lab-soft
software engineering laboratory

Bad Smells in Software Product Lines: A Systematic Review

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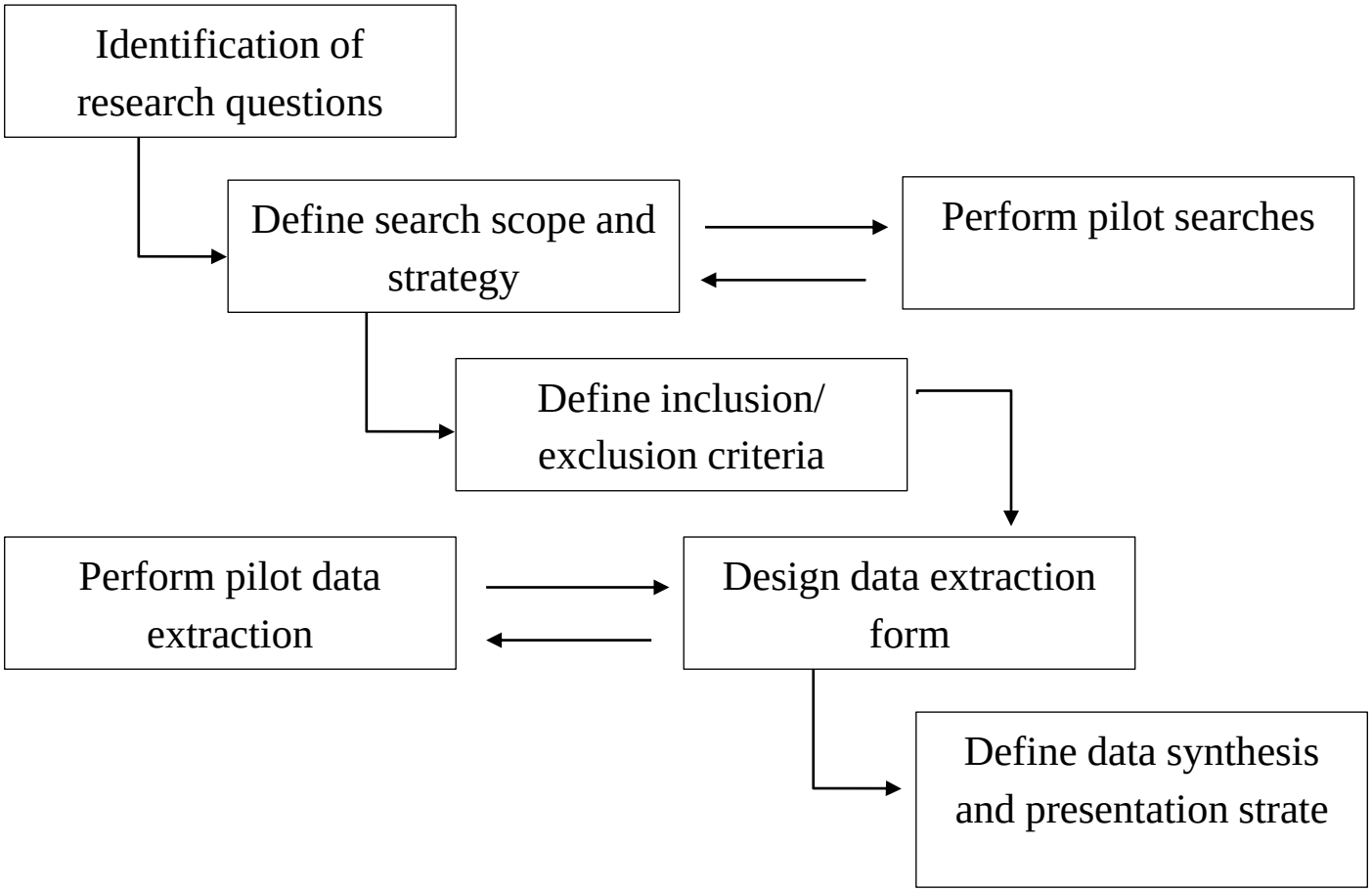
Introduction

- Bad Smell
  - Architectural
  - Code
- Software Product Line (SPL)
  - Variability Smell
- Motivation
  - In SPL context bad smells are still a young topic (Apel et al. 2013 - Feature-Oriented Product Lines)

Systematic Literature Review



Research Question (RQ)

- RQ-1: What definition has been presented in the research literature about Bad Smell in SPL context?
- RQ-2: What about Bad Smells in SPL context?

Search Strategy

- Publication Period
  - until April 2014
- Publication Space

Electronic data sources	Link	Search method
IEEEXplore	http://ieeexplore.ieee.org/	Automatic
Scopus	http://www.scopus.com	Automatic
Elsevier Science Direct	http://www.sciencedirect.com	Automatic
EI Compendex	http://www.engineeringvillage.com	Automatic
Web of Science	www.isiknowledge.com	Automatic
ACM Digital Library	http://www.acm.org/	Manual
DBLP Computer Science Bibliography	http://www.informatik.uni-trier.de/~ley/db/	Manual
Computer Science Bibliographies	http://liinwww.ira.uka.de/bibliography/index.html	Manual

Search String

("Bad Smell" OR "Code Smell" OR "code anomaly" OR "variability anomaly" OR "variability smell")

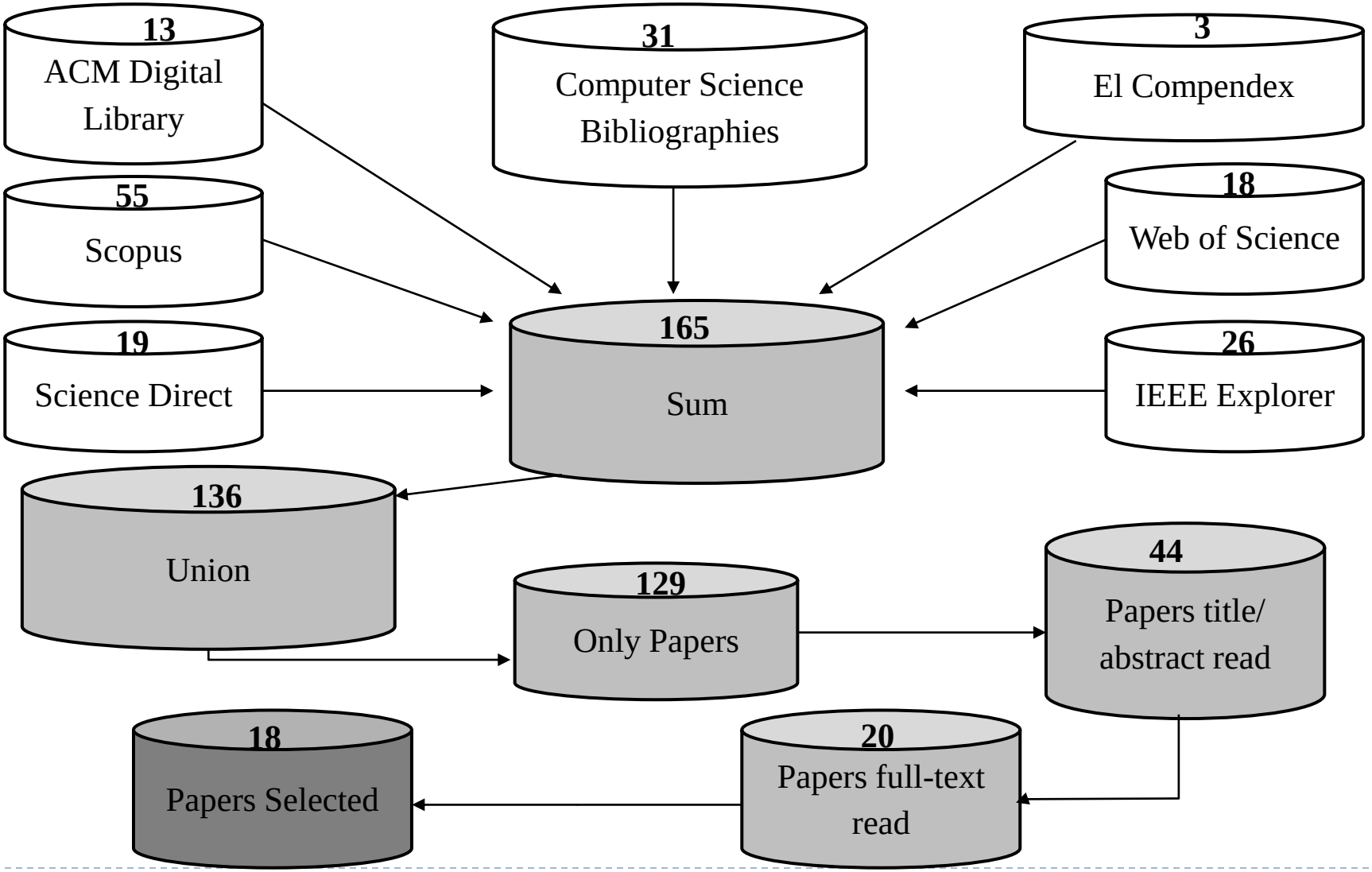
AND

("Software Product Line" OR "software product-line" OR "software product family" OR "software product-family" OR "software family based" OR "software family-based" OR "software variability" OR "software mass customization" OR "software mass customization production lines" OR "software-intensive system")

Selection criteria

- Need be a relation with computer science;
- Need be written in English;
- Need be completely in electronic form;
- Need be a relation between SPL and Bad Smells;

Paper Selection Process



Data Extraction

ID paper	Title Paper	Year	Scope	Studied Object

Scope (Ind. Or Acad.)

ID paper	SPL	Description	Size	Domain	Language	System Type

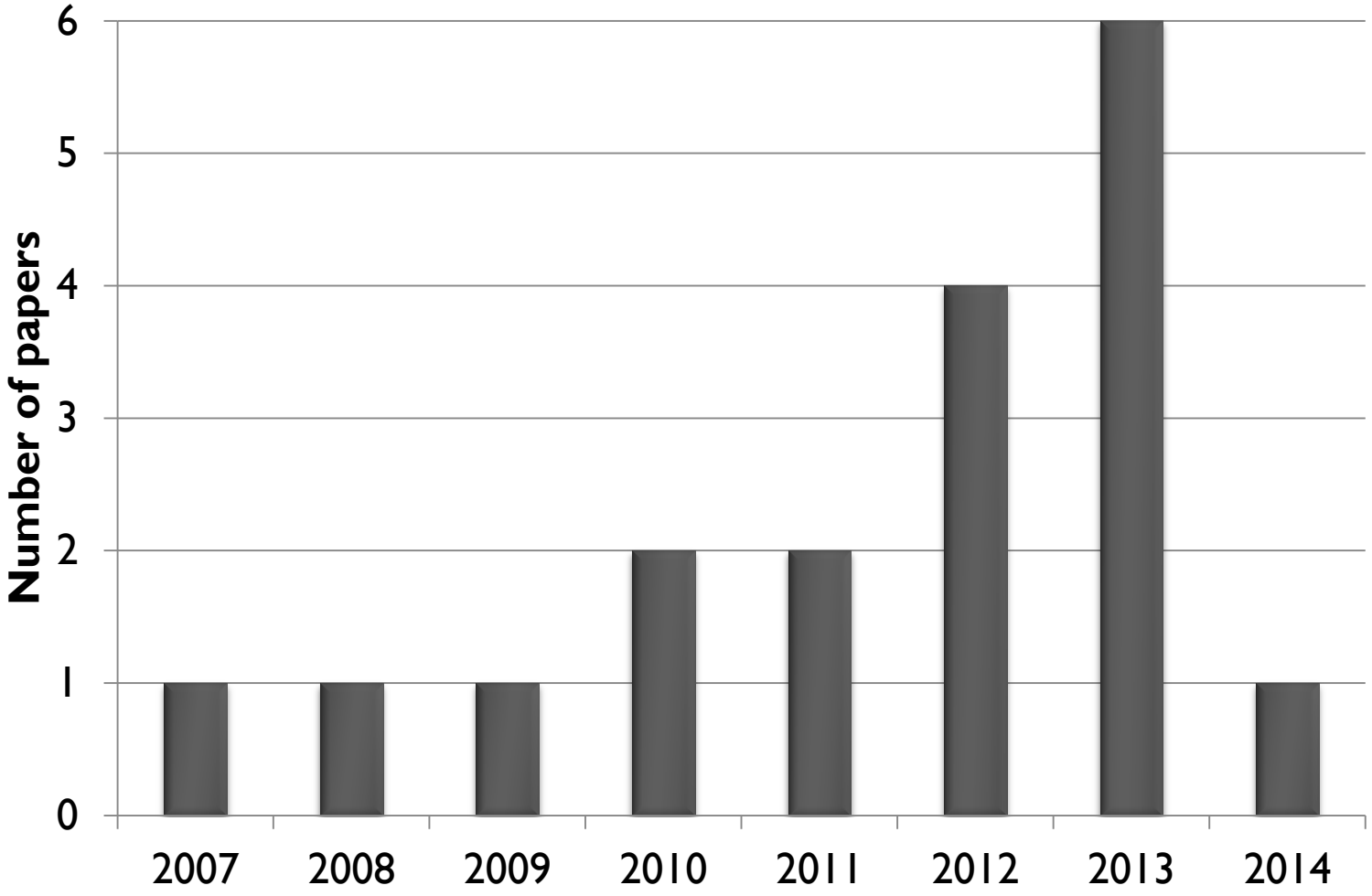
System Type (Toy/Real)

ID paper	Where?	Technology	Bad Smells	Description	Proposed by	Cited on ID papers

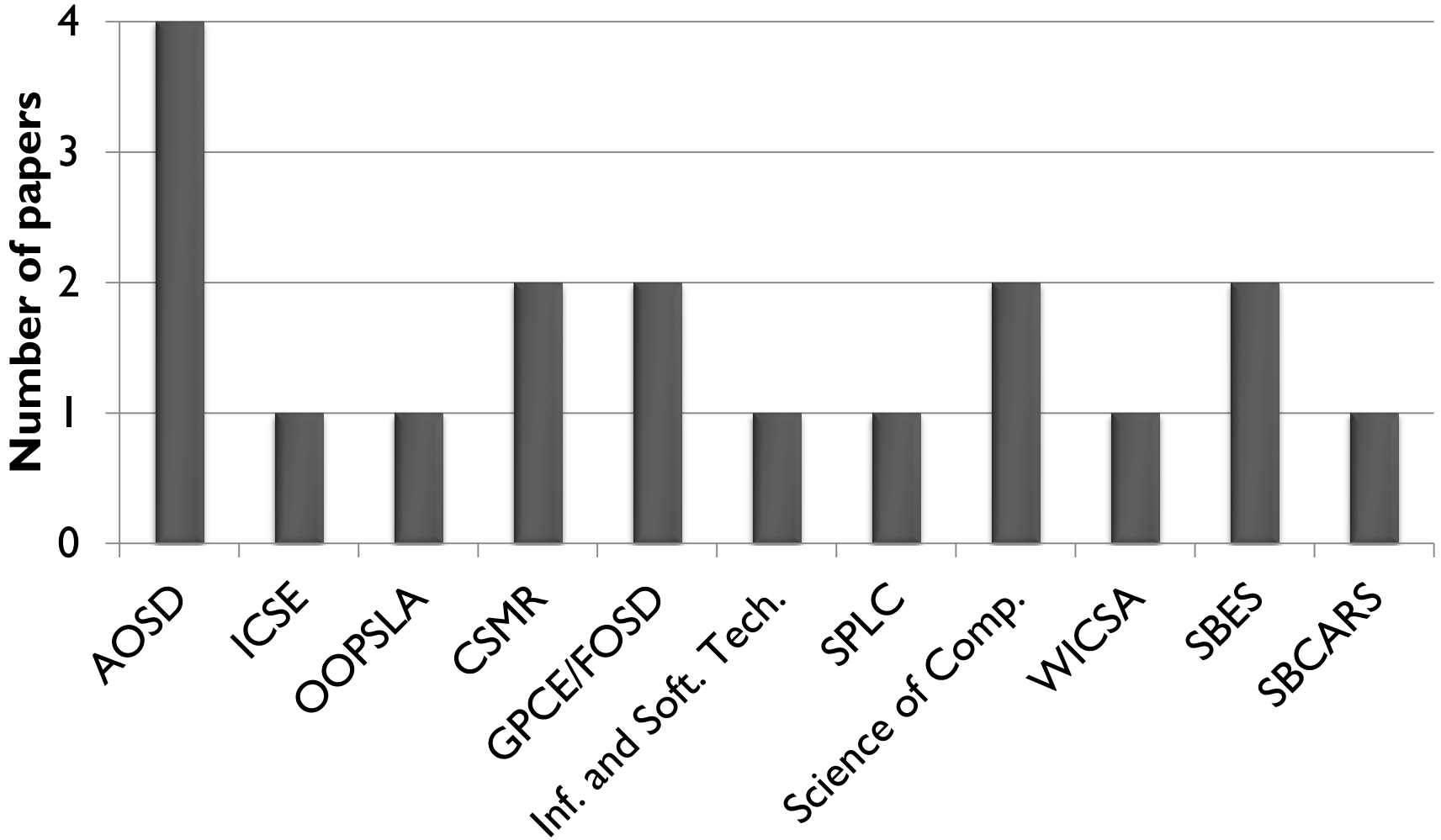
Where? (Architectural or Code)
Technology (such as OOP, AOP, FOP and DOP)

ID paper	Refactoring Method	Technology	Where?	Proposed by

Year-wise distribution of studies



Conferences and Journals of Selected papers



Appendix A – Selected Studies

- [A] Macia Bertran, I.; Garcia, A. & Von Staa, A. An exploratory study of code smells in evolving aspect-oriented systems. In: Proceedings of the 10th International Conference on Aspect-Oriented Software Development, AOSD.11, pp. 203-214, 2011.
- [B] Macia, I.; Garcia, J.; Popescu, D.; Garcia, A.; Medvidovic, N. & Von Staa, A. Are automatically-detected code anomalies relevant to architectural modularity? An exploratory analysis of evolving systems. In: AOSD'12 - Proceedings of the 11th Annual International Conference on Aspect Oriented Software Development, pp. 167-178, 2012.
- ...
- [R] Rattan, D.; Bhatia, R. & Singh, M. Software clone detection: A systematic review. In: Information and Software Technology , 55, pp. 1165 - 1199, 2013.

Research Method Reported

Method	Studies	Number	Percent
Exploratory Study	[A], [B], [C], [F], [H], [K], [P]	7	38.5
Systematic Mapping or Systematic Review	[D], [R]	2	11.2
Case Study	[E], [I]	2	11.2
Empirical Study	[L]	1	5.6
Controlled Experiment	[M]	1	5.6
Not mentioned	[G], [J], [N], [O], [Q]	5	27.9

One Dimension of Study Settings

View	Settings	Studies	Number
Scope	Industrial study	[I]	1
	Academic study	Remaining reviewed studies	17

SPL used in the reviewed studies (16)

Name	Size (~LOC)	Domain	Language	System type	Cited by
Aspectual Media (AM)	4K**	Manipulate media on mobile devices	Java/AspectJ	Toy	[B]
ATM	Not mentioned	Bank	DeltaJ	Toy (very simple)	[P]
. . .	. . .	. . .	. . .	. . .	. . .
µCOS	15K	Operational System	C/C++	Real	[I]

Bad Smells

- Code Smells (48) – Finished
- Architectural Smells (11) – running
- Hybrid Smells (7) – to do

Code Smells used in context of Software Product Lines

Code Smell	Technology	Language	SPL	Cited on	Proposed by
Proliferation of variant elements	OOP	C/C++	DPE; UN; µCOS	[I]	(Kolb et al., 2006)
Feature Envy	OOP/AOP	Java/AspectJ	MM/AM	[B]	(Fowler, 1999)
God Pointcut	AOP	AspectJ	MM; AM	[B] [F] [H] [K]	[A]
Duplicated Delta Action	DOP	DeltaJ	ATM		[P]

To do

- Bad Smells
  - Hybrid Smells (7)
- Refactoring Method (95)
  - Classified
- Answer main question
  - (Closed number of definitions in these topic)

Thank you !