

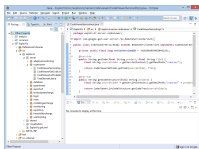
Comparing Trace Visualizations for Program Comprehension through Controlled Experiments

Florian Fittkau, Santje Finke, Wilhelm Hasselbring, and Jan Waller

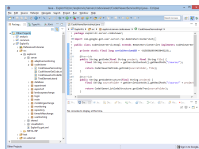
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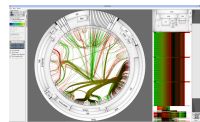
- ▶ Appropriate tools for efficient and effective program comprehension
- ▶ Empirical studies required
- ▶ Trace visualizations
- ▶ Cornelissen et al. [CZvDvR09] compared IDE, and IDE + Extravis



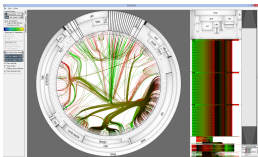
versus



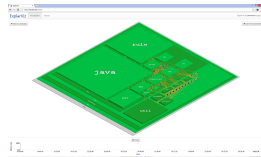
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- ▶ We compared Extravis to our web-based tool EplorViz in two experiments

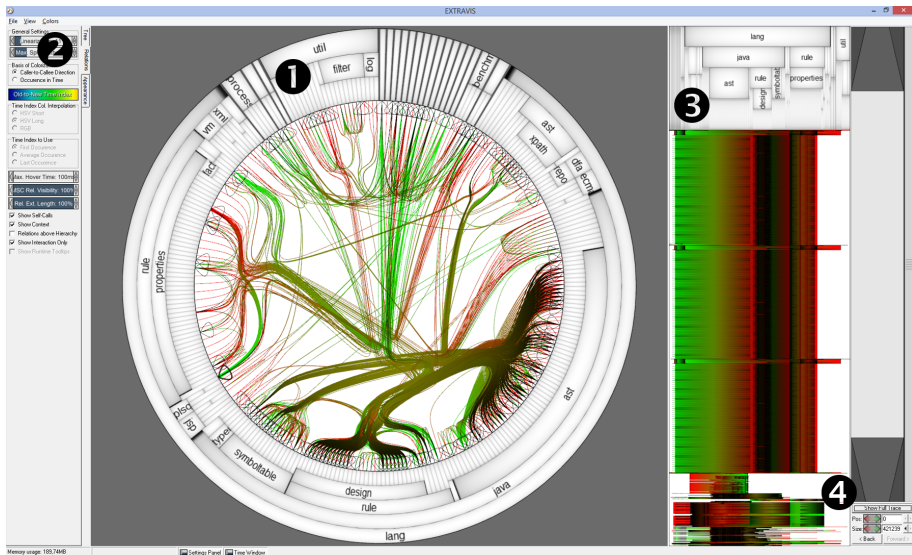


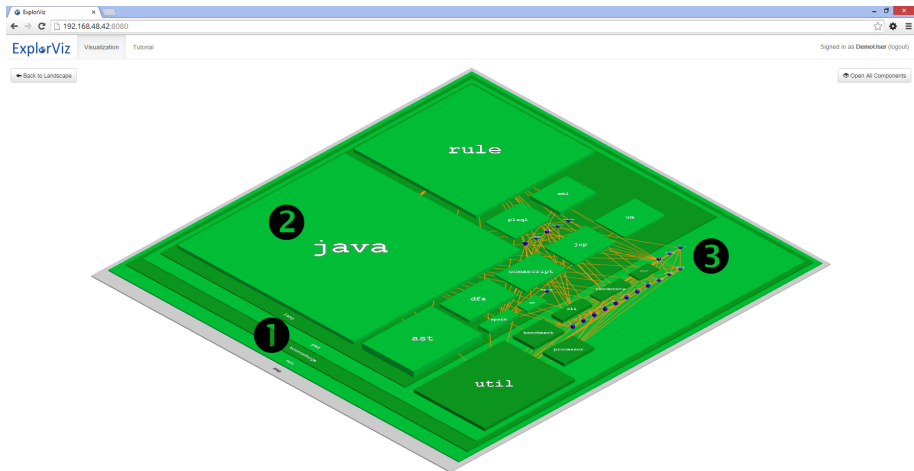
versus



- ▶ Reusable experimental design (experimental package [FFHW15])
- ▶ Employed strategies by the subjects
- ▶ Common challenges at conducting visualization experiments

Tools





- ▶ **H1:** Extravis and ExplorViz require different times for completing typical program comprehension tasks.
- ▶ **H2:** The correctness of solutions to typical program comprehension tasks differs between Extravis and ExplorViz.

- ▶ **PMD**¹ with 30 subjects
- ▶ Source code analyzer for, e.g., Java
- ▶ Used trace: 279 classes and about 420,000 method calls
- ▶ Fairness concern: Tasks similar to Cornelissen et al. (Checkstyle)

¹<http://pmd.sf.net>

	PMD			
	Time Spent		Correctness	
	EXTRAVIS	ExplorViz	EXTRAVIS	ExplorViz
mean	47.65	34.27	8.42	13.58
difference		-28.06%		+61.28%
sd	9.96	3.14	4.29	2.46
min	23.04	29.43	3	4
median	48.89	33.84	7	14
max	65.07	38.99	16	18
Analyzed users	12	12	12	12
Shapiro-Wilk W	0.8807	0.9459	0.9055	0.9524
Levene F		2.4447		2.0629
Student's t-test				
df		22		22
t		4.4377		-3.6170
p-value		0.0002		0.0015

- ▶ Replication: **Babsi**² with 50 subjects
- ▶ Small Android app for Antibiotic Stewardship
- ▶ Used trace: 42 classes and 388 method calls (smaller than PMD)
- ▶ Used task definition framework by Pacione et al. [PRW04]

²<http://babsi.sf.net>

	Babsi			
	Time Spent		Correctness	
	EXTRAVIS	ExplorViz	EXTRAVIS	ExplorViz
mean	31.55	29.14	9.40	13.04
difference		-7.64%		+38.72%
sd	7.25	6.48	3.60	3.23
min	18.94	19.38	3	6
median	31.27	27.19	9	13.5
max	43.20	41.56	18	18
Analyzed users	24	23	24	23
Shapiro-Wilk W	0.9618	0.9297	0.9738	0.9575
Levene F		0.4642		0.0527
Student's t-test				
df		45		45
t		1.2006		-3.6531
p-value		0.2362		0.0007

Recommendations

- ▶ Automated tutorial
- ▶ Electronic questionnaire
- ▶ Recordings of the PC screen

Challenges

- ▶ We had to implement an input file generator for Extravis
- ▶ Tutorial material and source code for Extravis unavailable
- ▶ Research prototypes should be available as open source

- ▶ Significant decrease in time spent and increase in correctness utilizing ExplorViz (PMD)
- ▶ Significant increase in correctness utilizing ExplorViz (Babsi)
- ▶ Open source web-based tool³

ExplorViz

Future Work:

- ▶ Professionals as subjects
- ▶ Comparison to other techniques, e.g., Trümper et al. [TBD10]
- ▶ Development of validated programming experience questionnaire

³<http://www.explorviz.net>



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 In [Proc. of the 17th IEEE International Conference on Program Comprehension \(ICPC 2009\)](#), pages 100–109, May 2009.



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