Impact of Language Choice on the Vulnerability of Multi-Language Software

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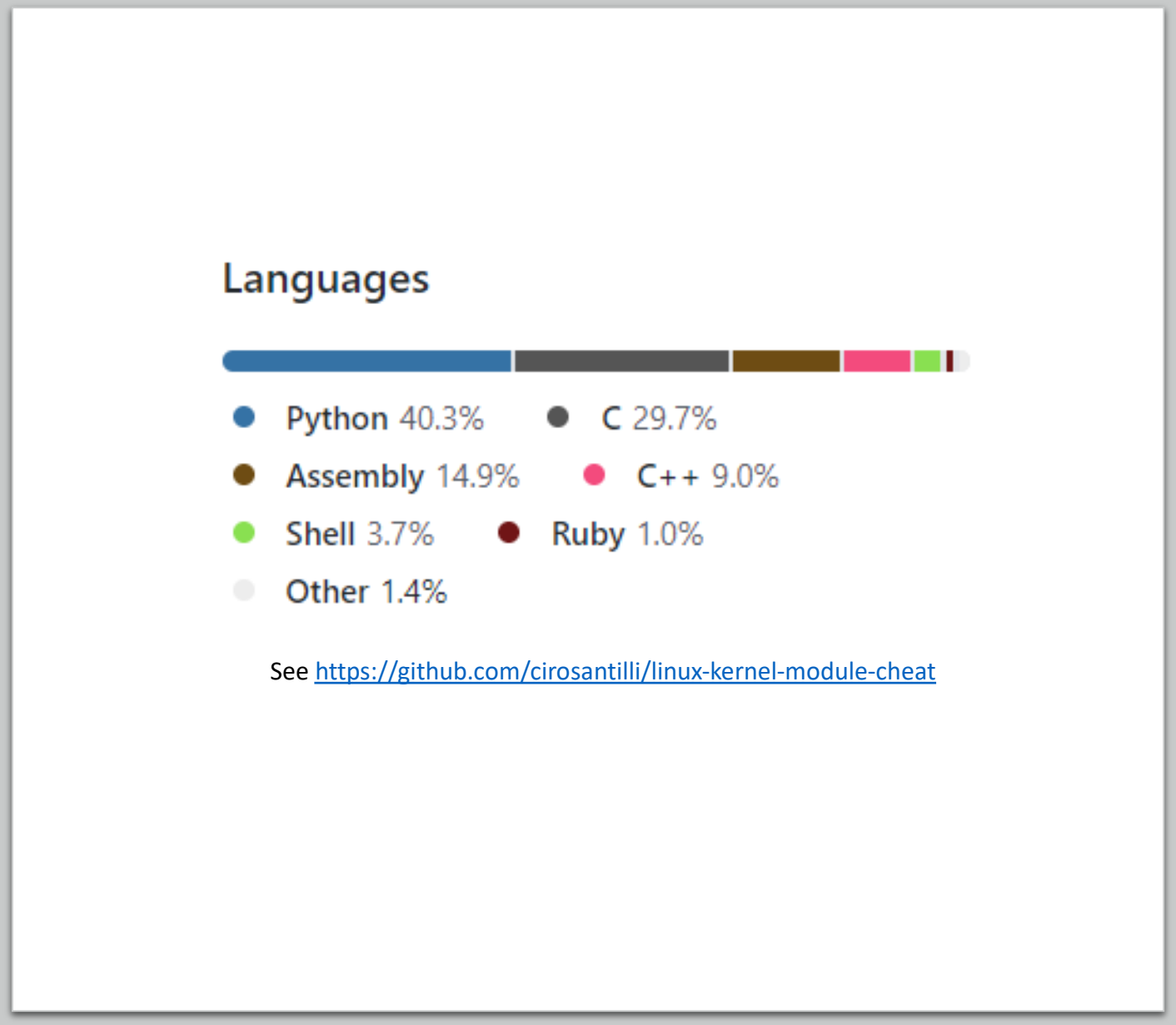
The Problem:

- Majority of modern applications written in **multiple** programming languages
- Lack of information on vulnerabilities introduced by multi-language development
- Software vulnerabilities are a **major** cybersecurity threat

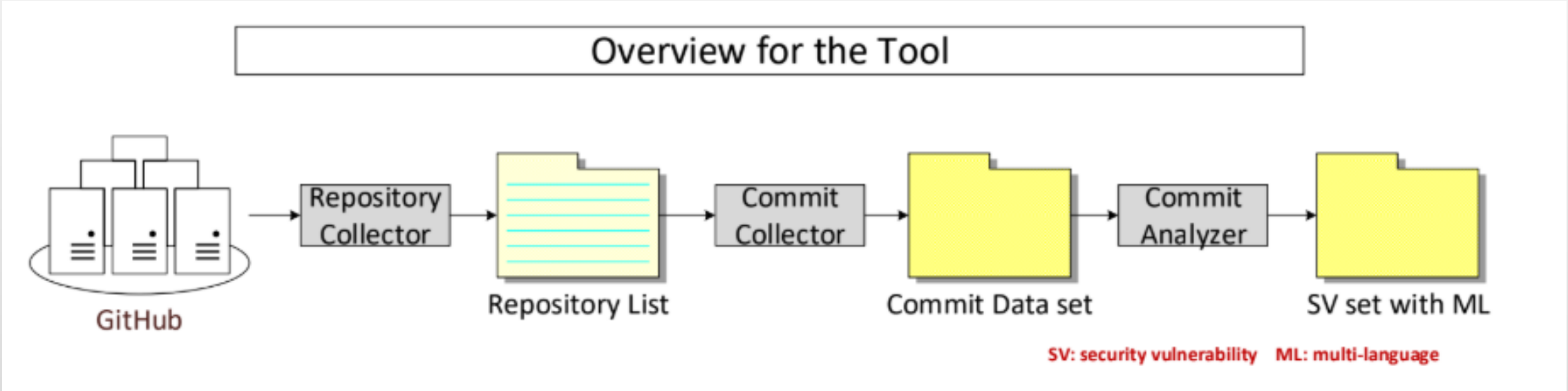


See https://github.com/cirosantilli/linux-kernel-module-cheat

Approach: Garner an Empirical Understanding

- Dataset: top 7,000 multi-language projects from Github
- Study the projects in context of our RQs:
  - RQ1: Are some multi-language selections more vulnerable than others?
  - RQ2: Are some language combinations associated with certain types of vulnerabilities?
  - RQ3: Is the vulnerability of language combinations related to functionality domains?
  - RQ4: What evolutionary perspective can we gain through such analysis?

Study Design



Collect projects and project metadata

Collect all commits, or **versions**, for each project

Analyze commits to find security vulnerabilities

Data Collection

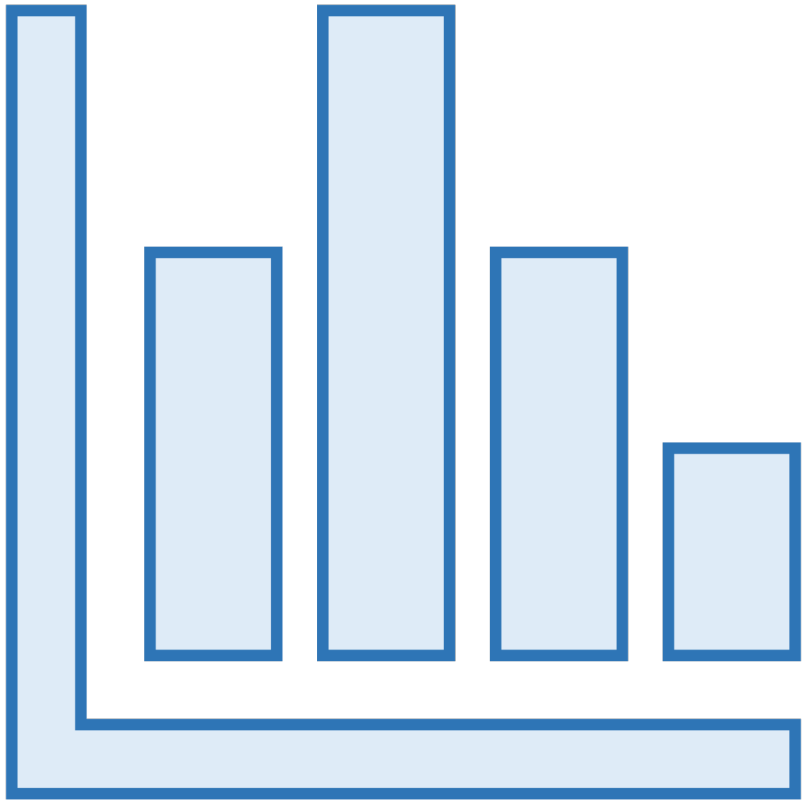
Code for data collection tools hosted at https://github.com/acielecki/WSU-REU/

Repository List

id	size	forks	open_issues	subscribers_count	stargazers_count	language_dictionary	owner_type	pushed_at	topics	description
#	122706	23609	289	8383	308356	{'css': 71539, 'html': 17627, 'javascript': 9927	Organization	2020-01-28T	['careers', 'certificat	the https and and www
#	27961	23497	435	6005	156213	{'css': 11301, 'html': 17839, 'javascript': 2832	Organization	2020-01-28T	['framework', 'front	vue js is a incrementally
#	150292	27430	574	6641	142959	{'c': 5225, 'c++': 44278, 'coffeescript': 16554,	Organization	2020-01-28T	['declarative', 'front	a and flexible javascript
#	152366	67974	433	7190	138322	{'css': 424038, 'html': 242563, 'javascript': 62	Organization	2020-01-28T	['bootstrap', 'css-fra	the most popular and ja
#	6163	18584	812	2585	102566	{'makefile': 59, 'perl': 3811, 'python': 2685, 'r	Organization	2020-01-28T	['productivity', 'term	a delightful community
#	3029	17883	115	3508	92096	{'javascript': 67844}	Organization	2020-01-28T	['arrow-functions', '	javascript style guide
#	41467	21750	5	4032	89726	{'javascript': 2401}	Organization	2020-01-28T	['visualization']	bring data to life with ca
#	2780119	30006	323	6852	85813	{'assembly': 9571217, 'awk': 38903, 'c': 7937	User	2020-01-28T	[]	linux kernel source tree

Commit Dataset

sha	author	date	message	commits	parents
fc9a03138c959f0d24301c6401f800eb6e7d3af9	Phil Hagelberg	2020-02-09T17:17:37Z	Merge pull request #36 from gonewest818/no-litteri...	https://api.github.com/repos/technomancy/better-de...	e051c5278f71af8414f8c6101695197dd4365cca bd4ee4a66...
bd4ee4a66198d725cfa2849675501bc7a39f2546	Neil Okamoto	2020-02-05T18:31:46Z	package-lint: should declare (emacs "25.1") as a r...	https://api.github.com/repos/technomancy/better-de...	45f6f46da18294422bbfe6414f38115532e8e821
45f6f46da18294422bbfe6414f38115532e8e821	Neil Okamoto	2020-02-05T16:20:12Z	avoid overriding `backup-directory-alist` if alrea...	https://api.github.com/repos/technomancy/better-de...	4f2f9227e56bd6ad6ec97d20b9d9745f17cce9ab
4f2f9227e56bd6ad6ec97d20b9d9745f17cce9ab	Neil Okamoto	2020-02-05T16:07:30Z	no need to set `save-place-file` because default i...	https://api.github.com/repos/technomancy/better-de...	e051c5278f71af8414f8c6101695197dd4365cca
e051c5278f71af8414f8c6101695197dd4365cca	Phil Hagelberg	2020-01-01T22:57:56Z	Merge pull request #34 from fabio-porcedda/savepla...	https://api.github.com/repos/technomancy/better-de...	01b8f00235c37bddf3e1a949e943dc0c9980863 c72e7d544...
c72e7d5448cd0d4fbca4af455455f7b2d1335c7f	Fabio Porcedda	2019-12-30T13:12:05Z	Updated Save Place activation to support GNU Emacs...	https://api.github.com/repos/technomancy/better-de...	01b8f00235c37bddf3e1a949e943dc0c9980863



Evaluation & Results

- Study currently in progress
- Target results:
  - To see a correlation between language combinations and vulnerabilities (or lack thereof)
  - Answers to our four RQs
- Evaluation:
  - Quality of information/data acquired
  - Recommendations we can make based on findings

Conclusions

Potential Impact

To scientific community: gaining new knowledge

To society: new knowledge -> new tools to address software security -> more secure digital lives

Next Steps

Expanding the dataset

Refining how we determine vulnerabilities and security fixes

Thank You

Acknowledgement

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