How Good is Genetic Programming at Predicting Changes & Defects?

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The extracted metrics

METRIC	DESCRIPTION
NOM - Number of Methods	The number of methods the class locally contains
DIT - Depth of Inheritance Tree	The maximum number of edges between a given class and a root class
RFC - Response for a Class	The number of the local methods of a class plus all the external methods directly called by any local method
NOM - Number of Children	The number of direct classes of the measured class
CBO - Coupling between Objects	The number of external classes whose attributes and methods are used from the measured class
TCC - Tight Class Cohesion	The relative number of method pairs of a class that access in common at least one attribute of the measured class
LOC - Lines of Code	The lines of code the methods of the class contain

Some characteristics of the inspected systems

System	Refered V	Start Date	End Date	Version Archive	Bug Tracking System	LOC	Types	Changes	Defects
ArgoUML	1	30/11/2003	30/11/2004	SVN	Issuezilla	83,487	1180	4036	1128
	2	01/12/2004	09/02/2006			107,125	1237	6038	546
	3	10/02/2006	13/02/2007			155,223	1476	4543	375
	4	14/02/2007	27/09/2008			144,075	1550	1412	657
	5	28/09/2008	16/08/2009			170,777	1780	1890	247
FindBugs	1	31/05/2006	31/05/2007	SVN	SourceForge	52,206	635	2261	31
	2	06/01/2007	06/05/2008			73,484	791	1484	61
	3	05/07/2008	05/08/2009			84,638	931	1983	94
	4	08/06/2009	30/11/2010			98,082	1022	2716	50
FOP	1	20/04/2006	21/08/2007	SVN	Bugzilla	78,425	771	2263	161
	2	26/08/2007	30/07/2008			86,565	816	5046	402
	3	04/08/2008	28/07/2009			97,397	1003	1392	230
	4	03/08/2009	24/12/2010			110,273	1145	3700	74
FreeCol	1	23/06/2005	23/07/2006	SVN	SourceForge	30,901	184	1359	230
	2	24/07/2006	13/07/2007			42,556	234	2333	244
	3	14/07/2007	11/07/2008			58,572	334	4061	174
	4	12/07/2008	01/08/2009			66,695	399	2540	268
	5	02/08/2009	08/08/2010			74,815	432	4962	235

Defects

Logs

Code

iProblems

Changes / Defects
per Class

iPlasma

Source Code Metrics
per Class

iPlasma 6.0

Load Group Property Filter

~root
class group of system /Users/cristina
model class filter

model class filter on (class group of system /Users/cristina/CaseStudies/*CaseSt (...) [1249]

Name	SVNBUGS	FINDBUGS	NOM
ParserDisplay	23	9	62
ModelFacade	21	0	184
FigNodeModelElement	17	8	56
CoreHelper	16	4	65
UMLActivityDiagram	15	9	10
FigActionState	15	2	16
PropPanelStubState	14	0	1
PropPanelComponent	14	0	1
PropPanelPseudostate	14	0	2
UseCaseDiagramRenderer	14	1	3
StateDiagramRenderer	14	1	3
PropPanelPackage	14	0	6
FigTransition	14	1	10
UseCaseDiagramGraphModel	14	1	16
StateDiagramGraphModel	14	2	21

Back Forward Save org.argouml.uml.generator.ParserDisplay Search

org.argouml.uml.generator.ParserDisplay

class public org.argouml.uml.generator. ParserDisplay

BrainClass 5 FeatureEnvy6 BrainMethod

Object
Parser
ParserDisplay

methods (62)

- private ParserDisplay
- public parseExtensionPointFig
- public parseModelElement BrainMethod FeatureEnvy
- private indexOfNextCheckedSemicolon
- public parseOperationFig
- public parseAttributeFig
- public parseExtensionPoint
- public parseOperation BrainMethod FeatureEnvy
- private parseParamList BrainMethod FeatureEnvy
- private setReturnParameter
- private getParamKind
- protected parseOutMultiplicity
- public parseAttribute BrainMethod FeatureEnvy

attributes (8)

- public ParserDisplay SINGLETON
- protected _cat
- private PropertySpecialString _attributeSpecialStrings
- private Vector _attributeCustomSep
- private PropertySpecialString _operationSpecialStrings
- private Vector _operationCustomSep
- private Vector _parameterCustomSep
- private String visibilityChars

iPlasma @WORK

RGP package

`symbolicRegression` function

population: 1000 individuals
functions: sin, cos, tan, sqrt, exp, log, +, -, *, /
max size of an individual: 250
steps: 250

Some individuals of the initial population

```
function (NOM, DIT, RFC, NOC, CBO, TCC, LOC)

population[35]
 TCC * exp(tan(TCC) * DIT)

population[38]
 0.347480498385232 *
 tan(DIT - NOM - sin(-0.350841547274093))

population[271]
 cos(sin(exp(tan(tan(sin(log(TCC/(sqrt(DIT) *
 (-0.866110688811329/NOM)), sqrt(NOC) *
 (NOC + log(-1.83248600199382, LOC))) * NOM)
 - (-0.216757951340953 - tan(RFC))) *
 exp(cos(sin(sin(NOM)))/-0.212654186842339 *
 NOC))/sqrt(DIT)))) - LOC
```

The extracted values for precision and recall

		CHANGES		DEFECTS	
System	**Version**	**Precision**	**Recall**	**Precision**	**Recall**
ArgoUML	1	0.7635	**0.9965**	0.1329	**1.0000**
	2	**0.9454**	**0.9990**	0.2155	**1.0000**
	3	**0.9148**	**0.9991**	0.2000	**1.0000**
	4	0.2796	**1.0000**	0.1909	**1.0000**
	5	0.3428	**1.0000**	0.0858	**1.0000**
FindBugs	1	**0.8129**	**1.0000**	0.0431	**1.0000**
	2	0.6275	**1.0000**	0.0615	**1.0000**
	3	0.6338	**1.0000**	0.0859	**1.0000**
	4	**0.9419**	**0.9952**	0.0433	**1.0000**
FOP	1	**0.9908**	**0.9947**	0.1491	**1.0000**
	2	**0.9852**	**0.9950**	0.8958	**1.0000**
	3	**0.9846**	**0.9940**	0.7622	**1.0000**
	4	0.3610	**0.9917**	0.0837	**1.0000**
FreeCol	1	**0.9885**	**1.0000**	**0.9540**	**1.0000**
	2	0.8538	**1.0000**	0.4272	**1.0000**
	3	**0.9936**	**0.9968**	0.1518	**1.0000**
	4	**0.7506**	**1.0000**	0.2175	**1.0000**
	5	0.8634	**1.0000**	0.1878	**1.0000**

(RQ1) Does the precision of predicting changes by symbolic regression tend to exceed X?
X∈{0.9148, 0.8129, 0.7506}

(RQ2) Does the recall of predicting changes by symbolic regression tend to exceed 0.99?

Symbolic regression is able to predict changes with a precision that tends to exceed 0.7506 and a recall that tends to exceed 0.99.

(RQ3) Does the precision of predicting defects by symbolic regression tend to exceed 0.0859?

(RQ4) Does the recall of predicting defects by symbolic regression tend to be 1.00?

Symbolic regression is able to predict defects with a precision that tends to exceed 0.0859 and a recall that tends to be 1.00.

Conclusions

Median values for Precision and Recall

CHANGES	Symbolic Regression	(0.85; 0.99)
	Naive Bayes	(0.74; 0.47)
	Support Vector Machine	(0.68; 0.45)
	Network and Neural Nets	(0.72; 0.60)
DEFECTS	Symbolic Regression	(0.16; 1.00)
	Naive Bayes, Bayesian Logistical Regression, Bayes Net, Logistic Regression	$\sim$ (0.70; 0.70)

Address Threats to Validity

Construct, Internal, External, Reliability Validity

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