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Security discussions in open source projects

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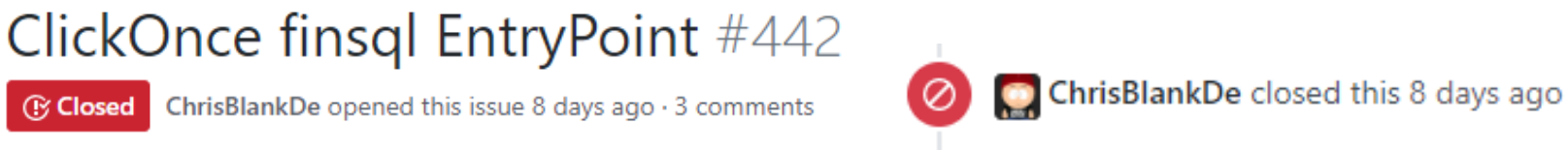
GitHub

- released in 2008
- extends distributed version control using Git with many other features
- acquired by Microsoft in 2018
- $>$ 100 million code repositories (April 2019)

Issues and pull requests

- Issues
  - 'reporting feature'
  - title, description, label(s)
  - can be assigned to user(s) for further investigation
- Pull requests
  - 'suggestion feature'
  - title, description, label(s), **referenced code**
  - someone wants to merge code

Issues and pull requests - lifecycle



Many ways to evolve:

- Active disucussion, change, revisions, agreement, merge/implementation
- Closed due to inactivity
- Closed as duplicate or irrelevant
- Merged without any review
- Remain untouched/open (for years!)

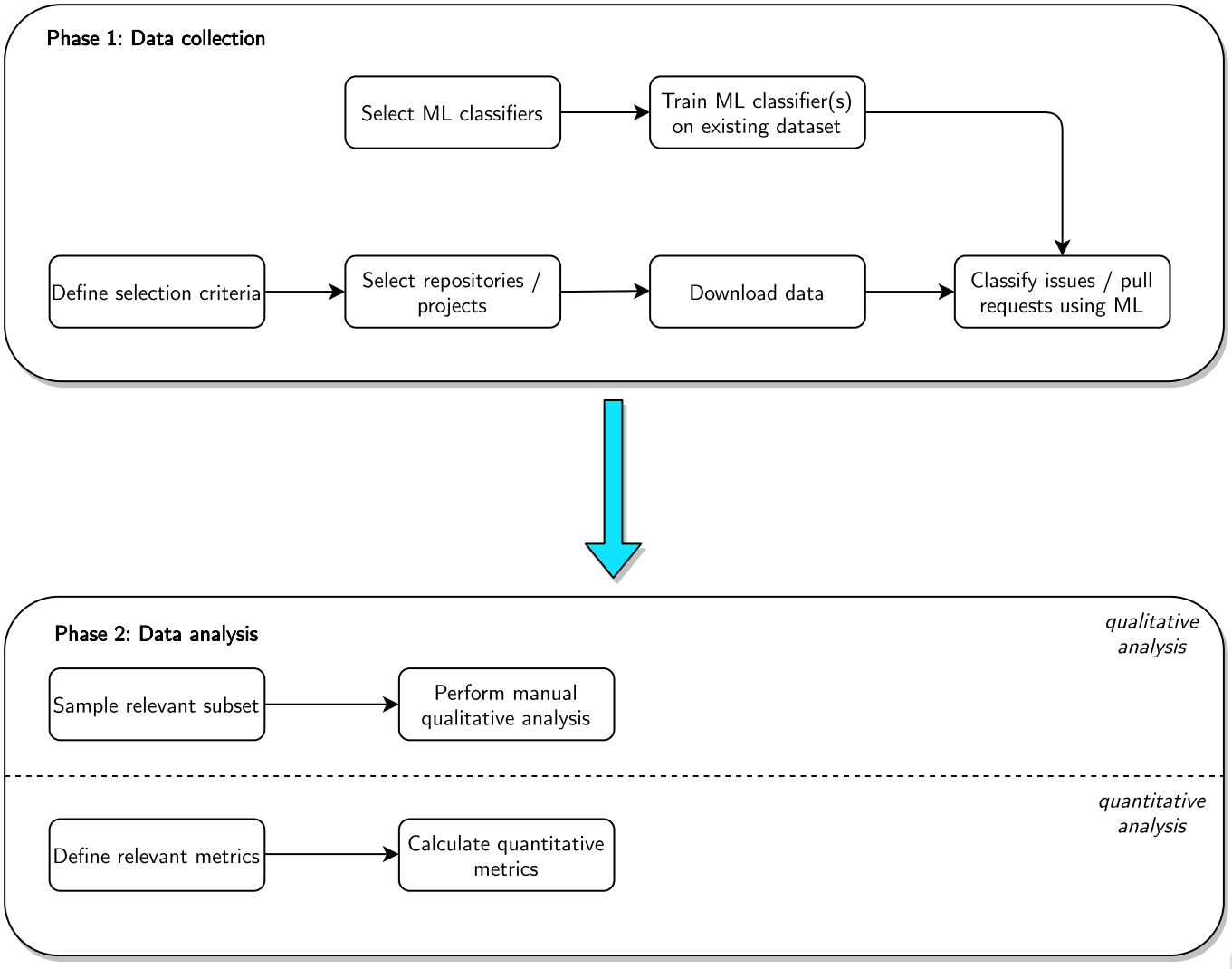
Possible research questions

- How often do people actually report security-related issues?
- How long does it take until a conclusion is reached?
- Who is involved in discussions of security-related issues and to which extent?

Why is it important?

- Open source software introduces opportunities and threats. (Cowan, 2003)
- Availability of the source code helps attackers manipulate software. (Payne, 2002)
- The faster a security issue (vulnerability) is fixed properly, the better.
- Lack of people with experience and proper knowledge may lead to bad implementation.

General approach



Data collection: selection criteria

- Suitable 'nature' of project
- Actual software development and not personal
- Criteria based on 'The Promises and Perils of Mining GitHub' (Blincoe et al., 2014)
  - number of commits
  - number of contributors
  - usage of pull requests and issues
  - multiple repositories for one project
  - ...

Data collection: downloading data

- GitHub REST API v3
- GitHub GraphQL API v4
- **GHTorrent**

Data collection: classification of issues/pull requests

- Preprocessing
  - Text extraction
  - Stemming / Lemmatization
  - Filtering, ranking and security **cross word** analysis (Peters et al., 2019)
- Training machine learning classifiers
  - Five available labeled datasets (Wu et al., 2019)
  - Hyperparameter Optimization (Shu et al., 2019)
  - Multiple classification algorithms were evaluated (Gegick et al., 2010)
- Apply trained classifiers on our data

Data analysis

- Quantitative analysis
  - Define and calculate metrics
  - Other statistical analysis
- Qualitative analysis
  - Sample relevant subset
  - Perform manual review by hand

Possible challenges

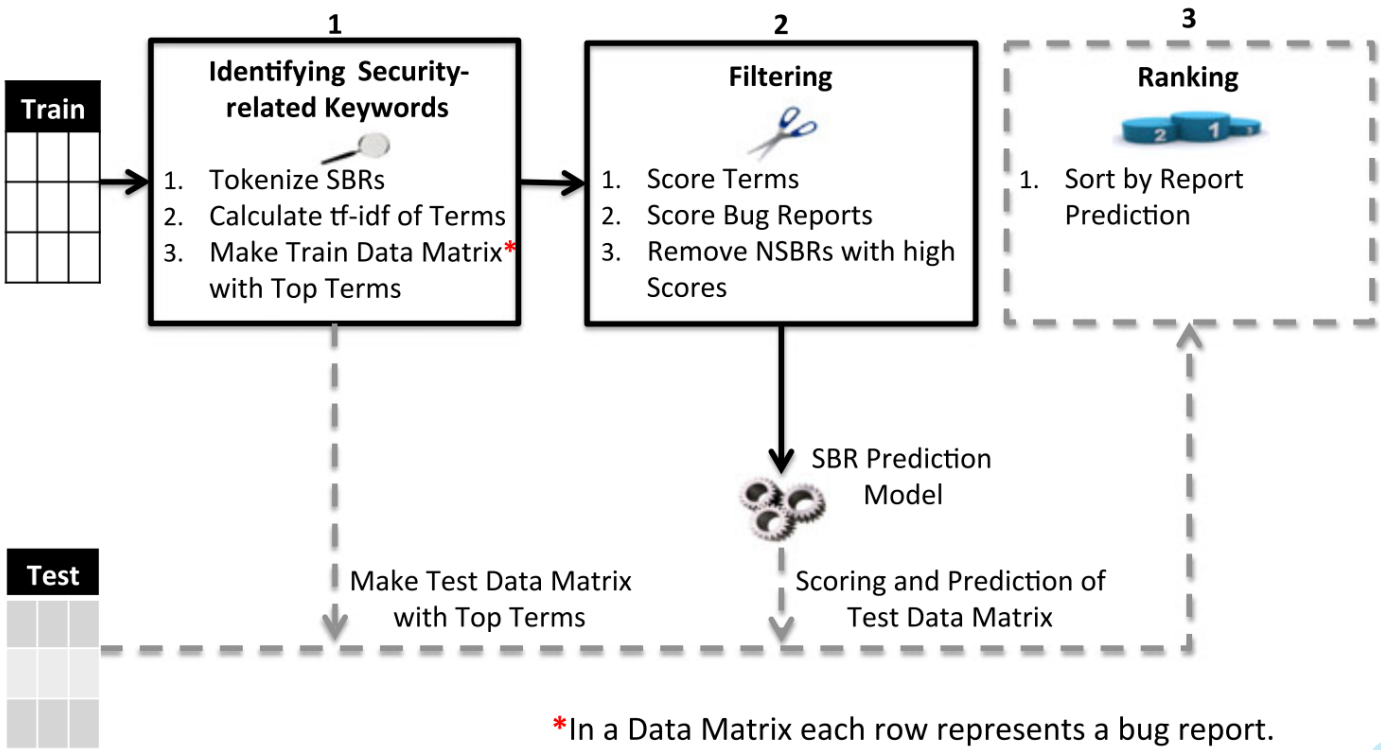
- representativeness of selected projects
- class imbalance, cross words and insufficient data
- transfer learning
- required time and knowledge for manual analysis

Thank you!

Questions?

Appendix: FARSEC

FARSEC, a framework composed of a combination of **F**iltering **A**nd **R**anking methods to reduce the mislabelling of **SEC**urity bug reports by text-based prediction models



Appendix: Sources - Part 1

- Cowan, Crispin. "Software security for open-source systems." IEEE Security & Privacy 1.1 (2003): 38-45.
- Payne, Christian. "On the security of open source software." Information systems journal 12.1 (2002): 61-78.
- Kalliamvakou, Eirini, et al. "The promises and perils of mining GitHub." Proceedings of the 11th working conference on mining software repositories. 2014.
- Peters, Fayola, et al. "Text filtering and ranking for security bug report prediction." IEEE Transactions on Software Engineering (2017).
- Wu, Xiaoxue, et al. "CVE-assisted large-scale security bug report dataset construction method." Journal of Systems and Software 160 (2020): 110456.

Appendix: Sources - Part 2

- Shu, Rui, et al. “Better security bug report classification via hyperparameter optimization.” arXiv preprint arXiv:1905.06872 (2019).
- Gegick, Michael, Pete Rotella, and Tao Xie. “Identifying security bug reports via text mining: An industrial case study.” 2010 7th IEEE Working Conference on Mining Software Repositories (MSR 2010). IEEE, 2010.