Karlsruhe Institute of Technology

Why you should swear more!!

Exploring the Correlation between the Use of Swearwords and Code Quality in Open Source Code

Disclaimer: Naughty Language Ahead!!

Source

Contents

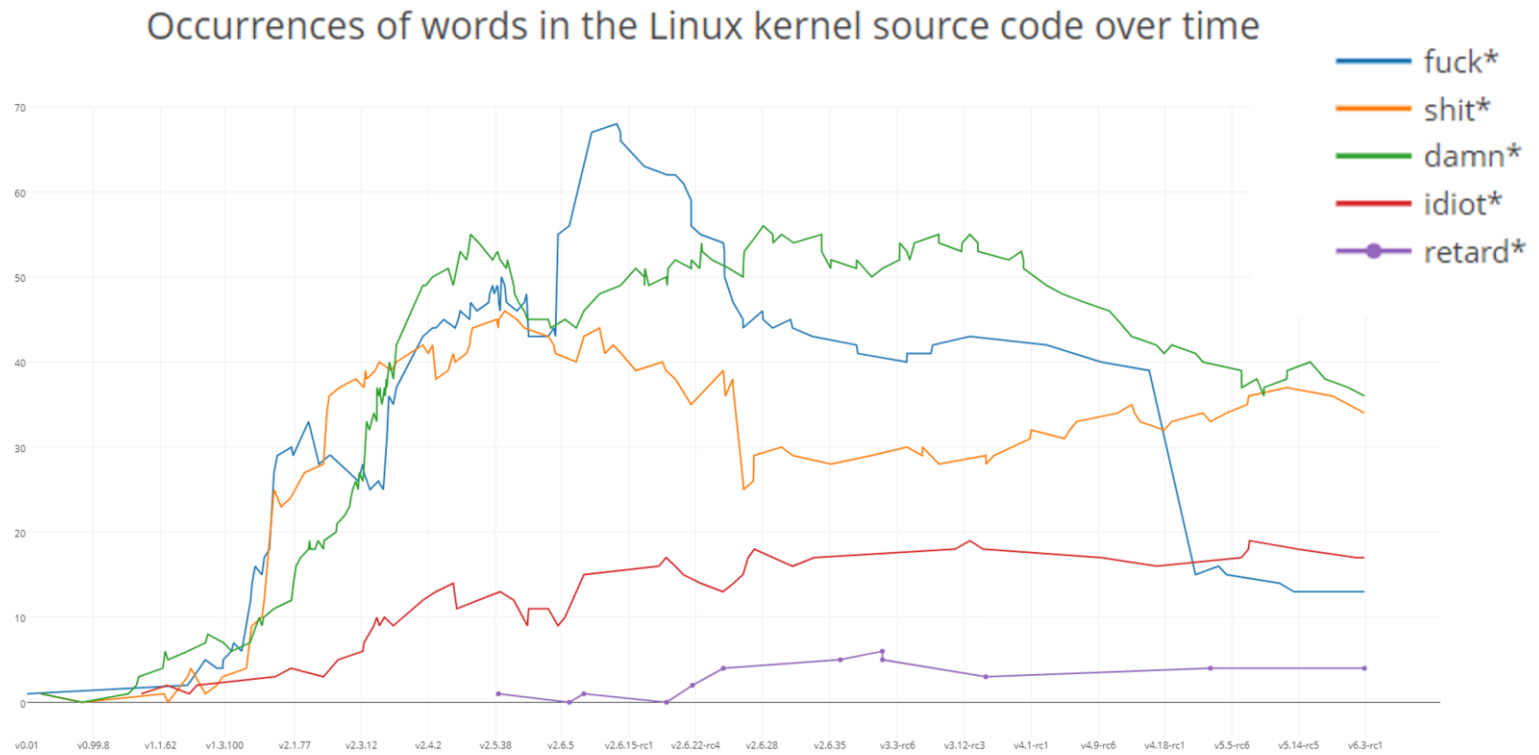
- Idea and Approach
- Methods
  - Data Gathering
  - Data Evaluation
  - Data Analysis
- Results
- Conclusion

Karlsruhe Institute of Technology

Idea and Approach

Idea

Source



Source

Approach

- Initial Hypothesis:
  - There is no difference in code quality with regards to the of swearwords in open-source code

- 4 Questions
  - How do we gather our data?
  - How do we identify Swearwords?
  - How do we measure Code Quality?
  - How do we compare the two samples?

Karlsruhe Institute of Technology

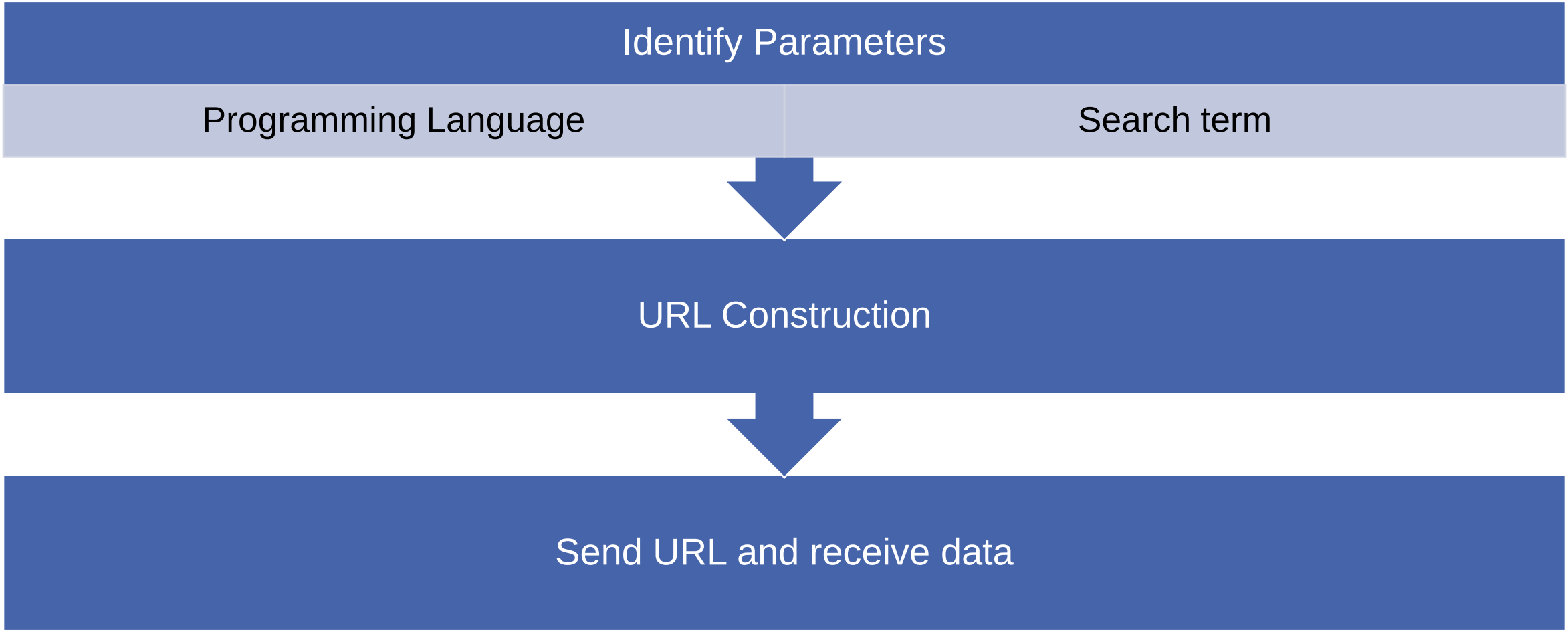
Data Gathering

Definitions

Star-repos: repositories ≥ 4 stars

Swear-repos: repositories ≥ 1 swearword

Git API


Identify Parameters
Programming Language
Search term
URL Construction
Send URL and receive data

Why we chose the Git-API?

Pro

- Easy to learn and use
- Already existing code search functionality
- Fast

Contra

- “Only” 1000 results per search-query
- Primary and secondary rate limit
- Timeout

Restrictions

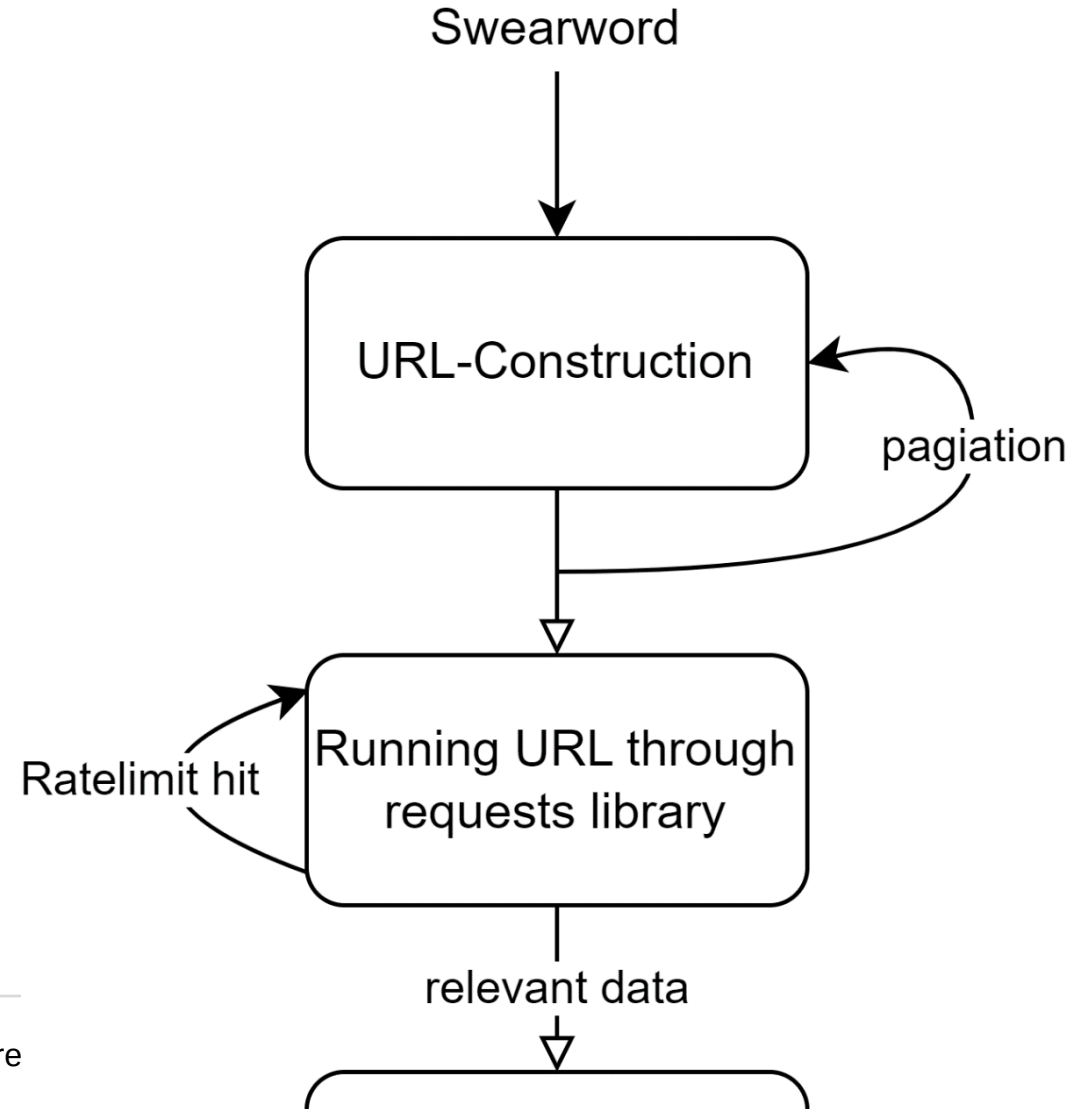
Repository

- Size ≤ 625MB
- Execution time of SoftWipe < 1h

Swearwords

- No swearwords that can be misinterpreted e.g.:
  - Ass and Asses
  - |swearword| > 3

Crawling flowchart



Karlsruhe Institute of Technology

Data Evaluation

SoftWipe

- Benchmark for scientific software in C / C++
- Uses static and dynamic code analysers
  - Number of compiler warnings / assertions / tests
  - Code style violations
  - Modularity of the software
- returns a score between 0 (low adherence) and 10 (good adherence)

Counting Swearwords

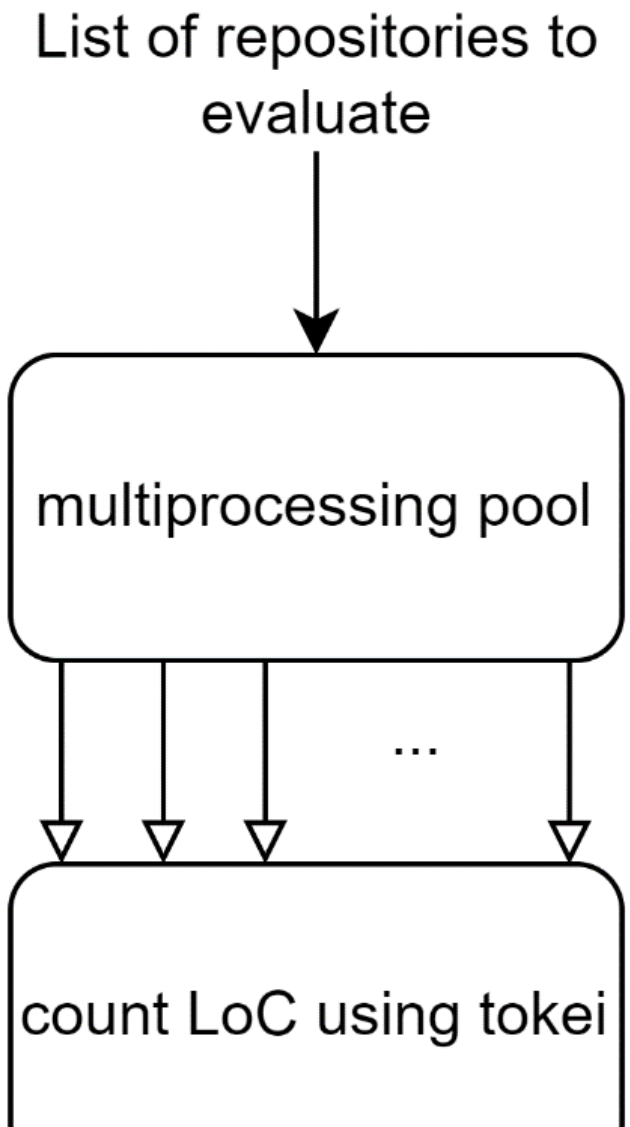
How?

- NLP vs. regex
  - → regex due to time constraints

Regex:

- \b\S*(-|_|[0-9]) swearword ((-|_|[A-Z]|[0-9])\S*)?\b
  - what_the_fuck
  - fuck10
  - fuckThis
- \b\S*(-|_|[0-9]))? swearword_first_cap ((-|_|[A-Z]|[0-9])\S*)?\b
  - whatTheFuck
  - Fuck
  - this_Fuck-ingOddity
- \b(\S*(-|_|[0-9]))? swearword_caps ((-|_|[0-9])\S*)?\b
  - WHAT_THE_FUCK
  - FUCK
  - FUCK_MY-badExamples

Evaluation flowchart



Runtime Bottlenecks and their Optimisation

Execution time of SoftWipe
→ Parallelisation

- Using multiprocessing library
- Creating a process pool
- 6 times faster due to 6 cores being utilised

Swearword counting
→ re2 library

- guarantees execution in linear time
- NFA → DFA
- 579s re → 8s re2

Karlsruhe Institute of Technology

Data Analysis

Data Analysis Goals

Defining our goals:

- Find inferences of sample → underlying population
- Find a relationship between the two samples → relationship of the target and the general population

- To determine if swear-repos do have a higher/lower code quality than the general population.

Statistical tests based on a single sample

- How accurate is the sample mean $\bar{X}$?
- Instead of a point estimator → confidence interval = interval of plausible values
- Accuracy can be determined by its width

- Requires:
  - The population has to be normally distributed
  - The true value of the population standard deviation is known.

- Given a large enough sample the requirements can be assumed to be true → Central limit theorem

Bootstrapping

- re-sampling method that returns measures of accuracy for a given sample statistic
  - confidence interval, standard error
- does not assume any underlying distributions

- The basic idea behind bootstrapping:
  - It is generally done by re-sampling the original sample with replacement
  - calculate a point estimate of that newly generated sample
  - repeat x amount of times (x=9999 usually)

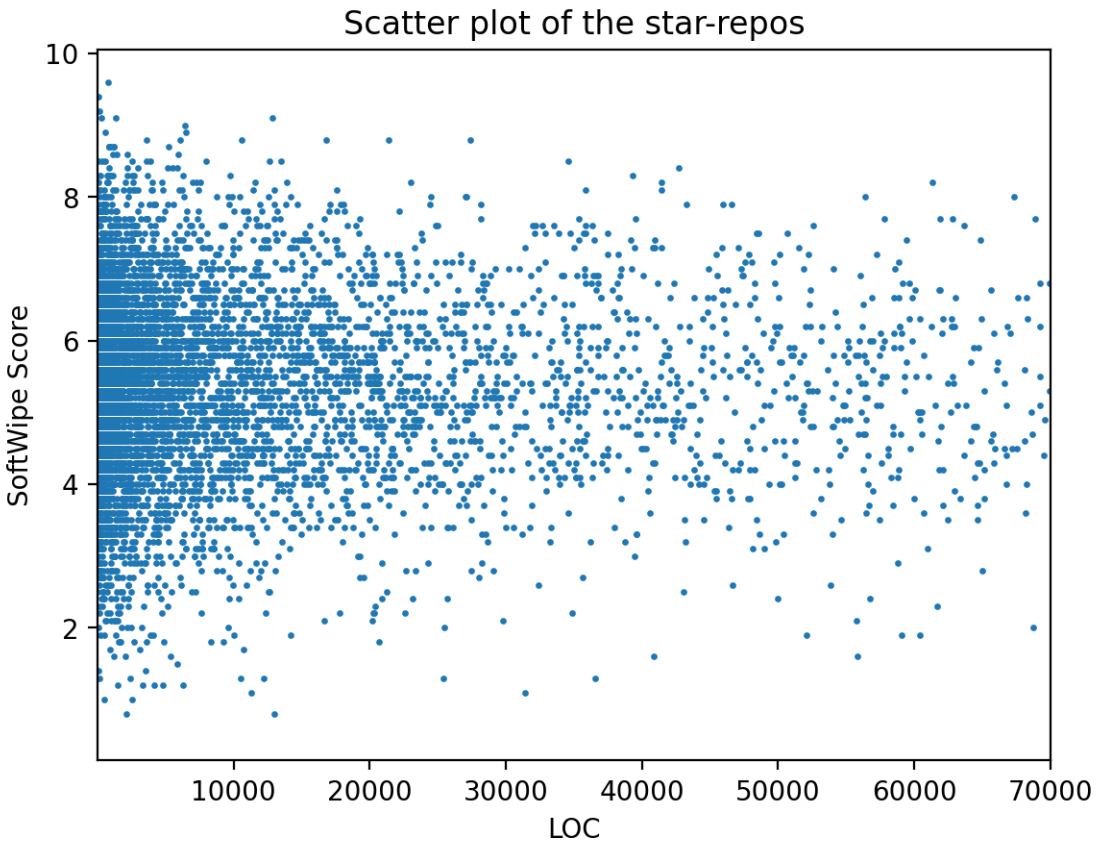
Analysis Methods

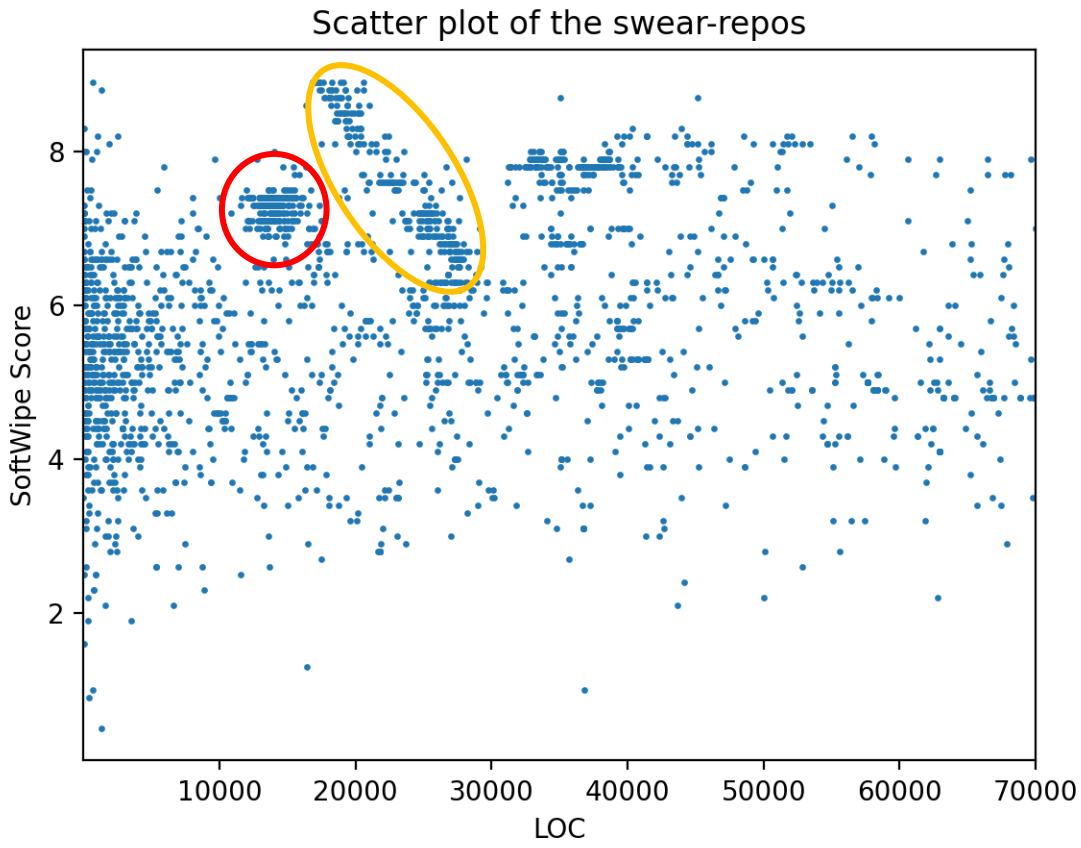
- Kolmogorov-Smirnov test
  - Determines whether two samples are from different distributions
- Welch’s t-test
  - Approximates whether the means of two population are different without assuming equal variances

Karlsruhe Institute of Technology

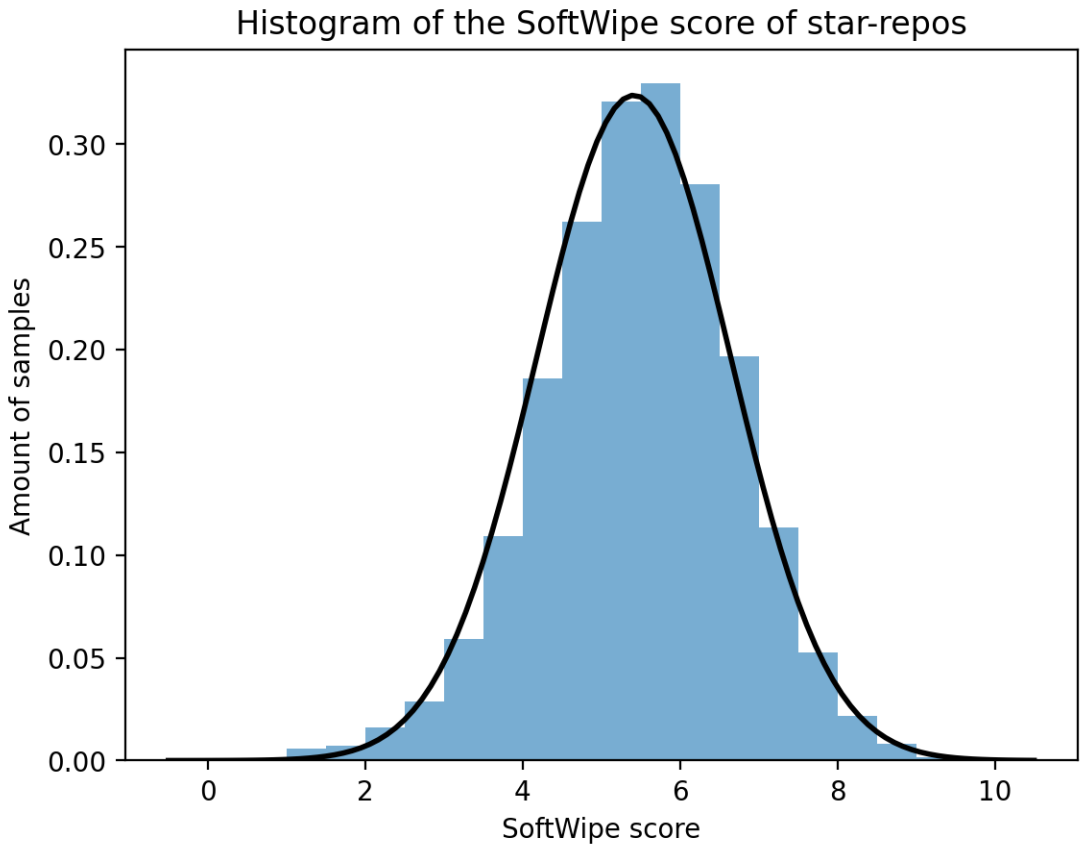
Results

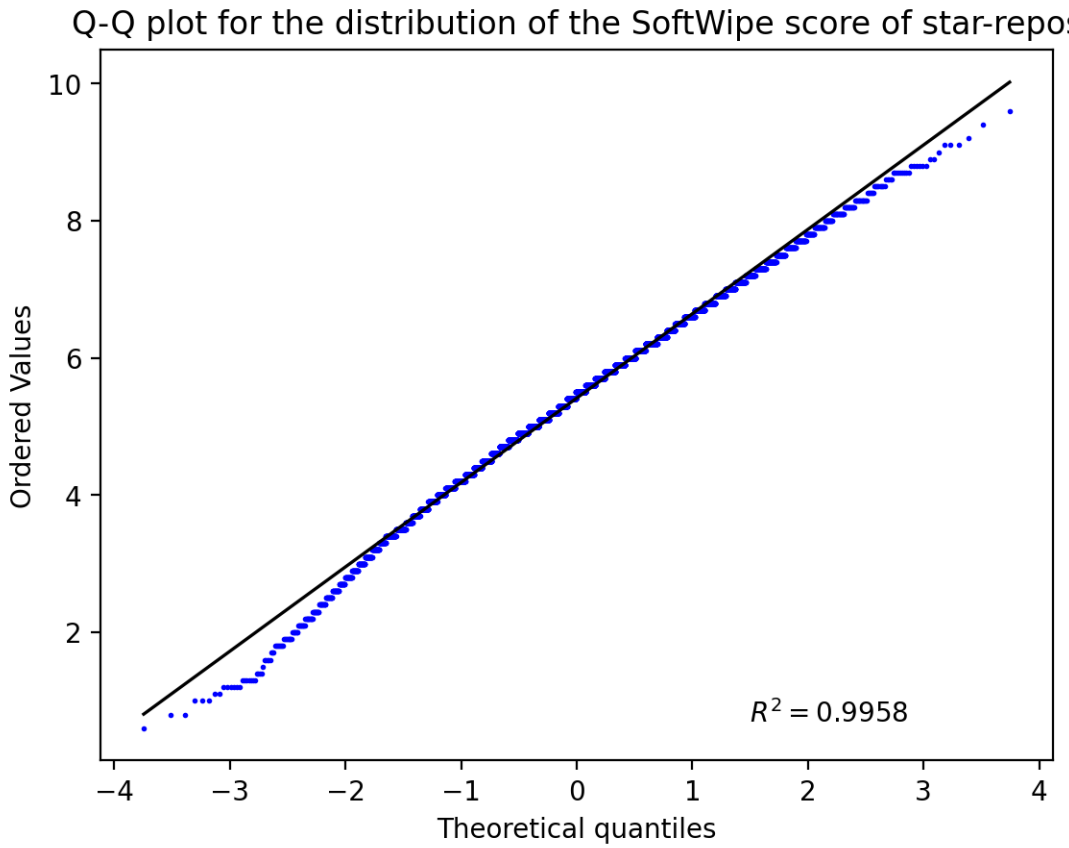
Scatterplots



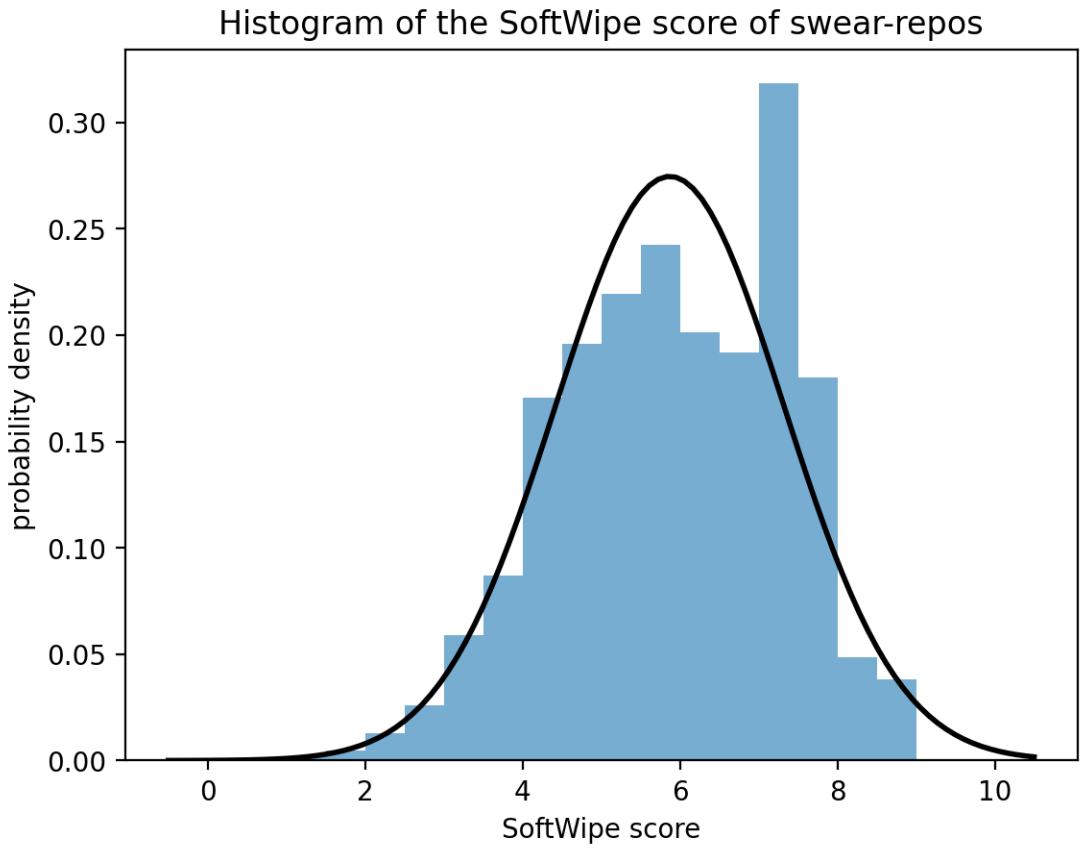


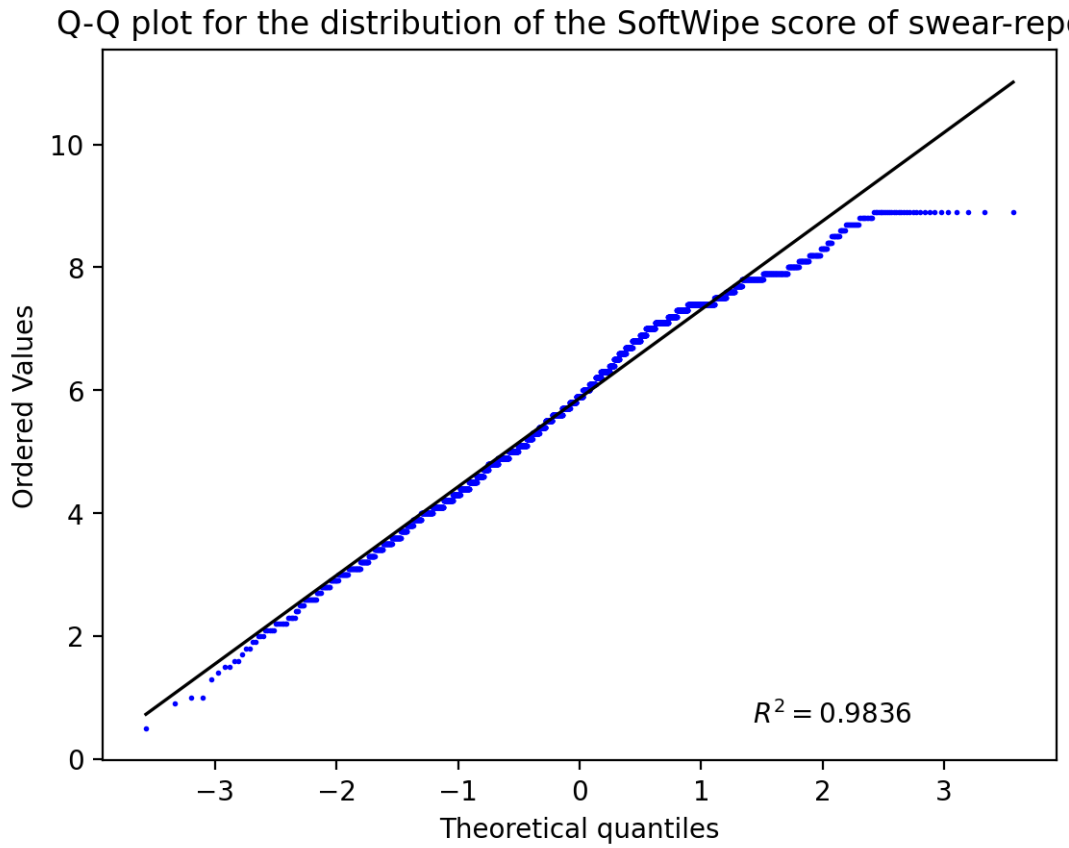
Star-repos


Histogram of the SoftWipe score of star-repos
Amount of samples
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
2
4
6
8
10
SoftWipe score


Q-Q plot for the distribution of the SoftWipe score of star-repos
Ordered Values
2
4
6
8
10
−4
−3
−2
−1
0
1
2
3
4
Theoretical quantiles
$R^2 = 0.9958$

Swear-repos


Histogram of the SoftWipe score of swear-repos
probability density
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
2
4
6
8
10
SoftWipe score


Q-Q plot for the distribution of the SoftWipe score of swear-repos
Ordered Values
0
2
4
6
8
10
−3
−2
−1
0
1
2
3
Theoretical quantiles
$R^2 = 0.9836$

Test results

- KS-test
  - statistic ≈ 0.20 and p-value ≈ 3.17 ∗ 10−89
- Welch's t-test.
  - statistic ≈ 16.71 and p-value ≈ 2.04 ∗ 10−61

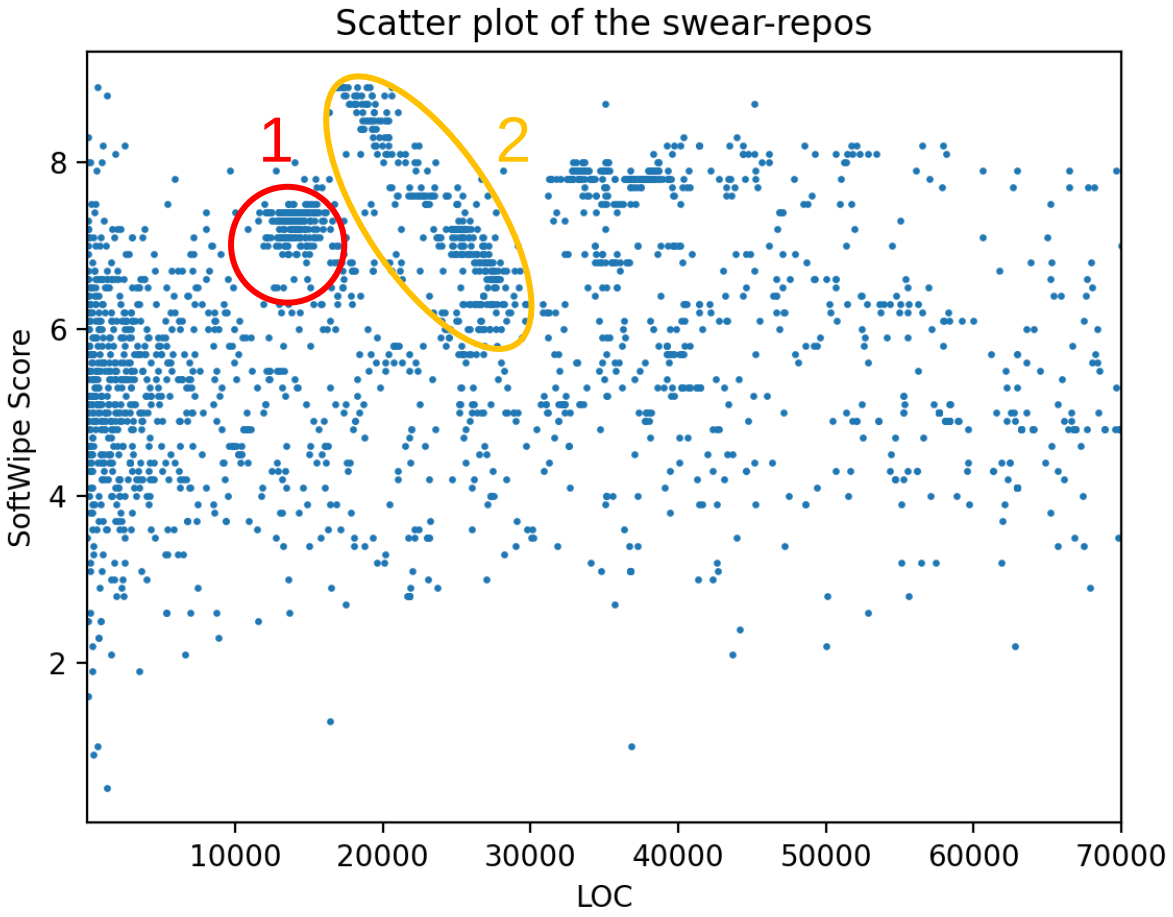
- → correlation between swearing and an improvement in code quality

	mean	confidence interval
star-repos	5.41	[5.38 - 5.45]
swear-repos	5.87	[5.81 - 5.93]

Conclusion?

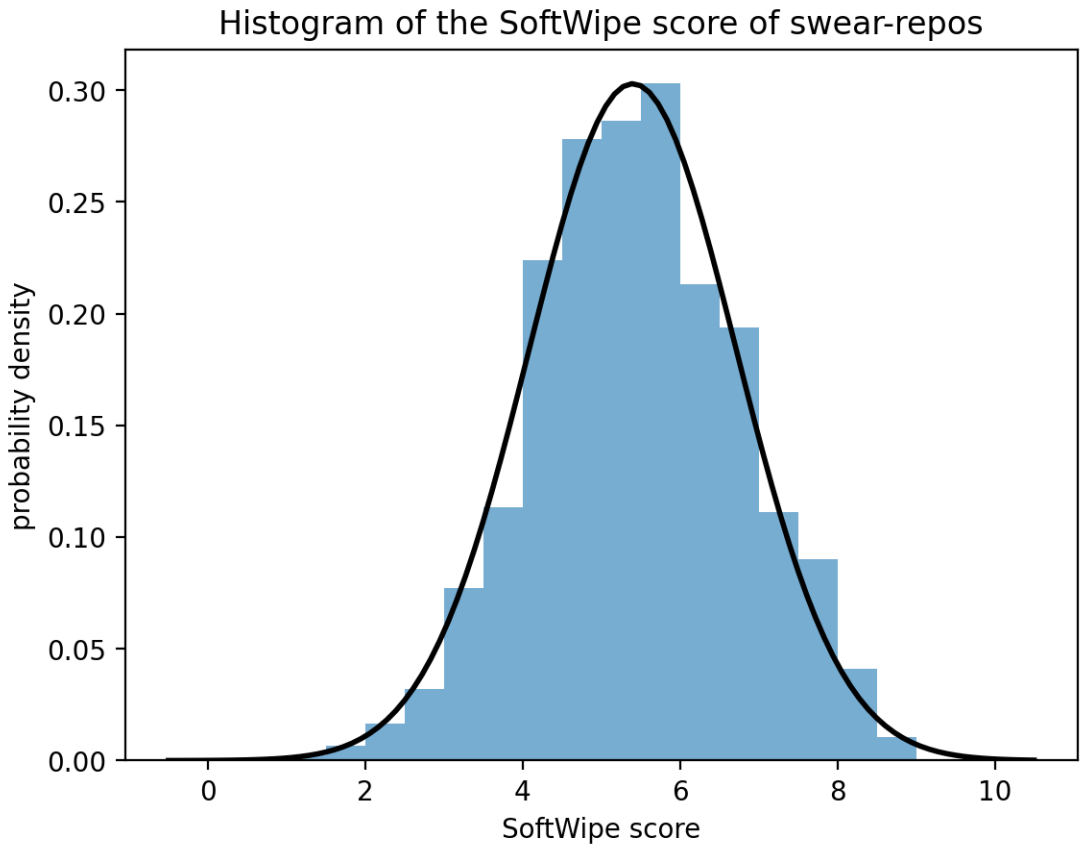
- Initial Hypothesis:
  - ~~There is no difference in code quality with regards to the of swearwords in open-source code~~
- Swear-repos exhibit a statistically significant higher average code-quality
  - 5.87 compared to 5.41
- But what about the clusters??

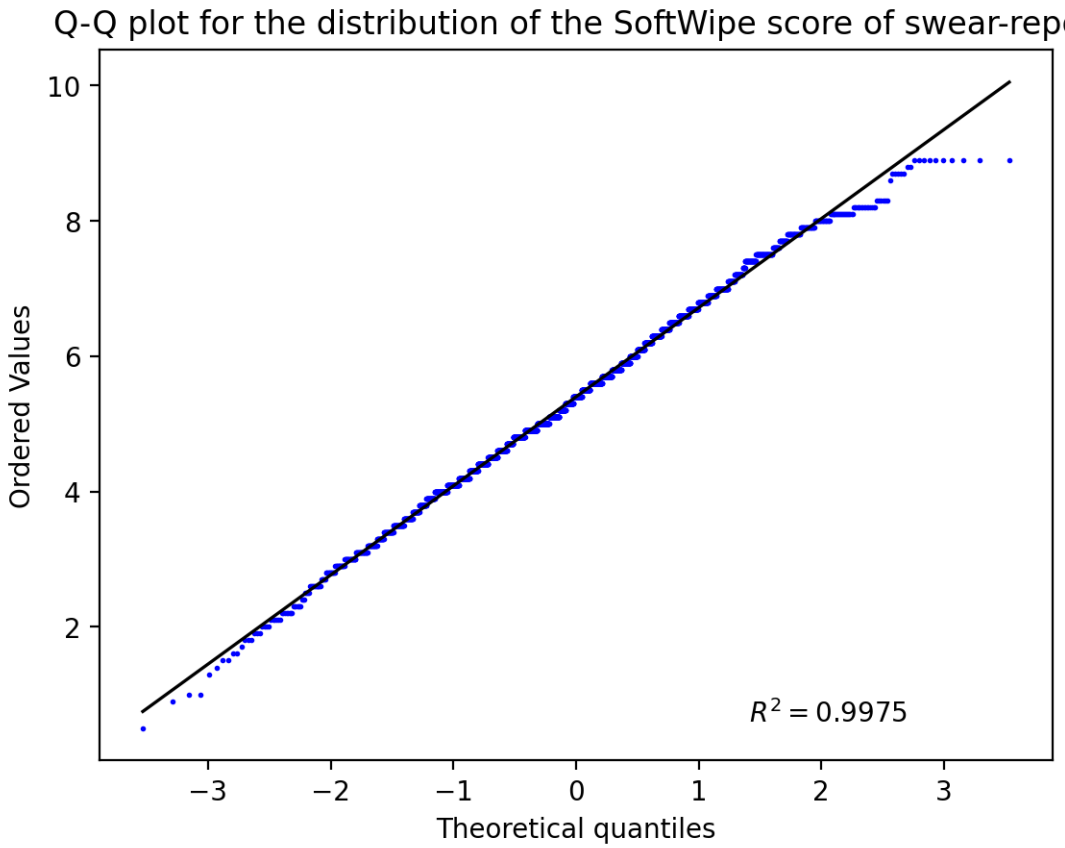
Cluster-Analysis



- Manual look at repositories in Cluster 1 and 2 to identify common denominator
- Cluster 1 (PintOS):
  - Introduction to OS at Stanford [2]
- Cluster 2 (OS/161)
  - Teaching OS used by University of Toronto and others

Swear-repos


Histogram of the SoftWipe score of swear-repos
probability density
0.00
0.05
0.10
0.15
0.20
0.25
0.30
0
2
4
6
8
10
SoftWipe score


Q-Q plot for the distribution of the SoftWipe score of swear-repos
Ordered Values
2
4
6
8
10
−3
−2
−1
0
1
2
3
Theoretical quantiles
$R^2 = 0.9975$

Test results

- KS-test
  - statistic ≈ 0.042 and p-value ≈ 0.0006
- Welch's t-test.
  - statistic ≈ -0.54 and p-value ≈ 0.59

- →NO correlation between swearing and an improvement in code quality

	mean	confidence interval
star-repos	5.41	[5.38 - 5.45]
swear-repos	5.40	[5.34 - 5.46]

Karlsruhe Institute of Technology

Conclusion

Conclusion and Outlook

- Swear-repos exhibit do not exhibit a statistically significant higher average code-quality
- Preferably:
  - It does not matter whether you swear or not so you might as well do it
- Look at the Code Quality of repositories with a lot of swearwords
- Publish a Paper

Questions?

Sources:

[1] “Central Limit Theorem”. In: The Concise Encyclopedia of Statistics. New York, NY: Springer New York, 2008, pp. 66–68. isbn: 978-0-387-32833-1. doi: 10.1007/978-0- 387-32833-1_50. url: https://doi.org/10.1007/978-0-387-32833-1_50.

[2] https://en.wikipedia.org/wiki/Pintos