

## Design-level constraints

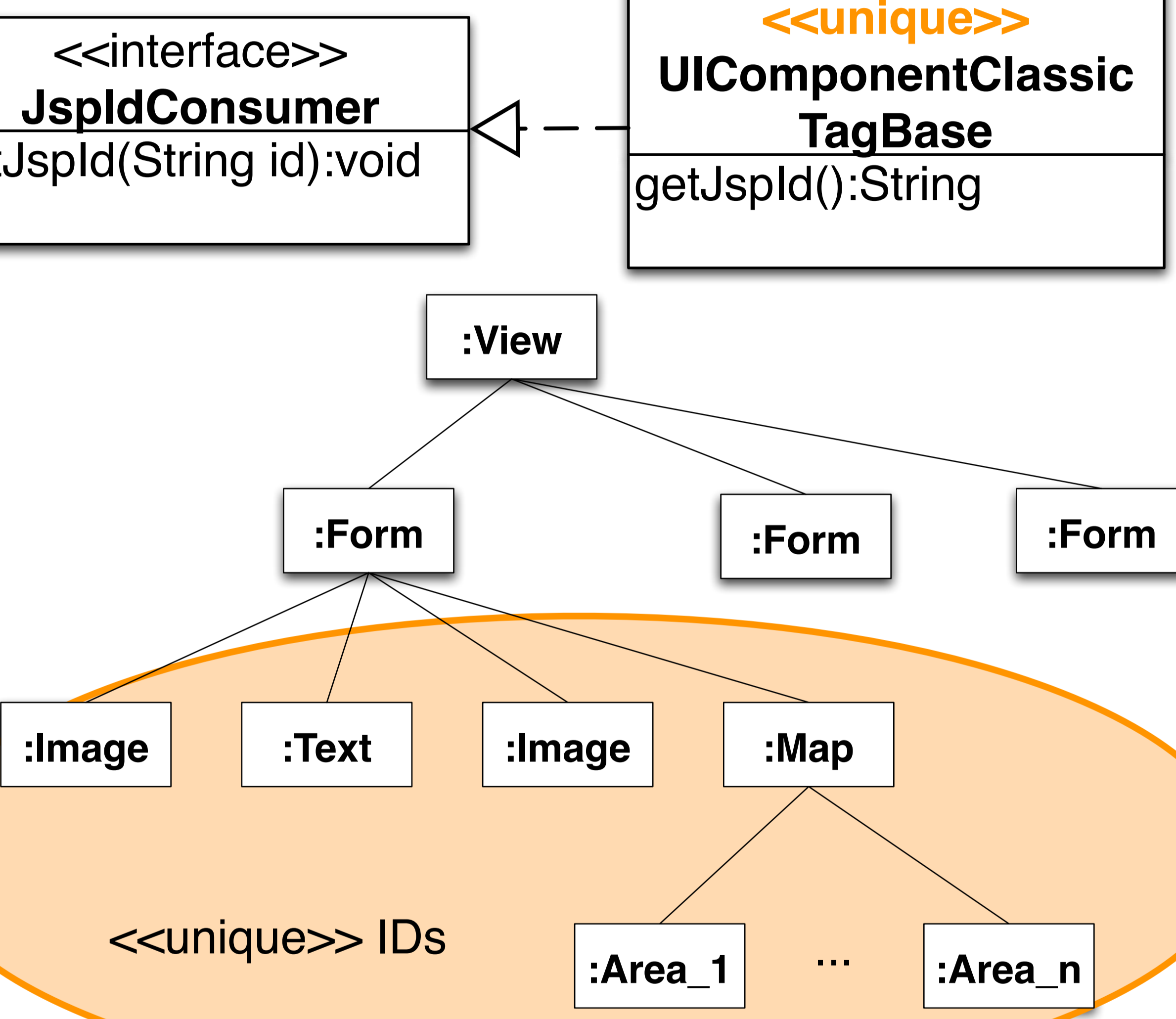
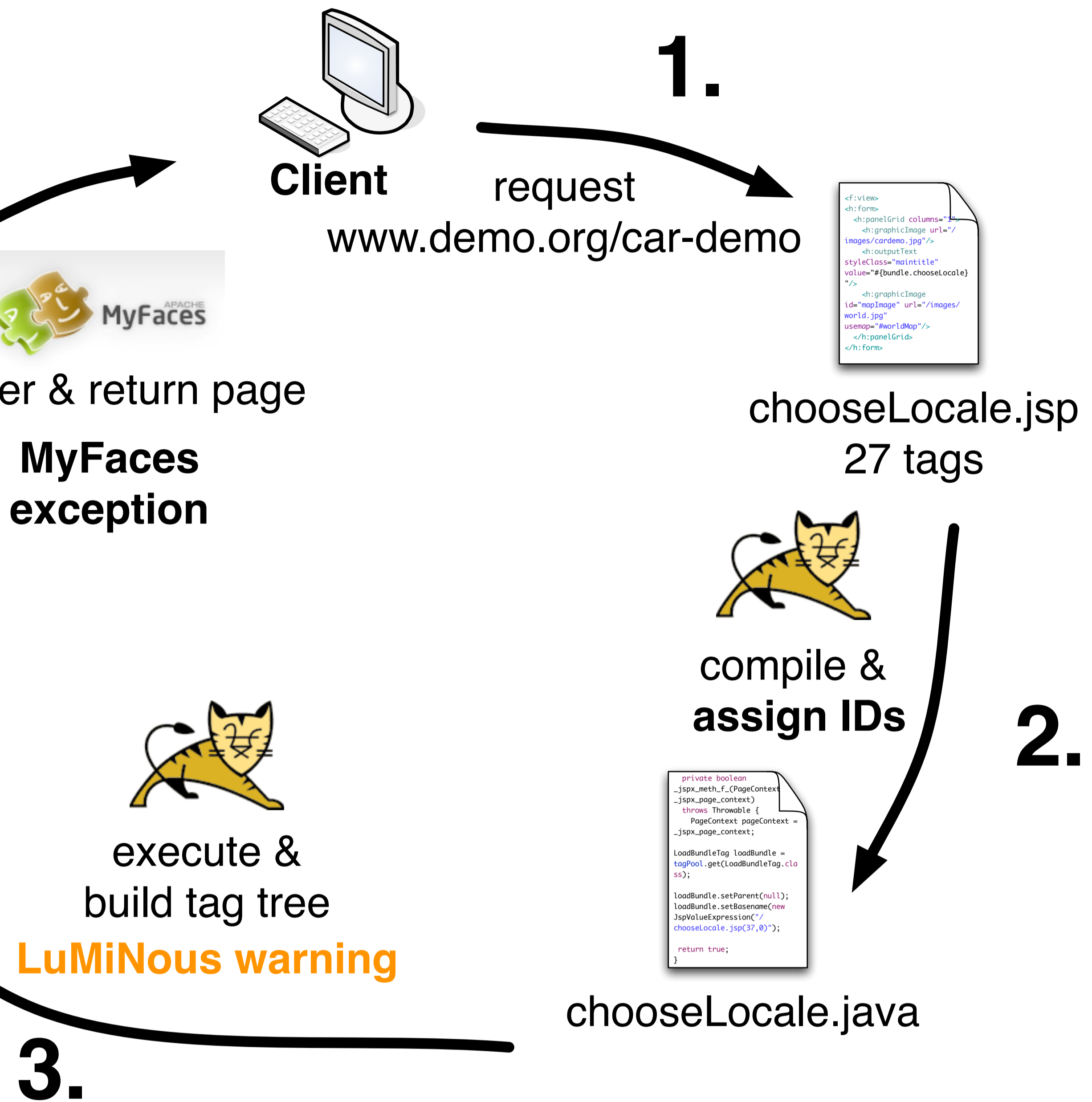
## map to

## runtime assertions

### Java Server Pages API

javax.servlet.jsp.tagext  
Interface JspIdConsumer:  
Each tag in a JSP page has a unique JspId

### LuMiNous



### Property Templates

- offer simple annotations to express model constraints: `<<unique>>`
- define placement rules for annotations
- encode constraints in assertions:  $\forall e_1, e_2 \in A: e_1 \neq e_2 \rightarrow e_1.id \neq e_2.id$
- define templates and placement rules for assertions

### Supported properties:

explicit	The constrained class must directly implement a given interface I.
immutable	The state of constrained elements must not change at runtime.
initialized	The constrained entity must complete custom initialization before use.
language	The constrained entity must match a given regular language.
unique	Instances of the constrained class must have distinct state in a given context.

`<<unique>>` constraint relevant in 137 locations

### Preliminary evaluation

Study	#Locations	Precision
unique	137	low
language	30	high
initialized	8 + 7	high

- We observe a wide distribution of assertions.
- Precision ranges from low to high depending on the property and case study.

### On-going work

- Empirical evaluation to:**
- consolidate property templates
  - assess precision and recall
- Consider other properties:**
- assess and improve performance
  - behavioral specifications
  - SLAs

### References

[1] Mauro Pezzè, Jochen Wuttke, "LuMiNous -- Model-Driven Assertion Generation for Runtime Failure Detection" in ICSE 09: Proceedings of the International Conference on Software Engineering, Companion Volume, 2009.

[2] Mauro Pezzè, Jochen Wuttke, "Automatic Generation of Runtime Failure Detectors from Property Templates" in B.H.C. Cheng, R. de Lemos, H. Giese, P. Inverardi, and J. Magee, editors, Software Engineering for Self-Adaptive Systems, Lecture Notes in Computer Science, vol. 5525, pages 223-240. Springer Verlag Heidelberg, 2009.

[3] Jochen Wuttke, "Property Templates and Assertions Supporting Runtime Failure Detection", technical report, University of Lugano, Switzerland, 2008.