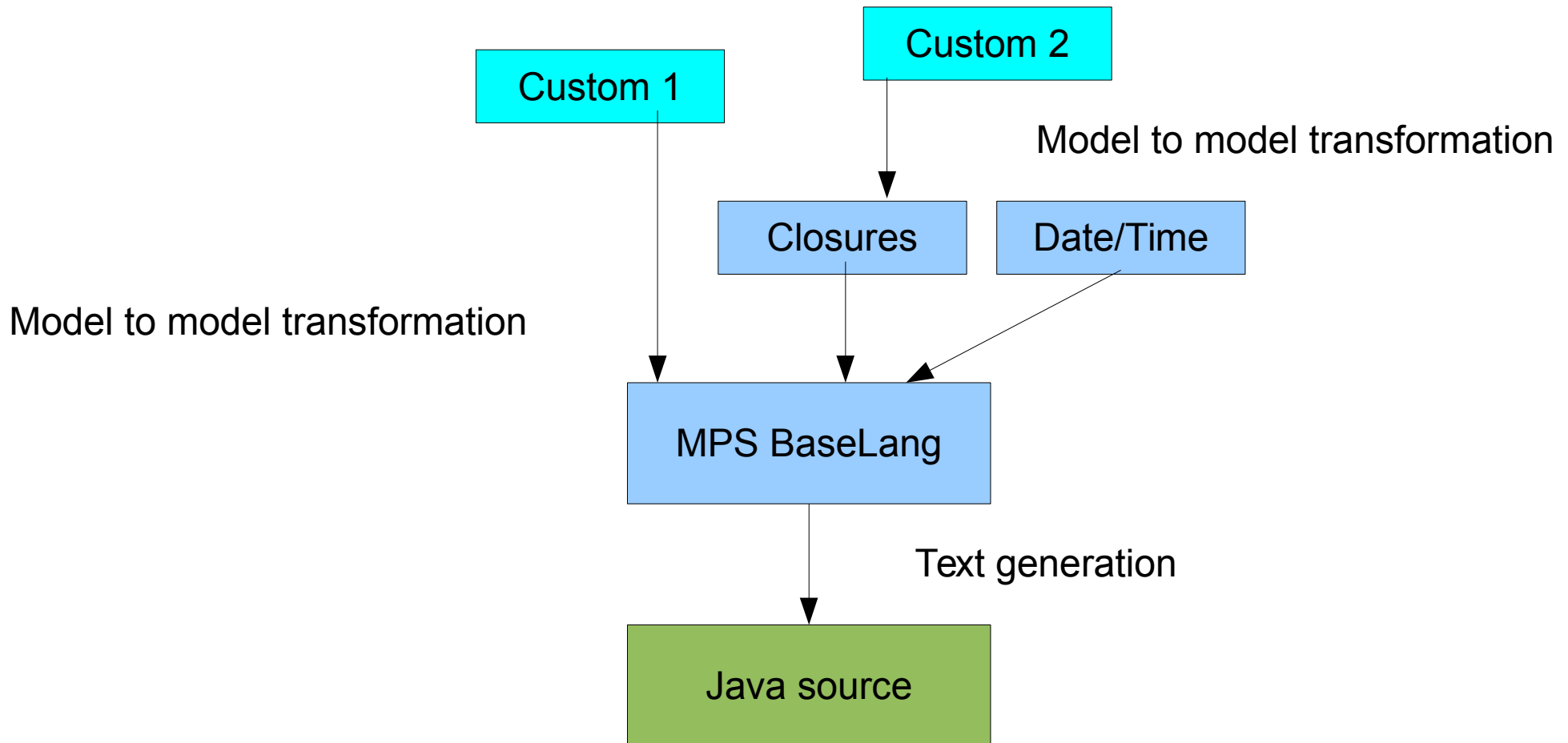


Code generation

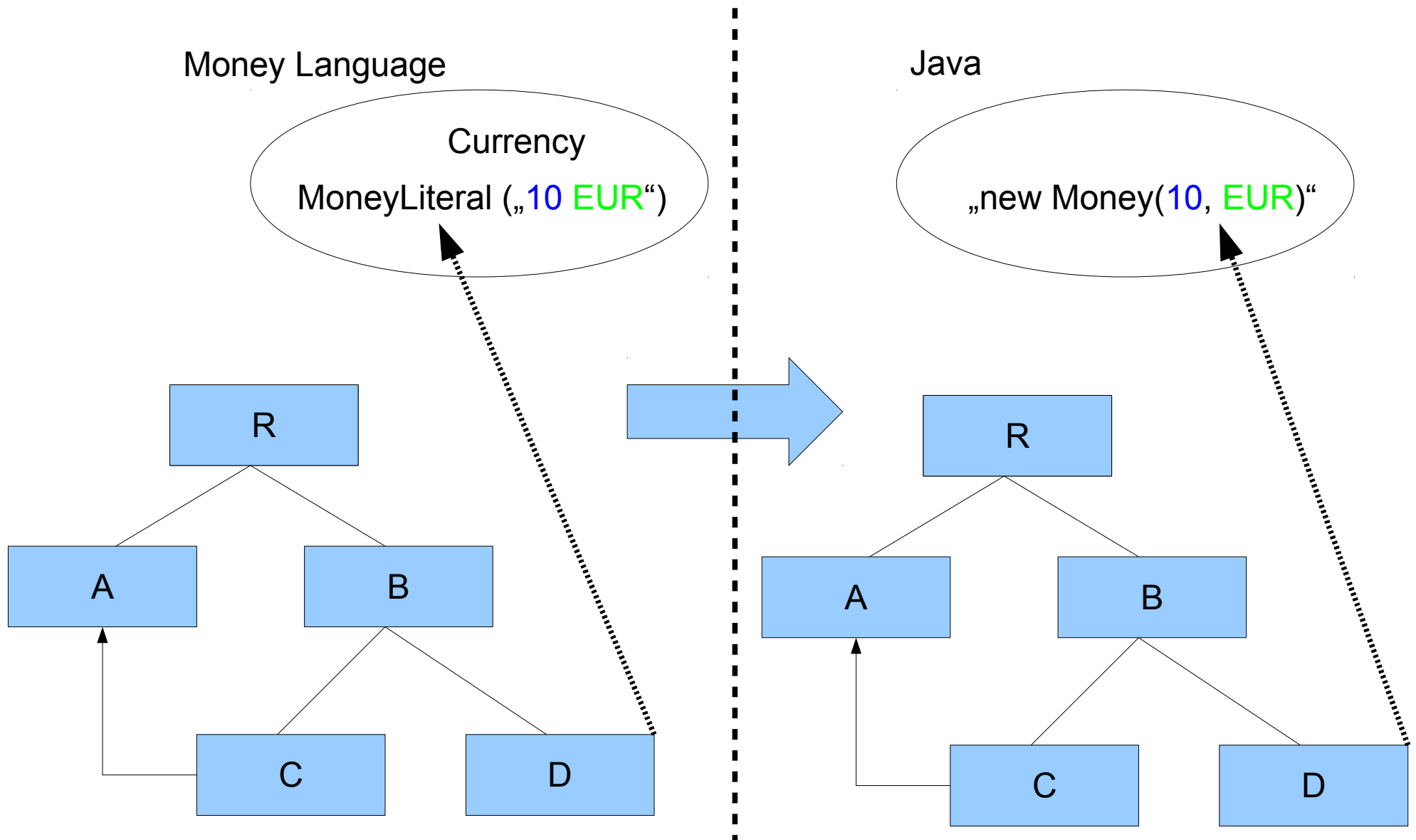
Model to model transformation



Code generation



Model-to-model transformation



Model-to-model transformation

```
template reduce_MoneyLiteral
input MoneyLiteral

parameters
<< ... >>

content node:
{
  <TF [new Money($[1], "$[2]") ] TF>;
}
```

 Structure  Editor  Constraints  Behavior  Typesystem  Generator

pector

brains.mps.lang.generator.structure.PropertyMacro

property macro

comment : <none>

value : (templateValue, genContext, node, operationContext)->int {
 node.amount;
}

Model-to-model transformation

```
while not wall ahead do  
  repeat 2 times  
    step  
  end  
end
```

```
end
```

```
template reduce_Repeat  
input Repeat
```

```
parameters  
<< ... >>
```

```
content node:
```

```
{  
  <TF for (int  $[i]$  = 0; i <  $[10]$ ; i++) { TF>  
    $COPY_SRC[System.out.println(" "); ]  
  }  
}
```

Structure Editor Data Flow Generator

ector

brains.mps.lang.generator.structure.PropertyMacro

property macro

```
comment : <none>  
value : (templateValue, genContext, node, operationContext)->int {  
  node.count;  
}
```

Model-to-model transformation

```
while not wall ahead do
  repeat 2 times
    step
  end
end
```

```
template reduce_Repeat
input Repeat
```

```
parameters
<< ... >>
```

```
content node:
```

```
{
  <TF for (int $[i] = 0; i < $[10]; i++) { TF>
    $COPY_SRC[System.out.println(" "); ]
  }
}
```

Structure Editor Data Flow Generator

ector

brains.mps.lang.generator.structure.PropertyMacro

```
property macro
```

```
comment : <none>
```

```
value : (templateValue, genContext, node, operationContext)->int {
  node.count;
}
```

Firefox - YouTrack

My MPS tasks

Found 2 issues sorted by: Priority desc

Tags (1)

Saved Searches (5)

Filters

Threads - JetBrains Forum

Threads

Problems with custom MPS build

Alexey Pomelov, last by Evgeny Gryaznov 6:54 am

Calling the textgen procedure for super concept

Alexey Pomelov

Creating pre-processor for meta-programming

Alexander Ivanov 23 Meta Pro

Smart re-processor for meta-programming

Dmitry Ivanov

Firefox - JetBrains Forum

Threads - JetBrains Forum

Threads

Problems with custom MPS build

Alexey Pomelov, last by Evgeny Gryaznov 6:54 am

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Alexander Ivanov 23 Meta Pro

Smart re-processor for meta-programming

Dmitry Ivanov

JetBrains MPS 2.0.1

Tabicum

create date: -no data-

protocol: Tabicum

samples:

```

@group: Plants type: Organism {
  organismKind: Nicotiana
  sample:
    Sample Name
    01
    02
    03
}

```

Input:

```

@id: 123
@description:

```

Output:

```

@id: 123
@description:

```

DATA

protocol: Coronerant

group: Coronerant

type: organism

subgroups:

```

@id: 123
@description:

```

blocks:

```

treatment block to cut back
[treatment protocol: cut back
sample input: coronerant - protocol input: coronerant
treatment parameters for sample:

```

Firefox - JetBrains Forum

Messages - JetBrains Forum

Messages

Meta Programming System > Calling the textgen procedure for super concept

6:39 am Evgeny Gryaznov

I'm afraid there is no way to invoke TextGen for the super concept. But if you have no text gen declared for the concept, the inherited one is used.

Instead you can extract text-generation code into an operation and reuse it in append clauses. Create a `LanguageTextGenDeclaration` root and declare an operation.

reply

jetbrains.mps.Launcher

Architectural - mbeddr/tutorial

File Edit View Navigate Code Analyze Build Run Tools VCS Window Help

Logical View

Components

StateMachines

Architectural

component InMemoryStore (0): stores

```

data Flights
ability store(data aFlight):
ability setup(): data SetupStat

```

component Driver (0): Coordinates the flight

```

SomeFlightData
laborates with InMemoryStore:

```

component Judge (0): Judges a flight

```

Mario StoreFlight (0): A flight in Mario StoreFlight
ver {
= Setup ==
> InMemoryStore.setup(): SetupStat
return SetupStat
}

```

statechart

Pages

Usages

Event Log

Inspector

734M of 1174M

youtrack-workflow - [C:\Users\Vadlav\youtrack\youtrack-workflow] - jetbrains-youtrack-subsystemAssignee/Set subsys...

File Workflow Edit Search View Go To Window Help

Notify on issue reassigned

Set subsystem owner as assignee for new issues

```

rule Set subsystem owner as assignee for new issues
when Assignee == null && (Subsystem.changed || project.changed) {
  if (issue.Subsystem != null) {
    issue.Assignee = issue.Subsystem.owner;
  }
}

```

State ^field (j.y.workflow.custom

Subsystem ^field (j.y.workflow.custom

Inspector

133M of 508M

Project1 - [C:\Users\Vadlav\RASEProjects\Project1] - com.example.Main - Reaaxy ActionScript Editor Beta...

File Edit Search View Go To Refactor Build Run Tools Version Control Window Help

Project

com.example

Main

```

package com.example {
public class Main extends Sprite implements <none> {
  <<initializer>>

  // static fields ----- /

  private static var image : Bitmap;

  // fields ----- /

  private var title : String;

  // constructor ----- /
  Stage flash.display
  StageAlign flash.display
  StageDisplayState flash.display
  StageQuality flash.display
  StageScaleMode flash.display
  StageVideoAvailabilityEvent flash.events
  StageVideoEvent flash.events
  StatusEvent flash.events
  String

  public function Main() {
  }

  <<static methods>>
  <<methods>>
}
<<out of package>>

```

Inspector

241M of 965M

YouTrack

The screenshot displays the YouTrack web application interface. The browser address bar shows the URL `http://youtrack.jetbrains.net/issues/MPS?q=for%3A+me+%23Unresolved+order+by:Priority+desc`. The page header includes navigation links for **New Issue**, **Issues**, **Dashboard**, and **Administration**, along with a user greeting: **Welcome, Vaclav Pech**. A search bar contains the query `for: me #Unresolved order by: Priority desc`. Below the search bar, a dropdown menu lists filters: **project**, **Priority**, **Product**, and **PR**. The search results table shows two issues:

Issue ID	Priority	Type	Fix Version	Status	Reporter	Affected Version
MPS-13273	Normal	Bug	No Fix version	Submitted	Vaclav Pech	Unknown
MPS-13275	Normal	Bug	No Fix version	Submitted	Vaclav Pech	Unknown

The footer of the page indicates: **JetBrains Issue & Bug Tracker YouTrack 3.0.4 (build #1819 [07-Sep-2011 19:48])**. It also includes links for **Help**, **Feedback**, **Powered by MPS**, and **Created in [5221 ms]**. There are also buttons for **Issues** and **Comments**.

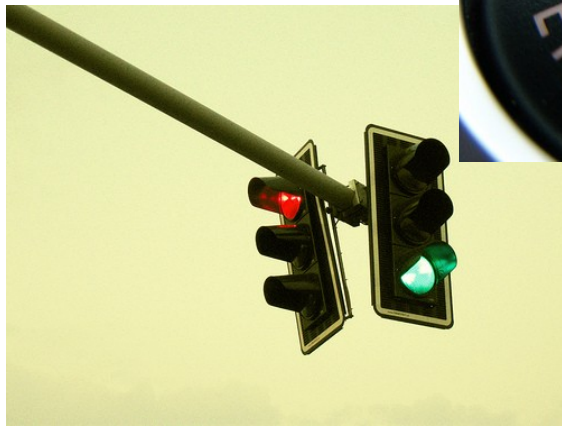
This screenshot shows the JetBrains MPS Launcher IDE. The main window displays a statechart diagram with nodes like `beforeFlight`, `landing`, and `finished`. The code editor shows snippets such as `component InMemoryStore { data Flights; ...}` and `component Driver { ...}`. The interface includes standard IDE menus like **File**, **Edit**, **View**, **Navigate**, **Code**, **Analyze**, **Build**, **Run**, **Tools**, **VCS**, **Window**, and **Help**.

This screenshot shows a code editor window with JavaScript code. A yellow highlight is visible on the line `(j.y.workflow.custom`. The code appears to be related to a workflow or state machine, with lines like `project.changed) {` and `(j.y.workflow.custom`. The editor interface includes a **Messages** pane at the bottom and a **Inspector** pane on the right showing memory usage (133M of 508M).

Code orchestra

The image displays a collection of software development tools and interfaces:

- YouTrack:** A project management tool showing a list of issues and threads. One thread is titled "Meta Programming System > Calling the textgen procedure for super concept".
- JetBrains Forum:** A forum page with a message discussing the "Meta Programming System > Calling the textgen procedure for super concept".
- IntelliJ IDEA:** The main IDE window showing a project structure with a package `com.example` and a class `Main`. The code for `Main` is visible, including a constructor and a `Main` function. A code completion popup is shown for the variable `title`, listing various classes like `Stage`, `StageAlign`, etc.
- Statechart Visualization:** A diagram showing a state machine with states like `beforeFlight`, `takeoff`, `landing`, and `landed`, connected by transitions.
- Inspector:** A tool showing the state of the application, including a `State` object with a `^field` property.

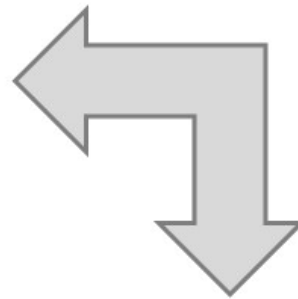


mbeddr.com

```
var avg(int, 10) currentSonar = 250;

doc State machine to manage the transition between
state machine linefollower {
  event initialized;
  event bumped;
  event blocked;
  event unblocked;
  initial state initializing {
    initialized [true] -> running
  }
  state paused {
    entry int16 i = 1;
    unblocked [true] -> running
  }
  state running {
    blocked [true] -> paused
    bumped [true] -> crash
    unblocked [true] -> crash
  }
  state crash {
    initialized [true] -> paused
  }
}

initialize {
  ecrobot set light sensor active(
```

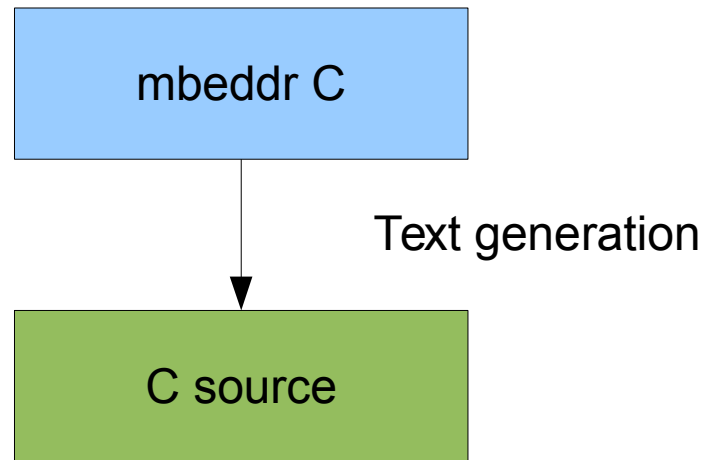


```
var avg(int, 10) currentSonar = 250;
```

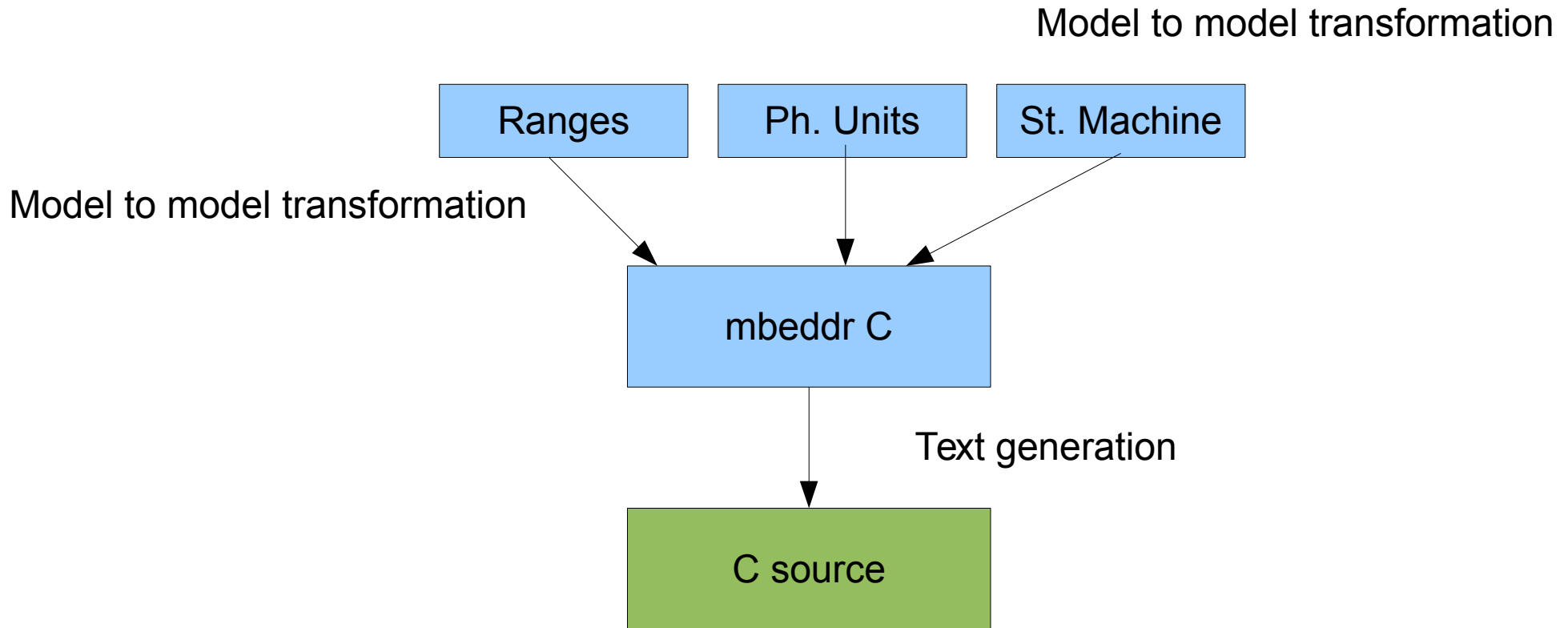
linefollower	initializing	paused	running	crash
initialized	true	running		true
bumped			true	crash
blocked			true	paused
unblocked		true	running	true

```
initialize {
  ecrobot_set_light_sensor_active(SENSOR_PORT_T::NXT_PORT_S1);
```

mbeddr code generation



mbeddr code generation



What to expect?

Graphical notations

Web-base editor

... and a lot more

Grasp the subject, the words will follow.

Cato the Elder

Questions



Want more?

<http://www.jetbrains.com/mps>

@vaclav_pech

Image credits

<http://www.flickr.com/photos/horiavarlan/4329908160/sizes/m/in/photostream/>

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<http://www.flickr.com/photos/orqwith/4325166853/>