

GEODES Research Day and Symposium Montreal, 2022

Domain-specific Version Control System

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Outline

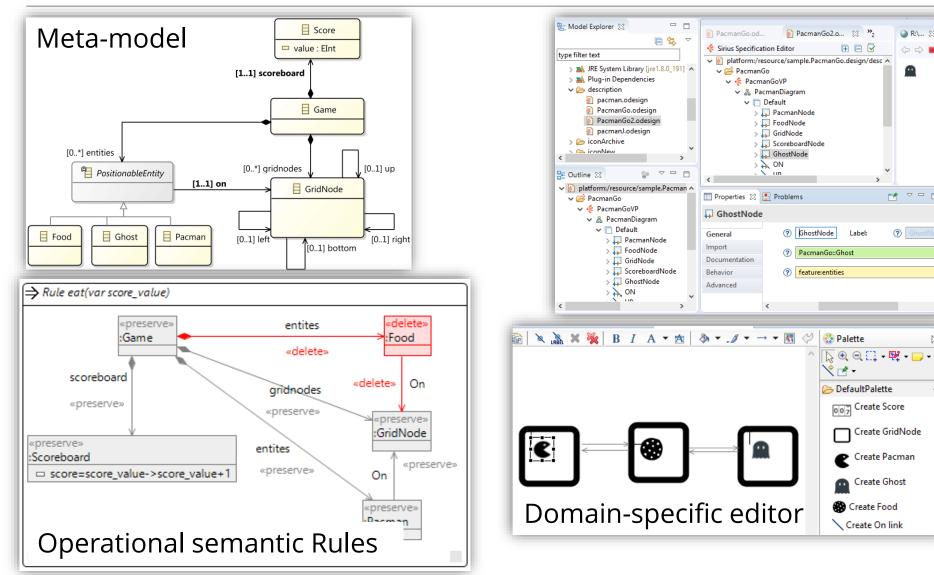
1. Current state of model comparison

2. Approach

3. Validation



Domain-Specific Modeling



Concrete syntax

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(- -) 🔳

(?) GhostNo

Create GridNode

Create Pacman

Create Ghost

FIF R

Label

<?xml version="1.0" encoding="UTF-8"?> <PacmanGo:Game xmi:version="2.0" xmlns:xmi=" http://www.omg.org/XMI" xmlns:xsi=" http://www.w3.org/2001/XMLSchema-instance xmlns:PacmanGo=" http://www.zadahmad.org/dsmcompare/PacmanGo"> <gridnodes right="//@gridnodes.1" id="1"/> <gridnodes left="//@gridnodes.0" id="5"/> <gridnodes up="//@gridnodes.3" id="GridNode 3"/> <gridnodes id="GridNode 4"/> <scoreboard value="1" id="7"/> <entities xsi:type="PacmanGo:Pacman" on="//@gridnodes.0" id="2"/> <entities xsi:type="PacmanGo:Food" on="//@gridnodes.0" id="3"/> <entities xsi:type="PacmanGo:Pacman" on="//@gridnodes.1" id="4"/> <entities xsi:type="PacmanGo:Food" on="//@gridnodes.1" id="6"/> <entities xsi:type</pre> Serialization on="//@gridnodes.2 </PacmanGo:Game>



Text-based model comparison

- Relying on text-based differencing
 - May lead to false positives
 - User has to manually find the semantics of changes



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1	< 1	1	
2		1 2 3	
3			
4		4	
5	n na-i	5	
6		6	xmlns:PacmanGo="http://www.zadahmad.org/dsm(
-	mpare/PacmanGo"		mpare/PacmanGo"
7	xsi:schemaLocation="http://www.zadahmad.org/d	7	xsi:schemaLocation="http://www.zadahmad.org,
	smcompare/PacmanGo///com.Zadahmad.DSEMF		<pre>smcompare/PacmanGo///com.Zadahmad.DSE/</pre>
	Compare/MetaModel/PacManGo.ecore">		Compare/MetaModel/PacManGo.ecore">
8	<pre><gridnodes< pre=""></gridnodes<></pre>	8	<pre><gridnodes< pre=""></gridnodes<></pre>
9 10	right="//@gridnodes.1" id="1"/>	9 10	right="//@gridnodes.1" id="1"/>
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12	left="//@gridnodes.0"	12	left="//@gridnodes.0"
13	right="//@gridnodes.2"	13	right="//@gridnodes.2"
14	id="2"/>	14	id="2"/>
15	<pre><gridnodes< pre=""></gridnodes<></pre>	15	<pre><gridnodes< pre=""></gridnodes<></pre>
16	left="//@gridnodes.1"	16	left="//@gridnodes.1"
17	id="3"/>	17	id="3"/>
18	Kscoreboard	18	<scoreboard< td=""></scoreboard<>
19	value="1"	19	value="2"
20	id="4"/>	20	id="4"/>
21	Kentities	21	<entities< td=""></entities<>
22	<pre>xsi:type="PacmanGo:Pacman"</pre>	22	<pre>xsi:type="PacmanGo:Pacman"</pre>
23	on="//@gridnodes.0"		
24	id="5"/>		
25	<entities< td=""><td></td><td></td></entities<>		
26	<pre>xsi:type="PacmanGo:Food"</pre>		
27	on="//@gridnodes.1"	23	on="//@gridnodes.1"
28	id="6"/>	24	id="5"/>
29	<pre><entities <="" pre=""></entities></pre>	25	<pre><entities< pre=""></entities<></pre>
30	<pre>xsi:type="PacmanGo:Ghost" ""</pre>	26	xsi:type="PacmanGo:Ghost"
31 32	on="//@gridnodes.2" id="7"/>	27 28	on="//@gridnodes.2" id="7"/>
	ld= / />		<pre>//> </pre>
22		29	N/Paciliando.ddille/

[Hunt, J. W., and McIlroy, D. 1976. An algorithm for differential file comparison. Tech. Rep. 41, AT&T Bell Laboratories.]

[Lin, Y., Gray, J. and Jouault, F., 2007. DSMDiff: a differentiation tool for domain-specific models. European Journal of Information Systems, 16(4), pp.349-



Model-based comparison



- The most promising and used model comparison approach
 - EMFCompare
 - An example
 - Comprehension gap
 - What the results means for user: "on changed" ???
 - And sth happened for the "Food" in the Lower panel
 - But user doesn't know OO principles !!!

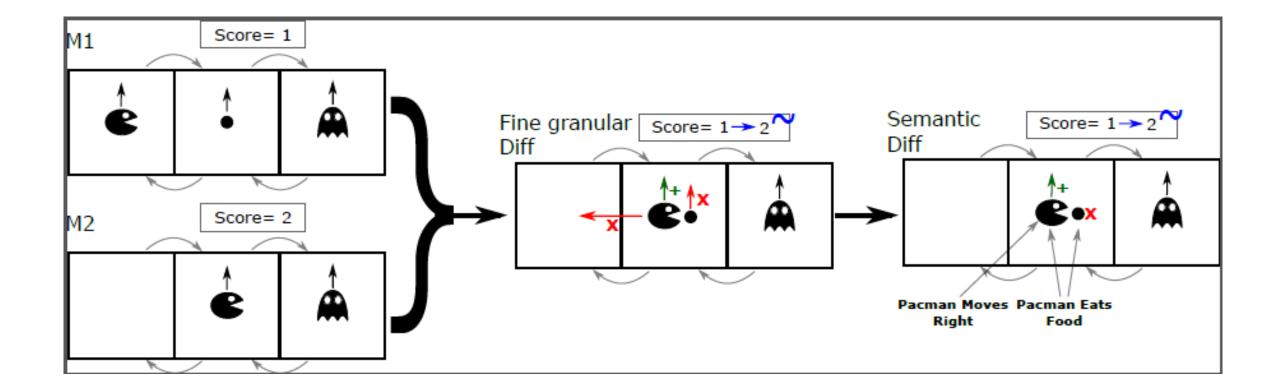
8.									
✓ ♦ > Pacman 5 ♦ ^{III} Grid Node 1 [on changed]									
									>
-									
♦■ Model Compare (Containment Features)									
DIA									
xmi									

[EMFCompare: Toulmé, A., & Inc, I. (2006, October). Presentation of EMF compare utility. In Eclipse Modeling Symposium (pp. 1-8).]



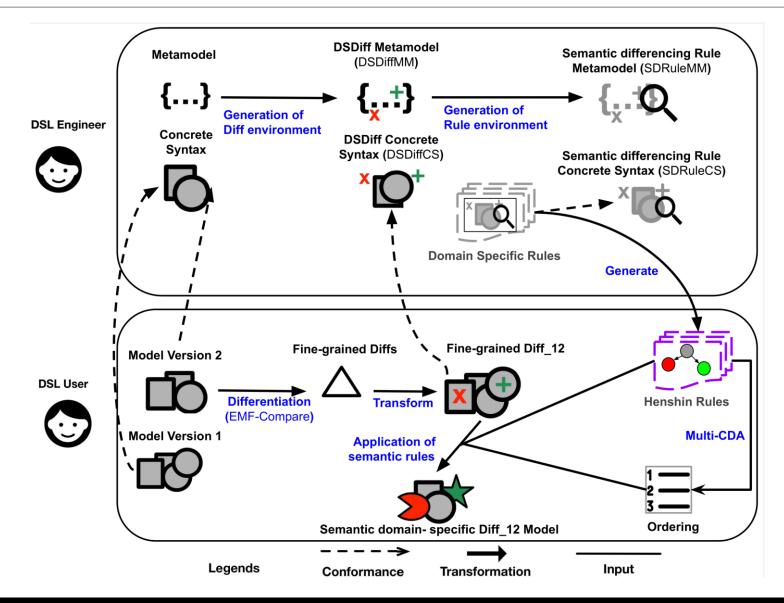
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What we want instead



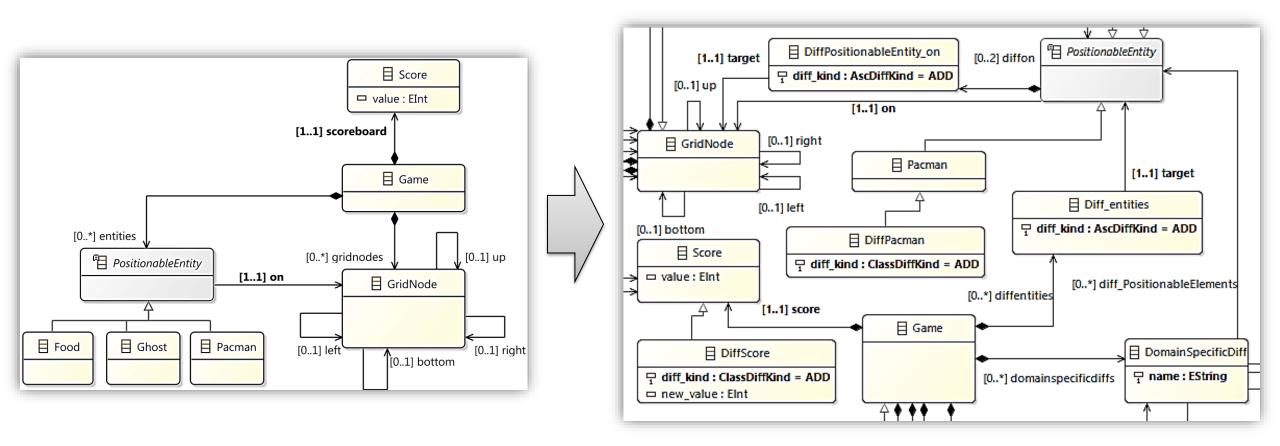


DSMCompare approach

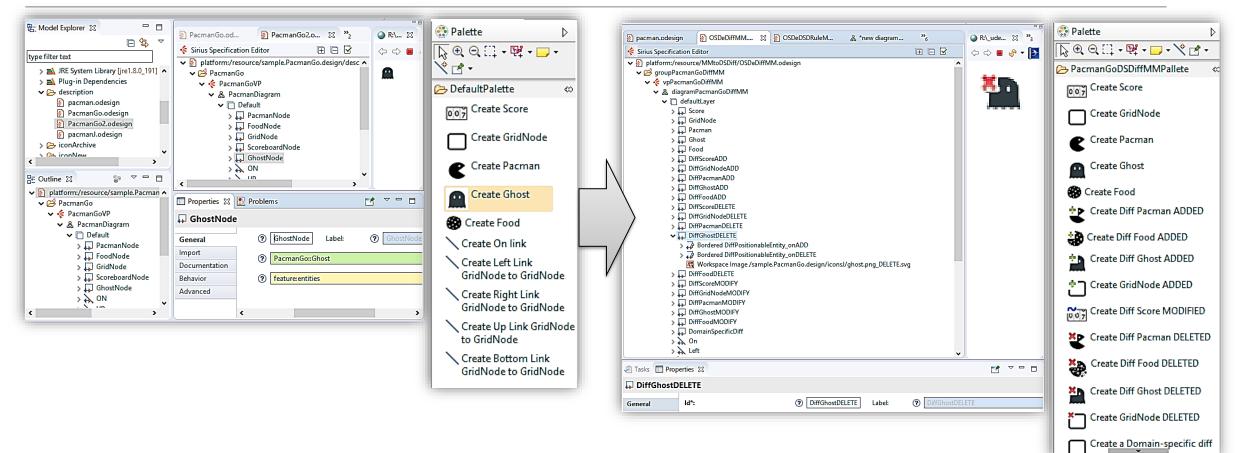




From DSL to DSL-Diff metamodel Pacman example

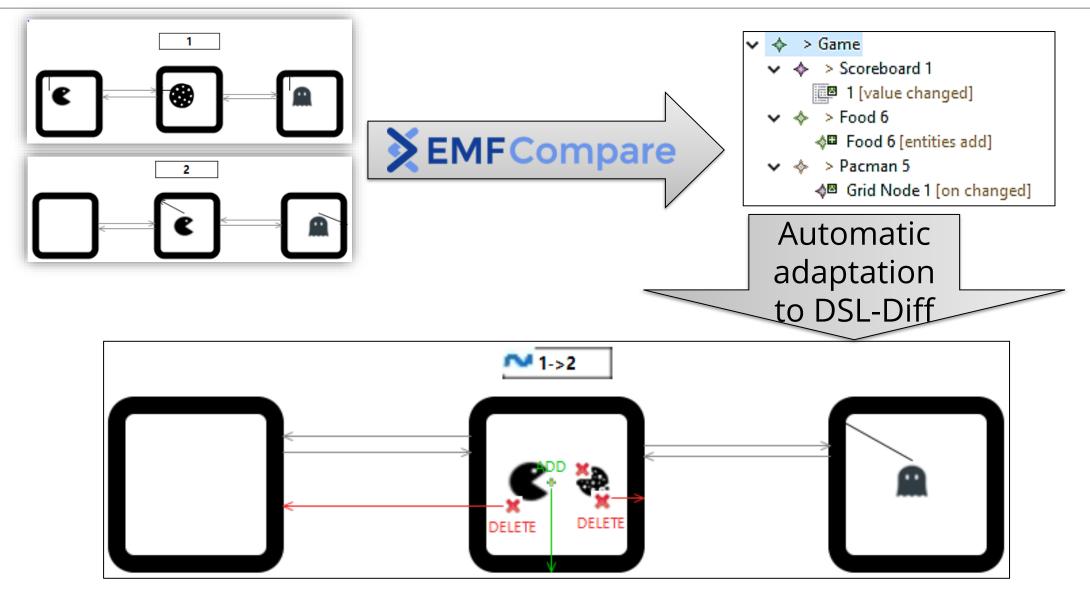


From DSL to DSL-Diff concrete syntax Pacman example





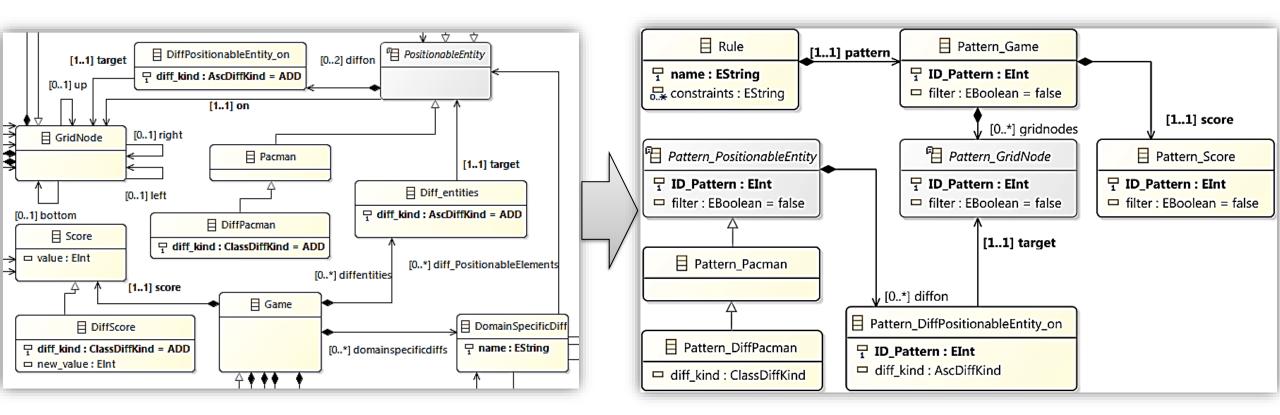
Diff in concrete Syntax





QCCCCS Research Day

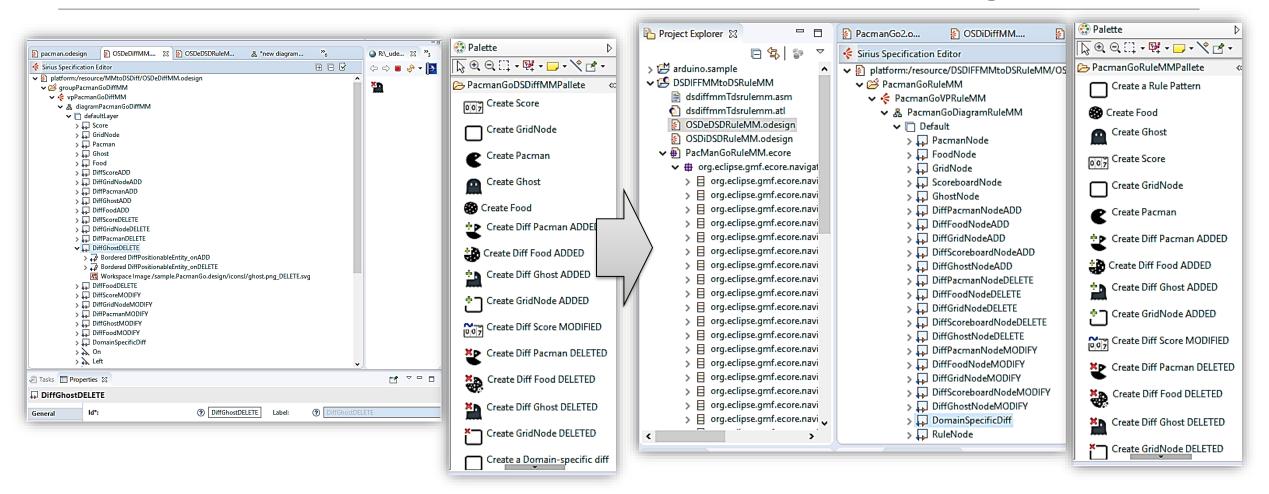
From DSL-Diff to DSL-Diff-Rule metamodel







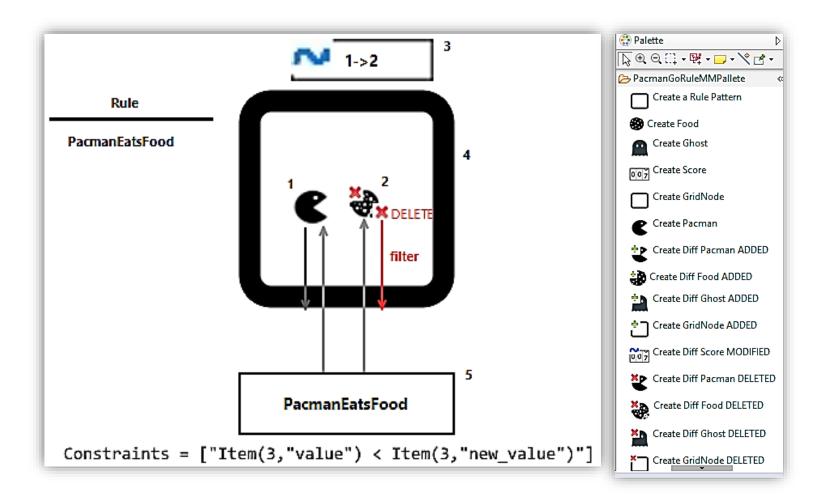
From DSL-Diff to DSL-Diff-Rule concrete syntax







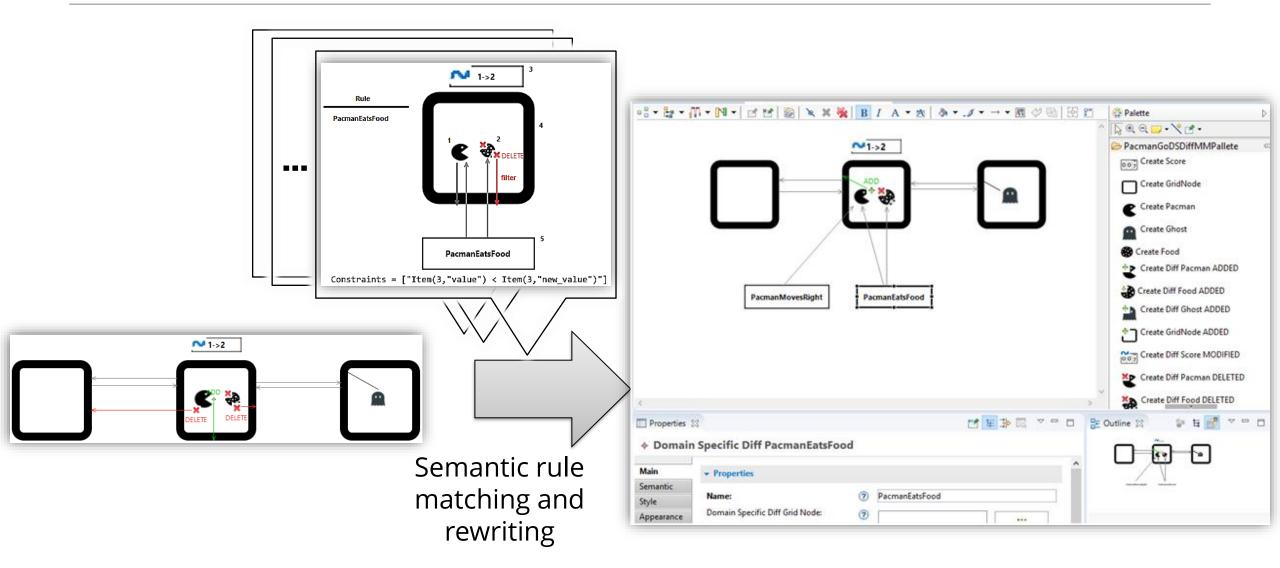
Semantic diff rule editor







Applying semantic rules



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Validation Research questions

RQ1. Can we extract semantic diffs from fine granular diffs?

RQ2. Are fine granular diffs more verbose than semantic diffs?

RQ3. Are semantic diffs recurring?





Case study Arduino Designer

- Open-source electronics DSL
 - Configurations (Hardware)
 - Programs (Sketch)
- Retrieved all versioned models (GitHub)
- Applied DSMCompare on it

History for arduino / examples / fr.obeo.dsl.arduino.examples.fadelight / model.arduino
Commits on Oct 16, 2013
Migrate fadelight example to sirius mbats committed on 16 Oct 2013
- Commits on Oct 10, 2013
Fadelight example
Description means the second s
Commits on Oct 7, 2013
Generate while
mbats committed on 7 Oct 2013
Create variable, constant, math operator
Description multiple and the second s
- Commits on Oct 6, 2013
Sub instructions
mbats committed on 6 Oct 2013
- Commits on Oct 4, 2013
While
Description must be address mu

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Example of DS-Diff

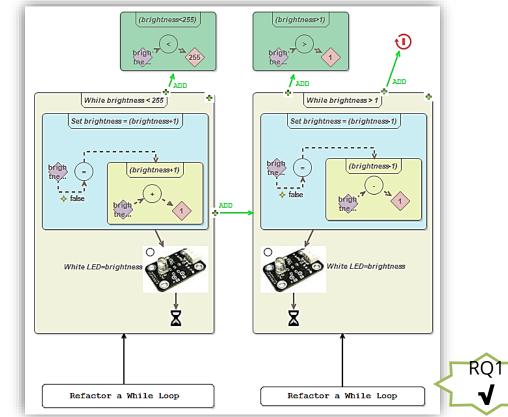
Without DSMCompare

- Diff reports many changes at AS level
- Developers have no notion of OO

00 -16,12 +16,11 00	
<instructions <="" td="" xsi:type="arduino:Level"><td><pre>16</pre></td></instructions>	<pre>16</pre>
<pre>next="//@sketch/@instructions.1/@instructions.1" level="//@sketch/@instructions.0"></pre>	<pre>next="//@sketch/@instructions.1/@instructions.1" level="//@sketch/@instructions.0"></pre>
<module <="" td="" xsi:type="arduino:OutputModule"><td>17 kmodule xsi:type="arduino:OutputModule"</td></module>	17 kmodule xsi:type="arduino:OutputModule"
href="//plugin/fr.obeo.dsl.arduino.design/resources/ArdublockKit.arduino#//@modules.	href="//plugin/fr.obeo.dsl.arduino.design/resources/ArdublockKit.arduino#//@modules
0"/>	0"/>
	18
- <instructions name="var1" xsi:type="arduino:Variable"></instructions>	
	19
<instructions <="" left="//@sketch/@instructions.0" td="" xsi:type="arduino:BooleanOperator"><td>20 <instructions <="" left="//@sketch/@instructions.0" p="" xsi:type="arduino:BooleanOperator"></instructions></td></instructions>	20 <instructions <="" left="//@sketch/@instructions.0" p="" xsi:type="arduino:BooleanOperator"></instructions>
right="//@sketch/@instructions.8" operator="lower"/>	right="//@sketch/@instructions.8" operator="lower"/>
<instructions <="" td="" xsi:type="arduino:NumericalOperator"><td>21 <instructions <="" p="" xsi:type="arduino:NumericalOperator"></instructions></td></instructions>	21 <instructions <="" p="" xsi:type="arduino:NumericalOperator"></instructions>
left="//@sketch/@instructions.0" right="//@sketch/@instructions.4" operator="plus"/>	left="//@sketch/@instructions.0" right="//@sketch/@instructions.4" operator="plus"/>
<pre><instructions value="1" xsi:type="arduino:Constant"></instructions></pre>	<pre>22 <instructions value="1" xsi:type="arduino:Constant"></instructions></pre>
- <instructions <="" next="//@sketch" p="" xsi:type="arduino:While"></instructions>	23 + <instructions <="" next="//@sketch/@instructions.11" p="" xsi:type="arduino:While"></instructions>
condition="//@sketch/@instructions.6">	condition="//@sketch/@instructions.6">
<instructions <="" td="" xsi:type="arduino:Set"><td>24 <instructions <="" p="" xsi:type="arduino:Set"></instructions></td></instructions>	24 <instructions <="" p="" xsi:type="arduino:Set"></instructions>
next="//@sketch/@instructions.5/@instructions.1" variable="//@sketch/@instructions.0"	next="//@sketch/@instructions.5/@instructions.1" variable="//@sketch/@instructions.0"
value="//@sketch/@instructions.7"/>	value="//@sketch/@instructions.7"/>
<instructions <="" td="" xsi:type="arduino:Level"><td>25 cinstructions xsi:type="arduino:Level"</td></instructions>	25 cinstructions xsi:type="arduino:Level"
next="//@sketch/@instructions.5/@instructions.2" level="//@sketch/@instructions.0">	next="//@sketch/@instructions.5/@instructions.2" level="//@sketch/@instructions.0">
<module <="" td="" xsi:type="arduino:OutputModule"><td>26 <module <="" p="" xsi:type="arduino:OutputModule"></module></td></module>	26 <module <="" p="" xsi:type="arduino:OutputModule"></module>
href="//plugin/fr.obeo.dsl.arduino.design/resources/ArdublockKit.arduino#//@modules.	href="//plugin/fr.obeo.dsl.arduino.design/resources/ArdublockKit.arduino#//@modules
0"/>	0"/>
@@ -32,10 +31,7 @@	
<pre><instructions <="" pre="" xsi:type="arduino:NumericalOperator"></instructions></pre>	31 <instructions <="" p="" xsi:type="arduino:NumericalOperator"></instructions>
left="//@sketch/@instructions.0" right="//@sketch/@instructions.4" operator="minus"/>	left="//@sketch/@instructions.0" right="//@sketch/@instructions.4" operator="minus"/>
<pre><instructions value="255" xsi:type="arduino:Constant"></instructions></pre>	<pre>32 <instructions value="255" xsi:type="arduino:Constant"></instructions></pre>
<pre><instructions value="0" xsi:type="arduino:Constant"></instructions></pre>	<pre>33 <instructions value="0" xsi:type="arduino:Constant"></instructions></pre>
- <instructions condition="//@sketch/@instructions.11" xsi:type="arduino:While"></instructions>	<pre>34 + <instructions <="" pre="" xsi:type="arduino:NumericalOperator"></instructions></pre>
	left="//@sketch/@instructions.0" right="//@sketch/@instructions.4" operator="plus"/>
- <instructions <="" left="//@sketch/@instructions.14" p="" xsi:type="arduino:BooleanOperator"></instructions>	<pre>35 + <instructions next="//@sketch" value="200" xsi:type="arduino:Delay"></instructions></pre>
right="//@sketch/@instructions.13"/>	
- <instructions name="var2" xsi:type="arduino:Variable"></instructions>	
- <instructions name="var3" xsi:type="arduino:Variable"></instructions>	
- <instructions xsi:type="arduino:BooleanOperator"></instructions>	
	36
	37

With DSMCompare

- Diffs represented as hardware & sketch
- Improves comprehension and productivity



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Results

Project	Version one	Version two	Fine Diffs Class/Association	Semantic Diff	Occurrences	Semantic Fine Diffs Class/Association
	Initialize	Migrate alarmlight example to sirius	41/16	Refactor a Repeat Loop	3	1/1
/alarmlight	Repeat	Fix Generation For Alarmizight Exact	Q2 52/8	Increase Repeat iter Refactor a Repeat Delete a Repeat Lo	$\frac{2}{1}$	1/0 1/1 1/1
/fadelight	While Fadelight example	Sub instructions Migrate alarmlight example to sirius	20/22 5/3	Refactor a While Loop Incomplete While Loop Deleted	2	1/2 1/1
/functions	Initialize	Add functions example	39/24	Add a function Function Call	1 2	1/0 1/1
/infraredsensor	Initialize	Add servo	15/2	Servo Feature enabled Support infrared connections	1	2/3 1/2
/morsecode	Morse code	Migrate morsecode example to sirius	2/0	-	-	-/-
/reset	Initialize	Add reset example	6/0	Reset functionality enabled	1	1/2
/rotationsensor	Initialize	While	6/0	-	-	-/-
/servo	Initialize	Migrate morsecode example to sirius	14/2	Servo Feature enabled Support infrared connections	1	2/3 1/2
/simpleinput	simpleinput	Simple input example	3/0	-	-	-/-
/tigger.all	Add Tigger example	Update the tigger example	99/36	Refactor a Repeat Loop Refactor to an if condition	1 1	1/1 1/2
/tigger.bubble	Initialize	Add tigger bubble example	41/14	Refactor to an if condition Refactor a Repeat Loop Refactor a Bubble machine	1 1 1	1/2 1/1 9/9
	Add tigger bubble example	Fix issue on bubble example	2/0	-	-	-/-
/tigger.necklace	Initialize	Add tigger necklace example	36/15	Refactor to an if condition Refactor a Repeat Loop A cat necklace added	1 1 1	1/2 1/1 9/9
/tigger.tail	Initialize	Update cat tail example to Add miaou sound	13/1	Refactor to an if condition Add music player	1	1/2 3/2
	Add Tigger tail example	Update tail example	2/2	-	-	-/-



Future work

• Domain-specific Merge

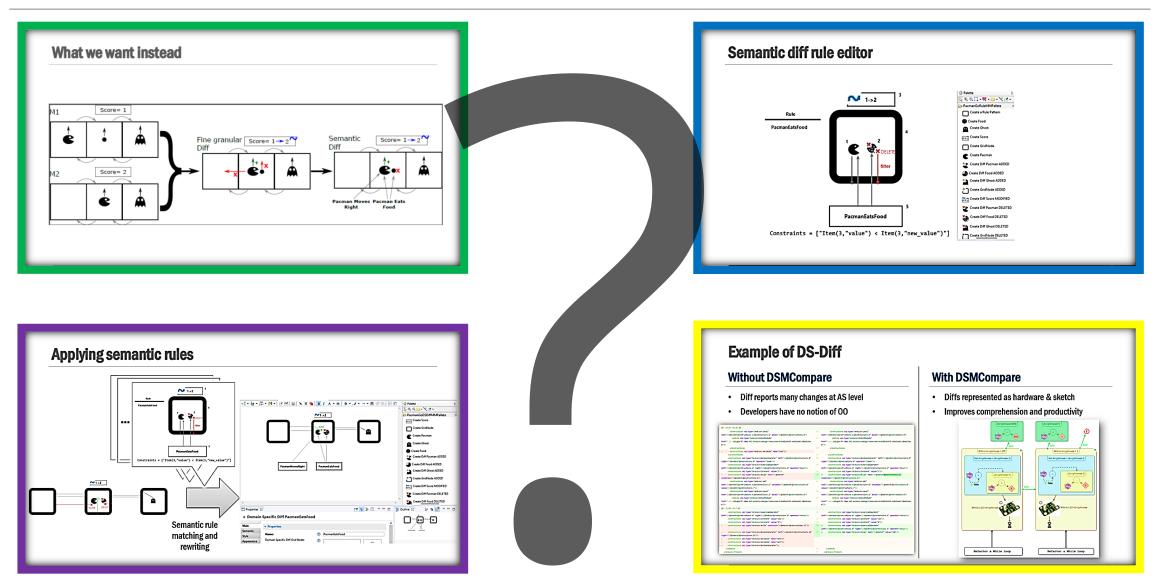
• Controlled user study to evaluate the usefulness of DSMCompare

• Integrate in a model-based VCS





Conclusion





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