

Experimental Data for the $A?B^*A$ Pattern in CSS: Inputs and Outputs

Leonard Punt, Sjoerd Visscher, Vadim Zaytsev
[@leonardpunt](#), [@sjoerdvisscher](#), [@grammarware](#)

■ Description

- DOI [10.1109/ICSME.2016.91](https://doi.org/10.1109/ICSME.2016.91)
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Experimental Data for the A?B*A Pattern in CSS: Inputs and Outputs

@leonardpunt
Leonard Punt
University of Amsterdam, The Netherlands
Q42, The Netherlands

@sjoerdvisscher
Sjoerd Visscher
Q42, The Netherlands

@grammarware
Vadim Zaytsev
University of Amsterdam, The Netherlands
Raincode, Belgium

The complete dataset is available under the MIT license from this web location: <http://leonardpunt.github.io/masterproject/dataset-and-results.zip>. This dataset is used to detect undoing style in CSS code. In total, this dataset contains 41 subjects. Each subject has its own folder, which contains the captured states, a `states.html` file, is used to load all captured states in one document, and a folder called `results`, which contains the detected undoing styles, the refactored style sheets and the detected semantic changes. The file `states.html` was used as an input for our detection tool [4].

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Ebay	Equus	About.com	ProToolExpress
Alibaba	UniqueVarieties	Apple.com	ICSE12
BBC	EmployeeSolutions	CNN	SyncCreative
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REFERENCES

- [1] D. Mazinianian, "Dataset for FSE'14 submission." [Online]. Available: http://fuers.enr.concordia.ca/~d_mazina/papers/FSE'14/
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■ Ancestor

- <http://dmazinianian.me/conference-papers/fse/2014/06/16/fse14.html>
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 - <http://www.scriptiesonline.uba.uva.nl/588297>



Laurence, What the World's Biggest Websites Looked Like at Launch, 2012.

<https://www.carocreative.uk/what-the-worlds-biggest-websites-looked-like-at-launch/>



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60 times a day”**

21900
small revisions
per year

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- Size
 - 23.4 MB packed
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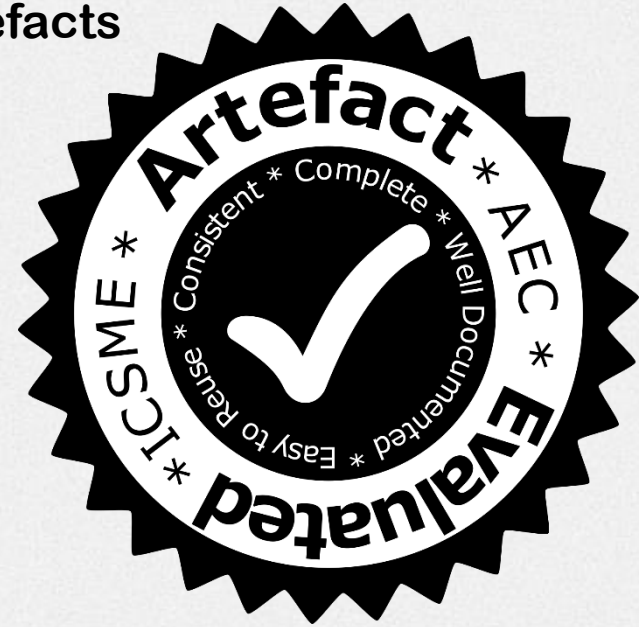
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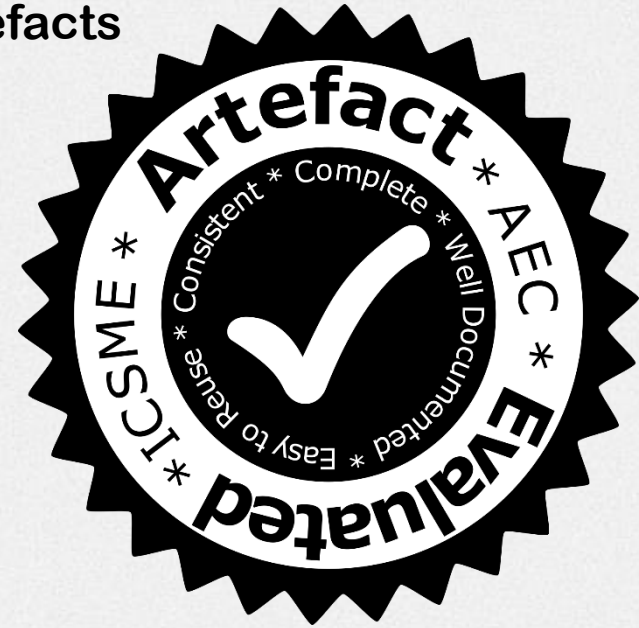
- Mostly inherited everything



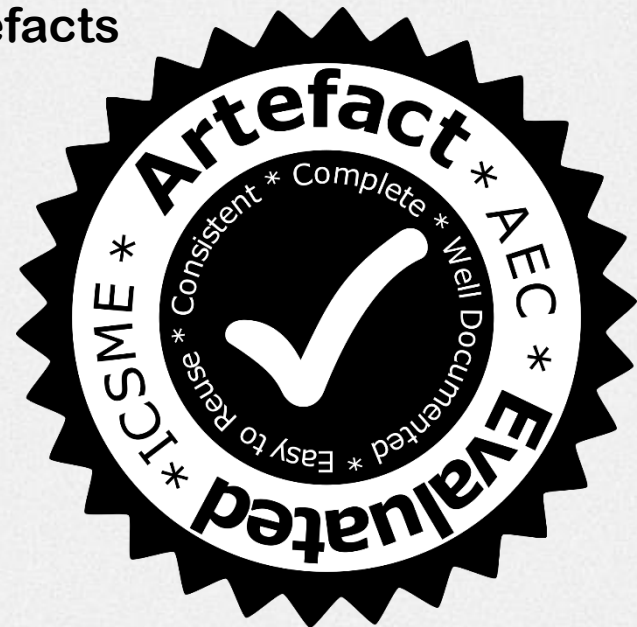
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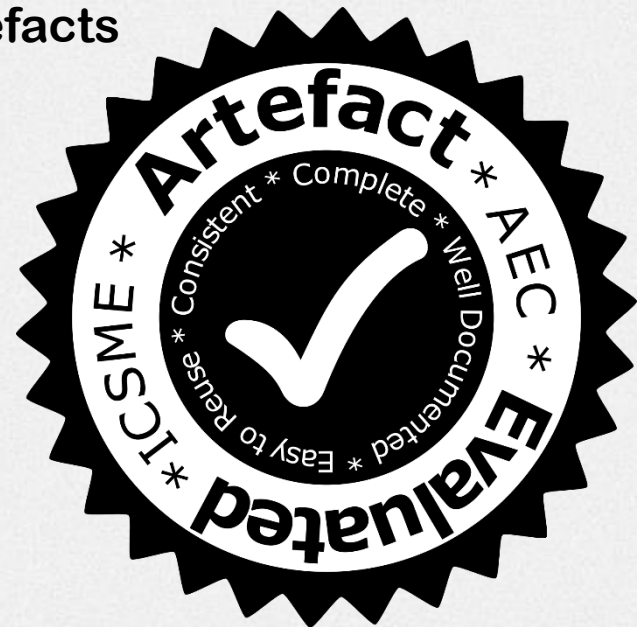
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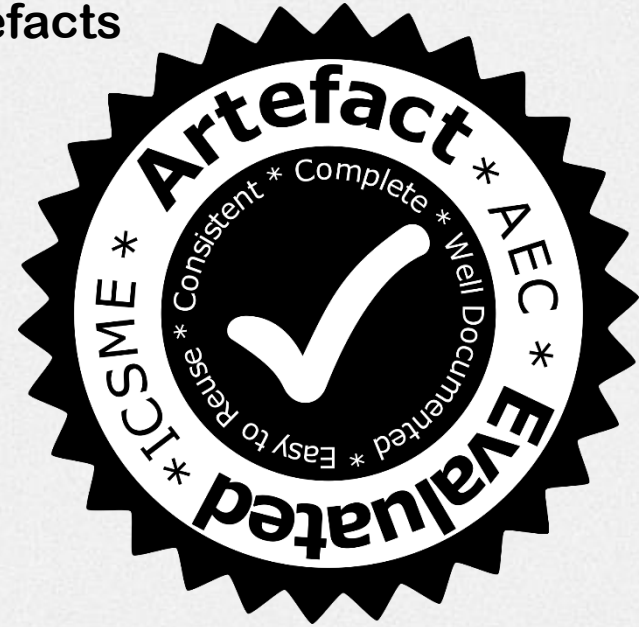
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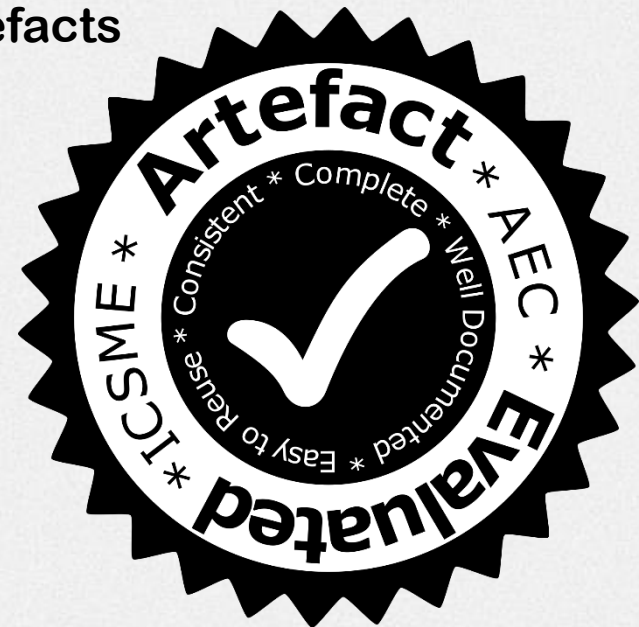
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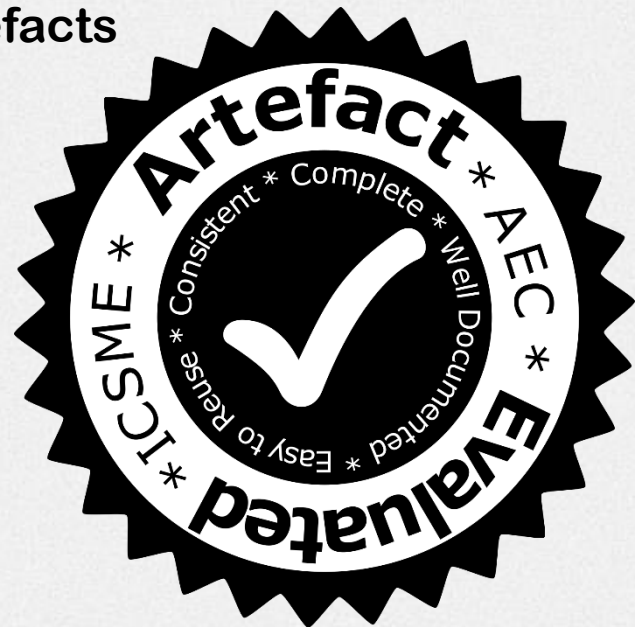
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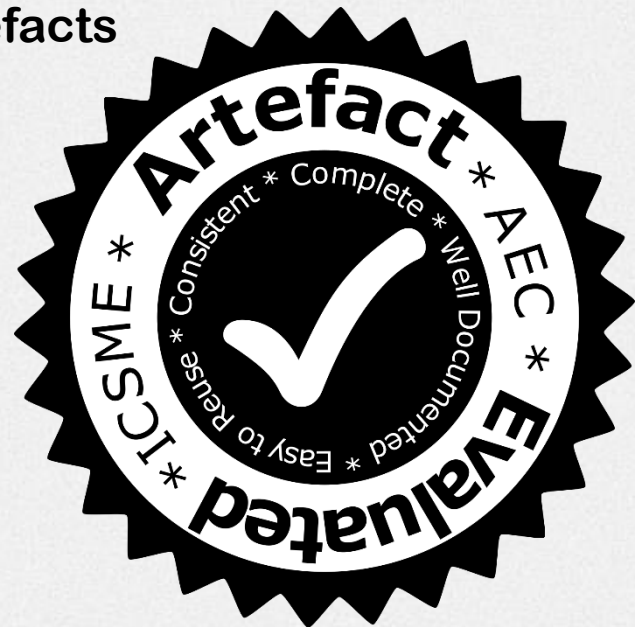
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 - CSS as a running example

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- Conclusion: 10-100 files parsed unambiguously
 - Student assistants went up to 300.



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 - Respect your data



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 - Like mining software repositories
 - ...without versioning



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 - Added results
 - Republished



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