Towards a quality object-oriented system: metrics-guided models and methods

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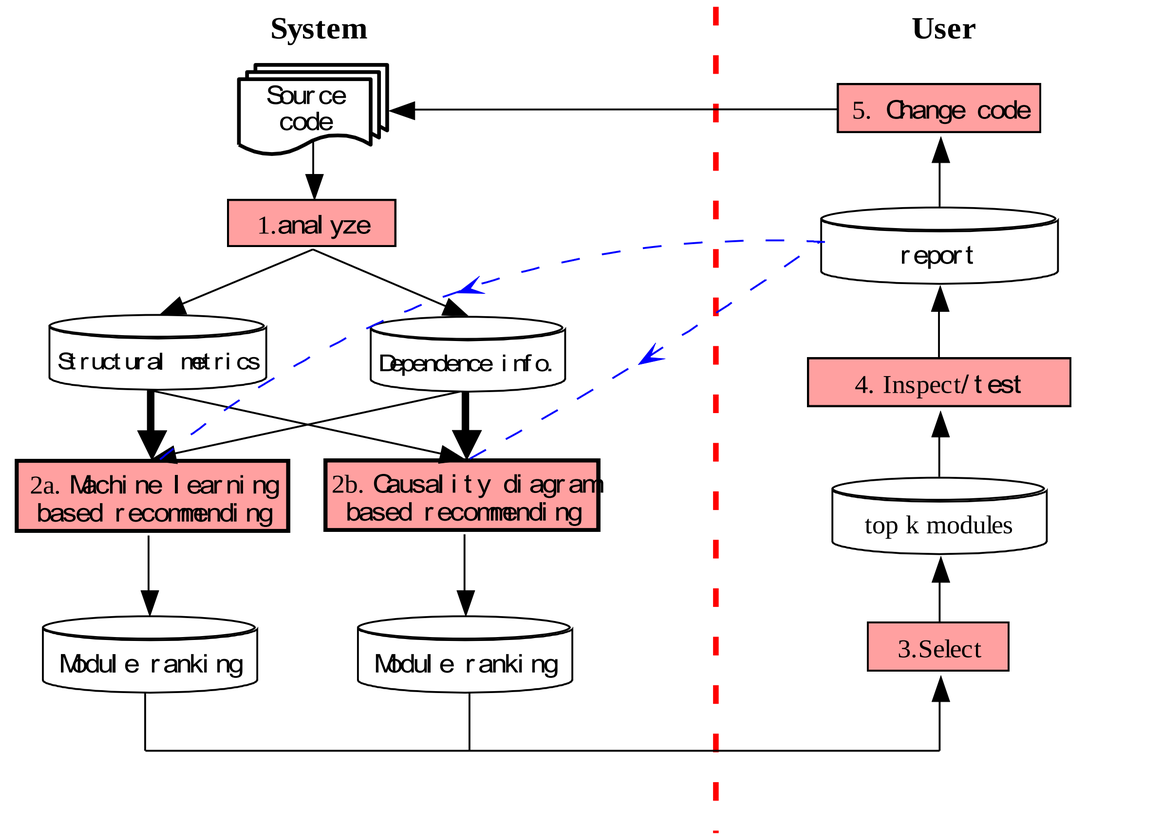
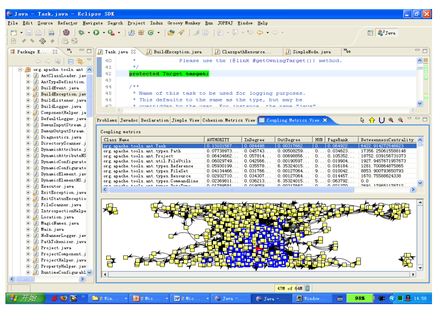
Abstract

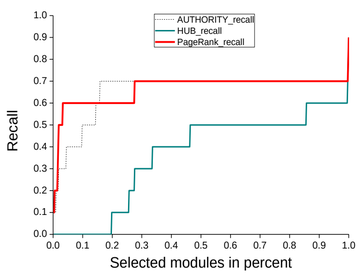
The objective of our three on-going projects is to help software developers to achieve high-quality object-oriented software systems using metrics-guided models and methods. The first project aims to develop cost-effective models that automatically recommend potentially fault-prone/important modules in an object-oriented system. The second project aims to identify a subset of object-oriented metrics that are of practical value to software development. The third project aims to develop a framework to support that an object-oriented system evolves towards high-quality software.

1. Recommending fault-prone/important modules





Identify important classes



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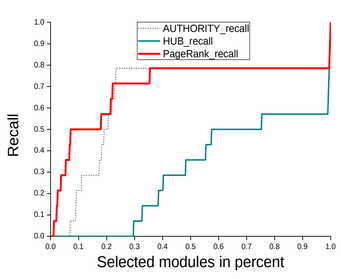

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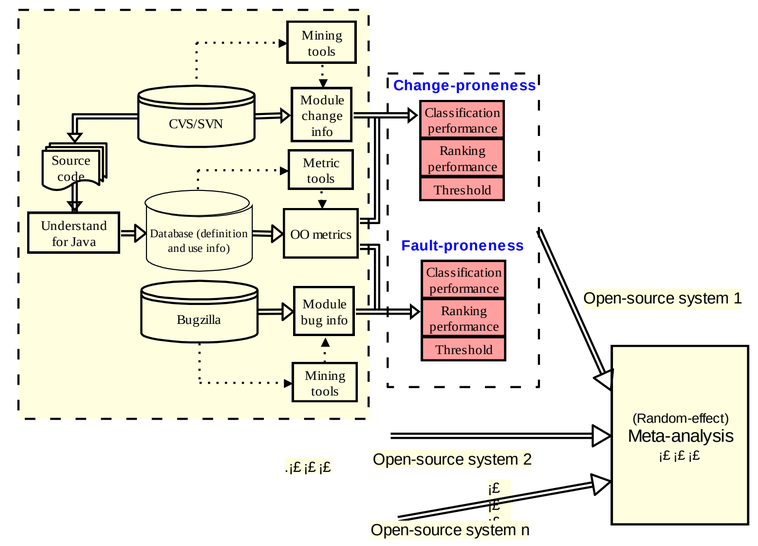
Cost-effective model

- Input: source code
- Output: module ranking
- Method:
  - ◎ Unsupervised/semi-supervised/active learning
  - ◎ Causality diagram
- Performance: efficient & effective

2. Meta-analyzing object-oriented metrics



Meta-analysis results for change-proneness (AUC ≥ 0.6)

Group	Metric	Direction	k	μ	95% CI	95% PI
Cohesion	LCOM1	+	99	0.668	[0.652, 0.684]	[0.533, 0.804]
	LCOM2	+	99	0.635	[0.618, 0.652]	[0.491, 0.780]
	...	...	...	...	...	...
	NHD	+	98	0.629	[0.614, 0.645]	[0.508, 0.751]
Coupling	CBO	+	99	0.717	[0.699, 0.734]	[0.558, 0.875]
	RFC	+	99	0.685	[0.668, 0.702]	[0.537, 0.834]
	...	...	...	...	...	...
	OMMIC	+	99	0.703	[0.686, 0.720]	[0.553, 0.853]
Inheritance	NMA	+	99	0.666	[0.649, 0.682]	[0.524, 0.808]
Size	NA	+	99	0.644	[0.623, 0.665]	[0.448, 0.840]
	NAIMP	+	99	0.657	[0.638, 0.676]	[0.486, 0.828]
	...	...	...	...	...	...
	SLOC	+	99	0.741	[0.724, 0.758]	[0.591, 0.892]

Practical thesholds for change-proneness (validation on testing data)

	Our results			Mean			Mean ± SD		
Metric	Type	Threshold	g-mean	Type	Threshold	g-mean	Type	Threshold	g-mean
SLOC	VARL(0.2)	63	0.638	Mean	115	0.536*	Mean + SD	150	0.493*
Stmts	VARL(0.2)	41	0.635	Mean	77	0.543*	Mean + SD	99	0.504*
CBO	VARL(0.2)	4	0.602	Mean	5	0.587*	Mean + SD	7	0.518*
OMMIC	VARL(0.2)	4	0.606	Mean	12	0.489*	Mean + SD	15	0.450*
MPC	VARL(0.2)	5	0.612	Mean	13	0.517*	Mean + SD	18	0.461*
ICP	VARL(0.2)	9	0.627	Mean	27	0.511*	Mean + SD	37	0.462*
RFC	VARL(0.2)	25	0.568	Mean	53	0.542*	Mean + SD	70	0.516*
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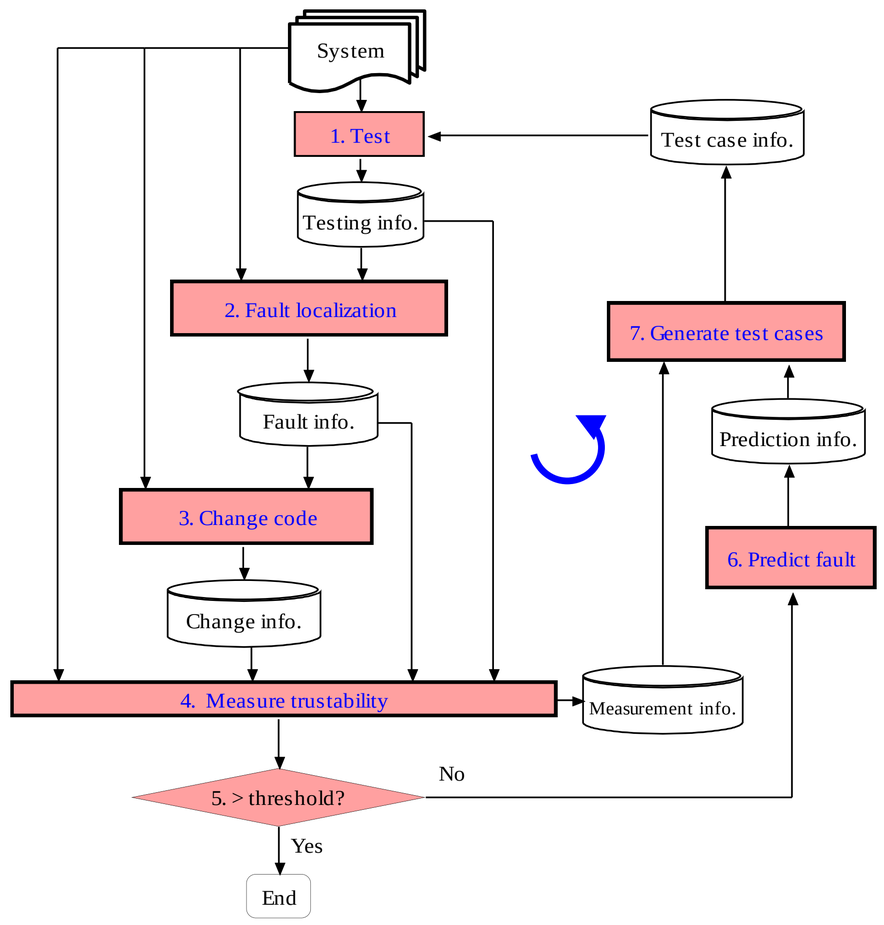
Benchmark study

- Base-line values
- Classification performance
- Ranking performance
- Thresholds

3. Supporting software evolution



A framework integrating testing, analysis, and measurement

- Metric-guided test case generation
- Test-info-driven fault localization
- Software trustability measurement

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